Myths and facts about deploying renewables in the power systems of Southeast Europe

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Disclaimer

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On the basis of the SEERMAP project

This document is based on the results of the SEERMAP project. Therefore, all information in this document – which is not cited from another source – is originated from the SEERMAP Reports (Szabó et al., 2017)[1].

[1] Szabó, L., Mezősi, A., Pató, Z., Kelemen, Á., Beöthy, Á., Kácsor, E., Kaderják, P., Resch, G., Liebmann, L., Hiesl, A., Kovács, M., Köber, C., Marković, S., & Todorović, D. (2017). SEERMAP: South East Europe Electricity Roadmap - South East Europe Regional report 2017. All country reports can be downloaded from: http://seermap.rekk.hu/.

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Living document

This is a living document meaning that the authors plan to permanently review the content of this document which will be published yearly.

Your comments and notes are very welcome to improve the document – please send them to Fanni Sáfián (fanni.safian@klimapolitika.com) or Sonja Risteska (sonja.risteska@agora-energiewende.de).

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Content

A. Physical and economic feasibility of RES

MYTH A1: We don't need more RES

"We have already too much new RES capacity. We don't need any more

FACT:

Massive deployment of RES is needed to achieve climate targets and provides numerous benefits.

INSIGHTS FROM BULGARIA:

The EU 2050 Low Carbon Roadmap implies a 93-99% emission reduction target in the electricity sector; this can be achieved through using energy efficiency, renewable sources, demand side management, smart grids as well as other technologies like nuclear power or carbon capture and storage technologies.

The SEERMAP project (Szabó et al., 2017) uses a model-based assessment of different long-term electricity investment strategies for Albania, Bosnia and Herzegovina, Bulgaria, Croatia, Greece, Kosovo*, former Yugoslav Republic of Macedonia, Montenegro, Romania and Serbia. 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:

1. 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;
2. The 'decarbonisation' scenario reflects a long-term strategy to significantly reduce CO_2 emissions, in line with indicative EU emission reduction goals for the electricity sector as a whole by 2050, driven by the CO_2 price and strong, consistent RES support;
3. 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.

Based on Bulgaria's status, trends and possibilities, the SEERMAP models show that a significant RES-based development is not only feasible but also cost optimal. A significant increase in RES shares is expected even if an emission reduction target is not set. Approximately 45% of current fossil fuel generation capacity, or more than 2600 MW, is expected to be decommissioned by the end of 2030, and 97% of today's fossil capacities will be decommissioned by 2050. The model results show that the contribution of renewables (especially wind and solar) will increase significantly under all scenarios under the assumed costs and prices: the RES electricity generation share will reach 32.5% in 'no target', 53.5% in 'decarbonisation' and 54.3% in 'delayed' scenarios. The latter means 4.6 TWh hydro, 10.0 TWh wind, 3.8 TWh solar and 3.4 TWh other RES power production by 2050.

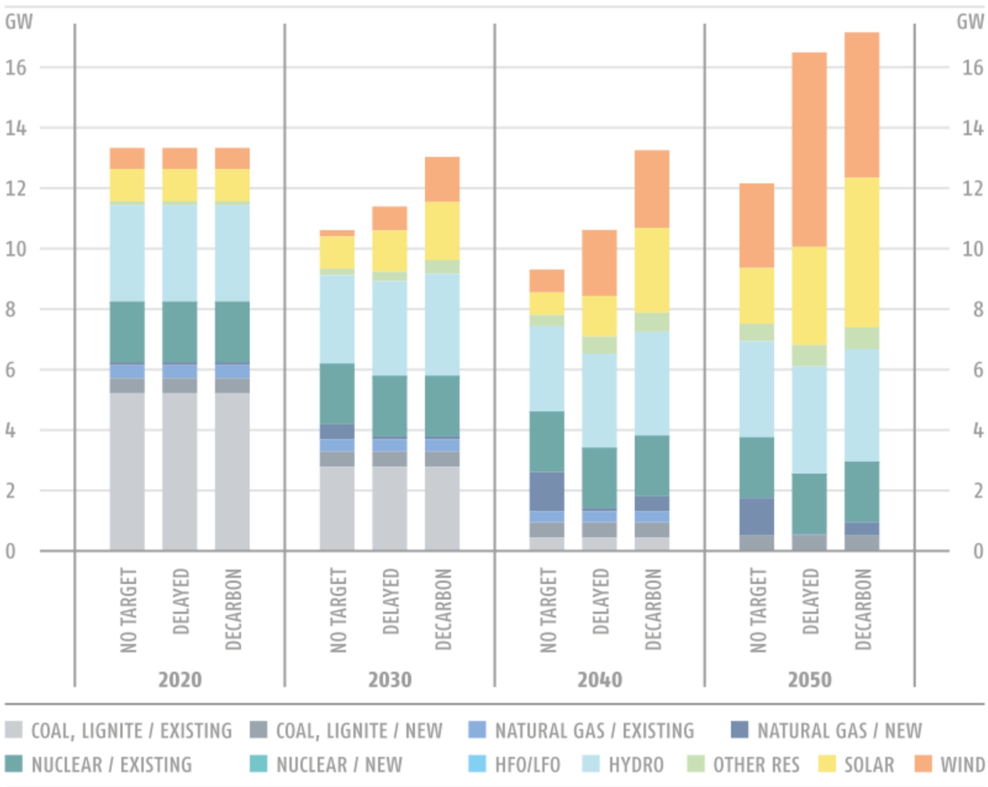

FIGURE 1 - INSTALLED CAPACITY IN THE 3 CORE SCENARIOS UNTIL 2050 (GW) IN BULGARIA, 2020-2050. SOURCE: SEERMAP COUNTRY REPORT BULGARIA.

IRENA, Joanneum Research, & University of Ljubljana, (2017) also confirms that Bulgaria has high cost-competitive renewable energy potential, including up to 18 GW wind, more than 6 GW solar, up to 1 GW biomass and 1,6 GW hydro potential.

Bulgaria has significant renewable potential relative to the EU average. However, high RES potential is not enough for achieving high decarbonisation targets, if it is not coupled with an adequate and affordable support system. The recent failure of the Bulgarian support system is still a sensitive experience. The decreasing technology costs and an initially generous and non-capped FIT led to a raising of electricity prices, which caused public resistance and ultimately led to the resignation of the government (IRENA, 2017). Thus the introduction of well-designed policies to utilize the RES potential is indispensable. The SEERMAP model results show that under a well-planned decarbonisation pathway initial RES support is relatively high, at 7.8 EUR/MWh, but this drops to 3.7 EUR/MWh by 2025 and decreases further to 1.4 EUR/MWh in 2050. This implies that the cost of a transition to a mainly RES based energy system can be kept in check if implemented in a planned way.

MYTH A2: Decarbonisation is expensive

Renewable-based ('decarbonisation') scenarios are costlier than BAU ('no target')."

FACT:

Decarbonisation is cheaper in the long run, especially when considering falling RES prices.

Concerning the cost of decarbonisation, the following should be noted:

1. a decline in the technology costs of renewables is expected, RES are becoming cheaper;
2. the investment cost of renewables can be further reduced in the region via reducing investment risks and by pooling resources to address high initial investment costs;
3. long-term RES support schemes help decrease the initial level of subsidies needed for the expansion of RES;
4. a mix of technologies and solutions needs to be used to reach decarbonisation targets most cost-effectively

The cost of decarbonisation highly depends on the carbon price (see myth A3), the technology costs and the cost of capital that influence energy transition in varying degrees both in EU member states and accession countries from the SEE region (Ecofys, 2017).

RES is not as expensive as many believe it to be

Capros et al. (2014) claim that in a cost-optimal way, "lower than 1% of GDP in the period 2015-2050 in cumulative terms" is needed to reach the European emission reduction targets.

The SEERMAP study shows that in order to achieve a 94% decarbonisation of the electricity sector by 2050, RES support relative to the electricity cost (wholesale price plus RES support) is only 2.6% at its highest level in the 'decarbonisation' scenario, indicating that if renewable energy deployment is well planned and forward-looking policies are in place, the impact of decarbonisation on households and businesses can be kept low.

If Europe aims for a 100% renewable based energy system, then "the total calculated annual socio-economic cost of the (SEE) region is approximately 20 billion EUR lower in the year 2050 than in the base year (2012)" (Dominković et al., 2016), which proves that decarbonisation is not only environmentally but also economically the most efficient and sustainable solution. Regarding country-specific system costs please see myth A4.

In general, according to the report of Energy Union Choices (2017), decarbonisation of the power sector that is faster than the one needed to reach the actual 2030 targets is technically feasible and the emissions reduction related to it could be doubled (55% instead of 30% between 2015 and 2030) compared to the EU reference scenario, while it could save 600 mEUR on system costs and bring 90 000 net jobs to Europe.

The price of renewable technologies has been continuously decreasing in the past decades and the trend seems to continue. According to IRENA et al. (2017) the technology costs of renewables as well as the cost of capital will further decline in the coming decades, which will increase the cost-competitiveness of both solar and wind, thereby making these technologies more cost effective. The newest World Energy Outlook of the International Energy Agency (IEA, 2017) highlights "the rapid deployment and falling costs of clean energy technologies" as the first major trend in global energy system. In particular solar energy, where the "growth in solar PV capacity was larger than for any other form of generation" in 2016. Since 2010 the new PV panel costs have decreased by 70% (while wind energy costs decreased by 25%, batteries by 40%)(IEA, 2017). Between 2014 and 2016, the average photovoltaic system price decreased by 23% (EY & Solar Power Europe, 2017).

Investment risks need to be addressed to further lower costs of RES

The fact that initial investment costs are higher for RES than for traditional fossil fuel-based technologies implies that the cost of capital is an important factor. The weighted average cost of capital (WACC) is significantly higher in the SEE region than in countries in Western Europe. In the SEERMAP report, WACC values in the region are assumed to be between 10 and 15% in 2016. Ecofys – Eclareon (Ecofys, 2017 via Szabó et al., 2018) estimated current WACC values for onshore wind to be between 7-13.7% and for PV between 7-12.4% for Bulgaria, Greece and Romania. IRENA et al. (2017) assumed medium level WACC values of 8 to 12% for SEE countries in 2016. The components of the risk premium which needs to be paid to investors include general country risk, policy risks specific to the energy sector, as well as technology related risks.

The DiaCore project results showed that insufficient RES policies and unreliable frameworks increase risk and therefore capital costs for investors (Noothout et al., 2016), which therefore decreases the utilization of the available RES potential – this is happening in South East Europe. One way to reduce policy risk is therefore to implement consistent long-term energy policies.

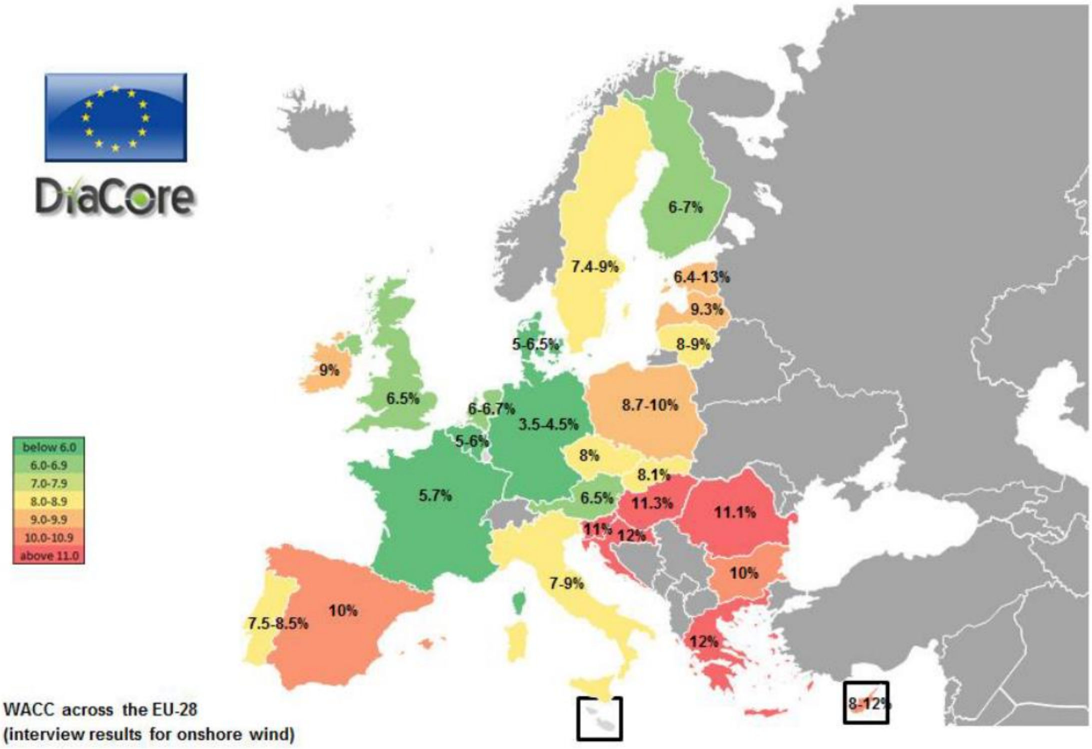

FIGURE 2 - WACC ESTIMATIONS FOR ONSHORE WIND PROJECTS IN 2014. SOURCE: NOOTHOUT ET AL., 2016.

Technology risk is also an important factor. The choice of investing in wind and PV increases the overall risk of the investments in question, as renewables are considered to be more risky than other average investments, which means "an additional 7% points to the cost of equity in Bulgaria and Romania, 5% points in the Slovak Republic, and 6% points in Hungary. However, in Greece, renewable energy investments are regarded as safer compared to average investments and decrease the risk by 2% points in the case of wind onshore and 3% points in the case of solar PV", according to Ecofys (2017).

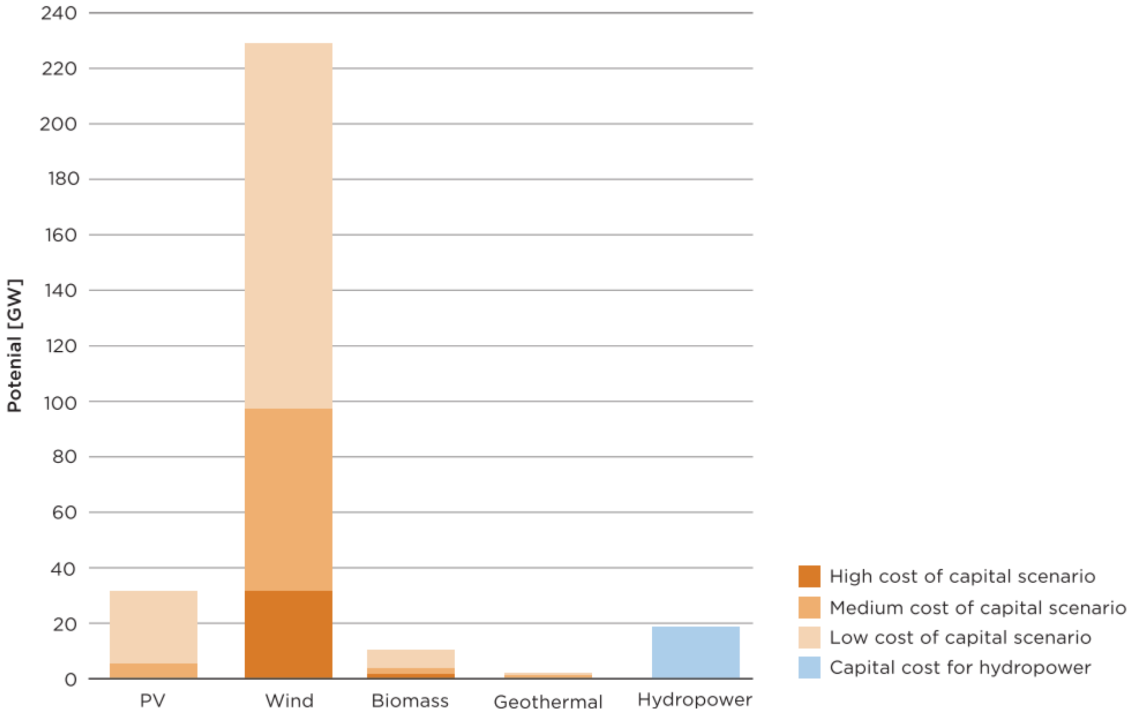

FIGURE 3 - CUMULATIVE ADDITIONAL COST-COMPETITIVE RENEWABLE POWER POTENTIAL FOR SEE IN 2016 UNDER DIFFERENT COST OF CAPITAL SCENARIOS. SOURCE: IRENA ET AL., 2017.

IRENA et al. (2017) show that if these issues associated with higher risks are managed, then under a low cost of capital scenario almost 300 GW of additional RES potential could be utilized compared with the current high-risk scenario. The study also reveals that under a medium cost of capital scenario (compared to today's high investment risk), 17% of the identified technical potential, equivalent to 126.9 GW RES could be installed in a cost-effective way in the SEE region. This is "15 times higher than the 8.2 GW of additional total capacity planned up to 2020, as required by the NREAPs".

Temperton, Buck, Graf, & Brückmann (2018) recommended a Renewable Energy Cost Reduction Facility towards the EU to reduce investments costs of RES and therefore save taxpayers' money. The SEERMAP report also claims that de-risking policies to address high cost of capital are important for the SEE region and that options for implementing regional level de-risking facilities should be considered. Policy related risks can also be reduced at the national level, by ensuring stable, long term renewable energy policy frameworks are in place. This should be a priority for subsequent governments in countries of the region.

One way of addressing the barriers associated with high initial investment costs is to pool resources. Community renewable energy production has already achieved success in low cost local energy production which is effective in dealing with energy poverty in some Western- and Northern European countries (Dryzek, Norgaard, & Schlosberg, 2011; Sáfián, 2014). For example in a peripheral Danish region of Samsø island, locally grown renewable-based community district heating solutions offer cheap residential district heating prices (sometimes defined by a local committee) and also jobs to the island which was lacking of it before (Jørgensen, 2007).

Long term planning is important to lower costs

According to the SEERMAP reports, strong, well-planned and consistent RES support schemes – starting as soon as possible – help the implementation of a feasible and effective decarbonisation of the energy sector. Delayed action on renewables is also an option, but compared to a long-term planned RES support scheme has distinct disadvantages such as stranded costs (see myth A3). In case of a long-term RES support scheme, the need for support decreases as the electricity wholesale price increases and thereby incentivises significant RES investment even without support.

The RES support relative to the electricity cost (wholesale price plus RES support) is only 2.6% at its highest level in the ‘decarbonisation’ scenario, indicating that if renewable energy deployment is well planned and forward-looking policies are in place, the impact of renewable subsidies on households and businesses can be kept very low.

To lower the cost of decarbonisation a mix of different technological solutions must be used

A fresh study of Climact & ECF (2018) modelled a wide range of methods (here: levers) to reduce emissions in all sectors (power production, industry, buildings, transportation, agriculture, forestry and land-use) to find cost-optimal pathways to reach net zero emissions by 2050 in the EU. The levers were categorized in six groups where not only technological but also organisational and other soft solutions such as diet change were taken into consideration. They used them in different mixes and with different importance in three main scenarios: the “Shared efforts” utilizes all levers in all sectors with no specific emphasis; the “Technology” scenario focuses on “efficiency and innovative technological options by raising their ambition to the highest levels”; the “Demand-focus” scenario utilizes demand-side levers to reduce demand for energy (-64% by 2050), meat, technological solutions etc. According to the results, they claim, that “social patterns, societal organisation and energy efficiency are key to make it easier to reach net-zero” future in the EU. Different results of the “Shared effort” scenario can be seen in the following graphs compared to the EU Reference scenario.

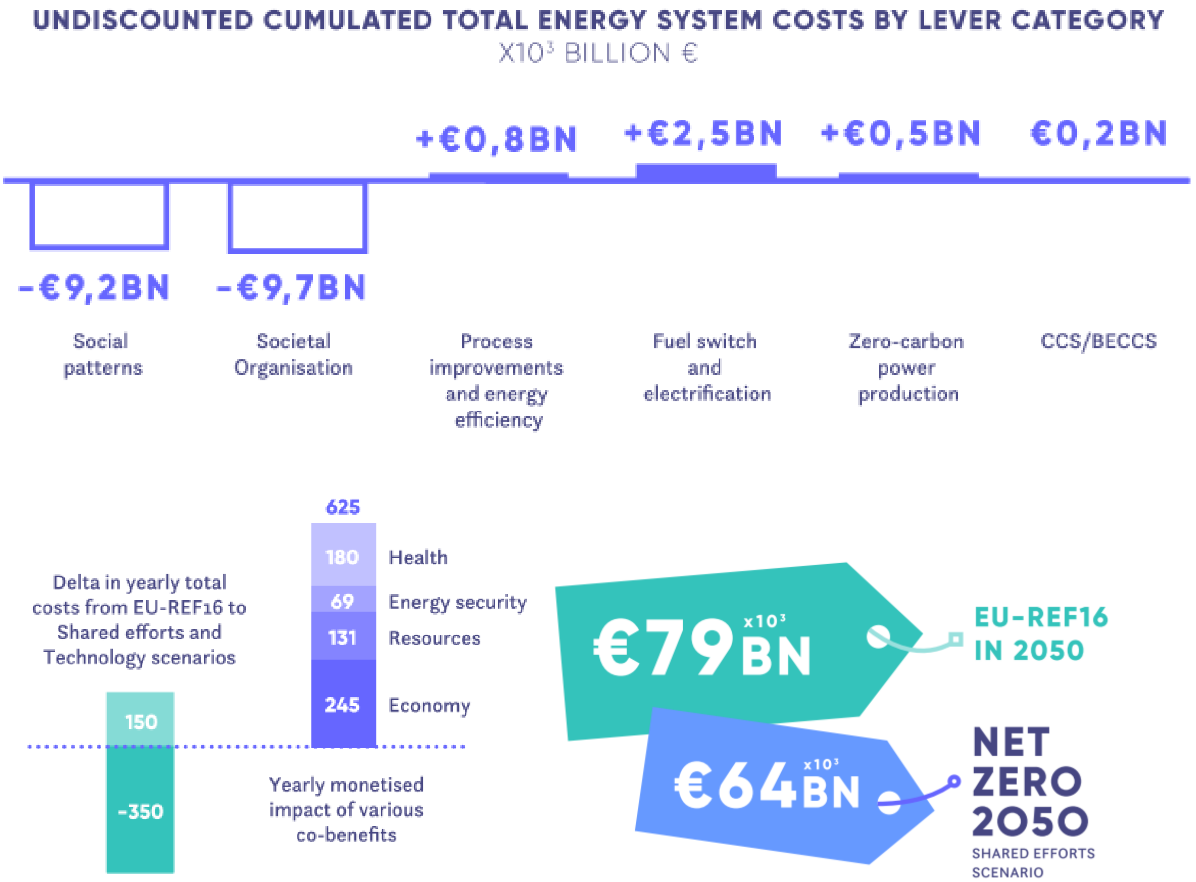

FIGURE 4 - DIFFERENCE IN TOTAL SYSTEM COSTS BY LEVER GROUP BETWEEN THE EU-REF16 AND THE SHARED EFFORTS NET-ZERO SCENARIO (UPPER FIGURE); COSTS AND INVESTMENTS COMPARED TO THE POTENTIAL IMPACT OF CO-BENEFITS AND CLIMATE DAMAGES (BOTTOM, LEFT); UNDISCOUNTED CUMULATED TOTAL ENERGY SYSTEM COSTS BY LEVER CATEGORY [x10³ BILLION EUR] (BOTTOM, RIGHT). SOURCE: CLIMACT & ECF, 2018.

The results show that the total system costs – if a more holistic approach is applied – are lower in the case of a net zero GHG emission scenario than the BAU (EU-Ref16), creating a win-win situation for the society and economy. "If all available levers are actioned, particularly on the demand side, the total energy system costs (Investment costs + operational expenditures + fuel costs) will be lower than in a business-as-usual scenario (the EU-REF16 scenario from the EU Commission). Essentially a net-zero society uses its resources much more efficiently across all sectors: products with longer lifetimes and increased asset utilisation (e.g., using fewer cars but using them more than the 5% of the time that is currently the case). (…) It shows how strong the impact of improving the way our society is organised can be." (Climact & ECF, 2018)

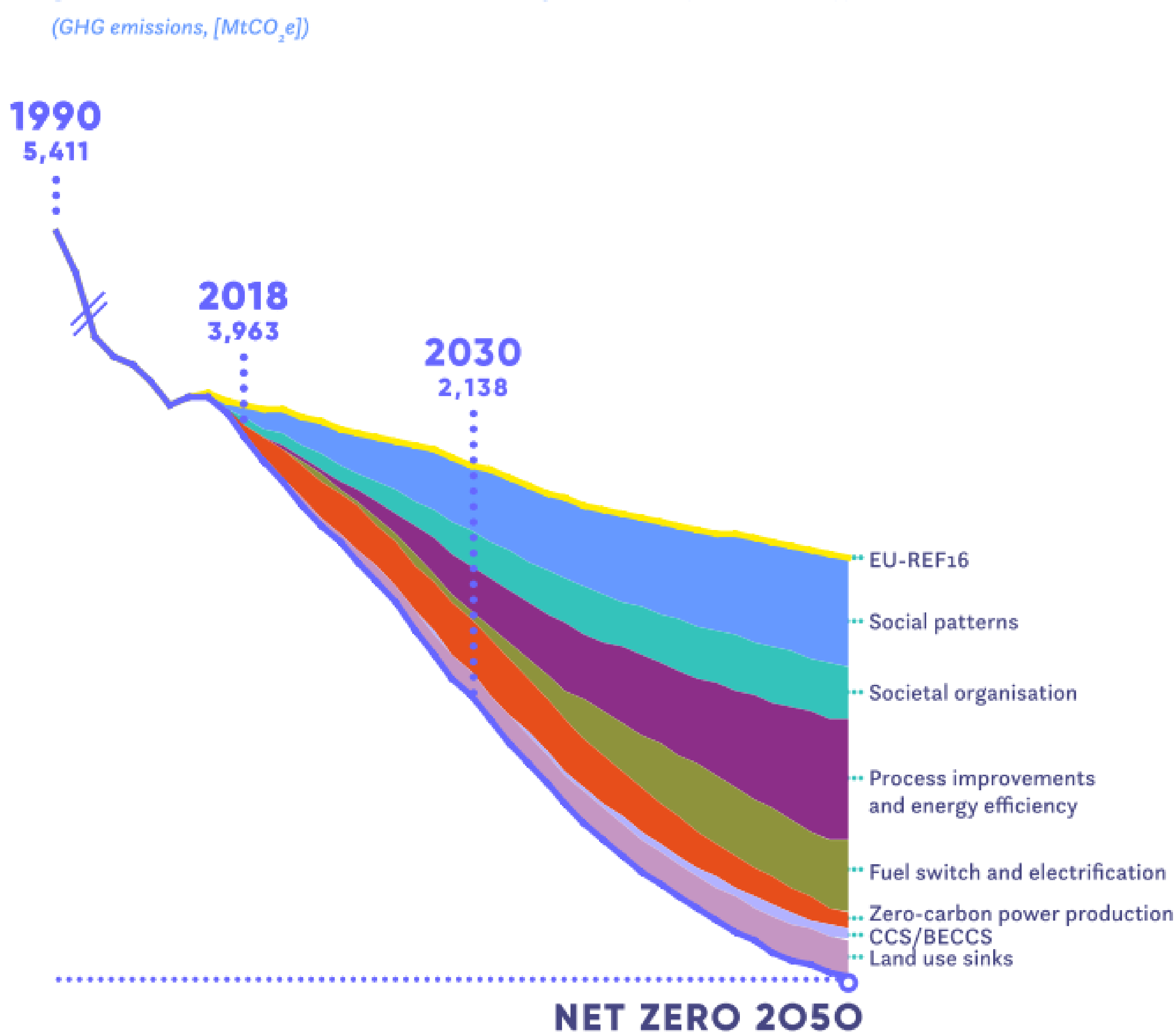

FIGURE 5 - GHG EMISSION REDUCTIONS BY LEVER TYPES IN A SHARED EFFORTS (SEE THE SECTION ON THE "ANALYTICAL BASIS" P.7 TO READ ON THE VARIOUS SCENARIOS USED IN THIS REPORT.) NET-ZERO SCENARIO [MTCO$_{2E}$]. SOURCE: CLIMACT & ECF, 2018.

MYTH A3: Fossil energy is cheap

"Fossil-based energy production is still the cheapest option."

FACT:

Fossil-based energy used to be cheap but will lose competitiveness due to upcoming market and legislative changes.

In the current legislative and market environment in South East Europe, especially countries which are not yet Member States, electricity production from existing fossil fuel power plants may be the cheapest option, as most of them are depreciated and investment costs have been recovered, enabling them to operate at prices which recover short term marginal costs only. However, policy makers also need to consider at least the following additional factors:

1. The projected increase in the carbon price[2] compared with current levels will make fossil fuel plants, especially coal and lignite less competitive and, eventually, render them non-competitive
2. The phasing out of direct and indirect subsidies to fossil fuel plants needs to take place to fulfil the requirements of the EU State aid rules that also have to be followed by Parties to the Energy Community Treaty. This is especially important in the Western Balkans, where such support is still significant. This will decrease the competitiveness of fossil-based generation;
3. New emission BAT requirements for large combustion plants published in 2017 need to be implemented for all new plants being permitted and from 2021 onwards for existing plants in the EU. For Energy Community countries a similar requirement is expected to be introduced but some of the Contracting Parties already include the EU BAT requirements in their domestic legislation. This will make investment in new coal installations and compliance with the rules for existing installations significantly more costly;
4. The cost of negative externalities caused by fossil fuel generation is high, especially environmental and health costs.

The SEERMAP project took into account only the first of these factors. Even if the other three factors are ignored, the analysis shows that over the medium to long term coal and lignite-based electricity generation will be priced out of the market by cheaper options. Policy makers therefore need to address the trade-offs which characterise fossil fuel investments. In particular stranded costs[3] related

[2] The carbon prices in the SEERMAP models were applied for all EU member states, and from 2030 onwards also in non-member states. The carbon price is assumed to increase from 33.5 EUR/tCO_2 in 2030 to 88 EUR/tCO_2 by 2050, in line with the EU Reference Scenario 2016. The corresponding carbon price, although significantly higher than the current price, is a medium level estimate compared with other estimates of EU ETS carbon prices by 2050. The EU ETS carbon price is determined by the marginal abatement cost of the most expensive abatement option needed to stay within the emissions cap.

[3] Stranded assets "are now generally accepted to be fossil fuel supply and generation resources which, at some time prior to the end of their economic life (as assumed at the investment decision point), are no longer able to earn an economic return (i.e. meet the company's internal rate of return), as a result of changes associated with the transition to a low-carbon economy" (Carbon Tracker Initiative, 2014). The common belief is that stranded costs are higher under a high RES scenario than under a low RES scenario. However, in the SEE region this is not the case, as most existing coal and lignite plants are old and have already recovered their initial investment costs. It is therefore not these generation assets which risk becoming stranded, but those newly built assets which are currently included in national plans and strategies. These new plants will not be profitable for long enough to recover the initial investment cost if the carbon price increases and the cost of renewable technologies continues to decrease, resulting in stranded assets. A well-planned high RES share pathway can help avoid such an outcome as it enables policy makers to switch to RES early on, avoiding significant investment in fossil fuel technologies.

to coal, lignite and natural gas generation assets need to be weighed against any short-term benefits that such investments may provide.

Carbon pricing will make coal expensive

Europe is currently experiencing a high increase in the carbon price, which has been fluctuating at around 20 EUR/tCO_2 since Summer 2018, even reaching 24.85 EUR/t in September (Markets Insider, 2018).

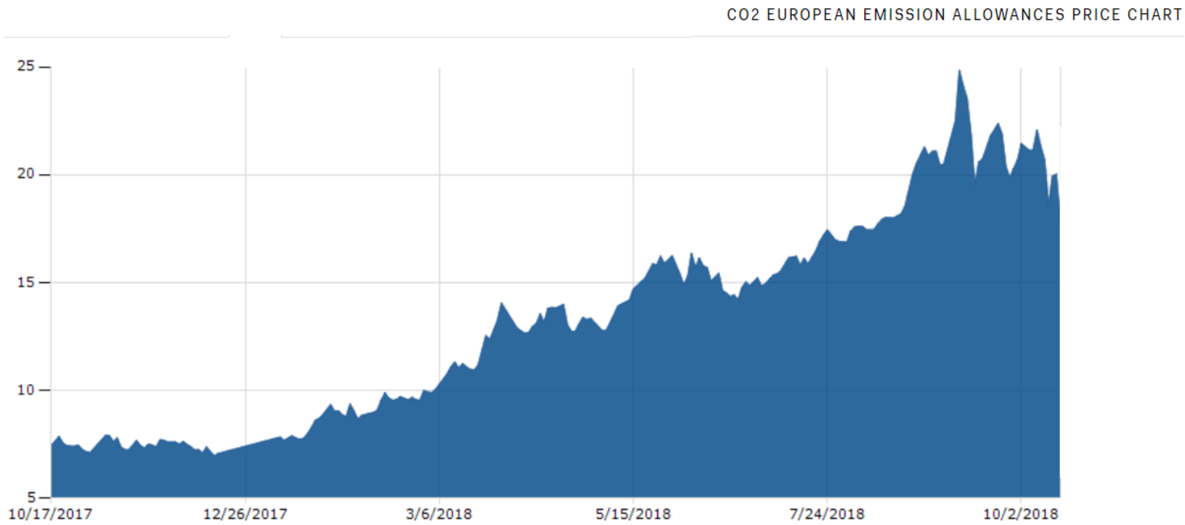

FIGURE 6 - EU CARBON PRICES CONSTANTLY GROWING IN 2017-2018 – CO_2 EUROPEAN ALLOWANCES PRICE IN EUR. SOURCE: MARKETS INSIDER, 2018.

This increase is expected to continue in the future. The European Commission's revision for ETS phase 4 (2021-2030) is meant to ensure the achievement of the EU's overall greenhouse gas emissions reduction target by 2030, according to which "sectors covered by the EU Emissions Trading Scheme (EU ETS) must reduce their emissions by 43% compared to 2005 levels" (European Commission, 2018a). It also includes plans for the EU to double the carbon price by 2021 and further increase it to 55 EUR/t by 2030 (Carbon Tracker, 2018).

If we consider exclusively the accession countries, the further penetration of coal, which is there still on-going, is a politically and economically short sighted and questionable path to follow. A recent study of CEE Bankwatch Network (2017a) reveals that once their power plants are also subject to the ETS, even the small Pljevlja II coal-based power plant in Montenegro would have to pay nearly 8 mEUR annually with an extremely low (5 EUR/t) CO_2 price, while considering a more realistic price (35 EUR/t) by 2030, the yearly costs rise to 55.6 mEUR. The same development would mean 21-146 mEUR extra costs for Ugljevik III in Republika Srpska, which will be the largest plant in the region if it is built.

Due to carbon pricing, investments made in coal power plants, and to some extent also natural gas power plants, will be stranded. Regarding stranded costs of fossil generation, a financial calculation was carried out in the SEERMAP project to determine these costs of fossil generation for plants that are built in the period 2017-2050. The utilisation rate of coal generation assets drops below 15% and gas generation below 25% in most SEERMAP countries in the 'delayed' and 'decarbonisation' scenarios by 2050. This means that capacities which generally need to have a 30-55-year lifetime (30 for CCGT, 40 for OCGT and 55 for coal and lignite plants) with a sufficiently high utilisation rate in order to ensure a positive return on investment will face stranded costs. Large stranded capacities will likely require public intervention, whereby costs are borne by society/electricity consumers. If these costs are collected as a surcharge on the consumed electricity over a period of 10 years after these gas and coal capacities finish their operation then fossil plants which are retired early would have to receive 2.6 EUR/MWh, 2.5 EUR/MWh and 0.6 EUR/MWh surcharge to cover their economic losses in the 'no target', 'delayed' and 'decarbonisation' scenarios respectively. This result shows that switching from fossil fuels to renewables early on can result in lower stranded assets. Stranded costs are particularly high in Bosnia and Herzegovina, Greece and Kosovo* in both the 'no target' and 'delayed' scenarios. Stranded costs reach 7.3 EUR/MWh, 3.9 EUR/MWh and 7.8 EUR/MWh in the no target scenario in these three countries, respectively. Most of these costs can be avoided by taking early action to decarbonise the electricity sector and avoiding investment in additional fossil fuel plants.

Coal subsidies will need to be phased out, making coal less competitive

The fossil-based energy production is in many cases believed to be cheaper just because it is financed by complex systems of state aids and other subsidies. The subsidies for fossil fuels can be extremely high in the SEE region compared to GDP.

	Estimation of fossil fuel subsidies (% of GDP, 2005-2009)	**Energy subsidies (% of GDP, 2015)**
Albania	7-8%	1.9%
Bosnia and Herzegovina	9-10%	37.0%
Bulgaria	n.a.	33.9%
Croatia	5-6%	3.7%
Greece	n.a.	2.6%
Kosovo*	35-36%	n.a.
FYR of Macedonia	8-9%	18.0%
Montenegro	10-11%	16.7%
Romania	n.a.	6.50%
Serbia	7-9%	34.7%

FIGURE 7 – FOSSIL FUEL SUBSIDIES IN THE REGION. SOURCE: KOVACEVIC, 2011; REN21 & UNECE, 2017 VIA KOPAČ, 2018.

The subsidies paid for fossil-based energy production are the highest in Kosovo* in the SEE region. Kosovo* has also state aid issues: Energy Community Secretariat concluded in June 2018 that state aid rules were not respected regarding the coal-fired Kosova e Re power plant (Balkan Green Energy News, 2018). Energy subsidies in general are high (more than third of the GDP) in Bosnia and Herzegovina, Bulgaria and Serbia.

Changes in the LCP BAT REF will shut down many existing coal plants and make new coal plants more expensive

EU member states as well as accession countries need to adhere to the requirements of the Industrial Emissions Directive. On 28th April 2017, a "new round of controls on air pollution" was adopted. (Gerrard Wynn & Coghe, 2017; CEE Bankwatch Network, 2017b; DNV GL-Energy, 2016). The limits approved stand as reference in the EU in large thermal power plants permission procedures. They are in accordance with the BREF document (best available techniques reference document) for Large Combustion Plants (LCP). The LCP BREF contains limits for air pollutant emissions such as nitrogen, oxides of sulphur, particulate matter or mercury. Not only newly built large combustion plants will have to follow BREF requirements: existing units will also have to comply by 2021, which means that management will have to decide in the near future on investments in pollution control technologies (Gerrard Wynn & Coghe, 2017). According to DNV GL-Energy (2016), 84 823 MW hard coal and 53 432 MW lignite power plant capacities will be in operation in EU-28 countries by 2021. Of these, only

18 991 MW hard coal-based (22.4%) and 5 956 MW lignite-based (11.1%) power plants will be compliant that time. Gallop & Ciuta (2017) highlight that new BAT standards had to be applied in countries of the Energy Community from the moment they entered into force in the European Union, as the IPPC Directive has been transposed to national legislation in the Contracting Parties with provisions stating that the EU BREF has to be used if there is no national-level BREF.

Gerrard Wynn & Coghe (2017) analysed the most polluting power plants in terms of SO_X and NO_X emissions above 300 MW_{th}. Most of them were concentrated in Eastern Europe and the Western Balkans and were at least 40% above the relevant BREF limits. The "best-in-class NO_X abatement would add 2-4 EUR/MWh" according to Wynn & Coghe (2017), and 0.3-7.7 EUR/MWh according to DNV GL-Energy (2016). The "best-in-class SO_X abatement would add 6-7 EUR/MWh" according to Wynn & Coghe (2017) and 0.4-221 EUR/MWh according to DNV GL-Energy (2016). Gerrard Wynn & Coghe (2017) concluded that particularly in the case of older power plants, these costs are so significant that it will be more rational to shut down these power plants. "BREF represents a significant new source of additional financial stress for much of Europe's coal power fleet", which will force asset owners to implement expensive investments in a few years, significantly restrict their operation or close the plants.

Pollution from coal incurs additional costs to society

In addition to the above costs, the costs of negative externalities, such as health costs should be also considered in the financial evaluation of fossil-based energy production as usually only a fraction of these costs (negative externalities) are taken into consideration. In general, among fossil fuels, coal-based energy production is the worst from many perspectives, but most importantly, it has substantial effect on the climate and environment.

An average coal-fired power plant emits 40% more CO_2 compared to a gas-fired power plant and 20% more CO_2 compared to an oil-fired power plant. In addition, the probability of making coal-based power plant cleaner is small, as well as its efficiency of energy production. In the first place, the "ultra-supercritical" (newly developed efficient) coal power plants would still produce more CO_2 compared to gas-based power plants (Tagliapietra, 2017).

In the SEE region, air pollution, energy poverty and coal dependency are important aspects of the daily life and the externalities related to them – if properly appearing in the calculations – outweigh the cost of RES deployment. In other words: RES scenarios can seem to be expensive, but they save lives and have lower social (external) costs.

Annually around 400 000 people die prematurely in Europe because of air pollution. Coal plants in Romania cause 1 600 deaths abroad (Jones et al., 2016). The emissions are not only CO_2, but SO_x, NO_x, $PM_{2.5}$ and ashes, as well as radioactive particles and heavy metals such as mercury which "can impact the immune system, with children most at risk". IRENA (2018) calculates that an amount of between USD 19 billion and 71 billion could be saved yearly until 2030 thank to the avoided negative health effects and that the increase of the share of renewable energy could help avoid yearly environmental costs of a minimum of USD 8 billion and a maximum of USD 37 billion for the same period.

MYTH A4: RES are not competitive

"The competitiveness of some RES will never reach that of conventional power technologies. RES are only for the wealthy."

FACT:

RES are the cheapest solution on system level on the long-run and provide more benefits for society.

The cost of renewable technologies is continuously falling and in some countries these technologies are already cheaper than traditional fossil fuel-based electricity generation technologies (IRENA et al., 2017; see also myth A2). In 2017, more investments were carried out in installation of new renewable energy capacities than of fossil-based units. In fact, IRENA, IEA, & REN21 (2018) claims that renewables have become a "technologically mature, secure, cost-effective and environmentally-sustainable energy supply option". According to the IEA's New Policies scenario, renewables become the most economic generation option for many countries by 2040, when the majority (two-thirds) of global power generation investments are expected to be renewable-based (IEA, 2017). However, in most locations renewable technologies still require support. In addition, initial investment costs are often high for RES technologies.

Currently renewable energy technologies are not yet fully competitive in the SEE region, but SEERMAP results show that over the short to medium term the support required to ensure RES expansion will be relatively low. Required support will reach 6.6 EUR/MWh at its highest on average in the SEERMAP region. However, by 2050 the necessary RES support level will drop to 2 EUR/MWh. At the same time, a reduction in the wholesale electricity price by 16 EUR/MWh can be achieved by 2050 compared with scenarios with a lower share of RES, thereby benefitting society.

There will be a significant increase in the price of carbon, to around 33 EUR/tCO_2 by 2030 and 88 EUR/tCO_2 by 2050[4], meanwhile the cost of renewable energy technologies will fall. The price of coal and lignite is expected to increase by approximately 15% by 2050 compared with 2016, according to IEA projections. All these factors are expected to make coal and lignite-based electricity production less competitive in future. This means, that coal and lignite-based power plants cannot remain operational until the end of their lifetime and some of the investment cost cannot be recovered (as formerly explained in myth A3, this is called stranded cost). A financial calculation was carried out on the stranded costs of fossil-based generation plants that are expected to be built in the period 2017-2050[5]. Both total stranded cost as stranded cost relative to total electricity production annualised over a 10-year period were calculated.

According to the SEERMAP results, driven by a high carbon price, a significant amount of fossil fuel-based generation capacity will be replaced by 2050. That time in 'decarbonisation' scenario the RES share in net electricity generation will be 86% while nuclear 12% and fossil penetration only 2%. Coal, lignite and oil capacities are phased out almost completely under all scenarios. However, despite the almost complete phasing out of fossil fuels, in the 'decarbonisation' scenario generation and system adequacy indicators remain favourable.

[4] It is hard to project future CO_2 prices. However, the price level is currently EUR 13 and the cap reduction factor will increase from 2021 onwards. Therefore, reaching EUR 33 in 2030 does seem feasible.

[5] The calculation is based on the assumption that stranded costs will be collected as a surcharge on the consumed electricity (as is the case for RES surcharges) for over a period of 10 years after these lignite based capacities become unprofitable.

An analysis was carried out by Öko-Institut commissioned by Agora Energiewende to determine and compare total system costs – including generation, grids and storage – of alternative (RES-based, coal-based and natural gas-based) energy systems in Germany by 2050 (Öko-Institut, 2017).

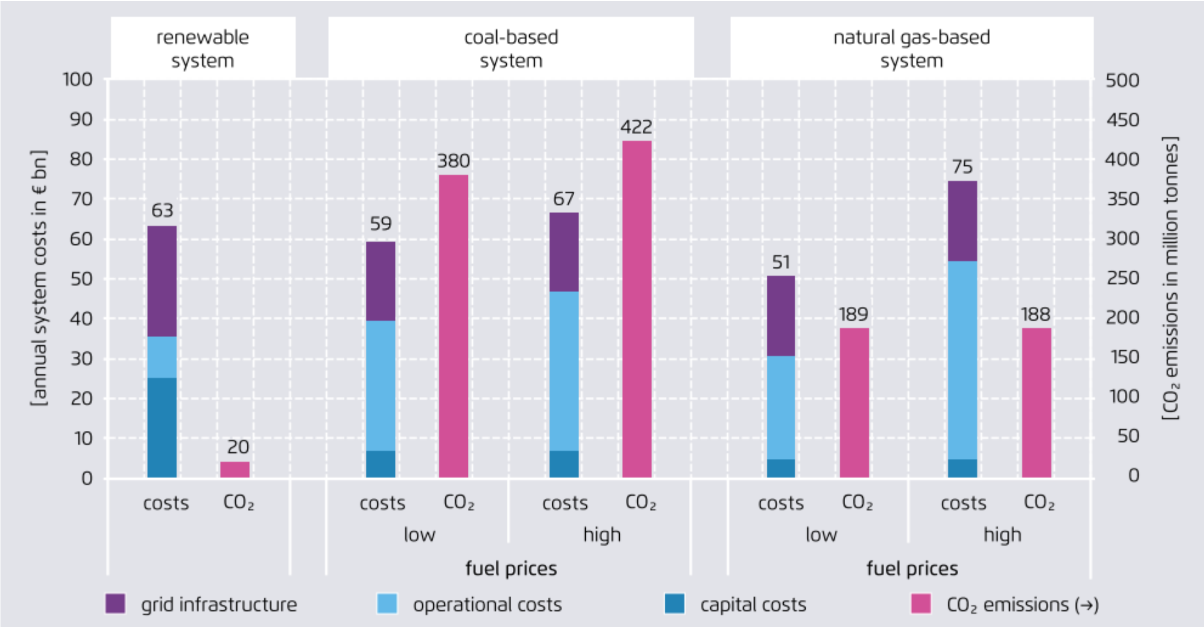

FIGURE 8 - COMPARISON OF TOTAL SYSTEM COSTS OF PREDOMINANTLY RENEWABLE, COAL AND NATURAL GAS-BASED POWER SYSTEMS WITH CO_2 PRICES OF 50 EUR, 2050. SOURCE: ÖKO-INSTITUT, 2017.

The results showed three important key findings:

1. In most cases, a 95% RES energy system is cheaper or is on the same price level as other, fossil-based scenarios. High coal share is only significantly cheaper if the CO_2 prices will be around 20 EUR/t which is lower than the expectations, while gas-based systems need low gas prices and CO_2 prices below 100 EUR/t.
2. High renewable shares stabilize energy prices as variable costs are only 5% while 30-67% in fossil-based systems, highly depending on variability of fuel and CO_2 prices.
3. While estimated CO_2 damage costs are 80 EUR/t on the short-term and 145-260 EUR/t on the long-term, a high share (95%) RES-based electricity system is able to decrease CO_2 emissions by 96% only for 50 EUR/t, providing a cost-efficient solution for tackling climate change. (Öko-Institut, 2017)

INSIGHTS FROM ROMANIA:

The SEERMAP modelling assumes that current coal and lignite fired generation plants are retired in all scenarios by 2030, in accordance with national plans. The model does not build any new lignite or coal capacities and he total share of fossil fuel-based generation decreases in all scenarios compared with current levels by 2050. This confirms – in line with the national strategies dealing with that period of time containing no new coal or lignite power plants – that coal is not a cost-efficient generation option in Romania. However, in spite of that, the draft of the new Energy Strategy of Romania does contain a new 600 MW lignite power plant to be built until 2030 (Romanian Ministry of Energy, 2018).

The sensitivity analysis showed that a low carbon price which is half of the level assumed in the 'decarbonisation' scenario is still not enough to make lignite and coal-based generation profitable in Romania over the medium term.

Renewables play an increasingly important role in all three scenarios meaning that they are economically feasible solution in the future. New wind capacity investment is particularly strong,

almost tripling by 2050 in the 'delayed' scenario and also increasing significantly in the 'decarbonisation' scenario, due to a combination of high wind potential, decreasing cost of technology and the price of carbon. New solar investments increase at an even higher rate, reaching five times 2016 levels by 2050 in the 'decarbonisation' scenario, but in absolute terms solar additions are more moderate, and the same applies to biomass. Meanwhile hydro capacity increases by approximately 20% across the period in both the 'delayed' and 'decarbonisation' scenarios.
See also myth A3 and A5.

IRENA et al. (2017) also confirm that the cost-competitive renewable energy potential is comparably high in Romania. Moreover, it "has the largest additional cost-competitive solar capacity in the whole SEE region (up to 16.9 GW)" and it also has a significant wind potential of 84 GW. IRENA et al., (2017) also highlights that "the total additional cost-competitive renewable energy potential (up to 71 GW) is approximately six times higher than the deployment level today or the level envisaged in the NREAP by 2020".

INSIGHTS FROM GREECE:
SEERMAP results show that coal, lignite and oil capacities are phased out under all scenarios by 2050. The decrease in the share of these fuels begins early, mainly driven by the rising price of carbon and the low marginal cost of RES which results in unprofitable utilisation rates of existing fossil fuel capacities. The share of coal falls to around 10% of total generation by 2040 in all scenarios. Whether or not Greece pursues an active policy to support renewable electricity generation, fossil fuel generation capacity will decline precipitously driven by the price of carbon. The sensitivity analysis showed that a 50% lower carbon price would increase the utilisation rates of coal power plants only by 11% in 2030 and by 10% in 2050. However, this is not enough to make coal competitive by 2050 as significantly higher utilisation rates are required to avoid plant closure. Policy makers need to address the trade-offs which characterise fossil fuel investments. Coal and oil generation capacities are expected to be priced out of the market before the end of their lifetime in all scenarios; coal investments made at any time during the modelled time period will result in stranded assets.

The decarbonisation of the electricity sector in Greece is "inevitable with or without new measures and policies and even without very high CO_2 prices[6]" based on the results of the 10 scenarios from CRES, NOA, SEERMAP and the EU 2016 Reference Scenario (Lalas & Gakis, 2017).At the same time the abatement costs related to fossil energy production should be also considered, when comparing costs of fossil-based and RES-based capacities in the energy system. The Dimitrios ST I-II power plant in Greece has NO_X emissions more than 150% above BREF (Best Available Techniques Reference; see myth A3)(Gerrard Wynn & Coghe, 2017). This means, that by 2021, the plant should be ready with new technological investments – which could add 2-4 EUR/MWh cost on electricity generation (Gerrard Wynn & Coghe, 2017) – or it has to be closed.

Roinioti, Koroneos, & Wangensteen (2012) designed and calculated 4 different long-term scenarios besides a reference scenario to provide an outlook to the Greek electric system by 2030 focusing on RES development. The scenarios' narratives are:

- Green scenario: low emissions, high growth; advanced RES technologies;
- Orange scenario: high emissions, high growth; traditional energy & RES;
- Red scenario: high emissions, low growth; traditional energy;
- Blue scenario: low emissions, low growth; advanced RES & traditional energy.

[6] They expect 8-15 EUR/MWh by 2020, 20-33.5 EUR/MWh by 2030 and 30-88 EUR/MWh by 2050.

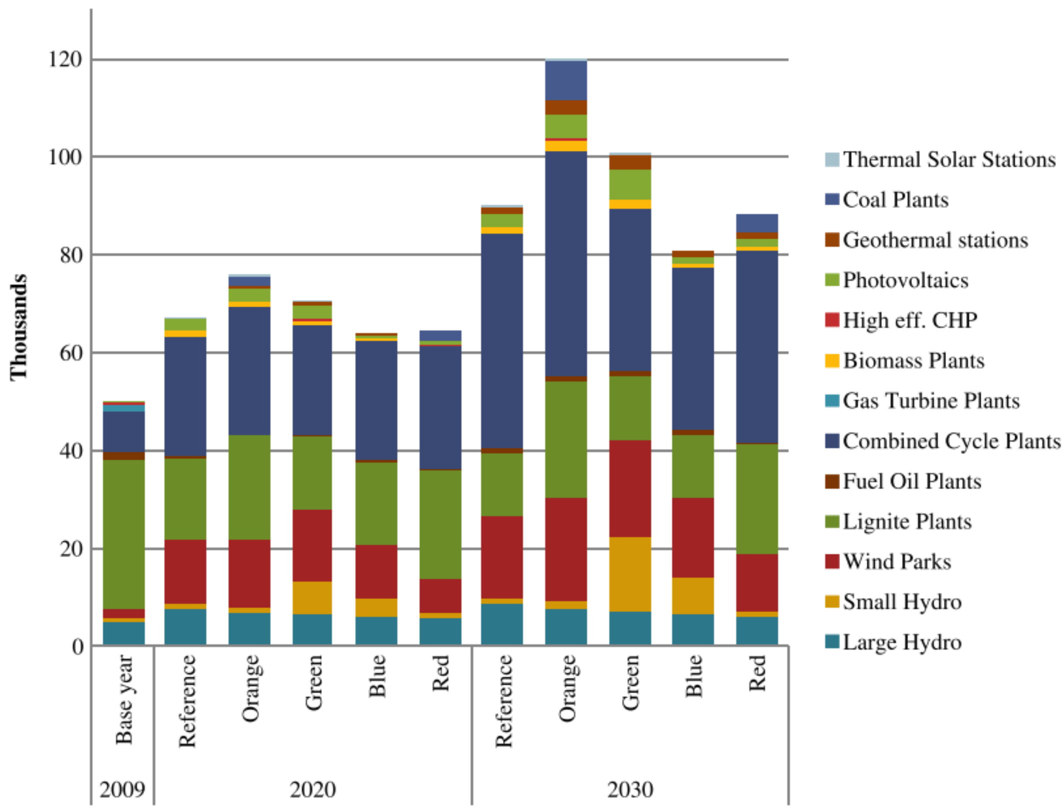

FIGURE 9 - ELECTRICITY GENERATION PER TECHNOLOGY TYPE AND SCENARIO (GWH). SOURCE: ROINIOTI, KORONEOS, & WANGENSTEEN, 2012.

Under the Reference scenario, natural gas-based electricity will expand from 19% in 2009 to 48% in 2030. In Green scenario, it increases to 32% by 2020 and does not change until 2030. Small hydro production share expands from 10% to 15% of electricity generation between 2020 and 2030. The RES share reaches 53.1% in the Green, 41.9% in the Blue, 33.7% in the Orange and 25.4% in the Red scenario by 2030 (Roinioti et al., 2012). This research clearly shows that in any scenarios, including the Reference scenario, the role of lignite-based power production will decrease while electricity from gas, wind and PV will increase dynamically by 2030.

Tigas et al. (2015) modelled 3 different scenarios (CP – current policies, RESM – renewable electricity share maximalisation, EMCM – environmental measures and cost minimalization) with several versions (RES-a with electricity import, EMCM-a uses CCS in lignite power plants).

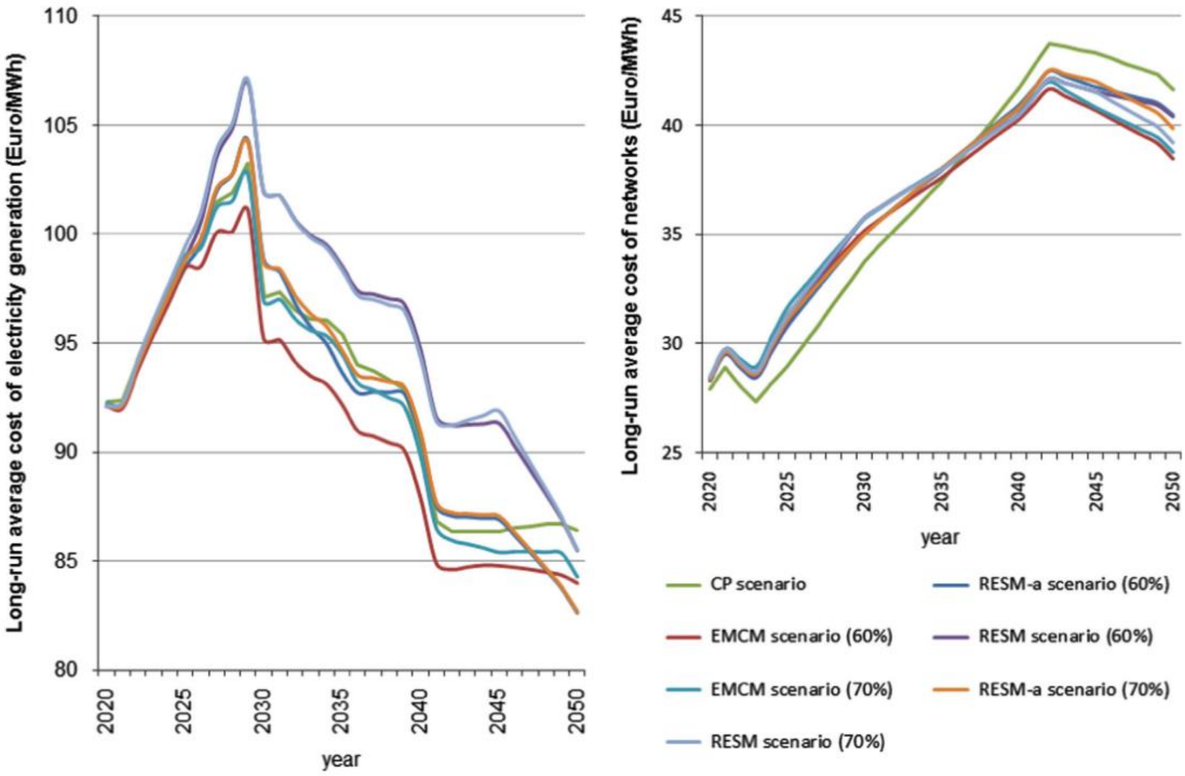

FIGURE 10 – LONG-RUN AVERAGE COST OF ELECTRICITY GENERATION AND NETWORK EXPANSION IN GREECE BETWEEN 2020 AND 2050. SOURCE: TIGAS ET AL., 2015.

The model results pointed out that Current Policies Scenario is the worst choice as it resulted in the most expensive generation and also network costs by 2050, while other scenarios' expenditures are falling after 2030. It is not only uneconomical but also cannot fulfil the CO_2 reduction expectations. Meanwhile the other scenarios provide 60-70% emission reduction compared to 2005, lower import dependency, more stable energy prices and create a domestic RES industry (Tigas et al., 2015).

A new research report from WWF and National Observatory of Athens investigating the potential for significant decarbonisation in Greece analysed the following scenarios (WWF & NOA, 2017):

1. Business as Usual (BaU)
2. Expansion of Lignite Use (LIG)
3. Expansion of RES Use (RES)
4. Energy Efficiency (EE)
5. Efficiency and Lignite Phase-Out (LPO)

The concluding remarks highlight that without phasing out lignite, the EU targets for 2030 cannot be achieved. RES share is expected to increase in all scenarios, which will require – depending on which scenario is followed – total investment costs of between 23 and 33 billion EUR (including new conventional power plants in some cases). The BAU and LIG scenarios, where the nowadays cheap lignite is further used or even expanded, do not provide cheap electricity by 2030. The reason is that cheap wind power will compete with lignite where fuels as well as emission allowances (25 EUR/t CO_2 in the study) have to be purchased.

INSIGHTS FROM THE FORMER YUGOSLAV REPUBLIC OF MACEDONIA:
The SEERMAP results showed that based on market model simulations, in all scenarios, phasing out lignite and reaching 61-89% RES share is the cost-optimal solution by 2050.

Taseska et al. (2011.) created three different energy scenarios for Macedonia with software modelling and optimizing tools to analyse the consequences of substituting two lignite power plants with gas-based CHPs (first mitigation scenario) or with more (180 GWh in 2050) renewables (second mitigation scenario).

Period 2008–2025	Cumulative CO_2-eq. emissions (kt)	Total system costs (k$)
Baseline scenario	205,901	8,985,039
First mitigation scenario	164,343	9,310,911
Difference	41,558	−325,872
Specific costs	7.84 $/t CO_2-eq.	
Baseline scenario	205,901	8,985,039
Second mitigation scenario	127,628	6,819,405
Difference	78,273	2,165,634
Specific costs	−27.67 $/t CO_2-eq.	

FIGURE 11 – MITIGATION COSTS IN BASELINE, FIRST AND SECOND MITIGATION SCENARIO. SOURCE: TASESKA, MARKOVSKA, CAUSEVSKI, BOSEVSKI, & POP-JORDANOV, 2011

According to the results, the total system cost in the first mitigation scenario is slightly more expensive than the baseline scenario, resulting in mitigation costs of 7.84 $/t CO_2-eq. Taseska et al. (2011) concludes that "the second mitigation scenario has a potential for reduction of almost 80 000 kt CO_{2eq} at negative price (win-win mitigation)", pointing out that decarbonisation is inexpensive with high-share RES scenario. This is possible by the liberalisation of the electricity market including the industrial sector and also due to the increasing investment costs of lignite power production because of the EU' Industrial Emission Directive (see myth A3 about BREFs).

A study of Ćosić, Krajačić, et al. (2012) reveals that by implementing energy efficiency measures that decrease consumption levels and with the installation of new generation capacities, a 100% renewables based electricity system is achievable by 2050.

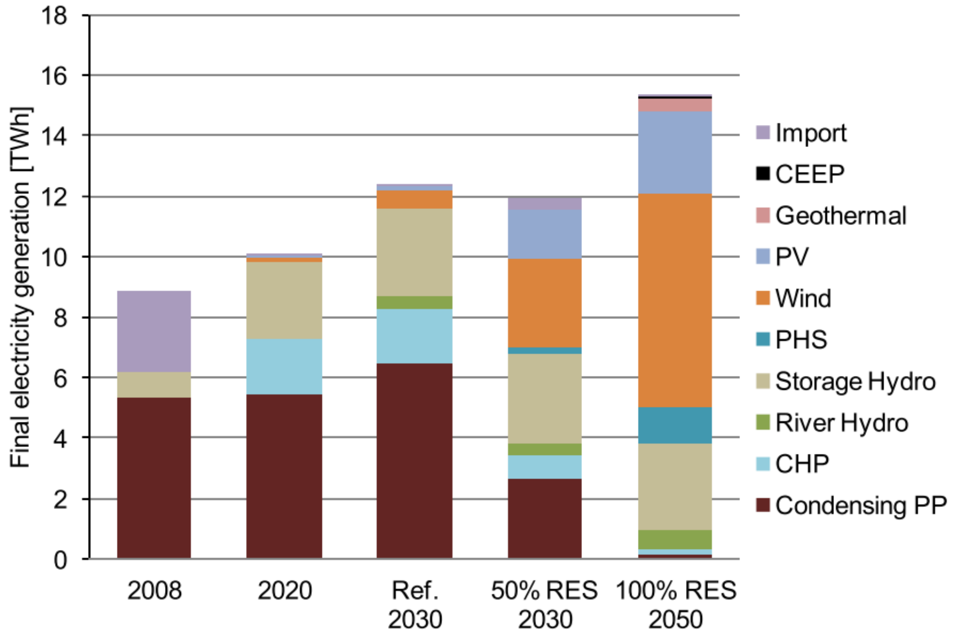

FIGURE 12 - ELECTRICITY GENERATION BY TECHNOLOGIES FOR DIFFERENT SCENARIOS. SOURCE: ĆOSIĆ, KRAJAČIĆ, ET AL., 2012

According to this study, biomass makes the most significant contribution to primary energy production (19,8 PJ). In order to achieve an electricity system relying 100% on renewables, high share of hydro (2.9 TWh), wind (7.08 TWh) and solar power (2.69 TWh) is necessary as well as the application of different storage technologies (including electric vehicles and heat pumps). If a high share of biomass and hydro is to be avoided for sustainability reasons, additional energy efficiency measures may be required especially in a region where numerous conflicts between renewable energy development and nature protection exist (see myth B1).

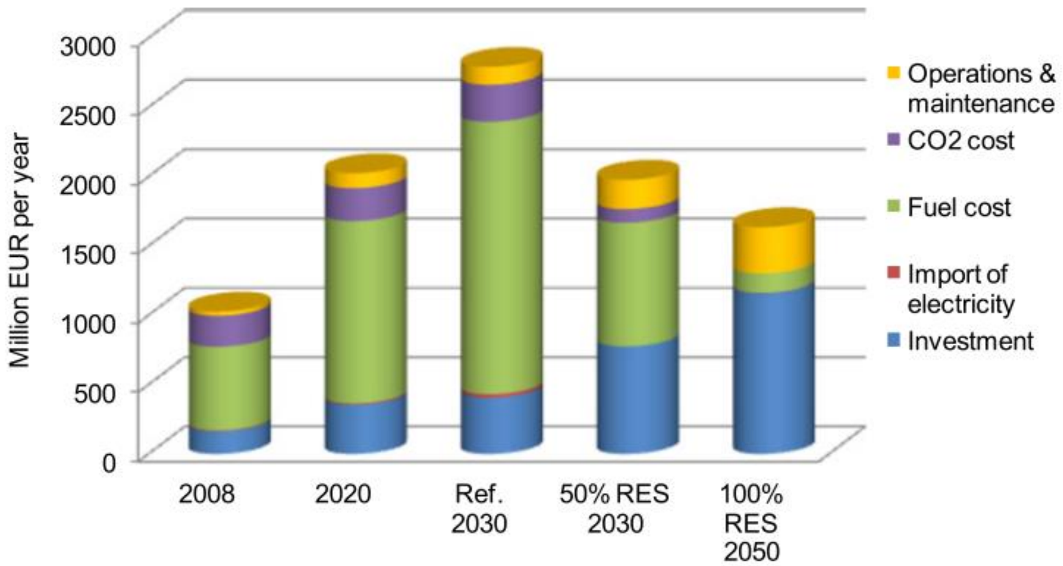

FIGURE 13 - ANNUAL OPERATING COSTS OF THE VARIOUS SCENARIOS. SOURCE: ĆOSIĆ, KRAJAČIĆ, ET AL., 2012

According to the hourly detailed energy system model of Ćosić, Krajačić, & Duić (2012), with a CO_2 price of 25 EUR/t, the "reference scenario in the year 2030 is the most expensive scenario due to high consumption of fossil fuels and because of CO_2 emissions". The 100% renewable energy system has the lowest fuel cost compared to reference scenario, but in this scenario annual investment costs are the highest. Total annual investment cost for the 50% renewable energy system is 776 mEUR while the annual investment costs for the 100% renewable energy system is 1161 mEUR.

INSIGHTS FROM SERBIA:

A report of UNEP (2013) provides an overview and starting point for Serbia's transition to a green economy based on a modelling research for 2030. The "results indicate that there are significant long-term benefits from a transition to a green economy in each of the (analysed) sectors" (energy demand, supply, agriculture and transportation) that would also decrease electricity prices making renewables a more affordable solution.

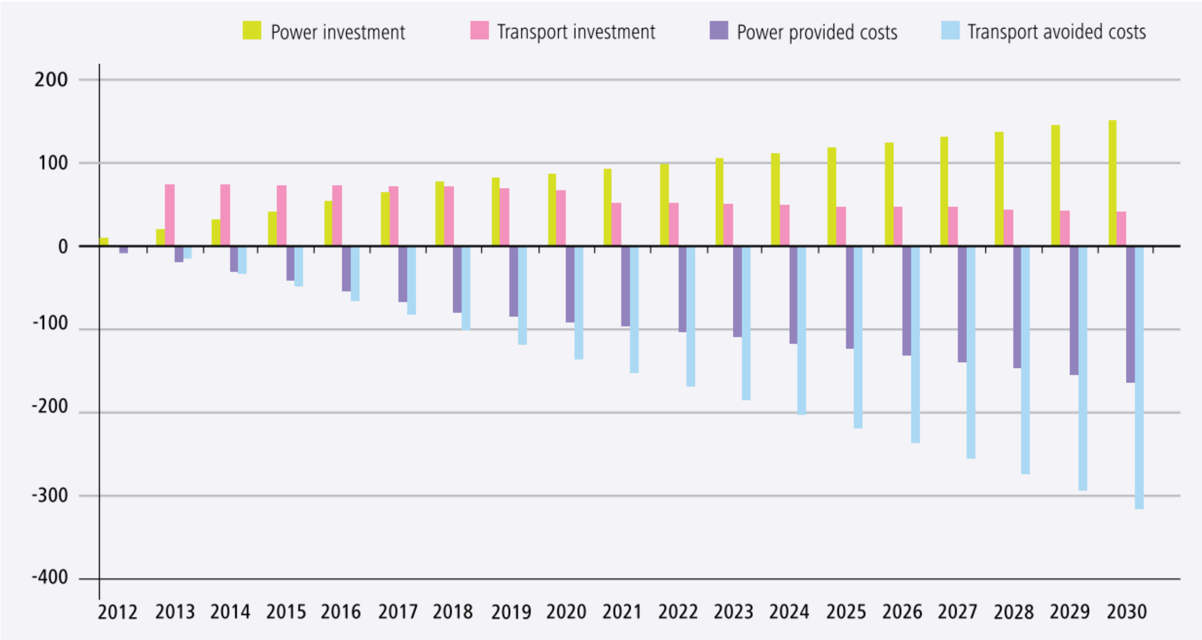

FIGURE 14 – COMPARISON OF ANNUAL INVESTMENTS (POSITIVE VALUES) AND AVOIDED COSTS (NEGATIVE VALUES) FOR POWER AND TRANSPORT IN SERBIA BETWEEN 2012 AND 2030. SOURCE: UNEP, 2013.

Regarding energy demand, "avoided costs will be higher than investments by 2030, reaching a cumulative net benefit of 1 to 2 billion EUR, or approximately 50 to 100 million EUR per year. Simulation reveals that the overall payback time is seven to 10 years, with the breakeven point (from an economy-wide perspective) being reached in 2019-2022."

On the supply side, 5 000 to 10 000 GWh coal-based energy production is avoided in 2030, resulting in approximately 1.3 billion EUR of capital savings. "Based on rough assumptions (at 20 EUR per ton) on the current and future cost of coal for power generation, the net investment for energy supply reaches a total of 10 to 40 million EUR in 2030, or reaching up to 50% of the annual investment." (UNEP, 2013)

INSIGHTS FROM BOSNIA AND HERZEGOVINA:

The SEERMAP results show that stranded costs equal 7.3 EUR/MWh in the 'no target' scenario and 7.6 EUR/MWh in the 'delayed' scenario, which adds up to total 1513 mEUR and 1565 mEUR, respectively, to the whole modelling period. The annualised stranded cost figure is the second highest figure (after Kosovo*) in the SEERMAP region and is significantly higher than the renewable support per MWh needed to enable Bosnia and Herzegovina to meet EU emission reduction targets in the 'decarbonisation' scenario.

INSIGHTS FROM KOSOVO*:

SEERMAP results show that stranded costs equal 7.8 EUR/MWh in the 'no target' scenario and 8.1 EUR/MWh in the 'delayed' scenario, which adds up to a total of 629 mEUR and 664 mEUR, respectively, over the whole modelling period. This annualised stranded cost figure is the highest figure in the SEERMAP region and is significantly higher than the renewable support needed to enable Kosovo* to meet EU emission reduction targets in the 'decarbonisation' scenario. By contrast, the stranded asset surcharge is only 0.1 EUR/MWh and 9 mEUR in total in the 'decarbonisation' scenario.

Other studies confirm that fossil-based energy production is the most expensive solution in the future in Kosovo*. According to the World Bank's Expert Panel's estimation, the new coal-based power plant in Kosovo* cannot be competitive with renewable generation as the LCOE of it is estimated to be approximately 81.42 EUR/MWh when it will be finished. The official "target" consumer price of the contract is 80 EUR/MWh – which does not contain all costs (Gerard Wynn & Azemi, 2018). The contract includes "availability payments", which seems to be prohibited state aid according to the new EU guidelines according to the Energy Community (Balkan Green Energy News, 2018).

Kittner, Dimco, Azemi, Tairyan, & Kammen (2016) find that a range of alternatives exists to meet present supply constraints all at a lower cost than constructing Kosova e Re, the proposed 600 MW coal plant[7]. The options include energy efficiency measures, combinations of solar PV, wind, hydropower, biomass and the introduction of natural gas.

For example, the Euro 2030 path is a pathway that meets Kosovo's future electricity demand in an economical and reliable manner. It is a trajectory that uses the original EU 2030 targets, namely 27% increase in energy efficiency, 27% reduction in Co_2 emissions and 27% RES share in final energy consumption. It can be seen that fossil based generation is decreasing over time while the share of renewables grow. By 2025, solar PV is expected to increase steeply which will lead to electricity production higher than consumption, thus even make the decrease of imports possible.

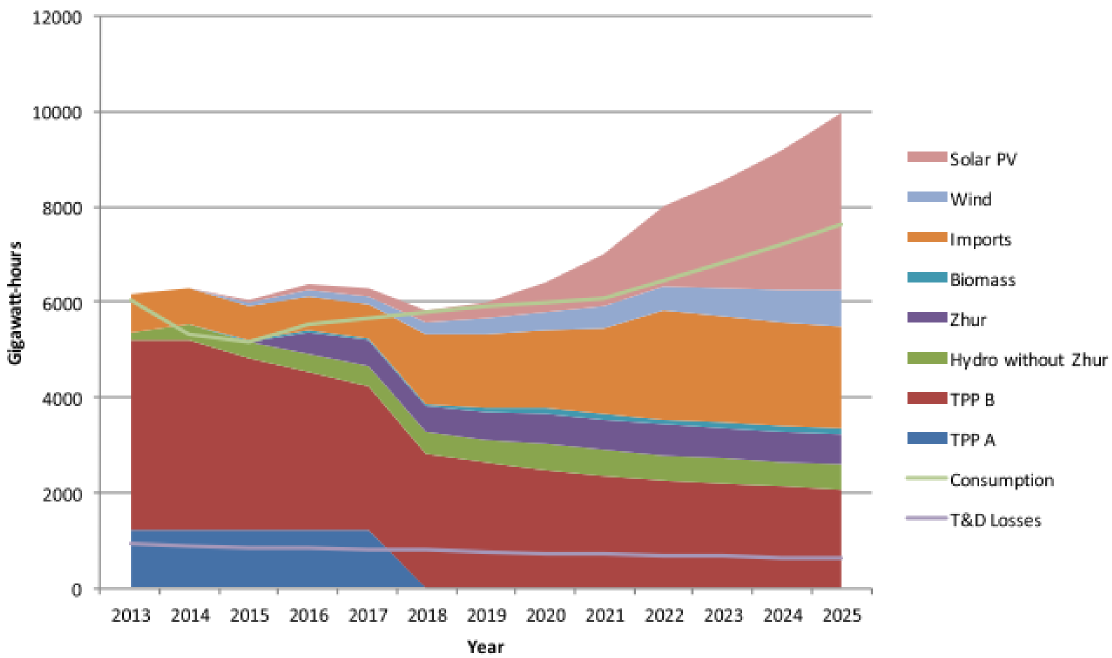

Figure 15 - EURO 2030 PATH: ENERGY EFFICIENCYMEASURES (27% INCREASE), 27%CO2 REDUCTION,>27%RENEWABLE CONSUMPTION, EXPANDED POWER EXCHANGE. SOURCE: KITTNER, DIMCO, AZEMI, TAIRYAN, & KAMMEN (2016).

[7] The contract was later signed for an 500 MW power plant in December 2017 by Kosovo's government and ContourGlobal (USA) (Jonuzaj, 2017). The construction works are planned to start in 2019, the power plant is expected to work from 2023 (Jonuzaj, 2018a).

MYTH A5: RES increase the price of electricity

"Electricity prices will grow because of renewables. RES support and expansion will lead to increased electricity bills. RES-based systems are more expensive. Transition to renewables is not financially feasible."

FACT:

The increase of the electricity price is mostly driven by the increase in the price of carbon and natural gas. RES decrease the electricity price on the long term.

Retail prices consist of the wholesale price plus subsidies, taxes, fees and network costs. Of these retail price components the SEERMAP report covered wholesale prices and RES support.

The most important result of the SEERMAP models is that the price of electricity follows a similar trajectory in all scenarios in all countries in the SEERMAP region, only diverging after 2045 when prices are lower in the scenarios which have decarbonisation targets as a result of the low marginal cost of RES electricity production. The SEERMAP model calculations show that compared to a scenario with no emission reduction target, decarbonisation policies do not drive up wholesale electricity prices. The wholesale price of electricity is not driven by the level of decarbonisation but by the CO_2 price, which is applied across all scenarios, and which apply in all EU member states irrespective of their RES targets, and the price of natural gas. See also myth A3.

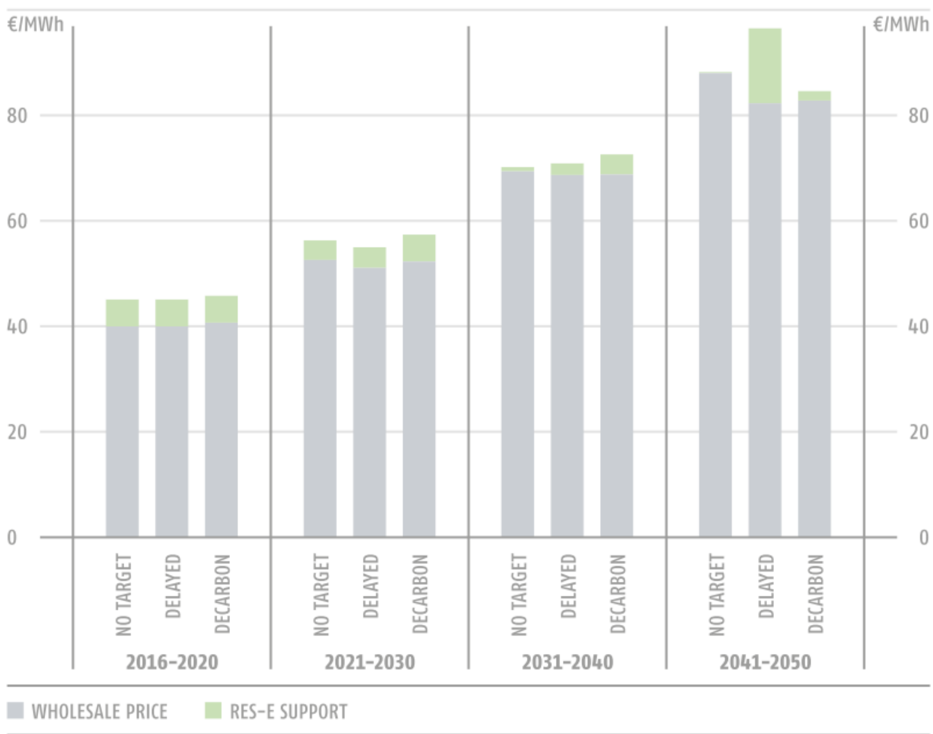

FIGURE 16 - WEIGHTED AVERAGE RES SUPPORT PER MWH OF TOTAL ELECTRICITY CONSUMPTION AND WEIGHTED AVERAGE WHOLESALE PRICE, 2016-2050 (EUR/MWh). SOURCE: SEERMAP REGIONAL REPORT SOUTH-EAST EUROPE.

Despite the significant investment needs associated with renewables, the renewables support needed to incentivise investments in the two decarbonisation scenarios decreases over time if a long-term RES support policy is implemented which enables countries to increase high RES shares gradually. The RES support needed to achieve almost complete decarbonisation in the 'decarbonisation' scenario is only

10.8% of the electricity cost (wholesale price plus RES support) in the period 2020-2025, and 2.7% in 2045-2050. RES support decreases in the ‘decarbonisation’ scenario despite increasing investment in RES capacities, mostly because the rising wholesale electricity price reduces the need for additional support.

The ‘delayed’ scenario demonstrates how delayed action on renewables can increase costs significantly. RES support needed in the 5-year period between 2045-2050 in the ‘delayed’ scenario is 24.3 EUR/MWh, compared with 2 EUR/MWh in the decarbonisation scenario.

External sources also verify the above results. Furthermore, the positive consequences of the higher penetration of variable renewables (mainly wind and solar) in terms of lowering electricity wholesale prices in the EU is already visible. “Higher penetration of volatile RES with very low variable cost of production (due to no fuel cost) has brought low prices to day-ahead markets (DAM) in EU, which made competing fuel-based technologies uncompetitive during windy and/or sunny days.” (Duić, 2015).

See also myth A2, A3 and A4.

INSIGHTS FROM BULGARIA:

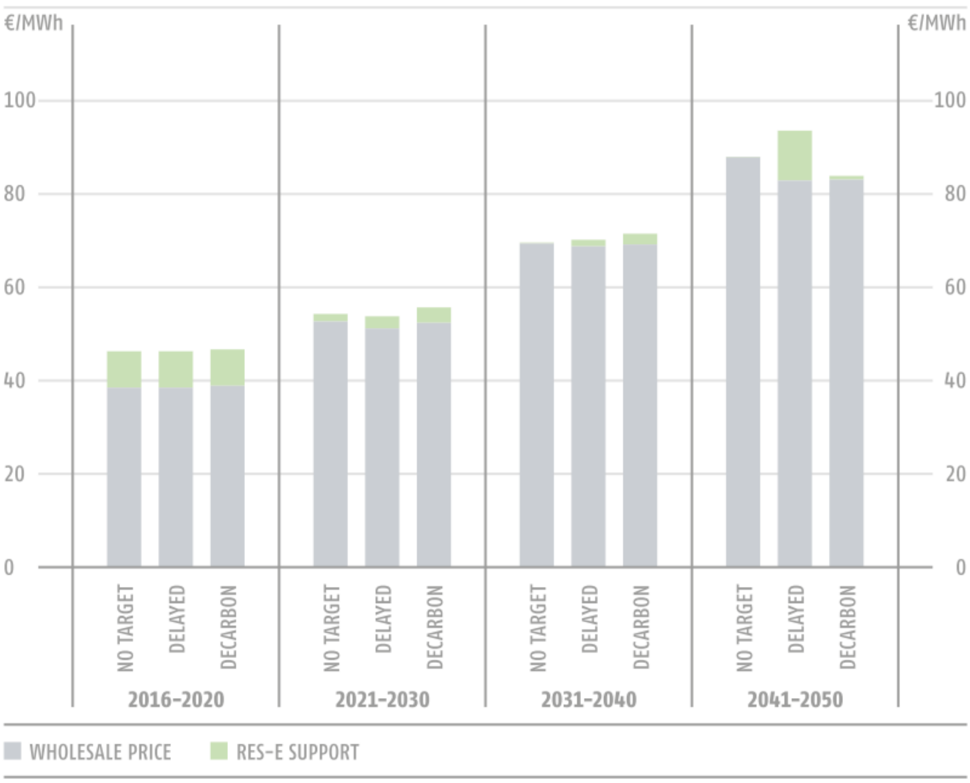

FIGURE 17 - AVERAGE RES SUPPORT PER MWH OF TOTAL ELECTRICITY CONSUMPTION AND AVERAGE WHOLESALE PRICE IN BULGARIA, 2016-2050 (EUR/MWh). SOURCE: SEERMAP COUNTRY REPORT BULGARIA.

FIGURE 17 clearly shows that the wholesale electricity price is expected to rise in the next decades independently of decarbonisation policy (therefore RES share). RES support relative to the cost of electricity (wholesale price plus RES support) in the ‘decarbonisation’ scenario is less than 15.9% in the 2020-2025 period, but only 1.8% in 2045-2050. If planned appropriately, RES support needed to achieve complete decarbonisation is moderate, staying below 4 EUR/MWh after 2025 and below 2 EUR/MWh after 2040. In the decarbonisation scenario RES support falls over the course of the modelled period while investment in RES capacity increases. The broad decline in RES support is made possible mainly by the increasing wholesale price for electricity which reduces the need for residual support. In addition, the SEERMAP results show that ETS auction revenues can cover the necessary RES support over the modelled period, thereby relieving the corresponding surcharge to consumers.

INSIGHTS FROM ROMANIA:

The wholesale electricity prices are expected to increase over time in every scenario in Romania. However, by 2050 the lowest wholesale prices and RES support will be provided by the 'decarbonisation' scenario.

RES support will gradually fall during the modelled period in the decarbonisation scenario. The required RES support is quite low compared to the other countries: the maximum amount is around 7.5 EUR/MWh, which decreases to 0.2-0.6 EUR/MWh by 2040-50 under the 'decarbonisation' scenario of the SEERMAP model.

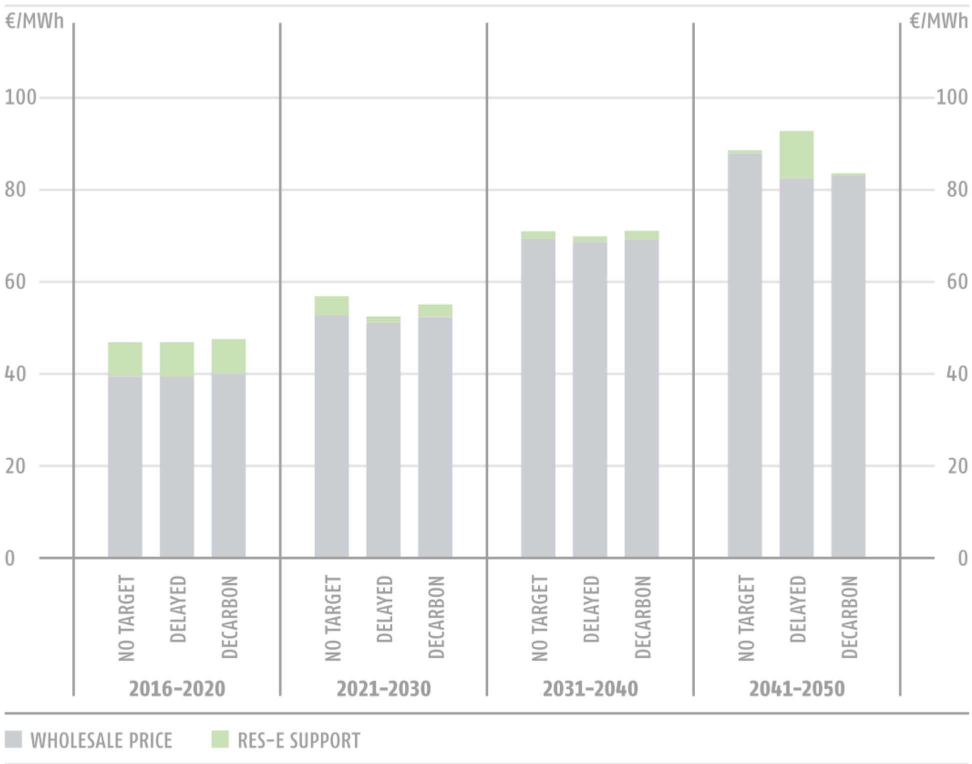

FIGURE 18 - AVERAGE RES SUPPORT PER MWh OF TOTAL ELECTRICITY CONSUMPTION AND AVERAGE WHOLESALE PRICE IN ROMANIA, 2016-2050 (EUR/MWh). SOURCE: SEERMAP COUNTRY REPORT ROMANIA.

A significant share of the RES support for decarbonisation of the electricity sector can be covered by EU ETS revenues, thereby relieving the corresponding surcharge to consumers. Furthermore, due to RES support, private investments will have a positive effect on GDP growth by about 0.7% on average between 2017 and 2050 in the 'decarbonisation' scenario.

INSIGHTS FROM GREECE:

RES support relative to the cost of electricity (the wholesale price plus RES support) in the 'decarbonisation' scenario is 25% in the period 2020-2025 but only 6% by 2045-2050. In this scenario the highest support needed is 22.6 EUR/MWh in the first years, decreasing to 4.7 EUR/MWh by 2050.

The results show that ETS revenues can cover a significant portion of the necessary support between 2021 and 2030, and most of the necessary support in the following decade, thereby relieving the burden on consumers.

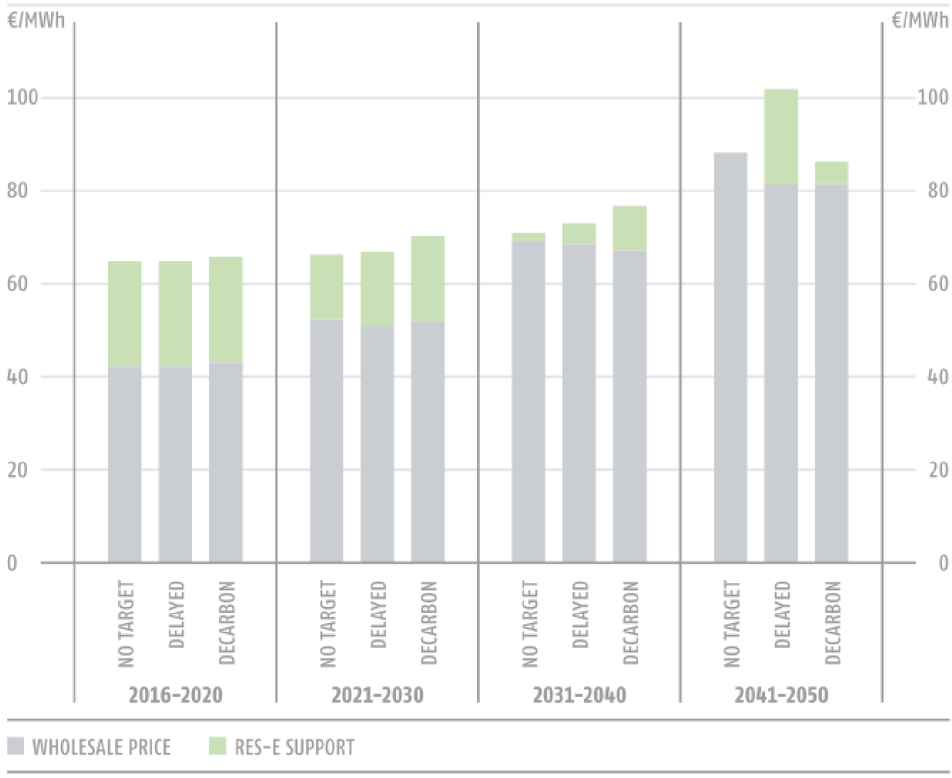

FIGURE 19 - AVERAGE RES SUPPORT PER MWh OF TOTAL ELECTRICITY CONSUMPTION AND AVERAGE WHOLESALE PRICE IN GREECE, 2016-2050 (EUR/MWh). SOURCE: SEERMAP COUNTRY REPORT GREECE.

INSIGHTS FROM CROATIA:

Croatia is facing increasing electricity prices in all scenarios. However, the wholesale prices are expected to be slightly higher in 'no target' scenario by 2050.

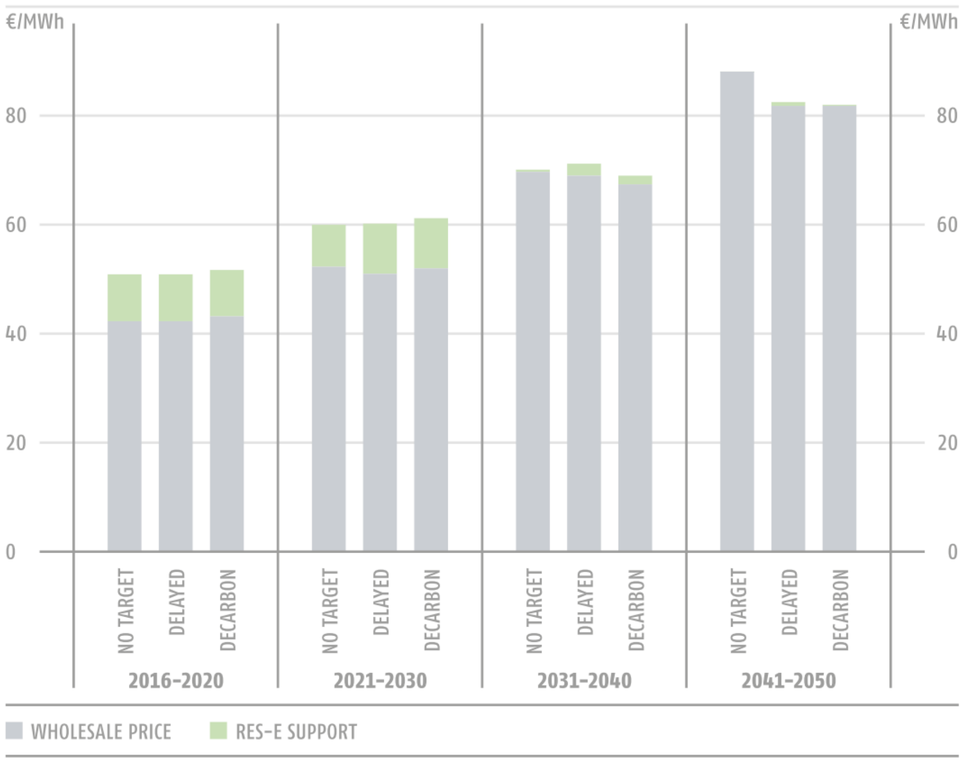

FIGURE 20 - AVERAGE RES SUPPORT PER MWh OF TOTAL ELECTRICITY CONSUMPTION AND AVERAGE WHOLESALE PRICE IN CROATIA, 2016-2050 (€/MWh). SOURCE: SEERMAP COUNTRY REPORT CROATIA.

Despite the significant investment needs associated with the 'decarbonisation' scenario, the renewables support needed to incentivise these investments remains relatively low, initially at 8.5 EUR/MWh and temporarily rising to 10.5 EUR/MWh before steadily decreasing to 0.3 EUR/MWh towards the end of the modelled time horizon. The RES support relative to electricity cost (wholesale price plus RES support) is 16.8% at its highest level in the 'decarbonisation' scenario.

Revenue from the auction of carbon allowances under the EU ETS is a potential source of financing for renewable investment. All scenarios have similar revenues, which may cover 25-30% of the RES support until 2030 and 100% after 2030.

Rajšl & Tomšić (2017) created 3 different future energy scenarios (with total of 10 sub-scenarios) in their research for the electricity sector of the Croatian Low Carbon Development Strategy. The main scenarios are a reference scenario (NUR), a scenario with gradual transition (NU1) and one with strong transition (NU2).

According to the results of the NU1a scenario, the levelized cost of electricity will grow until around 2028 and level out afterwards until 2050 under the NU1 scenario. The levelized cost of electricity is expected to increase initially until around 2029, and then fall to current levels by the mid-2030's. The structure of the levelized cost of electricity will change significantly in the next decade, with an increasing share of annual build cost and market cost decreasing share of RES subsidy.

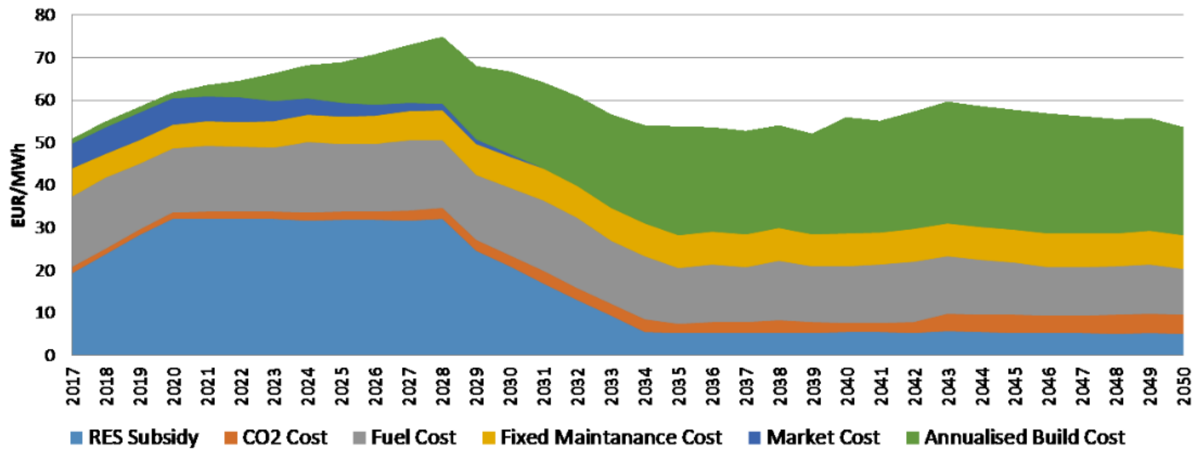

FIGURE 21 - LEVELIZED COST OF ELECTRICITY PRODUCTION IN CROATIA ACCORDING TO NU1A SCENARIO. SOURCE: RAJŠL & TOMŠIĆ, 2017.

A similar, but more up-to-date research was carried out by Pukšec et al. (2018) about possible scenarios of the Croatian energy transition. According to their estimations, due to the high share of wind and solar power in the transition scenarios, the yearly total marginal cost of electricity production is expected to be 18.77 EUR/MWh by 2030. This projects an almost 60% decrease from the Croatian prices of 2016 (45.65 EUR/MWh).

INSIGHTS FROM THE FORMER YUGOSLAV REPUBLIC OF MACEDONIA:

The SEERMAP model calculations show that compared to a scenario with no emission reduction target, decarbonisation policies do not drive up wholesale electricity prices. The price of electricity follows a similar trajectory in all scenarios, only diverging after 2045 when prices are lower as a result of the low marginal cost of RES electricity production.

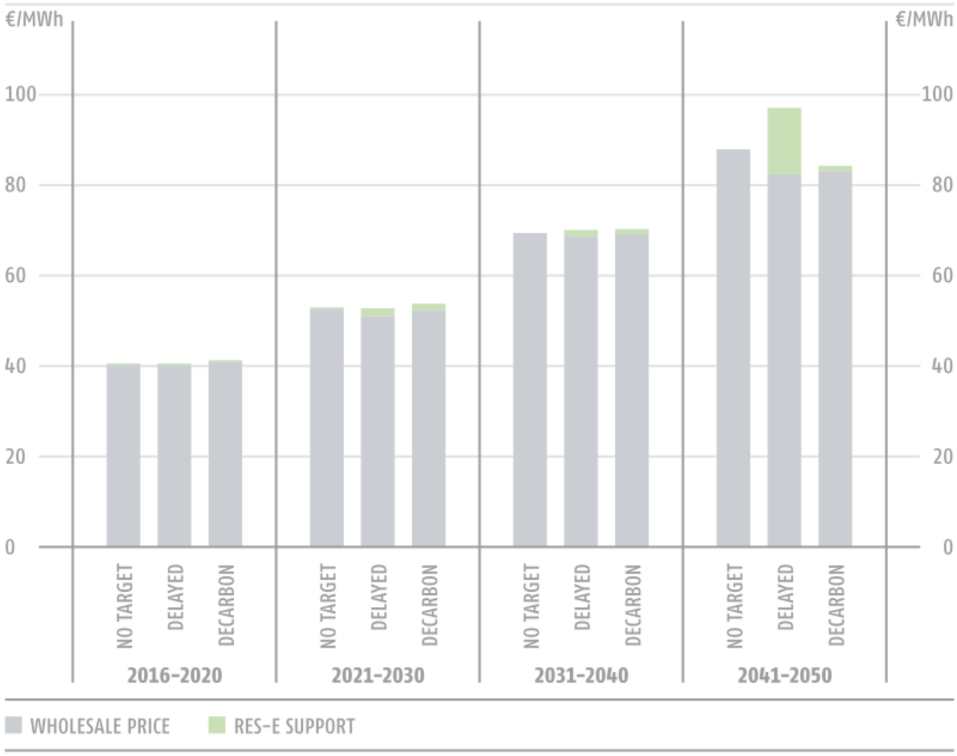

FIGURE 22 - CUMULATIVE RES SUPPORT AND AUCTION REVENUES FOR 4 AND 10 YEAR PERIODS, 2016-2050 (mEUR). SOURCE: SEERMAP COUNTRY REPORT FORMER YUGOSLAV REPUBLIC OF MACEDONIA.

Despite the significant investment needs associated with the 'decarbonisation' scenario, the renewables support required to incentivise these investments remains low, beginning at 0.4 EUR/MWh and staying below 2 EUR/MWh[8] towards the end of the modelled time horizon. The RES support relative to electricity cost (wholesale price plus RES support) is only 2.6% at its highest level in the 'decarbonisation' scenario.

INSIGHTS FROM KOSOVO*:

Similarly to The former Yugoslav Republic of Macedonia, the price of electricity follows almost the same trajectory under all scenarios. The average annual wholesale price increase in Kosovo* over the entire period is 2.9% in the 'no target', 2.2% in the 'delayed' and 2.3% in the 'decarbonisation' scenarios. The price of electricity only diverges after 2045 when prices are lower as a result of the low marginal cost of RES electricity production in the decarbonisation and delayed scenarios.

[8] Prices mentioned in throughout this document are in real (inflation adjusted) terms.

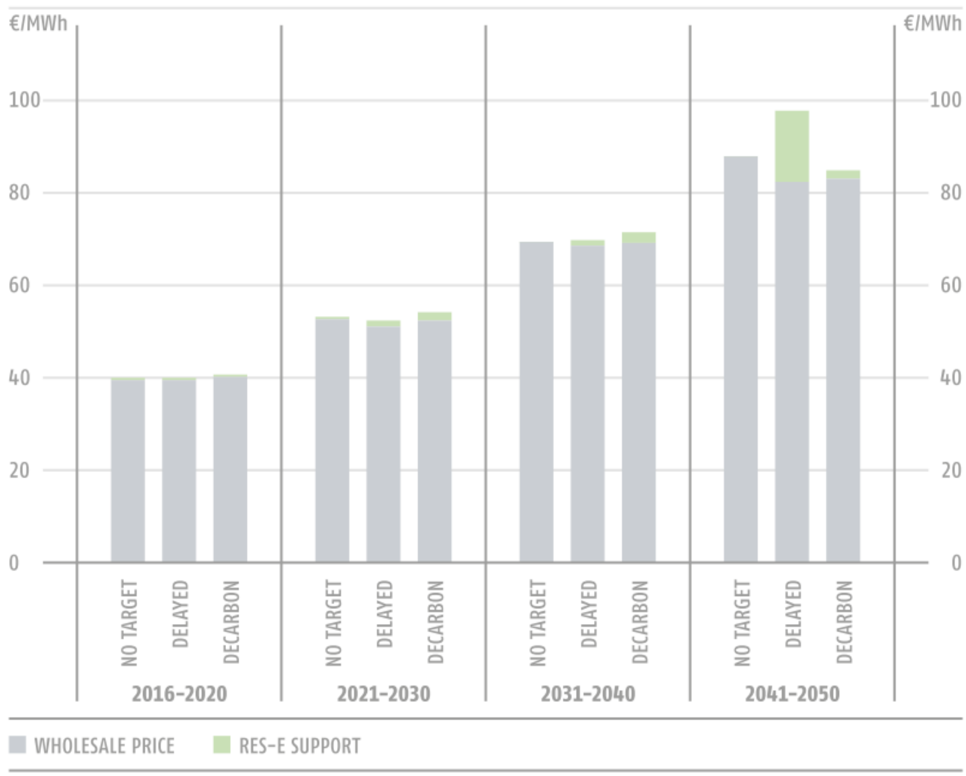

FIGURE 23 – AVERAGE RES SUPPORT PER MWh OF TOTAL ELECTRICITY CONSUMPTION AND AVERAGE WHOLESALE PRICE, 2016-2050 (EUR/MWh). SOURCE: SEERMAP COUNTRY REPORT KOSOVO.

The renewables support needed to incentivise RES investments in the 'decarbonisation' scenario remains negligible (under 2 EUR/MWh) throughout the entire period.

In the 'delayed' scenario rapid deployment of additional capacities towards the end of the modelled period are needed to achieve 2050 decarbonisation targets, raising required support to an estimated 15.4 EUR/MWh on average over the last decade, equivalent to 16% of total electricity cost. These results show that it is not renewables per se which are expensive, but that delayed, unplanned action on renewables will significantly drive up costs.

Research by Kittner et al. (2016) for energy scenarios for Kosovo* resulted in six different alternative energy scenarios that meet electricity generation requirements at a lower cost than the base case by 2025. As "a 30 EUR/ton price on CO_2 increases costs of coal generation by at least 330 mEUR", Kittner et al. (2016) claim that building a new coal power plant is "the most expensive pathway to meet future electricity demand" of Kosovo*.

Germanwatch (Johnston et al., 2018) comes to the same conclusion. According to their calculations "wind power is already competitive with new gas, coal and nuclear. Second, solar power is already competitive with new coal and nuclear, and with gas in areas of higher solar irradiance. Third, both wind and solar are highly competitive with the cost of new lignite power in Kosovo, as revealed by the proposed PPA of 80 EUR/MWh, or 0.08 EUR/kWh. Fourth, the costs of both wind and solar are projected to continue to fall."

INSIGHTS FROM SERBIA:
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. After this year, prices are lower in scenarios with high levels of RES in the electricity mix due to the low marginal cost of RES electricity production.

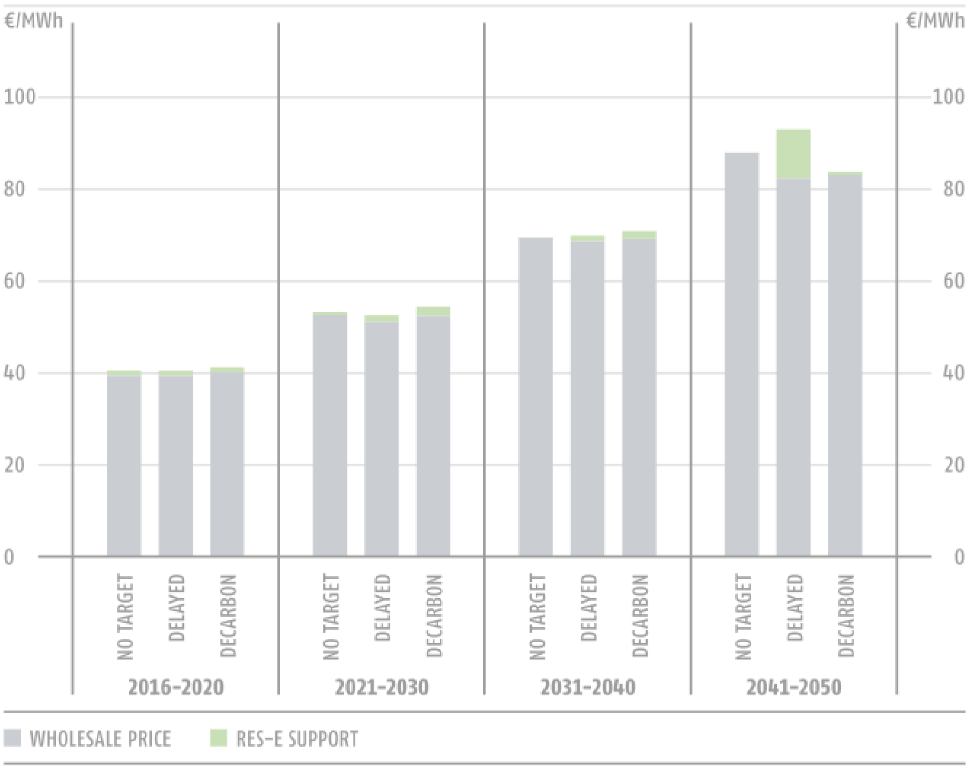

FIGURE 24 – AVERAGE RES SUPPORT PER MWh OF TOTAL ELECTRICITY CONSUMPTION AND AVERAGE WHOLESALE PRICE, 2016-2050 (EUR/MWh). SOURCE: SEERMAP COUNTRY REPORT SERBIA.

RES support falls over the period while investment in RES capacity increases. The broad decline in RES support is made possible mainly by the increasing wholesale price for electricity which reduces the need for residual support. The renewables support needed to incentivise RES investments in the 'decarbonisation' scenario remains negligible (under 2.1 EUR/MWh) throughout the entire period.

MYTH A6: RES undermine the profitability of fossil fuels

"RES are eroding energy security by undermining the economic basis of reliable coal-based generation."

FACT:

RES are only one of the causes of the inevitable coal phase-out. The system security can be maintained without coal.

Meanwhile the process itself is happening indeed, it should be stated that

1. coal is phased out anyway in numerous European countries;
2. RES do impact the profitability of coal negatively, but
3. this will not jeopardise system security.

Looking at global trends, one can see that coal phase out is already happening. Due to both climate and non-climate policy factors, 36 governments and 28 companies around the world have already committed to phasing out coal from the power sector by 2030. Momentum is also building in major coal-consuming economies. In large developing economies like China, India and South Africa, policies have been introduced recently or are being discussed to curb and/or reduce coal consumption over the coming decade (Johnston et al., 2018).

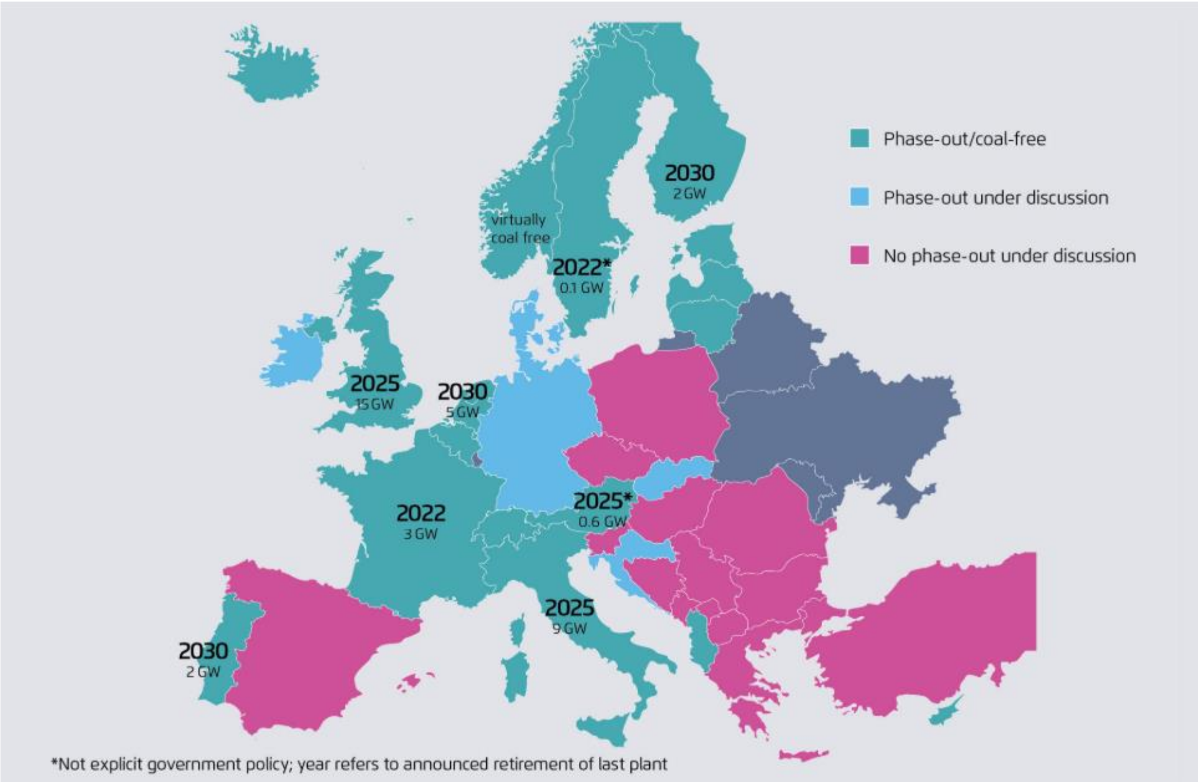

FIGURE 25 – COAL PHASE-OUT YEARS AND OPERATIONAL CAPACITY. SOURCE: BUCK, RISTESKA, & REDL, 2018.

Some EU countries also decided to phase-out coal until 2030 or this option is being discussed, as shown in the figure above (Buck et al., 2018). Furthermore, it seems likely that Germany will also phase-out in a similar timeframe (date to be set in the end of 2018) and this direction also emerged from the private sector in Hungary (Valaska, 2018).

The same process has been also started in SEE, where regarding coal-based power plants, “between now and 2023, almost all of these plants need investments to bring them in line with the countries’ commitments under the Energy Community Treaty or they must be closed” (CEE Bankwatch Network, 2017b). Therefore, irrespective of the penetration level of RES, the coal industry cannot be considered as a sector with bright future. This already has an effect on financing: the European Bank for Reconstruction and Development (EBRD) declared in November 2018 in their draft energy sector strategy (to be adopted in December 2018) that they will not finance coal projects in the future – therefore they are not considering supporting the Kosova e Re project (Jonuzaj, 2018b).

Renewables have an effect on baseload power plants which is described by the missing money problem (Gallo, 2015; Reid, 2015). This is caused by two factors: renewables lower electricity prices and they also satisfy an increasing share of electricity demand, thus squeezing the profitability of coal power plants from two sides: the amount of electricity they can sell, and the price they receive for a unit of electricity sold. The lowered electricity prices are a result of the fact that renewables such as wind and solar produce electricity without marginal fuel costs. The increased role of renewables in satisfying demand results in existing baseload power plants having to be powered down because of large amount of renewable electricity production, lowering their utilisation rates and thus their profitability. In both cases, the result is missing revenue for the investors of conventional power plants to cover their investment and operating costs (Newbery, 2016).

RES do undermine the economic basis of base load electricity generation. However, this does not negatively affect energy security. An energy system with high share of intermittent renewable energy capacities and without conventional power plants is feasible and able to satisfy energy demand and balance with supply with adequate grid interconnections, storage, supply side flexibility and demand side response measures, as has been shown by numerous studies (Lund, 2014; Lund, Andersen, Østergaard, Mathiesen, & Connolly, 2012; Matek & Gawell, 2015; Ueckerdt & Kempener, 2015). But it is not only working in simulations and on paper, but also in reality: in Germany, huge RES capacities are handled while providing secure electricity supply even in extreme situations like a solar eclipse (Redl, 2018). Read more about system balancing in myth D1.

In addition, in order to enable countries to continue to use fossil fuel power plants to balance supply and demand while they transition to a clean energy system, the European Commission do allow capacity mechanism payments as a tool for ensuring security of supply without distortion of electricity markets. There are already precedents that the European Commission set green light to capacity mechanism frameworks in order to maintain security of supply and help to integrate intermittent RES (European Commission, 2018b; European Parlamentary Research Service EPRS, 2017).The Guidelines on State aid for environmental protection and energy (EEAG) 2014-2020 adopted in July 2014 for the first time contain criteria for the Commission to apply when assessing capacity mechanisms. In addition, within the Clean Energy for All Europeans package, in its proposal for a Directive on wholesale electricity market design, the Commission would continue to allow for capacity payments, provided that certain conditions related to emissions and/or the time power plants are allowed to operate are satisfied.

MYTH A7: RES do not require subsidies

"Renewables do not need economic incentives."

FACT:

RES currently need support but will soon reach grid parity.

Renewable technologies are becoming more efficient and their costs are also coming down (see myth A2). However, most technologies currently still need some level of support. They have to compete with well-established industries that benefit from existing infrastructure, expertise and policy and they also have to cope with numerous barriers which mean higher risks and costs. However, the RES support required to significantly increase the share of renewables is not high.

The SEERMAP modelling results show that despite falling costs (see myth A2 and A4) which mean that RES technologies are already at grid parity in some locations, support may still be needed in 2050 to incentivise new investment. This is partly due to a locational effect, as the best locations with highest potential are used first and costs of the subsequent RES capacities are therefore expected to increase over time.

It has to be noted, that in many countries in the Western Balkans region, fossil fuel-based electricity production also currently benefits from different forms of direct and indirect subsidies (see more in myth A3).

Regarding efficient policies for RES development, IRENA, IEA, & REN21 (2018) highlights the importance of going beyond direct economic incentives as a sole support form and urges countries to apply comprehensive integrating and enabling policies. These can be used to support the development not only of renewable technologies but also of the needed infrastructure, market environment and information for stakeholders.

Policies to achieve the energy transition		Deployment (installation and generation) of renewables in the general context	Deployment (installation and generation) of renewables in the access context (including energy services)	Maximisation of socio-economic development from renewable energy deployment
Direct policies	Push	■ Binding targets for use of renewable energy ■ Electricity quotas and obligations ■ Building codes ■ Mandates (*e.g.*, solar water heaters, renewables in district heating) ■ Blending mandates	■ Rural electrification targets, strategies, programmes ■ Clean cooking strategies, programmes ■ Biogas digester programmes	Deployment policies designed to maximise benefits and ensure a sustainable transition (*e.g.*, communities, gender) including require-ments, preferential treatment and financial incentives provided to installations and projects that help deliver socio-economic objectives
Direct policies	Pull	■ Regulatory and pricing policies (*e.g.*, feed-in tariffs and premiums, auctions) ■ Tradable certificates ■ Instruments for self-consumption (*e.g.*, net billing and net metering) ■ Measures to support voluntary programmes	■ Regulatory and pricing policies (*e.g.* legal provisions, price/tariff regulation)	
Direct policies	Fiscal and financial	■ Tax incentives (*e.g.*, investment and production tax credits, accelerated depreciation, tax reductions) ■ Subsidies ■ Grants	■ Tax incentives (*e.g.*, reduction) ■ Subsidies ■ Grants ■ Concessional financing ■ Support for financial intermediaries	
Integrating policies		■ Measures to enhance system flexibility (*e.g.*, promotion of flexible resources such as storage, dispatchable supply, load shaping)	■ Policies for integration of off-grid systems with main-grid ■ Policies for mini-grids and smart distributed energy systems ■ Coupling renewable energy policies with efficient appliances and energy services	
Integrating policies		■ Policies to ensure the presence of needed infrastructure (*e.g.*, transmission and distribution networks, electric vehicles charging stations, district heating infrastructure, road access) ■ Policies for sector coupling ■ RD&D support for technology development (*e.g.*, storage)		
Integrating policies		■ Better alignment of energy efficiency and renewable energy policies ■ Incorporation of decarbonisation objectives into national energy plans ■ Adaptation measures of socio-economic structure to the energy transition		
Enabling policies		■ Policies to level the playing field (*e.g.*, fossil fuel subsidy reforms, carbon pricing policies) ■ Measures to adapt design of energy markets (*e.g.*, flexible short-term trading, long term price signal) ■ Policies to ensure the reliability of technology (*e.g.*, quality and technical standards, certificates)	■ Industrial policy (*e.g.*, leveraging local capacity) ■ Trade policies (*e.g.*, trade agreements, export promotion) ■ Environmental and climate policies (*e.g.*, environmental regulations)	
Enabling policies		■ National renewable energy policy (*e.g.*, objectives, targets) ■ Policies to facilitate access to affordable financing for all stakeholders ■ Education policies (*e.g.*, inclusion of renewable energy in curricula, coordination of education and training with assessments of actual and needed skills ■ Labour policies (*e.g.*, labour-market policies, training and retraining programmes)		
Enabling policies		■ Land-use policies ■ RD&D and innovation policies (*e.g.*, grants and funds, partnerships, facilitation of entrepreneurship, industry cluster formation) ■ Urban policies (*e.g.*, local mandates on fuel use) ■ Public health policies		
Enabling and integrating policies		■ Supportive governance and institutional architecture (*e.g.*, streamlined permitting procedures, dedicated institutions for renewables) ■ Awareness programmes on the importance and urgency of the energy transition geared toward awareness and behavioural change ■ Social protection policies to address disruptions ■ Measures for integrated resource management (*e.g.*, the nexus of energy, food and water)		

FIGURE 26 - UPDATED CLASSIFICATION OF POLICIES. SOURCE: IRENA ET AL., 2018.

Although globally some RES technologies have reached grid parity in some locations with technology costs continuing to fall, some support will still be needed in 2050 to stimulate new investment. This is because the best locations with highest potential are used first, and the levelized cost of electricity of new capacities therefore increases if more capacity is already installed.

INSIGHTS FROM THE FORMER YUGOSLAV REPUBLIC OF MACEDONIA:

The SEERMAP analysis has shown, that in order to decarbonise electricity production in the former Yugoslav Republic of Macedonia by 2050 the renewables support required to incentivise these investments is low, starting at 0.4 EUR/MWh and rising to 2 EUR/MWh towards 2050. The RES support relative to electricity cost (wholesale price plus RES support) is only 2.6% at its highest level in the 'decarbonisation' scenario.

However, if investment in renewables is not well planned and deployment of these capacities begins later, the rapid deployment of additional capacities towards 2050 that are needed to achieve decarbonisation targets will require substantial support, estimated at around 26% of total electricity cost. The SEERMAP modelling results demonstrate the role of policy planning in keeping renewable support levels low.

MYTH A8: RES potential is insufficient to cover energy demand

"RES development plans are not realistic. Renewables can contribute only a small share of our needs. RES alone can never fulfil market demands. We do not have sufficient RES potential especially as far as wind is concerned."

FACT:

In most countries of the SEE region RES would be able to cover the majority of energy needs or even more.

The SEERMAP study demonstrated that it is possible to reach an electricity mix with 83-86% renewable generation in the SEE region by 2050. The 'decarbonisation' scenario demonstrates that it is technically possible to reach decarbonisation targets suggested by the EU 2050 Roadmap in the SEERMAP region due to high RES potential. The utilisation of long-term RES potential in the 'decarbonisation' scenario will reach 51% for hydro, 58% for wind and 53% for solar.

Pleßmann & Blechinger (2017) investigated a cost-efficient strategy for SEE region to achieve EU decarbonisation targets by 2050. According to their models, this pathway is possible, reaching 97.4% emission reduction by 2050, with dynamic development in renewable utilization and phase-out of coal in line with the other EU countries' by 2035. Regarding renewables, capacity of PVs are expected to grow from 3.76 GW in 2016 to 120.7 GW in 2050 (in average 3.44 GW/a), while in case of wind an increase from 2.86 in 2016 to 92.4 GW (2.63 GW/a) is necessary.

IRENA et al., (2017) show that the SEE region has a large untapped technical RES potential at around 740 GW, mainly including wind (532 GW) and solar (120 GW) resources, but certainly there are significant differences across the region in terms of available locations for large-scale RES investments However, due to EU nature and landscape protection requirements, the implementable RES potential may be lower in reality. It is expected for example that the protected areas (which are considered to be minimal in some accession countries) will be expanded in the future.

It should also be noted that energy efficiency and sufficiency measures should always be applied in addition to renewable energy development – or even before the latter (see more in myth C5). Energy efficiency development is a key factor to ensure decarbonisation by decreasing energy needs, thereby enabling higher shares of renewable energy sources in the energy system. Energy efficiency itself has numerous benefits beside reducing import dependence – which can be crucial especially for net importing countries such as Serbia – and creating a more efficient and competitive economy on the long-term.

INSIGHTS FROM BOSNIA AND HERZEGOVINA:
SEERMAP modelling has demonstrated that achieving a very high share of renewables in the electricity mix by 2050 in Bosnia and Herzegovina is both technically feasible and financially viable. The EU 2050 Low Carbon and Energy Roadmaps imply a 93-99% emission reduction target for the electricity sector. This can be achieved through using energy efficiency, renewable sources, demand side management, smart grids as well as other technologies like nuclear power or carbon capture and storage technologies.

In Bosnia and Herzegovina, more than 35% of current fossil fuel generation capacity is expected to be decommissioned by the end of 2030 and nearly 85% by 2050 according to the 'decarbonisation' scenario of the SEERMAP model. The country has remarkable renewable energy potentials. The SEERMAP models showed, that across all scenarios, Bosnia and Herzegovina will experience a significant shift away from fossil fuel-based electricity generation towards renewables.

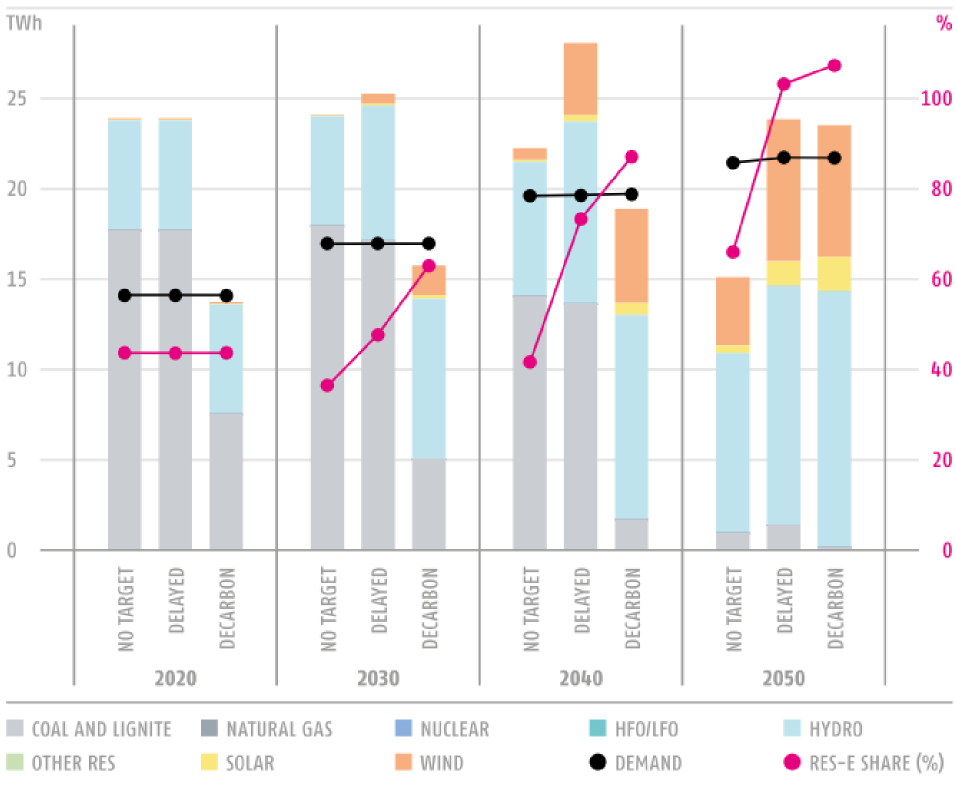

FIGURE 27 - ELECTRICITY GENERATION AND DEMAND (TWH) AND RES SHARE (% OF DEMAND) IN BOSNIA AND HERZEGOVINA, 2020-2050. SOURCE: SEERMAP COUNTRY REPORT BOSNIA.

The share of renewable generation as a percentage of gross domestic consumption reaches 66% in the 'no target' scenario, 103% in the 'delayed' scenario and 107% in the 'decarbonisation' scenario by 2050. Hydro and wind capacities will play a prominent role, contributing around 60% and 30% of total RES generation by 2050 respectively in the 'decarbonisation' scenario, while solar contributes 8%. The share of biomass in the generation mix increases but remains negligible in all three scenarios. Concerning potential conflicts due to competing water uses, nature protection and NIMBY effect, the large-scale hydropower and onshore wind power potential was analysed in a sensitivity analyses to be 25% lower than in the core scenarios. The results show that high RES scenarios are still feasible, resulting increased PV capacity. However, higher RES support is needed. (See also myth B1)

INSIGHTS FROM CROATIA:

The SEERMAP study has shown that Croatia has a high renewable energy potential, and renewables become the dominant mode of electricity production by 2050, irrespective of the phasing out of renewable support. This is due to the increase in both the price of carbon and the price of gas. According to the model results, Croatia is expected to achieve a minimum of 84% of RES-share in electricity consumption even if no renewables target is set, reaching 101% in the 'decarbonisation' scenario.

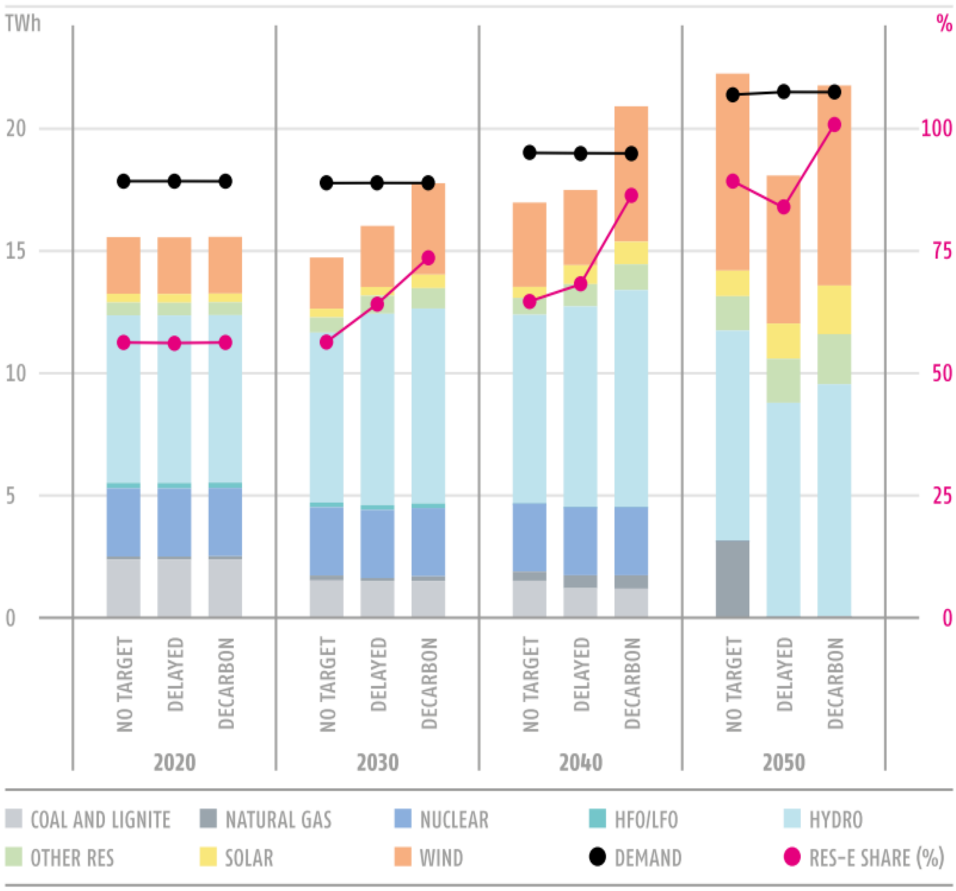

FIGURE 28 - ELECTRICITY GENERATION AND DEMAND (TWh) AND RES SHARE (% OF DEMAND) IN CROATIA, 2020-2050. SOURCE: SEERMAP COUNTRY REPORT CROATIA.

The 'decarbonisation' scenario demonstrates that an energy mix based on renewables only is feasible. It does not drive up wholesale prices compared to non-RES policy scenarios but, on the contrary, reduces them after 2045. Furthermore, resulting in a high share of RES and zero fossil fuel-based generation it does not pose a security of supply risk. Installed domestic generation capacity is capable of satisfying Croatia's demand in all modelled hours of the year in all scenarios.

Both the 'no target' and 'decarbonisation' scenarios have similar levels of wind capacity by 2050 (50% of the approximately 8300 MW renewable generation capacity), indicating that it is not primarily renewable energy support which drives investment for this technology.

Rajšl & Tomšić (2017) created 3 different future energy scenarios (see details in myth A5), where the RES utilization is expected according to the followings:

		2015.	2030.	2050.
Capacity				
HPP	MW	2.095	2.609	2.609 – 3.609
Wind	MW	418	1.520 – 2.200	2.200 – 6.720
SE	MW	48	1.140 - 1860	3.299 – 6.381
Other RES	MW	88	385 - 450	410 - 530
Biomass PP	MW	25	140 - 170	140 - 220
Biogas PP	MW	27	90 - 100	90 - 120
Geothermal PP	MW	0	35 - 40	40 - 50
Small HPP	MW	36	120 - 140	140

FIGURE 29 - RANGE OF RENEWABLES IN NU1 AND NU2 SCENARIOS. SOURCE: RAJŠL & TOMŠIĆ, 2017.

The results showed a significant RES share increase in all scenarios especially in photovoltaic and wind power. The authors highlight that in case of proper implementation of measures of the scenarios "Croatia would be able to develop and design its power system in alignment with international and European requirements regarding CO_2 emissions that are set". An important change will happen by 2042, when the existing nuclear power plant will be decommissioned, while more flexible power plants will enter the market to compliment intermittent RES production.

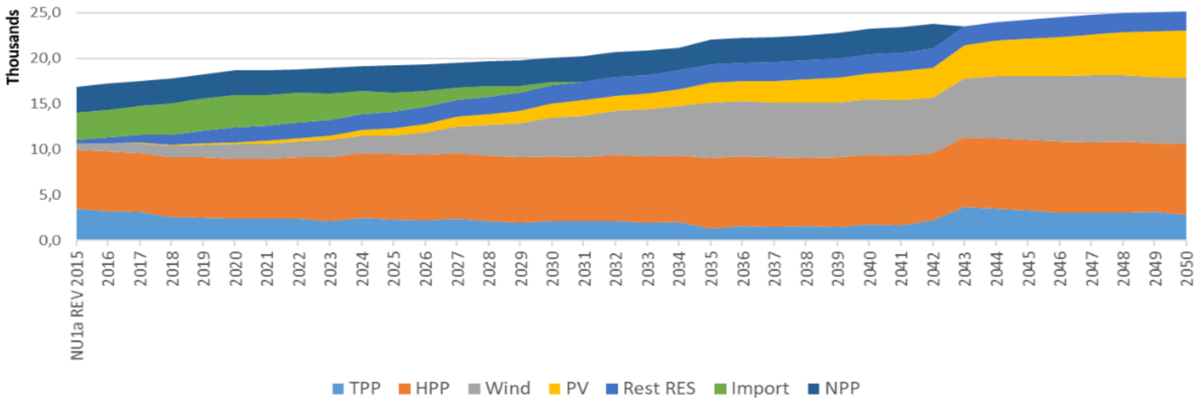

FIGURE 30 – THE STRUCTURE OF THE TOTAL ELECTRICITY PRODUCTION (GWH) IN NU1A SCENARIO. SOURCE: RAJŠL & TOMŠIĆ, 2017.

A similar research, carried out by Pukšec et al. (2018) analysed three different future energy scenarios for Croatia: a reference (1.), an intensive transition (2.) and a complete transition (3.) scenario. The results showed a significant RES share increase in all scenarios especially in case of photovoltaic (1000 MW in 1., 6000 MW in 2., 6500 MW in 3. scenario) and wind power (2200 MW in 1., 4500 MW in 2., 6000 MW in 3. scenario) by 2050. The diverse and intensive RES development enables to effectively reduce fossil-based power generation by 2050: compared to the reference scenario with 2500 MW gas-based electricity production of 5.6 TWh, the complete transition scenario would be able to reduce this to 1.6 TWh (with 400 MW gas-based capacity). Coal power is phased out in all scenarios by 2050, and it is an interesting development that hydro capacities are estimated to be more than 600 MW less in transition scenarios than in the reference scenario (constantly 2884 MW between 2030-50).

INSIGHTS FROM GREECE:

Under SEERMAP scenarios with an ambitious decarbonisation target and corresponding RES support schemes, Greece will have an electricity mix with close to 100% renewable generation, mostly solar and wind, and some hydro by 2050. If renewable support is phased out and no CO_2 emission target is set, the share of RES in electricity consumption will reach around 65% in 2050. While this represents a significant increase compared to current levels, it is insufficient compared with decarbonisation levels targeted by the EU by 2050.

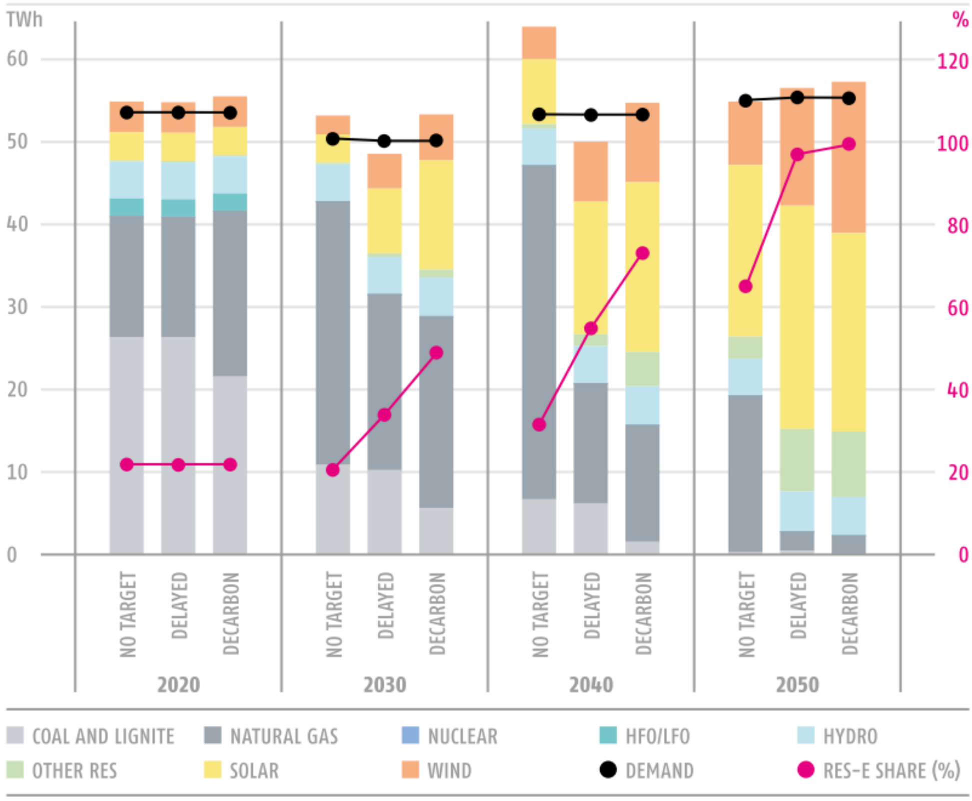

FIGURE 31 - ELECTRICITY GENERATION AND DEMAND (TWh) AND RES SHARE (% OF DEMAND) IN GREECE, 2020-2050. SOURCE: SEERMAP COUNTRY REPORT GREECE.

The share of renewable generation as a percentage of gross domestic consumption in 2050 is 64.6% in the 'no target' scenario, 97% in the 'delayed' scenario and 99.3% in the 'decarbonisation' scenario. In the scenario with the highest RES share in 2050 (the 'decarbonisation' scenario) long term RES potential utilisation reaches 33%, 68% and 64% for hydro, wind and solar respectively. This means that approximately two thirds of Greek wind and solar potential will be utilised by the end of the modelled period if this scenario is implemented.

Lalas & Gakis (2017) summarized the results of 11 scenarios for Greece based on the results of several studies.

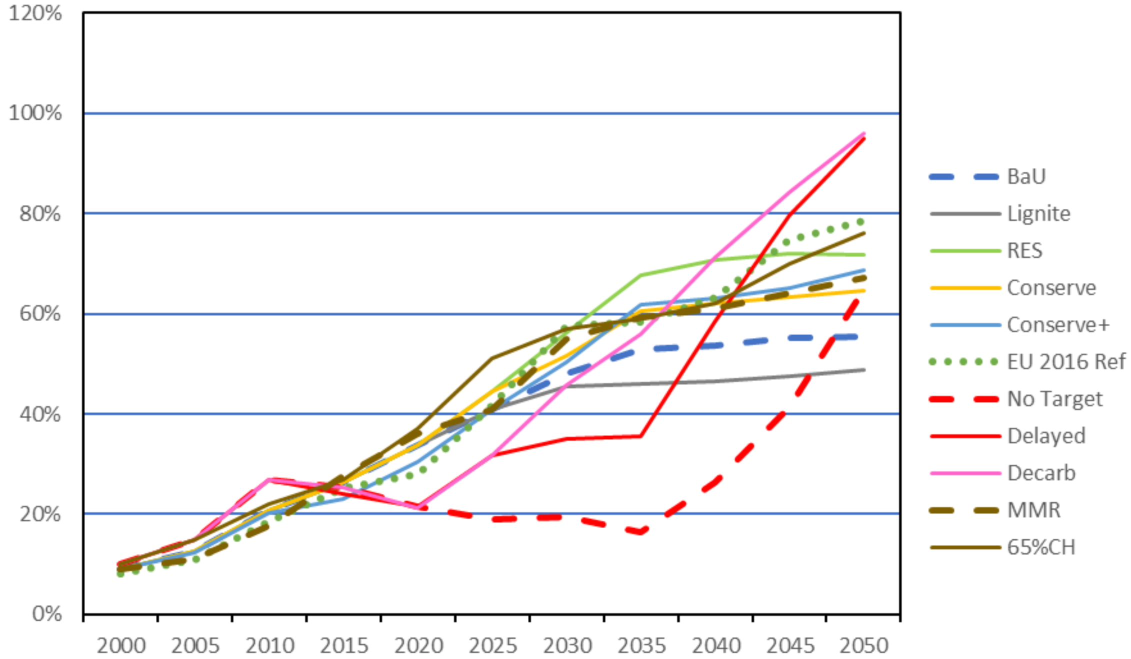

FIGURE 32 - RES IN ELECTRICITY GENERATION IN GREECE BETWEEN 2000-2050, ACCORDING TO RESULTS OF DIFFERENT ENERGY MODELLING REPORTS. SOURCE:LALAS & GAKIS, 2017.

According to these studies, the lowest RES shares are around 45-47% by in BAU or lignite scenarios, and they are above 50% in all other scenarios, already by 2030. By 2050, independently of the policy applied, RES share in electricity generation is between 50% and 80%.

The report from WWF and NOA created and analysed five different energy development paths until 2030 (see mythA4). The RES share in gross final electricity consumption can be seen on the following figure:

FIGURE 33 – EVOLUTION OF THE RES SHARE IN THE GROSS FINAL ELECTRICITY CONSUMPTION BASED ON THE SCENARIOS CONSIDERED. BLUE REGTANGLE: TARGET FOR GREECE FOR 2020. SOURCE: WWF & NOA, 2017

According to the scenarios in 2050, wind capacity amounts to 6.7-10.6 GW. Photovoltaics are expected to grow to 8.2 GW by 2030 and 11.3 GW by 2050 in the RES scenario (WWF & NOA, 2017). The study also concludes that decarbonisation level which complies with the EU targets cannot be achieved in the BAU and LIG (lignite expansion) scenarios, while 61-65% emission reduction could be realized in the other scenarios.

Tigas et al. (2015) modelled 3 different scenarios (CP – current policies, RESM – renewable electricity share maximalisation, EMCM – environmental measures and cost minimalization) with several versions: 60% and 70% relates to the level of CO_2 emission reduction by 2050 (compared to 2005); RESM-a calculates with electricity import, EMCM-a uses CCS in lignite power plants.

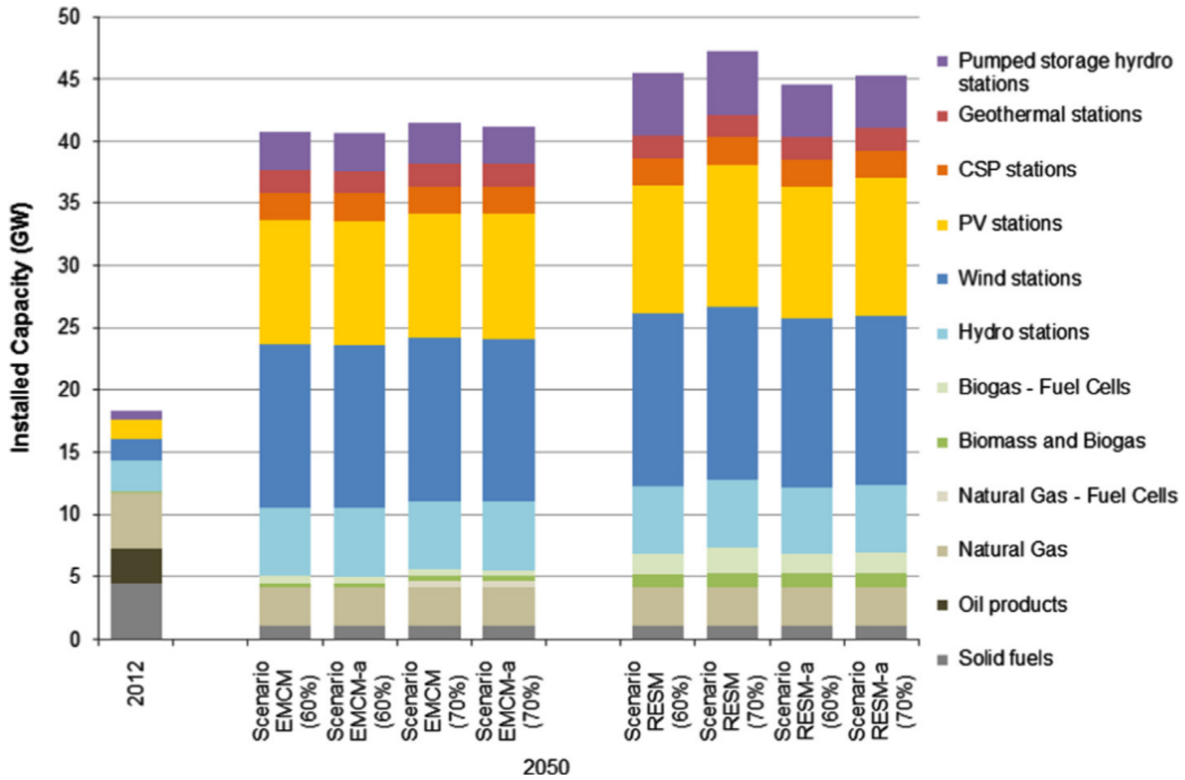

FIGURE 34 – DISTRIBUTION OF INSTALLED ELECTRICITY GENERATION CAPACITY IN 2050 FOR VARIOUS SCENARIOS. SOURCE: TIGAS ET AL., 2015.

The RESM (70%) scenario provides 85% RES power share with 70% emission reduction by 2050. The models showed that 13-14 GW wind and 10-11.5 GW PV capacity is possible by 2050 with 5.5 GW hydro and 3 GW pumped hydro storage (in EMCM 60%). These, with additional 2 GW reserve capacity help to balance the system (Tigas et al., 2015).

INSIGHTS FROM THE FORMER YUGOSLAV REPUBLIC OF MACEDONIA:

According to the SEERMAP results, the former Yugoslav Republic of Macedonia can significantly increase its current share of RES generation in all scenarios by 2050, reaching a 61% share of consumption in the 'no target' scenario and 85-89% in the other two scenarios with a decarbonisation target. At the same time, the share of fossil fuels will be reduced significantly by 2050, falling to 19% in the 'no target' and zero in the 'decarbonisation' scenario.

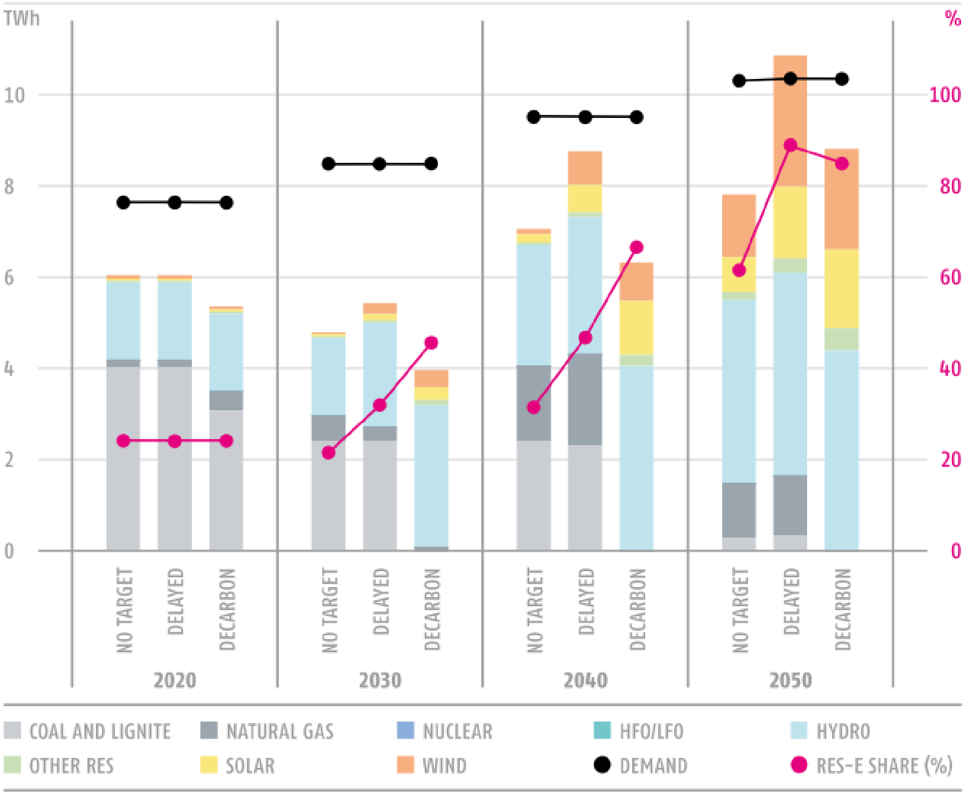

FIGURE 35 - ELECTRICITY GENERATION AND DEMAND (TWh) AND RES SHARE (% OF DEMAND) IN THE FORMER YUGOSLAV REPUBLIC OF MACEDONIA, 2020-2050. SOURCE: SEERMAP COUNTRY REPORT FORMER YUGOSLAVIAN REPUBLIC OF MACEDONIA.

In all scenarios hydro emerges as the dominant RES technology in the former Yugoslav Republic of Macedonia, reaching 40-50% of total generation by 2050[9]. Consequently, energy efficiency and demand side management measures are of utmost importance, as the development of hydro always raises issues concerning nature protection (see myth B1). The contribution of wind and solar is also significant. In the 'decarbonisation' scenario, wind is responsible for 25% of total generation and solar adds almost 20% by 2050. This represents a 30-fold increase in wind generation and more than 50-fold increase in solar generation by 2050 compared with current levels. Biomass remains insignificant (below 6%) in all scenarios. For details of the RES potential assumptions and calculations please see myth B2.

Ćosić, Markovska, Krajačić, Taseska, & Duić (2012) analysed four different RES scenarios by 2020. The results of scenario analyses show that the CO_2 emissions from the energy sector can be reduced even in relatively short timeframe: in eight years between 0.84% and 9.54% compared to the reference scenario.

Ćosić, Krajačić, et al. (2012) created and analysed a 100% RES-based energy scenario for Macedonia. They used an hourly detailed simulation which minimises electricity import or export and fuel use. They calculated with rising electricity demand from 7.68 TWh in 2008 to 12.37 TWh in 2030, (2.11%/year). By 2030 (50% RES) and 2050 (100% RES), they expected the following main capacity changes:

[9] The SEERMAP modelling shows hydro capacity increasing to 1754 MW by 2050, in the restricted potential scenario to 1388 MW. It is approximately the same amount as in the UNDP study for Macedonia proposing three optimal generation capacity mixes (scenarios) expecting 1279 MW hydro by 2030. However, defining sustainable hydro capacities needs careful planning concerning nature protection areas and negotiations with the inclusion of local population.

- Bitola 1, Bitola 2 and Oslomej coal power plants phased out by 2030, all coal and gas fired power plants by 2050;
- Wind power increases to 1500 MW by 2030;
- Photovoltaics increase to 1100 MW by 2030 and to 1600 MW by 2050;
- Natural gas replaces coal and oil DH boilers;
- 50 MW geothermal power plants by 2050;
- 50 MW of large heat pumps in district heating systems by 2050;
- Pumped hydro storage expanded from 700 MW to 1800/1500 MW.

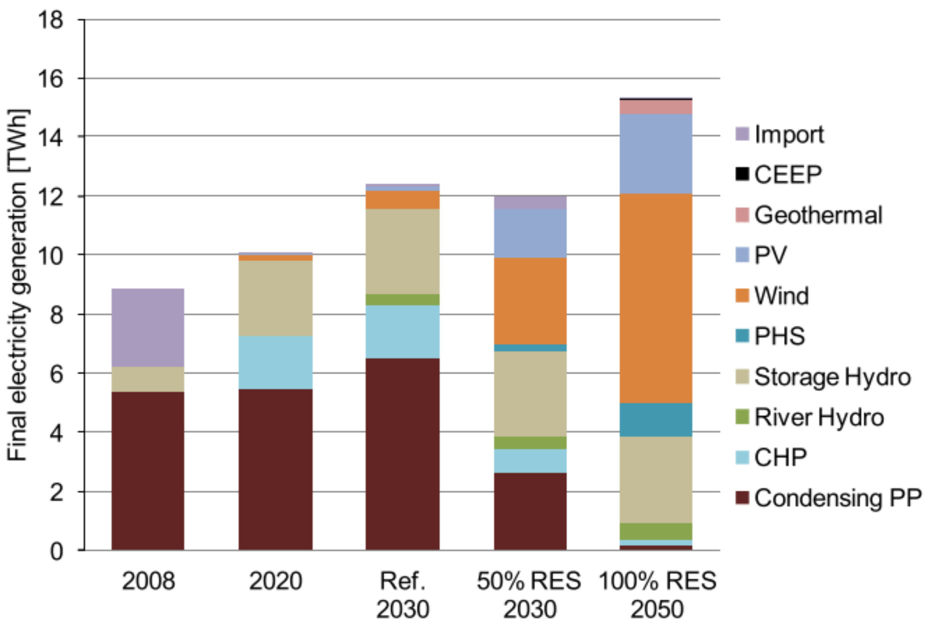

FIGURE 36 - ELECTRICITY GENERATION BY TECHNOLOGIES FOR DIFFERENT SCENARIOS. SOURCE: ĆOSIĆ, KRAJAČIĆ, ET AL., 2012.

As Ćosić, Krajačić, et al. (2012) concludes, "results of analyses show that the 100% renewable energy system in Macedonia is possible, however, to achieve this goal high share of biomass, wind power and solar power as well as different storage technologies are needed." Therefore they included flexible technologies such as electric cars and heat pumps. They highlight, that the calculated biomass production (19.8 PJ) "may be too high for Macedonia by 2050" and they recommend implementation of energy efficiency policies to prevent high level of biomass consumption. The authors claim that while both scenarios are feasible, the 50% RES scenario seems more likely to be realized: "with new energy efficiency measures which will lead to a decrease of consumption and installation of new generation capacities this goal can be easily achieved."

INSIGHTS FROM KOSOVO*:

Regardless of whether or not Kosovo* pursues an active policy to decarbonise its electricity sector, RES-based capacities will expand significantly from current low levels. Kosovo* is set to achieve 44% RES-share in electricity consumption by 2050 even if no emission reduction target is set; the share of RES even reaches 85% in the 'delayed' scenario. The high penetration of RES found in all scenarios suggests that the energy policy of Kosovo* should focus on enabling RES integration.

The above results can be achieved only when a mix of renewable energy sources are utilized including solar, hydro and wind.

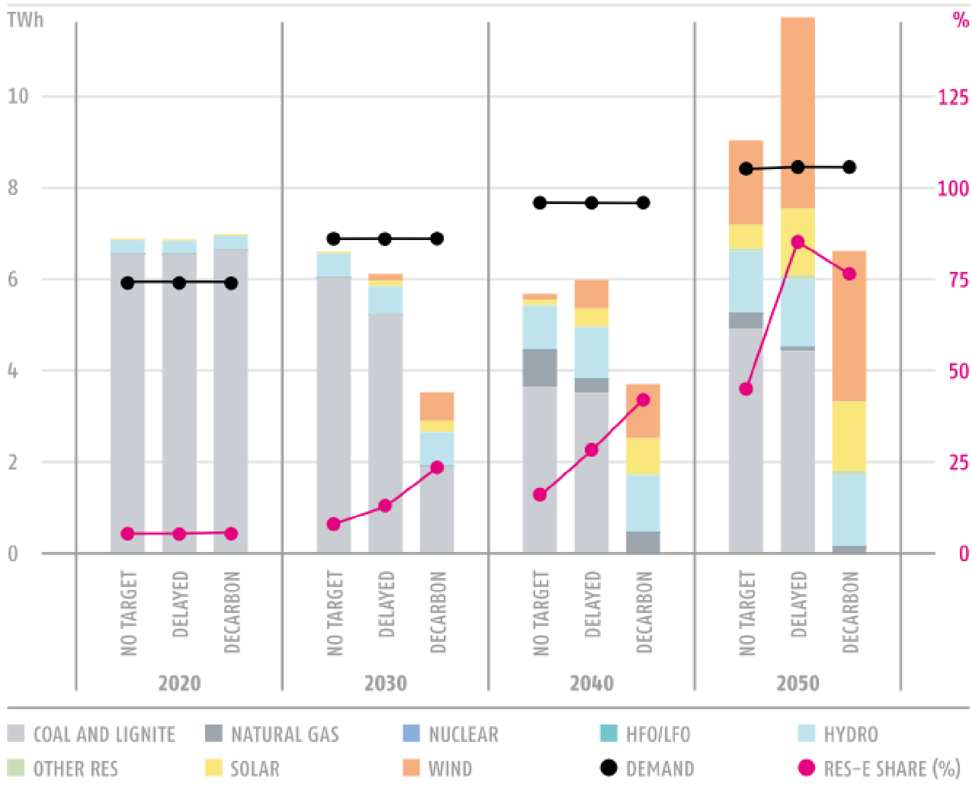

FIGURE 37 - ELECTRICITY GENERATION AND DEMAND (TWh) AND RES SHARE (% OF DEMAND) IN KOSOVO, 2020-2050. SOURCE: SEERMAP COUNTRY REPORT KOSOVO*.*

The utilisation of RES technical potential is highest in the 'delayed' scenario in 2050, over 80% for hydro, 91% for wind[10] and 71% for solar. In the 'decarbonisation' scenario, utilisation of wind potential is significantly lower at 72%.

MYTH A9: PV does not work in cold climates

"Photovoltaics cannot work in cold and cloudy places."

FACT:

Solar potential in this region is usually ideal for electricity production.

INSIGHTS FROM THE FORMER YUGOSLAV REPUBLIC OF MACEDONIA:

The former Yugoslav Republic of Macedonia has a significantly higher physical solar potential than the European average. Even sites with lower solar potential in the former Yugoslav Republic of Macedonia have higher potential than the best sites in Germany (SOLARGIS 2017), where, in spite of that, approximately 43 GW PV produced around 40 TWh power in 2017 (Fraunhofer ISE 2018).

The former Yugoslav Republic of Macedonia will not rely exclusively on solar, but also on other renewable energy technologies. The total renewable energy potential in the country is high. The SEERMAP results for long-term potentials and costs of renewables are shown in the figure below.

[10] Regarding wind potentials, the long-term technical potential was estimated based on several factors including the efficiency of conversion technologies and GIS-based data on wind speed, reduced by land use and power system constraints. It is also assumed that the long-term potential can only be achieved gradually, with renewable capacity increase restricted over the short term. As a result, wind capacities reach 814 MW in 'no target' and 1841 MW in 'delayed' scenario by 2050.

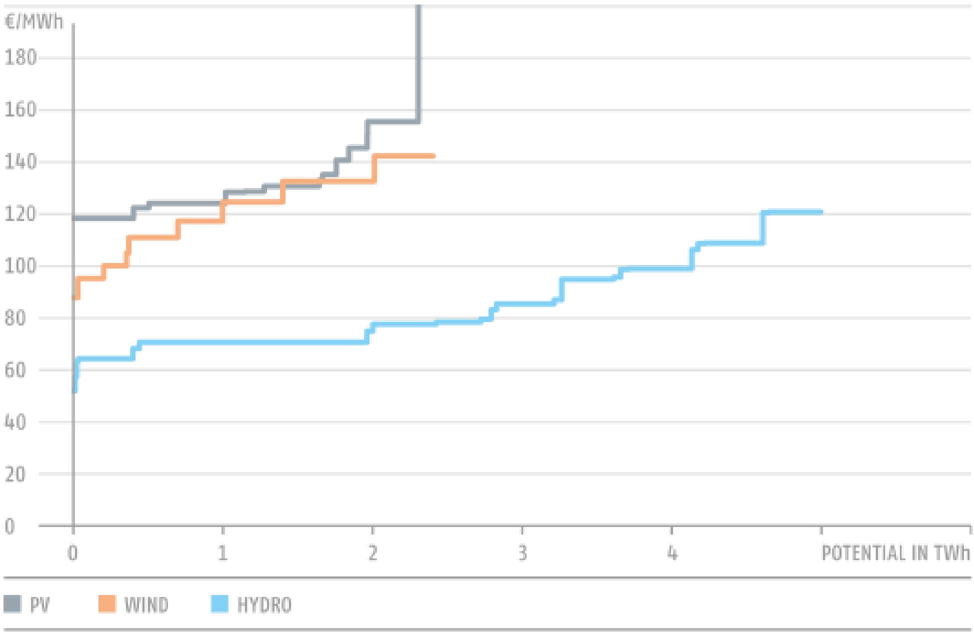

FIGURE 38 - LONG TERM POTENTIAL AND COST OF RENEWABLE TECHNOLOGIES IN THE FORMER YUGOSLAV REPUBLIC OF MACEDONIA. (EUR/MWh). SOURCE: SEERMAP COUNTRY REPORT FORMER YUGOSLAVIAN REPUBLIC OF MACEDONIA.

See also myth B2.

B. Environmental sustainability

MYTH B1: RES are not sustainable

"RES (especially wind) pose a threat to ecosystems (e.g. birds). Renewables are equally harmful to the environment as conventional energy."

FACT:

The environmental balance of RES is positive, but conflicts exist. With careful planning and advanced solutions the negative environmental effects can be reduced.

Deployment of renewable energy has positive effects on the environment, such as reduced air pollution, reduced water pollution, climate mitigation or for example – in the case of terminating surface mining – increase in the landscape value. At the same time, careful planning is needed to minimise the negative effects on the environment.

Planning and analysis related to the siting, technology and operation of wind farms is necessary in order to avoid negative ecological consequences. There is a significant amount of research which focuses on the effect of different types of wind turbines at various geographical locations on different species (AWWI, 2014; Hötker, Thomsen, & Jeromin, 2006; Kingsley & Whittam, 2005; Powlesland, 2009), and there are recommendations on how ecological damage can be avoided by choosing the appropriate type of wind turbine and location. Therefore, detailed local studies must be outlined to explore the potential conflict areas and to exclude them from the list of sites made available to wind investors. This way the environmental consequences of wind power plants can be reduced to a minimal level. In addition, operating choices can also reduce negative ecological impacts. For example, curtailing blade rotation at low wind speeds results in substantial reductions (50-87%) in fatality of bats and selective shutdown of high-fatality turbines may be an effective strategy for reducing fatalities of some raptor species (more than 50%). Bird monitoring and control systems, including "automatic real-time actions, such as warning and dissuasion of birds in collision risk", are also effective solutions to reducing threats to birds (Barlovento, 2014).

The case of hydro energy is more complicated from a sustainability perspective. Wetlands and river ecosystems are endangered habitats in general and they give home to rare and unique species globally. Dams and connecting infrastructure create modifications on upstream and downstream water regimes which degrades these ecosystems – in addition to other impacts such as displacement of human settlements and altering soils etc. "When natural flows are highly altered, populations of freshwater species can plummet or even be driven to extinction." For these issues, integrated basin planning with a system level approach is needed which integrates hydro power with river basin management, flood control operations and floodplain management (Harrison, Opperman, & Richter, 2007).

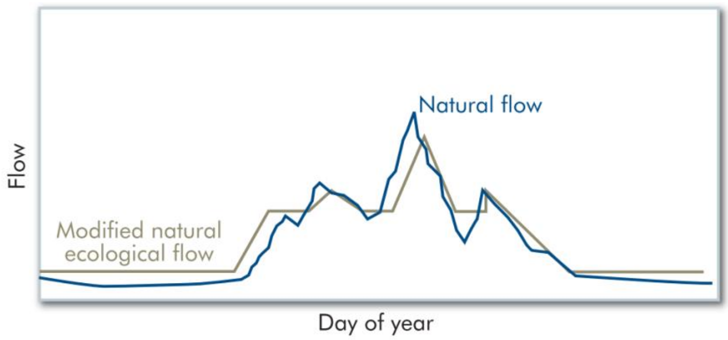

FIGURE 39 - A MODIFIED 'RUN-OF-RIVER' OPERATION COULD BE ADOPTED TO PROVIDE 'NATURAL-LIKE' FLOW PATTERNS DOWNSTREAM OF THE DAM CASCADE. SOURCE: HARRISON ET AL., 2007.

For an example, hydro power plants can aim to adopt the natural flow patterns of a river by adjusting their operation to keep the original characteristics of the downstream flow as far as possible (Harrison et al., 2007).

The issue is especially sensitive in the Balkan region which, for freshwater biodiversity, is the most important part of the Mediterranean biodiversity hotspot. The region contains a very high percentage of rivers in good or pristine condition: 80% of the 35 000 km of Balkan rivers are in this category. Unfortunately, this extraordinarily rich ecosystem is threatened by around 2800 hydropower projects of different size which are planned in the region (Weiss et al., 2018).

The Bern Convention on the Conservation of European Wildlife and Natural Habitats and – for EU member states – the European Birds Directive and the European Habitats Directive are the legally binding international instruments for species and habitats protection in the region. To ensure that nature protection is respected throughout the planning of hydropower facilities, the EU has already started to push for the extension of EU environmental and nature protection as well as water management legislation – such as the Birds Directive, Habitats Directive, Water Framework Directive or the Environmental Impact Assessment Directive – to the whole of the Energy Community (Vejnović & Gallop, 2018). The EU has undertaken steps toward this: the Western Balkans Investment Framework, with funding from the EU, has recently drafted Principles for Sustainable Hydropower Development in the Western Balkans. This document stresses the importance of the fact that hydropower should be only one element amongst others in the renewable energy mix of the region (Western Balkans Investment Framework, 2018).

As described in myth C2, corruption in the SEE's energy sector – the whole of the energy sector, not only the renewable sector – is significant and combined with inadequate nature protection can lead to important damage in protected areas. The conflict between nature protection and energy demand can never be fully resolved, as power generation will always have some effect on nature. Therefore, in addition to careful planning of new renewable capacities, the importance of energy efficiency and demand side management has to be emphasized as often as possible, as measures connected to these are crucial from the point of view of nature protection as well.

INSIGHTS FROM GREECE:
In Greece, a large survey was carried out by WWF Greece first in 2008-2009 (Doutau, Kafkaletou-Diez, Cárcamo, Vasila, & Kret, 2011), then in 2009-2010 (WWF Greece, 2013) in Thrace, North-eastern Greece, an area of exceptional ornithological importance. The researchers estimated the mortality rate per turbine, and outlined a proposal for area delineation of exclusion and increased protection zones; and also areas suitable for the installation of wind farms in Thrace. Their methodology can serve as a blueprint to follow in other parts of Greece. A good starting point can be the Map of Technically and Economically Exploitable Wind Capacity in Greece (CRES, 2012). Bird monitoring and control systems are already in operation there.

INSIGHTS FROM THE FORMER YUGOSLAV REPUBLIC OF MACEDONIA:
The sustainability of renewable capacities, such as in the case of hydro, depends on their scale and proper planning. On one hand, several conflicts arise between hydro and nature protection, on the other hand, due to climate change precipitation, the viability of these investments will also decrease in the coming decades making hydropower generation less efficient (UNDP, 2011).

In the past decade, it has been observed that hydropower production of the country was in the range of 600 to 1650 GWh per year, which shows a high vulnerability to changes in precipitation. As negative effects of climate change get more severe, further decrease in precipitations is expected, resulting in more uncertainty from the point of view of economic viability and security of supply (UNDP, 2011).

According to Vejnović (2017) the process of Environmental Impact Assessment (EIA) is not implemented in an adequate manner in the former Yugoslav Republic of Macedonia, resulting in environmental permits easier to obtain than under EU legislation, although hydropower plants are often built in regions of high biodiversity value. Residual flow requirements (10%) are too low and do not take into consideration seasonal fluctuation of precipitation. This has a negative effect on the area's ecology. New analysis of all water resources in the country should be conducted before new projects are approved. All small and large HPP investments are currently approved on the basis of a study carried out in the 1970's in the former Yugoslav Republic of Macedonia.

MYTH B2: RES require too much space

"Renewables require too much space."

FACT:

If planned in an optimal mix, RES require only a few percent of a country's land area.

Jacobson et al. (2017) estimated that achieving 100% renewable based energy systems in 139 countries in the world would require only 1.14% of the land area of these countries. This does not account for land gained from eliminating some of currently existing energy infrastructure, such as open pit mining. From this share, only 0.22% is required by the generator units – mostly for utility scale PV – and further maximum 0.92% spacing area is required for onshore wind. However, the areas where wind turbines are sited remain available for other uses (e.g. agriculture).

Artifical surfaces	0%
Arable land	25.0%
Permanent crops	15.0%
Pastures	20.0%
Heterogeneous agricultural areas 1	10.0%
Heterogeneous agricultural areas 2	10.0%
Heterogeneous agricultural areas 3 (agro-forestry)	5.0%
Forests	5.0%
Natural grasslands, moors	22.5%
Sclerophyllous vegetation & Transitional woodland-shrub	22.5%
Beaches, dunes, sands	10.0%
Bare rocks	0.0%
Sparsely vegetated areas	30.0%
Burnt areas & glaciers	0.0%
Inland wetlands	5.0%
Maritime wetlands	5.0%
Inland waters	0%
Marine waters	0%

FIGURE 40 - OPPORTUNITIES FOR ONSHORE WIND INSTALLATIONS TAKING INTO CONSIDERATION LAND USE RESTRICTIONS SOURCE: RESCH ET AL. (2016).

In SEERMAP, the estimation of long-term technical RES potential took into consideration several factors including the efficiency of conversion technologies, power system constraints and GIS-based data on wind speed and solar irradiation. Calculation of physical potential also took into account land use constraints. The table below shows the assumptions regarding the maximum land area that can be used for siting onshore wind installations for each surface type. The SEERMAP analysis shows that even if accounting for land use constraints, a very high share of onshore wind can be achieved in electricity production.

In addition to land use constraints, the analysis also took into account other types of constraints which limit realisable renewables potential. Factors limiting economic potential include risks from policy and country risks, RES technology costs and learning rates. Finally, limits on technology diffusion from one year to the next were also considered (Resch, Liebmann, & Hiesl, 2016).

MYTH B3: RES cannot be sited in cities

"Renewables are not practical in urban areas."

FACT:

There is a growing number of RES technologies which can be sited in cities such as rooftop solar and small-scale wind.

PV systems can be located both in urban or rural areas. Using rooftop instead of ground mounted photovoltaics reduces the effect of the energy industry on the landscape, saves energy by shortening the distance between producers and consumers, and can help climate mitigation by providing shade. Heating with biomass is also available in cities, however, it is recommended that biomass is utilised in modern CHPs rather than individual heating due to sustainability and air quality issues. Ambient heat (shallow geothermal) can be utilized in residential houses and offices with heat pumps; solar collectors and panels on any suitable rooftops, supermarkets, or above parking lots. Furthermore, a new generation of small-scale rooftop wind generators can be effectively used on taller buildings, especially on standardized apartment blocks which are common in some parts of the Western Balkans.

FIGURE 41 - WIND GENERATOR ON AN APARTEMENT BLOCK IN PÉCS, HUNGARY. SOURCE: NÉMETH, 2017.

MYTH B4: The energy balance of RES is negative

"Producing renewables consumes more energy than it delivers."

FACT:

Looking at the whole life cycle RES are net energy producers.

Except for some extreme examples of unsustainable biofuel production, all renewable technologies have positive energy balances. Production processes are energy intensive for some technologies, such as for PVs, but still, their energy payback time is only 1-4 years compared with the further 26-29 years when they are producing clean electricity (Bhandari, Collier, Ellingson, & Apul, 2015).

Regarding wind turbines, a comprehensive LCA (life cycle assessment) study considering manufacturing, transportation, installation, maintenance and end of life showed a 5.2-6.4 month energy payback time in case of 2 MW turbines (Haapala & Prempreeda, 2014). Without recycling, for a larger, 3.6 MW turbine the energy payback period is 10.76 months (125 m high version) and 9.69 months (90 m high version) (Wilhelmsson, 2012).

When looking at the energy return on investment (EROI) of different fuels, it is true that renewables have lower values except for hydro energy, which has an EROI above 100:1, while fossil fuels reach an EROI of between 8:1 and 80:1. According to data from the 2000's, bioethanol and biodiesel can have the lowest EROI, with values between 0.8:1 and 10:1 (Hall, Lambert, & Balogh, 2014). However, optimization of technology is ongoing and might lead to better EROI values (Hall et al., 2014).

C. Social impacts of RES

MYTH C1: RES cause employment losses

"Transition from coal induces loss of employment that cannot be compensated for. RES cannot sustain jobs that exist in power plants using conventional energy forms and related activities (e.g. in lignite mining)."

FACT:

RES and energy efficiency can provide more jobs per energy produced than coal.

The main messages relating to the job impacts of the transition to a low carbon energy system are the following:

1. Job losses resulting from a transition to a low carbon energy system are generally overestimated, as the ongoing increase in labour productivity means that there are fewer and fewer coal sector jobs even without a change in coal output;
2. However, even if numbers are lower than claimed by many, job losses in the coal sector are real and the shutting down of coal mines can cause unemployment and economic downturn in regions currently reliant on the coal industry;
3. A just transition is needed, whereby focus is placed on supporting coal workers in entering new jobs and strengthening the local economy;
4. Overall, renewable energy and energy efficiency already create more jobs than coal.

A new report of the European Commission's Joint Research Centre (JRC) describes a decline in the number of coal-based jobs in the EU (Alves Dias et al., 2018). According to the estimations, approximately 237 000 jobs are provided currently by the coal sector, of which 185 000 in coal mining, while further indirect workplaces are estimated to be 215 000. Between 2020 and 2030, approximately two thirds of the existing coal-fired power capacity will close. "Coal mines are already closing down due to a lack of competitiveness": 27 mines closed between 2014-2017 in the EU, and further mines are expected to close threatening 109 000 mining jobs (Alves Dias et al., 2018).

At the same time, studies examining jobs in the coal sector found that in the cases of new nuclear power plants and mines, the expected number of jobs and employees are overestimated(Ciută & Gallop, 2018; Tagliapietra, 2017). In reality, due to efficiency and productivity gains, even the current level of employment cannot be sustained and the number of jobs has already started to decline for example in Serbia and Montenegro. The labour productivity levels in lignite mining are in average 3-4 times lower in the countries of this region than in Germany, as such, further rationalisations and employment reductions in these countries will be required over the long-term. This means that even without any renewable deployment, the number of jobs in the coal sector is expected to decline significantly (Ciută & Gallop, 2018).

Country	Tonnes lignite 2015	Employees lignite 2015	Tonnes/worker 2015
Bulgaria	35,900,000	11,765	3,051
Czech Republic	38,100,000	7,869	4,842
Germany	178,100,000	15,428	11,544
Greece	45,400,000	4,919	9,230
Hungary	9,300,000	1,655	5,619
Poland	63,100,000	9,574	6,591
Romania	24,000,000	10,600	2,264
Slovakia	1,800,000	2,190	822
Slovenia	3,200,000	1,274	2,512
Total	398,900,000	65,274	6,111

FIGURE 42 - LIGNITE MINE PRODUCTIVITY, 2015, EU COUNTRIES. SOURCE: CIUTĂ & GALLOP, 2018.

According to employment data, Greece has the highest productivity level in lignite mining, the electricity generation per worker is relatively low compared to other countries in the region. The authors claim that the sector keeps workers in the production chain to maintain an "artificially high level" of employment to be able to show that "it is a major source of job creation and maintenance". All in all, it can be said that there is already an overemployment in coal and lignite mining sectors in this region and significant job reductions can be expected in the future irrespectively of RES development (Ciută & Gallop, 2018).

Furthermore, an important challenge is still ahead: compliance with the new LCP BREF limits (see myth A3 about BREF). Apart from the new Stanari power plant – which fulfils the requirements contained in the BREF documents – there are 36 existing coal-based power plants in Bosnia and Herzegovina, Kosovo*, Macedonia, Montenegro and Serbia with more than 8000 MW capacity (Ciută & Gallop 2018). They will have to carry out expensive investments or close within the next few years.

Alves Dias et al. (2018) points out that in some coal regions, due to one-sided economy, other sectors are not well-developed. Consequently, the region's GDP/capita is lower than the national average and if coal mining discontinues, the social impacts are high – this is the case e.g. in regions in Greece, Bulgaria and Romania.

Nevertheless, in spite of the negative trends in the coal industry, this situation includes opportunities and new development paths for future regional development as well. Alves Dias et al. (2018) points out that with the closing of units in the coal industry there is an opportunity to develop new businesses and jobs built on the industrial heritage of the regions in question. Strategic planning which focuses on supporting coal workers is needed to take advantage of this opportunity, to increase the quality of the local environment and strengthen the local economy by investments in competitive fields, in a way that allows the energy sector to "remain a driver for regional development. Conversion into wind or solar parks, for example, could provide re-employment opportunities for coal workers after an adjustment of skills, since electrical and mechanical skills, experience of working under difficult conditions and sophisticated safety experience are highly valued in the wind and solar energy industries." The same is true in the case of geothermal or hydro connected to ex-mining sites (Alves Dias et al., 2018). However, proper planning and implementation is the key here as well: according to Sartor (2018), thinking and planning at the earliest time possible is of utmost importance for successful transition. Time, anticipation and experience is needed to achieve just transition via development of well-designed re-education programmes and reach a satisfying level of local economic resilience.

The concept of 'just transition' was developed to ensure that no one is left behind when the shift to a low carbon economy is realized. In addition to energy poverty, the impacts of the energy transition on the coal and mining industries and communities are the most relevant issues for a just transition in South East Europe. It requires well developed social and economic plans for people and communities affected by a coal phase out. Most newly created jobs must be comparable to those that disappear in terms of wages and the level of qualification required. Bird & Lawton (2009) emphasises focusing on keeping jobs in vulnerable industries especially where organisations are not able to provide the needed steps in a low carbon transition such as compensation and retraining. They highlight the importance of creating 'decent' jobs "which pay a living wage, provide decent working conditions, are accessible to people with a range of skills and offer clear career progression opportunities" (Bird & Lawton, 2009).

The European Union has recognized the importance of addressing job losses and general economic decline in coal regions, and has launched a Platform for Coal Regions in Transition (European Commission, 2017). "The Commission is already supporting the transition in coal and carbon-intensive regions through its Cohesion policy. […] In parallel, the Commission is working on a pilot basis with a small number of regions in Member States on planning and accelerating the process of economic diversification and technological transition through technical assistance, information exchange and tailored bilateral dialogue on relevant EU funds, programmes and financing tools."

The amendment of the current regulation governing European Globalisation Adjustment Fund (EGF) was done in 2009; use of EGF to support the transition is possible at both stages: when the works are terminated as well as before the termination, enabling better handling of situations such as the shut-down of coal mines (Tagliapietra, 2017).

The growing renewable energy sector is able to provide more jobs than the coal sector. According to the study of Biofuels & Electricity (2011), technologies utilizing RES "are more labour-intensive than fossil fuel technologies", where photovoltaics provide the highest job-years/GWh over the technology lifetime. This is especially true if photovoltaics are installed as rooftop systems, where three times more jobs are created than is the case for ground-mounted systems (EY & Solar Power Europe, 2017). Compared to fossil fuels, where in general 0.15 jobs are created per GWh produced, the average in the RES sector is 0.65 jobs/GWh, and including energy efficiency it jumps to 0.80 workplaces/GWh (Blyth et al., 2014).

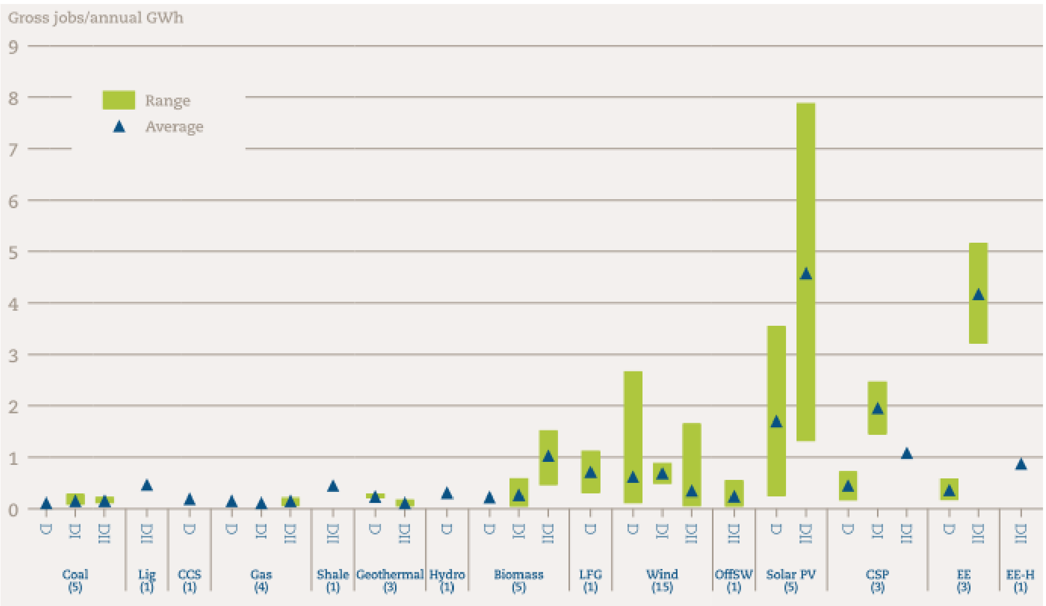

FIGURE 43 - GROSS JOBS CREATED BY UTILIZING DIFFERENT ENERGY SOURCES AND ENERGY EFFICIENCY. (LEGEND STANDS FOR DIRECT (D), INDIRECT (DI) AND INDUCED (DII) JOBS.) SOURCE: BLYTH ET AL., 2014.

According to IRENA, jobs in solar energy now outnumber jobs in coal mining and the oil and gas industry added together; furthermore, the renewable energy sector employs more women than the oil, gas, and coal sector (IRENA, 2017a). Today the renewable sector employs about 1.2 million people in Europe, which number would increase substantially with meeting EU targets by 2030 (IRENA, 2018). EY & Solar Power Europe (2017) estimates that the number of full-time equivalent jobs in solar industry of 81 000 increases to 175 000 between 2016 and 2021 in the EU-28, while more than doubles the gross value added to 9 500 mEUR.

Recent reports in OECD countries come to the same conclusion: renewable technologies and energy efficiency create more jobs than the fossil industry (Blyth et al., 2014). An analysis investigating results of 84 research papers from the OECD countries found that on average, renewables create more gross jobs per year and significantly more short-term jobs during the construction period than conventional energy sources.

Jacobson et al. (2017) created and analysed a scenario for 139 countries where mainly wind, water and solar energy sources (100% RES) will supply all electricity demand in line with electrification of all sectors. The results show, that following this scenario would create 52 million new jobs while only 27.7 million job losses would be expected, resulting in 24.3 million net new long-term, full-time jobs. These scenarios would also help to avoid 1.5°C global warming, and they would almost eliminate deaths from air pollution.

Although it is likely that the totality of people formerly employed in the fossil fuel sector will not find a job in the RES sector, no matter how good the planning, training and education are, leaving the coal industry by itself can lead to a better position on the labour market from a certain perspective: human capital is more valuable when healthy. Research shows that working in coal mines or even just living in coal mining regions results in more respiratory and chronic heart disease (Sapire, 2012).

INSIGHTS FROM GREECE:
Almost 5000 people were working in the lignite industry in Greece in 2015, while a further 2500 people had jobs which were indirectly linked to the lignite sector (EURACOAL, 2018a).

The estimated number of people directly employed by the wind sector was 1800 in 2007, when the installed capacity was 871 MW according to EWEA. At the end of 2017, the installed capacity grew to 2651 MW (Wind Europe, 2018) and based on SEERMAP results this will increase to 4376 MW by 2050 according to 'no target' or 10 485 MW according to the 'decarbonisation' scenario. This means, that in the 'decarbonisation' scenario, the wind industry alone could provide more jobs by 2035 than lignite sector today.

Furthermore, 16 000-18 500 MW of PV is expected by 2050 in Greece according to 'no target' and 'decarbonisation' scenario. In 2016 the solar PV industry employed 2008 people in Greece (Ernst and Young and Solar Power Europe, 2017). Assuming that employment per installed MW remains constant and taking into account the projected increase in installed solar capacity based on the SEERMAP 'decarbonisation' scenario, employment levels in the solar PV sector alone could reach the current level of employment of the lignite sector by 2025. According to Ernst and Young and Solar Power Europe (2017), the total jobs per year are expected to be 10 094 in Greece by 2021 in the PV sector.

However, Greece has to pay special attention to the transition. As Alves Dias et al. (2018) highlight: "Regions with highest unemployment rates (for example in Greece and Spain) are likely to be more sensitive to additional jobs losses. It is expected that the region EL53 (Dytiki Makedonia) with 31.5% of unemployed population in 2016, will face the highest social impact if an additional 3.5% of active population becomes unemployed due to the decommissioning of power plants and mines. In this region, the GDP/capita is already 25% lower than the national average."

INSIGHTS FROM SERBIA:

Around 28 thousand people were working directly or indirectly in the lignite industry in Serbia in 2015, mostly in lignite mining or related jobs (EURACOAL, 2018b). This level of employment is higher than in most other countries in South East Europe, and the trends are also different as the level of lignite mining is not decreasing but expanding and new mines are planned to open. However, the labour productivity of Drmno (4427 t lignite/worker in 2017) and Kolubara (2950 t lignite/worker in 2017) mines are still below the EU average (6111 t lignite/worker/year), which means that approximately 600 (from Drmno) and 5260 (from Kolubara) employees would have to leave their workplaces (Ciută & Gallop, 2018).

Employment		2015
Direct in hard coal mining	thousand	1.600
Direct in lignite mining	thousand	12.360
Other lignite-related*	thousand	14.050

FIGURE 44 - EMPLOYMENT IN COAL INDUSTRY IN SERBIA. SOURCE:EURACOAL, 2018B.

A report of UNEP (2013) provides an overview and starting point for Serbia's transition to a green economy based on modelling for 2030. The simulations resulted in a potential of 5000-8000 jobs in the energy demand side by 2030, of which approximately 2000-3000 jobs in the residential, commercial and industrial, the remaining in the transportation sector. However, due to lack of green job statistics in Serbia, these numbers are rough estimations (UNEP, 2013).

On the supply side, estimations shows that approximately 1500-2600 additional jobs could be generated if relevant policies are implemented and also if there is domestic production of renewable generation units. "If solar panels and wind turbines, among others, are imported and only installed domestically, the potential new job creation would be confined to a small percentage of the full potential, and employment creation in 2030 would be estimated to average 1 500 to 1 600 jobs" (UNEP, 2013).

MYTH C2: RES cause corruption

"All RES projects are corrupt. The whole RES program is aimed entirely at making the right oligarchs richer. Local communities will gain nothing from a large RES penetration (only large companies will profit). RES are designated to privileged individuals which do not care for local communities and their needs. The RES sector is highly corrupted"

FACT:

Corruption is not a characteristic of RES projects but of the broader institutional and legislative systems or decision-making processes.

A study by Gennaioli & Tavoni (2016) measuring the correlation between renewable energy support and corruption in the Italian wind energy industry found that corruption increases in high wind potential areas, especially after the introduction of favourable support policies, such as green certificates. Furthermore, the expansion of the wind sector is positively correlated with the extent of criminal activity, more precisely both the level of wind and the functioning of social and political institutions play a crucial role in the increase of corruption. The overall conclusion of the study is that if socio-political institutions don't function correctly, even well-designed policies can have a negative impact and act as perverse incentives. Thus countries characterized by heavy regulation, poorly functioning institutions and large renewable potential need to pay special attention to avoiding corruption linked to RES. It has to be underlined that the authors state that complicated regulation and major public expenditure are factors that can encourage corruption, and that the RES sector is one sector amongst others that is characterized by these elements.

Moreover, research shows that corruption is also prominent in case of traditional fossil energy sources, which are characterised by larger projects and lower transparency. Transparency International (2018) identifies the oil and gas sector as one of the major corruption areas, with benefits accruing to a small elite group.

Current political allies should not necessarily be protected from the changes implied by the energy transition. Practices in the fossil-based energy sector imply several abuses of the system by a small group, making society pay more for energy production. According to an opinion article in The World Bank website Serbian tax payers pay the salary of a coal mine, Resavica through subsidies, at the same time the mine is forced by law to sell its coal to certain privileged traders for an exorbitantly low price, instead of directly selling the coal to the power plants. Then traders purchase the dirty resource for market price with a more than 100% mark-up, with the price difference paid by Serbian citizens (Verheijen, 2016).

A study published in July 2018 points out that the dissatisfactory state of the rule of law is a general phenomenon in the Western Balkans, and that this creates space for corruption in all sectors at all levels (Marović, 2018). There are also examples of state capture such as in the case of the (now suspended) South Stream gas pipeline, where the former Yugoslav republic of Macedonia, Serbia and Bulgaria was also affected and “encountered similar governance issues and difficulties in managing gas agreements with Gazprom and meeting EU rules on transparency and third party access” (SELDI, 2016).

Therefore, the solution is not to avoid investment in renewable energy technologies, but to strengthen the rule of law, take effective steps against corruption via detailed financial reporting, tracking revenues, and making governments accountable for their budget and publishing results of findings (Transparency International, 2018). According to SELDI (2016b), “the corporate mismanagement of state-owned energy enterprises, the dependence and incompetence of energy regulators, and inconsistencies in energy policies” are the main obstacles of development of transparent and robust energy governance, while this improvement would provide substantial steps towards anti-corruption and integration to the EU. They recommend to implement the following actions:

- increasing transparency and access to energy data;
- improving corporate governance of SoEs (state-owned energy enterprises) by introducing compulsory corporate governance standards;
- “reducing the political leadership’s direct involvement in the operational management of energy enterprises”;
- “introducing international accounting standards in the reporting of SoEs, such as the international financial reporting standards (IFRS)” (SELDI, 2016).

SELDI paid particular attention to the procurements in the Bulgarian energy sector, where “one in four public procurement contracts relates to the energy sector, which renders it one of the biggest spenders of taxpayer money. However, 38% of all procedures for the awarding of public procurement contracts in the energy sector for 2012 were non-competitive” (SELDI, 2014). All in all, according to SELDI’s estimates, Bulgaria is the most corrupt country in the region based on political leaders’ corruptness. However, they did not distinguish the different energy sources regarding corruptness.

Where the benefits of a high RES penetration accrue is largely dependent on legislation and institutions. RES development can potentially provide numerous benefits for local communities, for example through community energy projects. This can be maximized when the control (decisions, or influence over decisions) and the benefits (income, jobs, professional knowledge etc.) of the RES project are local. As Walker et al. claim (Walker & Devine-Wright, 2008; Walker, Hunter, Devine-Wright, Evans, & Fay, 2007; Walker & Simcock, 2012), this has to be ensured through proper legislation. For that, the Community Energy Strategy of the United Kingdom (Department of Energy & Climate Change, 2014), the toolkits of Centre for Sustainable Energy (2009), Rae & Bradley (2012) and Community Power (2013) can provide useful guides.

MYTH C3: RES create losers

"Transition to renewables creates losers among political allies and random winners.".

FACT:

Energy transition creates winners and losers indeed, therefore preparation and influence the process are important.

The energy transition requires the transformation of today's global energy system from the current centralized mainly fossil and nuclear based power generation to a decentralized interconnected network that enables a massive use of renewable resources. This necessarily involves radical changes in production patterns, consumer behaviour, policy approach and in the general way of thinking regarding energy (Loorbach & Verbong, 2012; Markard, Raven, & Truffer, 2012). Since global economic development is so intertwined with energy production and consumption, this change requires fundamental adjustments in multiple sectors at different scales – from individual to societal. This process can shift some actors to new situations where they can gain benefits or lose their former status. In any case, society as a whole will be a winner as total system costs will be lower on the long run and further benefits will be gained. Furthermore, new winners can be created as well through community energy for example.

In general, just transition is a key concept regarding the issue of winners and losers of the energy transition (see myth C1).

Just transition focuses on supporting the most exposed and sensitive groups such as mine workers; however, it should not be forgotten that companies, owners and investors are also affected in the fossil sector. Benn, Bodnar, Mitchell, & Waller (2018) claim that the write-offs – or stranded asset costs which arise when a coal power plans has to be shut down before the end of their lifetime – can have crucial consequences to the unit owners, therefore they should prepare in time. "Proactive planning for the end of the coal era can preserve shareholder value and avoid financial shocks to equity and debt holders alike".

See also myth C2 and C6.

MYTH C4: RES are forced on countries by the EU

"The EU dictates the targets which should be unconditionally respected. The deployment of RES seen from the policy level perspective is rather perceived as a matter of an obligation deriving from the EU perspective and integration process."

FACT:

RES are part of the solution for tackling climate change and ensure better life quality by providing economic, environmental and health benefits.

The EU targets related to the development of renewable energy production, energy efficiency and interconnections ensure competitiveness, more economic opportunities, better life quality and healthier environment for the whole region over the long-term. Furthermore, only the targets are set by the EU: the countries are able to decide on which technologies to incentivise, support schemes used and strategies to reach the targets.

These targets are not easy to achieve. However, technologies are there, support in know-how and also funding can be provided; and all existing examples and research point out that these efforts and investments are beneficial over the long term.

All SEERMAP scenarios show that fossil fuels will become uneconomical and renewable energy sources will not only be better for the climate but also for the national economy and for public health. "Increasing liquidity in the organised markets by broadening the participation of generators, demand response and other resources bring considerable cost savings" (Capros & Zampara, 2017). The rapid positive change in air quality can save tens of thousands of lives per year and also billions of Euros (see myth A3 and also myth B3).

INSIGHTS FROM MONTENEGRO:
Parties to the Paris Agreement, which Montenegro has also ratified, have made a commitment to holding the increase in the global average temperature to well below 2°C above pre-industrial levels. The EU climate policy targets are aimed at contributing to the global 2°C target, respecting the principle of common but differentiated responsibilities and respective capabilities set out in the UN Framework Convention on Climate Change.

The costs of renewable energy technologies, which can contribute to this target, are decreasing rapidly. The development of renewable energy production, energy efficiency and interconnections contribute to economic competitiveness, more economic opportunities, better life quality and healthier environment for the whole region.

Montenegro's renewable potential is high, which can ensure a 125-165% RES-share by 2050 under the different SEERMAP scenarios and also significant electricity exports over the long-term.

If a renewables-based strategy is chosen, long term planned action offers clear advantages:

- The 'decarbonisation' scenario demonstrates that it is technically possible and financially viable to reach 100% of decarbonisation for Montenegro with its abundant RES resources by 2030;
- Long term planned support for RES does not drive wholesale prices up relative to other scenarios with less ambitious RES policies, but on the contrary, it reduces them after 2045;
- Decarbonisation does not jeopardise Montenegro's position as a net electricity exporter, installed generating capacity within the country enables Montenegro to satisfy domestic

demand using domestic generation in all seasons and hours of the day, with higher a share of net exports than in the 'no target' scenario;

- The macroeconomic analysis shows that household electricity expenditure relative to household income is expected to increase over time, but the increase is smallest in the decarbonisation scenario;
- Long term planned support for RES reduces the cost of stranded investments from 2.7 EUR/MWh in the 'no target' scenario to zero.

INSIGHTS FROM KOSOVO*:
Kosovo* has a favourable renewable energy potential, which could potentially ensure 85% RES share in electricity consumption by 2050. Utilizing renewable energy sources will be the cheapest possible solution over the long term as the price of fossil fuels and CO_2 emissions increases and the cost of RES technologies declines.

If a renewables-based strategy is chosen, long term planned action offers clear advantages:

- Stranded cost is a magnitude higher in the scenario where delayed action is taken, compared to the decarbonisation scenario (8.1 EUR/MWh versus 0.1 EUR/MWh).
- The renewables support needed to incentivise investment is considerable in the scenario with delayed action on renewables, estimated at 15.4 EUR/MWh support level (16% of total electricity generation cost) over the last ten years, because towards the end of the modelled period rapid deployment of additional capacities is required.
- The price of electricity is lower over the long term in a system with a high RES share as a result of the low marginal cost of RES electricity production.

MYTH C5: RES inhibit energy efficiency

"There is a trade-off between energy efficiency and renewable energies; policy-makers must decide on which one to focus on when pursuing low carbon paths."

FACT:

Energy efficiency and RES are mutually reinforcing.

Energy efficiency and renewable development are not alternatives; both are necessary for a cost-efficient, secure and sustainable energy system (Eurelectric, 2009). A new report of IEA-IRENA (2017) claims that it is possible to globally reduce energy-related CO_2 emissions by 70% by 2050. However, it cannot be done by only renewables: they "can account for about half of those reductions, with another 45% coming from increased energy efficiency and electrification." Maximizing the synergy between the two crucial objectives can drastically reduce energy-related carbon emissions – highlights IRENA (2017b). "Renewable energy and energy efficiency work in synergy. When pursued together, they can bring faster reduction in energy intensity and lower energy costs (…). Crucially, improved efficiency reduces total energy demand, allowing the share of renewables in the energy mix to grow faster."

The Energy Roadmap 2050, the official long-term technology-neutral framework of the European Union, has come to the same conclusion when targeting 80-95% emission reduction by 2050 compared to 1990. Its two main strategies are energy efficiency, where "the prime focus should remain", and renewable energy, "the second major prerequisite for a more sustainable and secure energy system" (European Commission, 2012).

The Fifth Assessment Report of the IPCC also highlights that switching to low-carbon energy carriers alone would not ensure a successful energy transformation pathway. “Transformations of the energy system rely on a combination of three high-level strategies: (1) decarbonisation of energy supply, (2) an associated switch to low-carbon energy carriers such as decarbonized electricity, hydrogen, or biofuels in the end-use sectors, and (3) reductions in energy demand” (Clarke & Jiang, 2015).

Moreover, according to energy modelling research carried out jointly by Wuppertal Institute and Energiaklub, focusing exclusively on renewables without energy efficiency would result in as high energy system costs on the long run as with no target policy (Lechtenböhmer, Prantner, Schneider, Fülöp, & Sáfián, 2016). At the same time, increasing energy efficiency without renewables would result in only a moderate reduction in emissions while several economic, societal and environmental benefits would be missed.

An example for the positive consequences of applying energy efficiency measures together with RES deployment is shown by the study of the World Bank (Jorgensen & Timislina, 2016), modelling different energy scenarios in Romania. The results show in the baseline scenario that without energy efficiency measures, emissions decrease only by 2% by 2050 (compared to 2005) and energy supply costs in total 336 billion EUR between 2015-2050. With demand side energy efficiency measures 16% emission reduction can be achieved over the same period with a total cost of 323 billion EUR. In other words, demand side energy efficiency costs 19 billion but by reducing total fuel costs and preventing need of new capacities it saves 29 billion EUR. “Thus, improving energy efficiency across the board in all economic sectors but especially in the residential sector and district heating offers the most effective and also viable means for containing the growth of energy demand” (Jorgensen & Timislina, 2016) (see also myth A2).

MYTH C6: RES have no short-term benefits

“Losses from the transition are immediate while gains are of mid- term and longer-term nature.”

FACT:

RES have some short-term benefits e.g. regarding air pollution and health effects, as well as several long-term benefits.

The energy transition will result in benefits and losses which will accrue to different groups of winners and losers at different times. Some actors who are winners of the current fossil fuel-based regime may lose out, but other actors will gain from an increase in the share of renewables (and connected technologies). However, broad experience to date shows that in a well-legislated system society as a whole will benefit over the long term (see also myth C2, C3 and C4).

It has been shown that a transition to renewable energy has multiple benefits. Energy transitions can address multiple challenges faced by the current energy system, such as rapid depletion of resources, air pollution, greenhouse gas emissions, energy poverty and nuclear risks (Markard et al., 2012). Some of these benefits would materialise as immediate short-term gains, such as health benefits from improved air quality. These benefits should not be underestimated, especially in the SEE region: only in Serbia, there were almost 11 000 premature deaths in 2014 due to air pollution from fossil power plants, while estimated health costs account to 4 billion EUR annually (Burki, 2018). However, not only air pollution and health issues, but also energy poverty and coal dependency are general issues in this region, which could be eased for the next generations.

Winners of the transition to renewables may include farmers, local sustainable energy communities, workers in the renewable energy industry and related industries and services etc. Moreover, SEERMAP results show that sustainable energy-based economy would also reduce electricity prices in the long run leading to benefits at the societal level. Losers of the energy transition may be concentrated in some sectors (e.g. fossil fuel generation industry) or some regions (e.g. coal mining regions), which should be taken into consideration when managing the transition (see myth C1).

The shift in the energy system will take place over time, currently operating thermal power plants will not all cease operations in the short term. Thus, the losses resulting from the energy transition will not materialize at once and with plans for just transition via adequate political, economic and societal preparations they can be reduced and compensated for by gains from the renewable energy sector.

INSIGHTS FROM SERBIA:
As a UNEP (2013a) report on Serbia shows, the long-term economic, social and environmental benefits of an energy transition can be substantial. This is why "policy packages that include mandates/targets to ensure action, incentives to share costs, and capital investments to stimulate research and development and emerging sectors" are required to find balance regarding costs, responsibilities, benefits and also to provide support to sensitive social groups (UNEP, 2013).

Renewables can also contribute to the diversification of the energy sources, which is the key to ensure energy security. Floods, such as the one during May and June 2014 meant that "work ground to a halt at TPPs and large hydro plants and Serbia was then forced to import all of its energy teach that a diverse portfolio of energy sources can prevent such events (Brnabic & Turkovic, 2015).

D. Security of supply

MYTH D1: RES cannot ensure security of supply – baseload power plants are needed.

"Renewables do not deliver reliable energy on demand; are non-flexible and unpredictable; they cannot provide security of electricity supply. RES-based systems are unstable and inflexible due to intermittency; they can negatively influence the security of supply which cannot be maintained if more RES will be added to the grid; it should be restricted; they lead to system failure; they threaten energy security; they are relying on power imported from baseload power stations elsewhere. Higher than 30% penetration of RES (excluding hydro) is not technically feasible. Security of supply can only be achieved by baseload/coal/fossil power plants; they will enable self-sufficiency and ensure energy security and independence. Co-firing of coal and biomass is the viable transitional solution. Phasing out coal towards RES is nonsense and even more non-sustainable. RES-based systems provide electricity which is of lower power quality."

FACT:

Compared to the present practice, new – but available – technologies and methods are needed to ensure security of supply with high RES share. Baseload production is the basis of the current energy system but it is not necessary and may even hinder the future energy system as it is inflexible, with obsolete units, stranded assets and high marginal costs.

Electricity production from some renewable resources such as storage hydro, biomass, biogas or geothermal can be regulated, while the other, so-called intermittent sources such as wind, solar and run-of-river hydro are weather-dependent. However, an energy system with a high share of intermittent renewable energy is also feasible.

Baseload (mostly fossil) capacities are not necessary in an energy system, even with high RES penetration (Lund, 2014; Lund et al., 2012; Matek & Gawell, 2015; Ueckerdt & Kempener, 2015). In a flexible energy system (Lund, 2007), where all energy system actors are active, energy prosumers, smart solutions, electric cars, heat pumps, controllable CHP plants, demand side management, energy storage and transformation technologies all work together to integrate as much intermittent renewable energy as possible.

SEERMAP modelling has been very conservative with respect to the flexibility that can be achieved on the demand side. It was assumed that demand side management can shift only 3.5% of total daily demand from peak load to base load hours by 2050. The 3.5% assumption is a conservative estimate compared to other projections, e.g. McKinsey & Company (2010)[11] or TECHNOFI (2013)[12]. No demand side measures were assumed to be implemented before 2035 and no storage capacity was assumed. Even with only limited demand side response, assuming only slightly higher interconnectedness between SEE countries than is currently the case, by relying on a mix of both intermittent and dispatchable RES, supply and demand can be balanced in an electricity system which by 2050 has an

[11] McKinsey assumed that the level of demand side management will increase from 2% in 2020 to 10% in 2050, based on Roadmap 2050, where 2050 values of 0% and 20% were analysed.

[12] TECHNOFI claim that studies verify the high WACC (Weighted Average Cost of Capital) values across the region: Ecofys – Eclareon (2017) estimated 7-13.7% for on shore wind and 7-12.4% for PV and IRENA (2017) 8 - 10% for SEE countries in 2016.

83.2% RES share and only around 1% fossil fuel-based generation. In the 'decarbonisation' scenario demand and supply can be balanced even though only 294 MW fossil capacity remains in the system in contrast to 9723 MW renewable capacity by 2050.

In order to assess the validity of concerns about the impact of high RES shares on energy security, three security of supply indices were calculated for all countries and scenarios in the SEERMAP project: the generation capacity margin, the system adequacy margin, and the cost of reducing the generation adequacy gap to zero. Even with such conservative assumptions relating to demand side measures, the generation adequacy indicator[13] remains favourable for the SEERMAP 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 modelled. The system adequacy[14] indicator for the region as a whole, which takes into account import possibilities as well as regional generation capacities, is even higher.

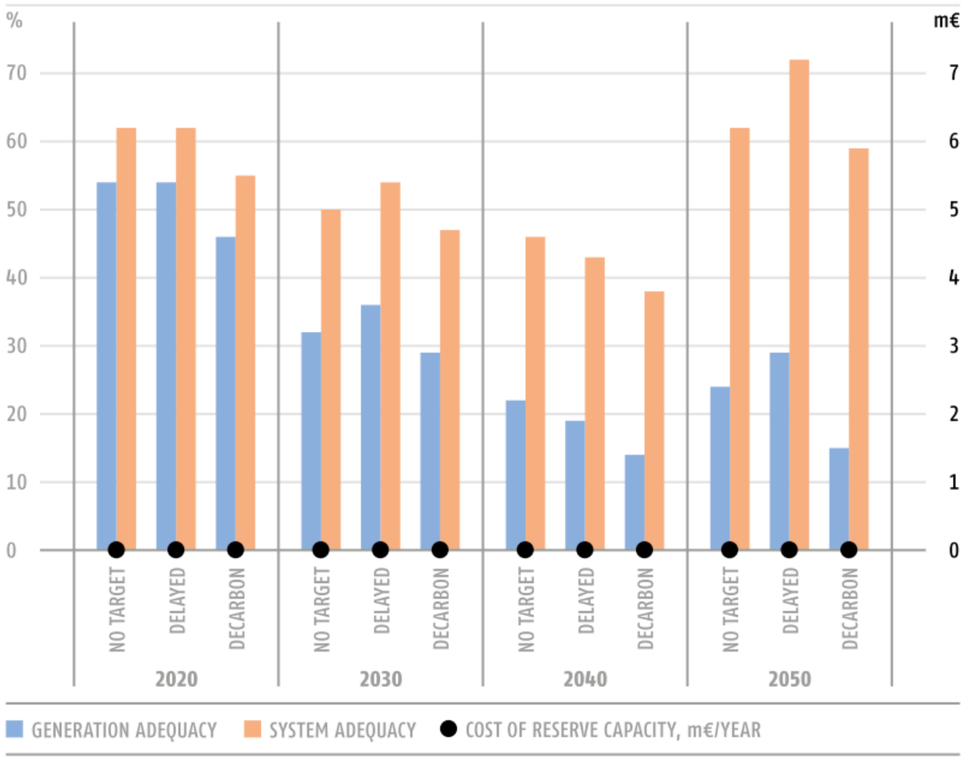

FIGURE 45 GENERATION AND SYSTEM ADEQUACY MARGIN FOR THE ENTIRE SEERMAP REGION, 2020-2050 (% OF LOAD). SOURCE: SEERMAP REGIONAL REPORT SOUTH-EAST EUROPE.

[13] Generation adequacy is the ability of generation to match load in the power system at all times. Generation adequacy analysis is important for energy consumers because it seeks to demonstrate whether the electricity supply is able to remain secure and available when needed (JRC 2016 - EUR 27944).
The generation adequacy margin is defined in SEERMAP model as the difference between available capacity and hourly load as a percentage of hourly load. If the resulting value is negative, the load cannot be satisfied with domestic generation capacities alone in a given hour and imports are needed. The generation adequacy margin was calculated for all of the 90 representative hours and the lowest value was used as the indicator. For this calculation, assumptions were made with respect to the maximum availability of different technologies. Fossil fuel power plants were assumed to be available 95% of the time, and hydro storage 100% of the time. For other RES technologies historical availability data was used. This is a simplified version of the methodology formerly used by ENTSO-E. (See e.g. ENTSO-E 2015, and previous SOAF reports)
[14] System adequacy means, that a country is able to fulfil all electricity needs for all hours in a year using its own electricity generation fleet as well as electricity imports.
The system adequacy margin is defined in SEERMAP model similarly to generation adequacy, but net transfer capacity available for imports is considered in addition to available domestic capacity. This is a simplified version of the methodology formerly used by ENTSO-E. (See e.g. ENTSO-E (2015a), and previous SOAF reports)

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. This is in line with a broader EU approach which relies on cooperation and solidarity between member states – to which the countries of this region are also committed through their membership of the Energy Community.

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 and also the decrease in the need for new investments in hydro power generation.

In a flexible energy system (Lund, 2007), where all energy system players are active in integrating high shares of renewable energy, energy prosumers, smart solutions, electric cars, heat pumps, controllable CHP plants, demand side management, energy storage and transformation technologies all work together to utilize as much intermittent renewable energy production as possible and also to balance energy supply with demand. For achieving high reliability levels back-up options (e.g. use of flexible gas turbines to secure peak load cost-effectively, but hydropower or any other storage technology can also provide a back-up) as well as electricity to electricity storage (batteries, pumped hydro, etc.), flexible demand, electricity to other forms of energy storage (RES-based power to gas, hydrogen, heat, etc.) and regional integration are crucial. (Fraunhofer IWES, 2015)

A study of Agora Energiewende (Fraunhofer IWES, 2015) on flexibility challenges shows that geographical smoothing facilitated by strong electricity grids can smooth flexibility challenges in case of a high level of RES share in the energy mix. This requires regional level power system integration that relies on cross-border power flows. This integrated power system also necessitates a mix of flexible resources for high reliability, accompanied by increased flexibility of the demand side in all countries and the adjustment of the operation of the existing conventional capacities.

Dominković et al. (2016) clearly showed "that a 100% renewable energy system of the whole [SEE] region is possible". According to their results, to achieve 100% renewable energy system, contribution from several sectors is needed to enable balancing of demand and supply at all times. These solutions include the integration of power and district heating sectors with the application of advanced CHPs and heat pumps coupled with thermal energy storage, use of solar thermal and heat pumps in buildings which cannot be connected to district heating systems, electrification of transport and use of vehicle to grid technology, electrification in industry, installation of storage solutions including pumped storage hydro where possible and CSP with storage, use of dispatchable RES such as waste incineration, and implementation of energy efficiency measures in all sectors (Dominković et al., 2016).

Regarding power quality[15], high penetration of e-car charging stations and intermittent renewable energy generators can cause degradation in power quality such as "frequency and voltage fluctuations, voltage drop, harmonic distortion and power factor reduction" (Farhoodnea, Mohamed, Shareef, &

[15] Defined as a steady supply voltage that stays within the prescribed range, steady a.c. frequency close to the rated value, and smooth voltage curve waveform (resembles a sine wave). In general, it is useful to consider power quality as the compatibility between what comes out of an electric outlet and the load that is plugged into it.

Zayandehroodi, 2013).). However, there are several already widely used as well as new technical solutions which can prevent degradation in quality in high-RES in electricity systems:

- phasor measurement units (PMU) monitor and automatically maintain power quality (Shertukde, 2017););
- power converters using new generation of "semiconductor models are highly efficient and can withstand high oscillations" (Guran, 2013););
- energy storage can provide advanced auxiliary services which can serve excellent power quality (Görtz, 2015);
- predictive control (model predictive control [MPC] and vector-sequence-based predictive control [VPC]) are still under development but results are promising for flexible power supply "the active and reactive powers supplied by the PV and wind generator can be controlled flexibly with excellent steady-state and transient performance. (…) Predictive control tends to be an attractive and powerful technique for power electronics converters in renewable energy systems" (Hu & Cheng, 2017).

INSIGHTS FROM BOSNIA AND HERZEGOVINA:
Even if only a single lignite power plant is built (the Stanari lignite-based power plant which is already existing since 2016), security of supply can be achieved. A high RES share electricity mix is able to satisfy demand in Bosnia and Herzegovina in all hours of the year in all years until 2050 according to the 'decarbonisation' scenario model results, where only 300 MW existing coal power plant will run by 2050 (with utilisation rate of 7.6%).

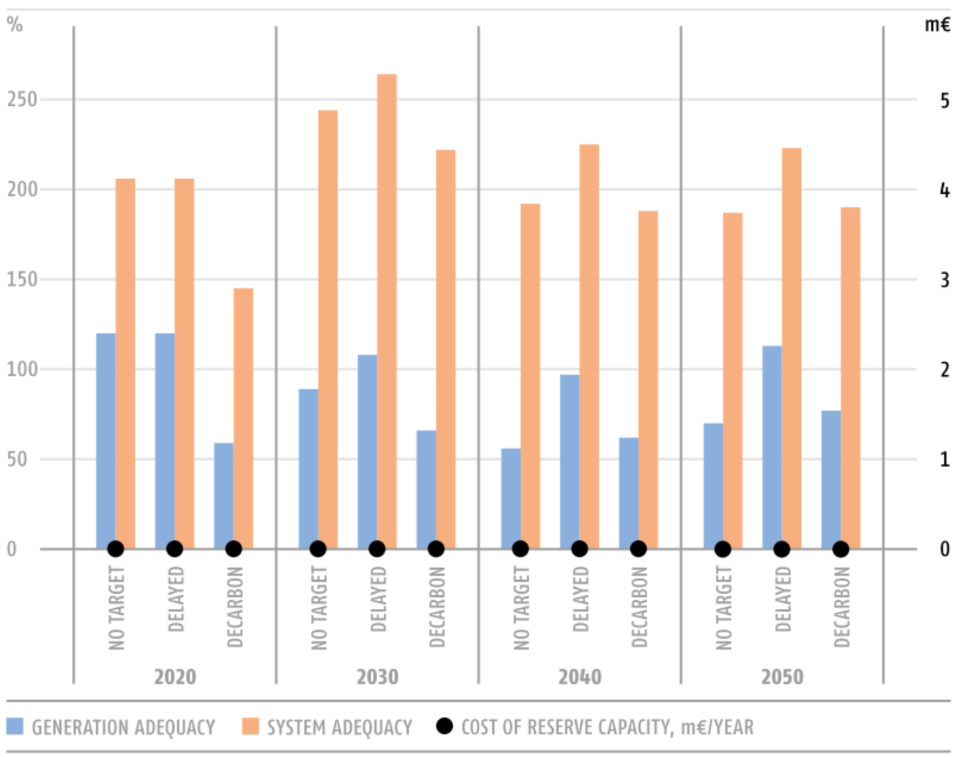

FIGURE 46 GENERATION AND SYSTEM ADEQUACY MARGIN FOR BOSNIA AND HERZEGOVINA, 2020-2050 (% OF LOAD): SEERMAP COUNTRY REPORT BOSNIA AND HERZEGOVINA.

For Bosnia and Herzegovina, the generation adequacy margin is positive throughout the modelling period for all scenarios, meaning domestic generation capacity is sufficient to satisfy demand in all hours of the year for all of the years modelled. The system adequacy margin is even higher.

INSIGHTS FROM BULGARIA:
For Bulgaria, the generation adequacy margin is positive in both the 'no target' and 'decarbonisation' scenarios over the entire modelled time period, although the value of the indicator nears zero after 2040. This means that domestic generation capacity will be sufficient to satisfy domestic demand during all hours of the year in both scenarios.

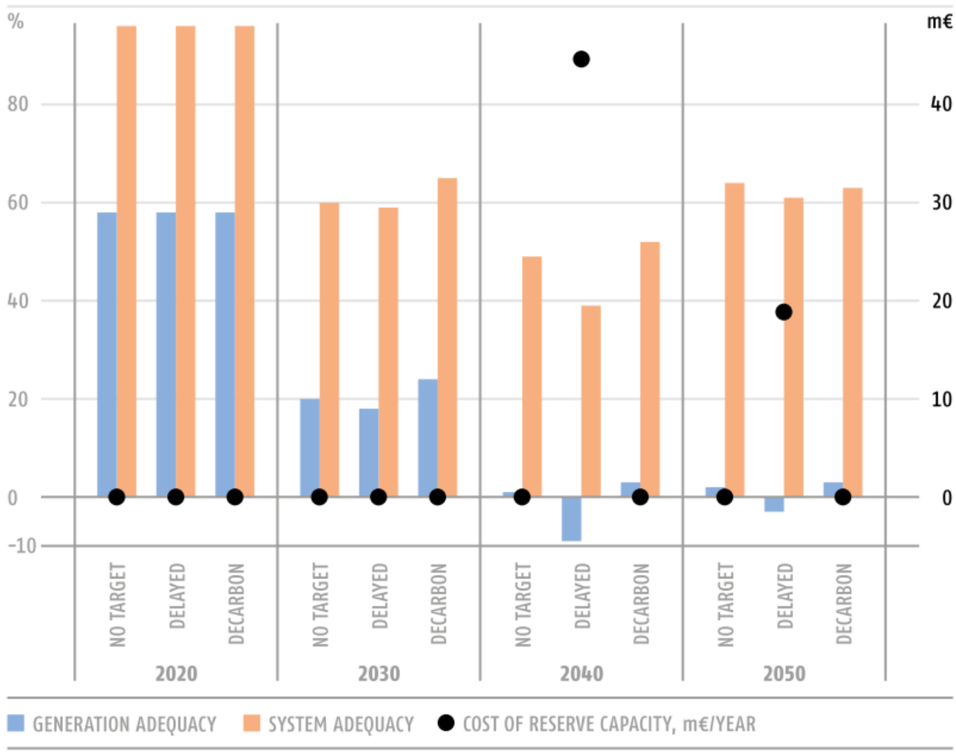

FIGURE 47 GENERATION AND SYSTEM ADEQUACY MARGIN FOR BULGARIA, 2020-2050 (% OF LOAD): SEERMAP COUNTRY REPORT BULGARIA.

The system adequacy margin is even higher throughout the whole modelling period. The fact that the generation adequacy indicator is similar in the 'no target' and in the 'decarbonisation' scenario indicates that an increase in the RES share by 2050 of around 20% will not have a negative impact on security of supply. Measures which could be considered include demand side measures, increased network connections and storage solutions.

INSIGHTS FROM CROATIA:
For Croatia, the SEERMAP results show that the generation adequacy margin is positive throughout the whole modelling period in all scenarios, i.e. domestic generation capacity is sufficient to satisfy domestic demand in all hours of the year for all of the years modelled even with a high share of renewables (84% in 'no target' and 101% in 'decarbonisation' scenario). The system adequacy margin is even higher.

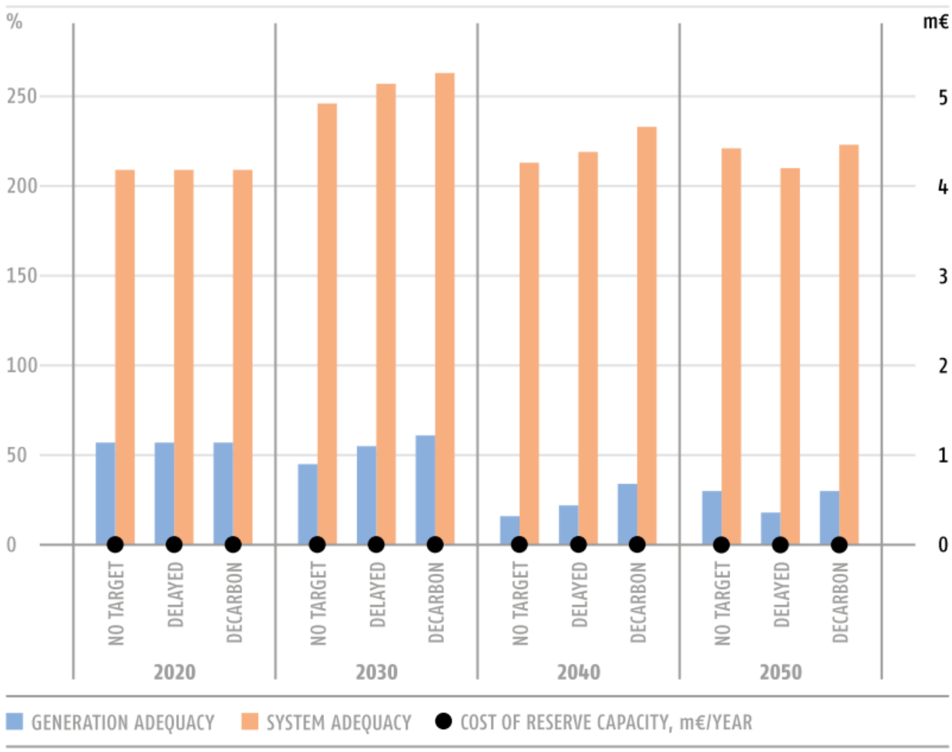

FIGURE 48 GENERATION AND SYSTEM ADEQUACY MARGIN FOR CROATIA, 2020-2050 (% OF LOAD): SEERMAP COUNTRY REPORT CROATIA.

The results clearly show that RES integration should be the focus of energy policy in Croatia since RES shares will increase in every scenario, reaching a minimum of around 84% by 2050, while the security of supply will be not affected in a negative way.

INSIGHTS FROM GREECE:

Greece's generation and system adequacy indicators remain favourable in all scenarios; installed generation capacity within the country enables Greece to satisfy domestic demand using domestic generation in all years in all hours of the day for the entire modelled period. This is true even under scenarios with an ambitious decarbonisation target and corresponding RES support schemes, with close to 100% renewable generation, mostly solar and wind, and some hydro by 2050.

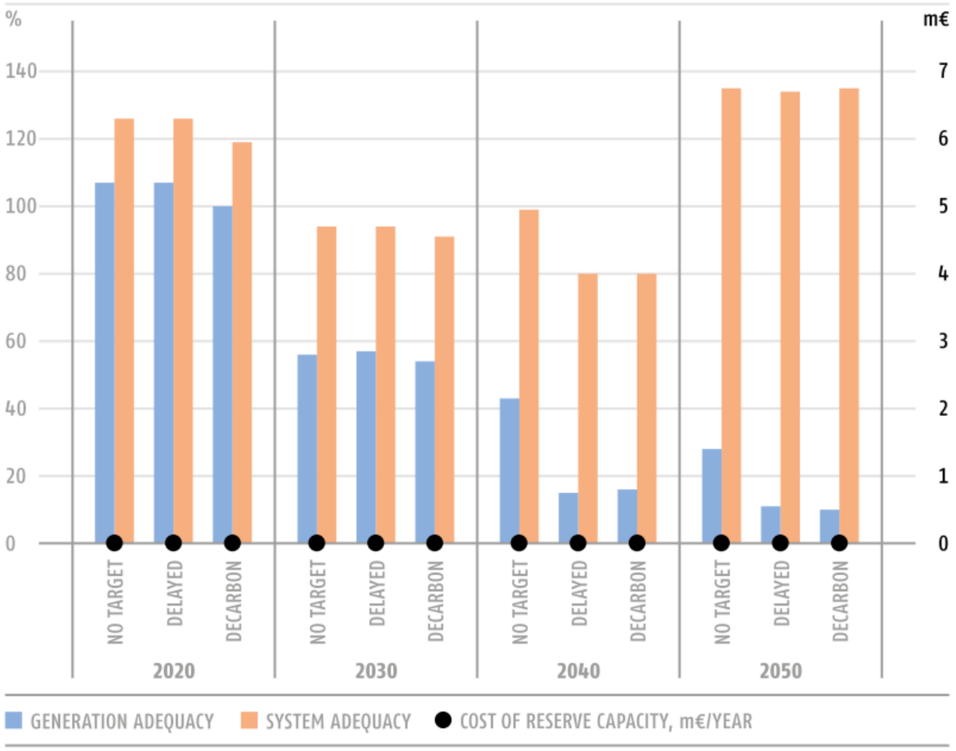

FIGURE 49 - GENERATION AND SYSTEM ADEQUACY MARGIN FOR GREECE, 2020-2050 (% OF LOAD). SOURCE: SEERMAP COUNTRY REPORT GREECE.

INSIGHTS FROM THE FORMER YUGOSLAV REPUBLIC OF MACEDONIA

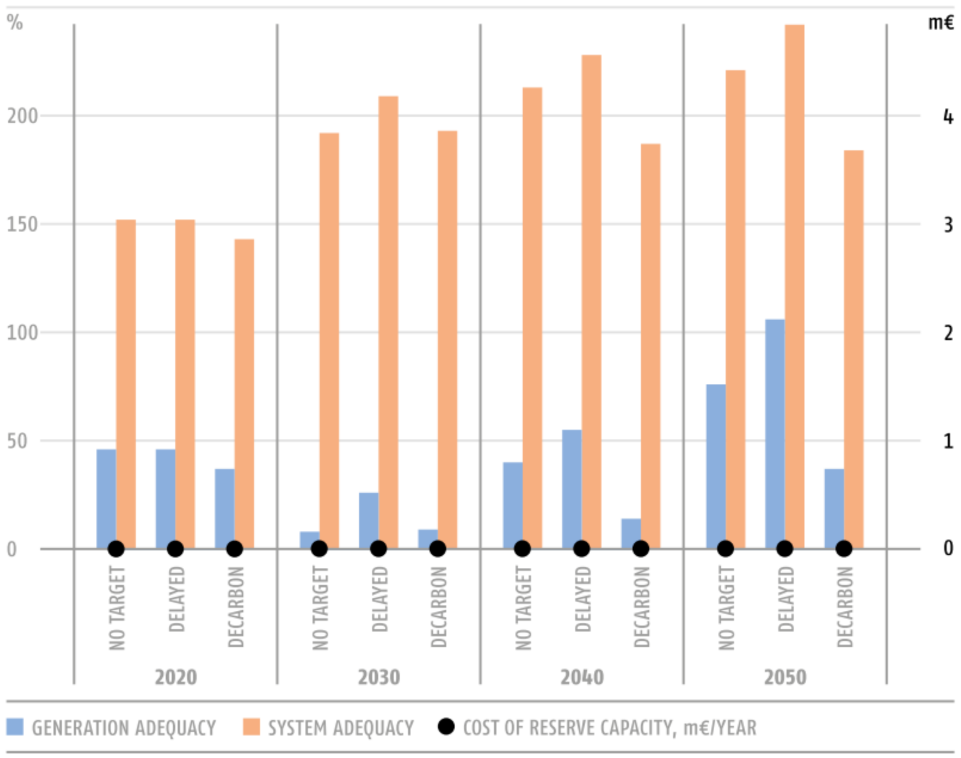

FIGURE 50 - GENERATION AND SYSTEM ADEQUACY MARGIN THE FORMER YUGOSLAV REPUBLIC OF MACEDONIA, 2020-2050 (% OF LOAD). SOURCE: SEERMAP COUNTRY REPORT FORMER YUGOSLAV REPUBLIC OF MACEDONIA.

The generation adequacy margin for the former Yugoslav Republic of Macedonia is positive for all years for all scenarios, meaning the country has sufficient generation capacity to satisfy demand using only domestic capacity in all hours of all years even with RES share of 85-89%.

INSIGHTS FROM KOSOVO*:

For Kosovo*, the generation adequacy margin turns negative in 2025 and remains so throughout the modelled period in the 'decarbonisation' scenario. In the other two scenarios the generation adequacy margin turns positive at the end of the period. The system adequacy margin, however, is positive for all hours of all years. This means that in some hours of the year Kosovo* will have to rely on imported electricity to satisfy its demand.

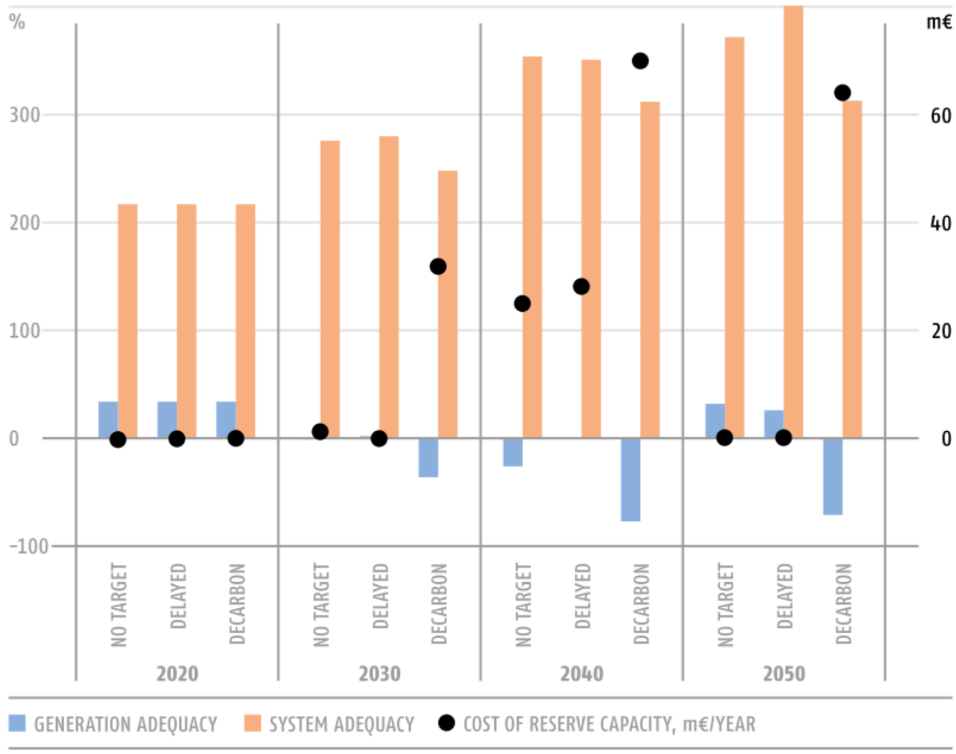

FIGURE 51 - GENERATION AND SYSTEM ADEQUACY MARGIN KOSOVO, 2020-2050 (% OF LOAD). SOURCE: SEERMAP COUNTRY REPORT KOSOVO*.*

Alternatively, relying on national capacity alone would imply an additional reserve capacity cost of 40 mEUR/year on average between 2025-2050, reaching 60-70 mEUR/year from 2040. This demonstrates that although ensuring that a country is able to satisfy demand at all times using exclusively domestic capacity may seem like an attractive option to policy makers for energy security reasons, it comes at a significant price. Ensuring high interconnectivity is a more cost-optimal option.

INSIGHTS FROM MONTENEGRO:

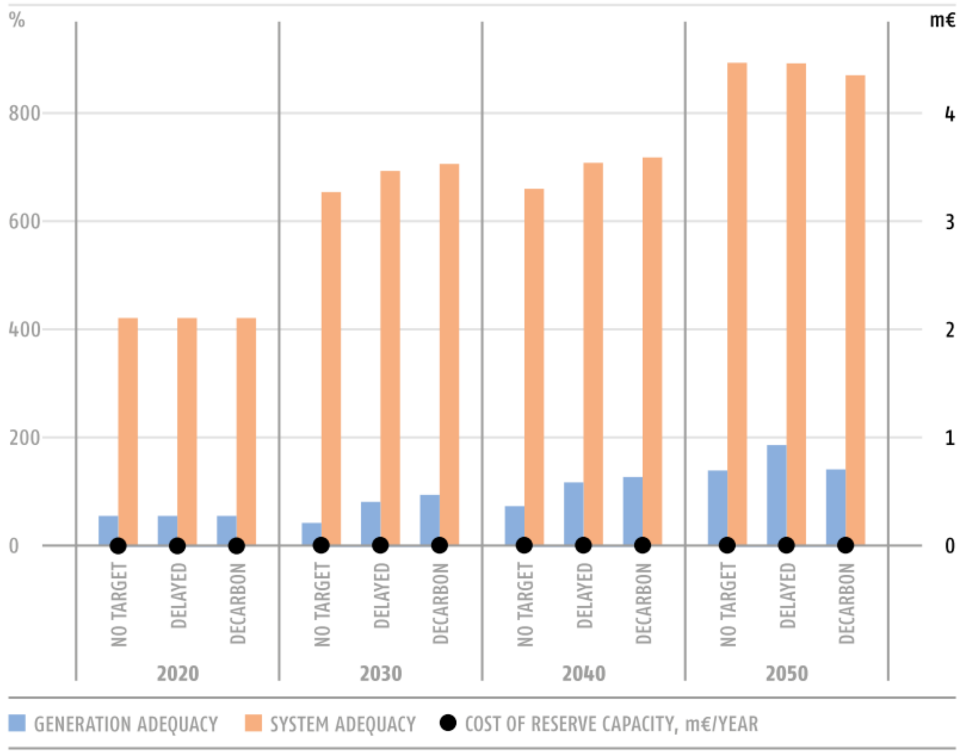

FIGURE 52 - GENERATION AND SYSTEM ADEQUACY MARGIN MONTENEGRO, 2020-2050 (% OF LOAD). SOURCE: SEERMAP COUNTRY REPORT MONTENEGRO.

According to the SEERMAP model results, Montenegro's generation and system adequacy indicators remain favourable; installed generation capacity within the country enables Montenegro to satisfy domestic demand using domestic generation in all seasons and hours of the day, throughout the modelled period even with above 100% RES share.

INSIGHTS FROM SERBIA:

The 'decarbonisation' scenario shows that it is feasible and possible to supply the Serbian power system without any fossil-based capacity by 2050, mainly with hydro, wind and solar capacities of total of more than 12 000 MW.

For Serbia, the generation adequacy margin is negative during the second half of the modelled time period for all scenarios and for the entire modelling period in the 'decarbonisation' scenario. This means domestic generation capacity is not sufficient to satisfy domestic demand in some hours of the year during this time period. However, the system adequacy margin is positive, indicating that demand can be satisfied during all hours if import potential is considered in addition to domestic capacities.

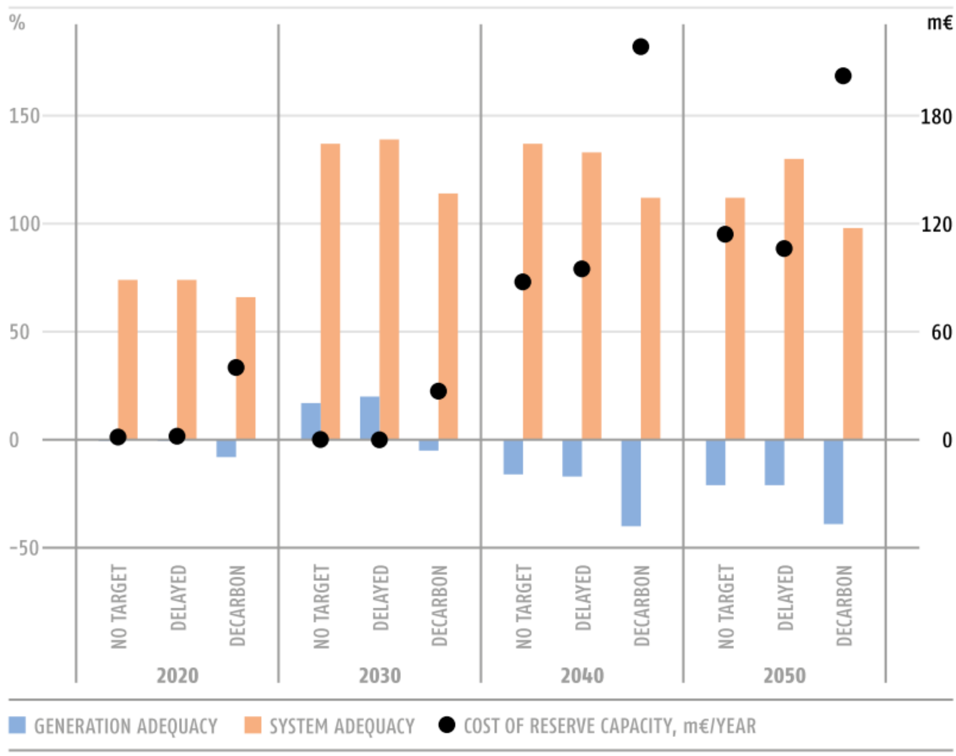

FIGURE 53 - GENERATION AND SYSTEM ADEQUACY MARGIN SERBIA, 2020-2050 (% OF LOAD). SOURCE: SEERMAP COUNTRY REPORT SERBIA.

Alternatively, relying on national capacity alone would imply an additional reserve capacity cost of 219 mEUR/year in 2040 and 203 mEUR/year in 2050 in the 'decarbonisation' scenario, while it is about half in the other two scenarios. Although ensuring that a country is able to satisfy demand at all times using exclusively domestic capacity may seem like an attractive option to policy makers for energy security reasons, it comes at a significant price. Ensuring high interconnectivity is a more cost-optimal option. This demonstrates the importance of regional markets.

Batas Bjelić, Rajaković, Ćosić, & Duić (2013) created a hourly detailed energy system model of the actual existing Serbian energy system to prove that it is possible to integrate more than 500 MW wind capacity into the grid. They analysed critical excess electricity production (CEEP) which is "the sum of energy imbalances for the whole year". As balancing tools, they list the following possible tools and solutions:

1) "Consumer load flexibility;
2) Increased flexibility from traditional generators:
    a) Reduced technical minimum,
    b) On/off cycling time reductions,
    c) Up/down load ramp increase;
3) Energy storage;
4) Regional market dispatch e interconnection imbalance;
5) Transmission upgrades;
6) The integration of the different sectors in the energy system (electricity, heat and transport);
7) Curtailment of wind production." (Batas Bjelić et al., 2013)

The results show that the existing system is able to integrate 1500 MW or 2500 MW wind power or to the system with less than 5% and 20% CEEP of wind power production, respectively. It is worth mentioning that consumer load flexibility and demand side response (in domestic hot water production) was able to reduce CEEP by 0.3-0.61 TWh/year (Batas Bjelić et al., 2013).

MYTH D2: RES require expensive grid investments

"RES expansion has led to increased network costs. Renewables need expansive grid upgrades. The upgrade of the old infrastructure is very costly and hardly affordable in the short run."

FACT:

In general, grid investments are continuously needed; however, the additional grid investment needs are low compared with investment in generation capacity.

The transmission gird in the SEERMAP region is historically well-connected, especially within the former Yugoslavia. In the future, additional network investments are expected to facilitate higher RES integration and cross-border electricity trade and to account for significant growth in peak load. Consequently, domestic high voltage transmission and distribution lines will need investments in the future in most of the SEERMAP countries.

The SEERMAP network analysis covered a number of ENTSO-E impact categories, including contingency analysis[16], Total Transfer Capacity (TTC) and Net Transfer Capacity (NTC) assessment and network losses. Analysis of the network constraints anticipates contingencies in the SEE region. These problems can be solved by investments into the transmission network – e.g. by building additional lines or improving substations – where investment costs are estimated based on benchmark data for the region. In the 'delayed' scenario additional transmission network costs are 24 and 64 mEUR in 2030 and 2050, respectively. For the 'decarbonisation' scenario these values are 233 and 132 mEUR (not including the value for Greece). These costs are not significant compared to the overall investment costs in RES generation capacities demonstrating that moderate investments in transmission line development will ensure that the network will not constrain a higher level of RES deployment projected for the region.

The SEERMAP regional report highlights that regional cooperation can significantly lower support costs and results in slightly lower investment needs for meeting RES targets. Regional cooperation requires interconnections. 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.

Fürsch et al. (2013) also found that grid extensions due to high RES shares are cost-optimal solutions for the system. They claim that to reach a cost-optimal status of the European electricity network, further 228 000 km (76% extension) should be built by 2050. These connections will be also useful to transmit excess RES electricity production to regions where there is higher demand, therefore additional storage capacities can be also avoided.

According to a review conducted by Brown et al. (2018), additional grid costs tend to be typically around 10-15% of total system costs in European countries. A study for the European Commission of the European electricity system by 2030 examined the consequences for both the transmission and distribution grid of renewable energy penetration up to 68% (KEMA, DNV GL-Energy, Imperial College,

[16] Contingency analysis is also called 'if-then' analysis; aimed at analyzing static security of the power system by testing the impact of the failure of individual grid elements on the functioning of the gird and identifying the optimal response.

& NERA, 2014). For total annual system costs of 232 billion EUR/year, only 4 billion EUR/year is assigned to the costs of transmission grid investments and 18 billion EUR/year to the distribution grid. For 100% RES systems, the cost of grid expansion as a share of the total system costs vary between 10% and 15% in Germany depending on the application of smart solutions (Ackerman, Koch, Rothfuchs, Martens, & Brown, 2014 via Brown et al., 2018).

At the same time other studies, such as Haller, Ludig, & Bauer (2012) show that "emission reductions of up to 90% are still feasible without expanding transmission capacities". This study assumes a situation where the system is fragmented, therefore no significant long-distance electricity transmissions are possible. Although the regions achieve self-sufficiency in such a scenario, they need to invest in, large diurnal storage capacities (especially in regions with PV), rely on temporary curtailments to ensure balance of supply and demand, and variable electricity prices would result both in time and between the regions (Haller et al., 2012).

INSIGHTS FROM ROMANIA:

With a modest investment in the transmission network Romania can harness the benefits of increasing renewable penetration in the form of higher NTCs available for electricity trade and decreasing network losses.

Romania's transmission system is already well-connected with neighbouring countries. In the future additional network investments are expected to be realised to accommodate higher RES integration and cross-border electricity trade and to meet significant growth in peak load. The recorded peak load for Romania in 2016 was 8 752 MW (ENTSO-E DataBase), while it is projected to be 8 696 MW in 2030 (SECI DataBase) and 10 279 MW in 2050. The contingency analysis of the network constraints anticipates contingencies in the Eastern part of the country. The estimated level of investment needed in the Romanian transmission network system is 117 mEUR until 2050 in addition to investments contained in ENTSO-E TYNDP 2016. These upgrades would allow for the integration of new capacities, increase cross-border capacities available for trade, and at the same time reduce network losses.

INSIGHTS FROM THE FORMER YUGOSLAV REPUBLIC OF MACEDONIA

The transmission system of the former Yugoslav Republic of Macedonia is well-connected with that of neighbouring countries but additional network investments in high voltage transmission lines and the distribution system are needed to accommodate greater RES deployment in the future. The network will have to cope with higher RES integration and cross-border electricity trade. Contrary to other countries in the region peak load is expected to decrease significantly from 1457 MW in 2016 (ENTSO-E DataBase) to 1160 MW in 2030 (SECI DataBase) and 1400 MW in 2050.

Overall, the network modelling does not show any congestion in the transmission network of the former Yugoslav Republic of Macedonia provided that the planned TYNDP developments are realised in the future. This implies that no further investment in the transmission network beyond investment planned in the TYNDP will be required to accommodate a high share of renewables. This figure includes not only the transmission network costs, but those necessary for connecting facilities, as well as reinforcement of the national grid to facilitate the expected increase in RES generation. However, the SEERMAP network modelling did not take into account investment needs related to the development of the distribution network, which may be significant due to growth in solar generation capacity in particular – but will also help reduce distribution losses in general.

INSIGHTS FROM KOSOVO*:

Kosovo's* transmission system is already well-connected with neighbouring countries but additional network investments in internal high voltage transmission lines and at the distribution level will be needed. The network will have to cope with higher RES integration and cross-border electricity trade and peak load that is expected to increase significantly from 1182 MW in 2016 (ENTSO-E DataBase) to 1630 MW in 2030 (SECI DataBase) and 2310 MW in 2050.

The contingency analysis of the network constraints anticipates contingencies that could be solved by investments of 72.5 mEUR by 2050 (in addition to ENTSO-E TYNDP 2016 recommendations).

According to the network analysis, transmission network losses are affected in different ways. On the one hand losses are reduced as renewables, especially PV, are connected mostly to the distribution network and as a result the distance between production and consumption decreases. On the other hand, high levels of electricity trade by 2050 in the summer season will increase transmission network losses.

Overall, some investment in the transmission network is necessary to accommodate new RES capacities in Kosovo's* electricity system, but the estimated cost of network investments remains below 173 mEUR for the period, in addition to the investments contained in ENTSO-E TYNDP (Entso-e, 2016). This number includes not only the transmission network costs, but those necessary for connecting facilities, as well as reinforcement of the national grid to facilitate the expected increase in RES generation. It does not include, however, investment needs related to the development of the distribution network, which may be significant due to the increase in solar generation capacity in particular, but will also help reduce the massive distribution losses in Kosovo.

INSIGHTS FROM MONTENEGRO:
Montenegro's transmission system is already well-connected with neighbouring countries. In the future further new network investments are expected to be realised, in order to cope with higher RES integration and cross-border electricity trade. Peak load is expected to increase significantly, this will also have an impact on network development needs. For 2016 the recorded peak load on the transmission network of Montenegro was 576 MW (ENTSO-E DataBase), while the projected value for 2030 is 2039.6 MW (SECI DataBase) and 2489.5 MW for 2050. Internal high and medium voltage transmission lines, as well as the distribution level will need investment.

Analysis of the network constraints foresees several contingencies. Because of the projected tripping of the 110 kV overhead line connecting Bar and the Mozura Wind Power Plant, a new line needs to be built connecting the power plant with Ulcinj at a projected cost of 3.5 mEUR in the 'delayed' scenario. In the 'decarbonisation' scenario, an additional investment of 8 mEUR may become necessary for another line connecting Virpazar, Golubovci and Podgorica. A new substation for RES collection may become necessary at Brezna, incurring a cost of 20 mEUR. Furthermore, constraints on lines connecting the Perucica Hydro Power Plant to the grid may call for a new line between Vilusi and Herceg Novy at a cost of 5.5 mEUR.

A moderate amount of investment in the transmission network is necessary to accommodate new RES capacities in the Montenegrin electricity system in addition to ENTSO-E TYNDP (Entso-e, 2016). The estimated cost of network investments is over 30 mEUR for the modelling period until 2050. This figure includes not only the transmission network costs, but the necessary connecting facilities, as well as reinforcement of the national grid to facilitate the expected increase in RES generation. It does not include, however, investment needs related to the development of the distribution network, which may be significant due to the increase in solar generation capacity in particular.

MYTH D3: RES endanger self-sufficiency

"We must remain electricity exporters or we will lose enormous profit. Import dependence has to be avoided – we have to be self-sufficient. Cross-border coupling will promote imports of low-cost electricity from other countries, thus penalizing local electricity production and especially RES."

FACT:

Energy security doesn't have to mean self-sufficiency, but utilizing domestic, renewable energy sources decreases import dependency.

There is a historically embedded belief in the SEE region that a country has to be self-sufficient to achieve energy security. However, energy security can also be achieved at a regional, rather than national level, by developing interconnections. This increases the security of supply by sharing benefits as well as risks (International Hydropower Association, 2017).

A competitive electricity market, if unconstrained by cross-border network capacity, will result in trade flows which ensure economically optimal allocation of production across countries. Exporting electricity is only beneficial to a country if electricity can be produced at a lower cost in that country than in neighbouring countries. In this case, electricity producers can make a profit by producing electricity and exporting it to other countries. If this is not the case, and electricity imports are cheaper than domestic production, then importing electricity is the economically optimal solution, as it ensures a lower electricity price which is beneficial to consumers. Along the same logic, aiming for full self-sufficiency in electricity production can come at a significantly increased cost compared to a situation when the country is able to rely on cheaper imports.

Furthermore, developing renewables can decrease import dependency, as renewables are generally domestic resources and can substitute for imported resources.

INSIGHTS FROM BULGARIA:
In all SEERMAP scenarios, Bulgaria will import electricity after 2035, in contrast to its present net exporter position. By 2050, net imports increase to more than 22% in the 'no target' scenario and around 14% of total consumption in the other two scenarios. This indicates that producing electricity in Bulgaria is more expensive than in other countries in the region. However, a decarbonisation policy has the benefit of reducing import dependency by 10% compared to the 'no target' scenario, implying that decarbonisation can help to reduce import dependency.

INSIGHTS FROM GREECE:
According to the SEERMAP results, in contrast to its present net import position, Greece becomes self-sufficient in electricity generation in all three scenarios. Stronger and faster growth in RES generation compared to some neighbouring countries (e.g. Bulgaria and the former Yugoslav Republic of Macedonia) allows for this market development.

MYTH D4: Natural gas is required as a bridge fuel

"Natural gas is a necessary bridge fuel in future power systems."

FACT:

Natural gas can be useful for balancing supply and demand in some cases, but it is not required and can cause stranded assets on the long term.

Natural gas is often considered a bridge fuel between the current fossil fuel-based economy and the future low carbon economy due to its lower emission factor and higher efficiency of gas combustion technologies relative to some other fossil fuel generation technologies, such as coal. Natural gas-based generation is also said to provide the necessary flexibility in an electricity system with a high share of renewables. However, the 'bridging fuel' argument is often used to justify a higher role for natural gas than necessary.

The SEERMAP results show that initially all scenarios foresee a rise in natural gas use for electricity generation. However, in the 'decarbonisation' scenario regional natural gas-based electricity generation plays only a very minor role towards the end of the modelled period, accounting for 1.5% of generation in 2050. Under the 'no target' scenario, gas still provides 15% of regional electricity generation in 2050 with peak production expected around 2035.

Regarding capacities, this means 8500 MW installed natural gas capacity for 'no target' and 2200 MW capacity for 'decarbonisation' scenario by 2050 in the SEERMAP region. In the 'decarbonisation' scenario total gas capacity declines from 2020 onwards, with the rate of new capacity additions lower than the rate of outgoing capacity. Even without an increase in capacity, gas-based electricity generation is still sufficient to bridge the transition from fossil to renewable based electricity mix due to higher utilisation rates which peak between 2025 and 2035 in this scenario.

In most countries, natural gas does not play a bridging role in scenarios which are consistent with long-term EU decarbonisation targets. The only scenario where the share of natural gas is significant is in the 'no target' scenario, but this scenario is not in line with EU policy goals.

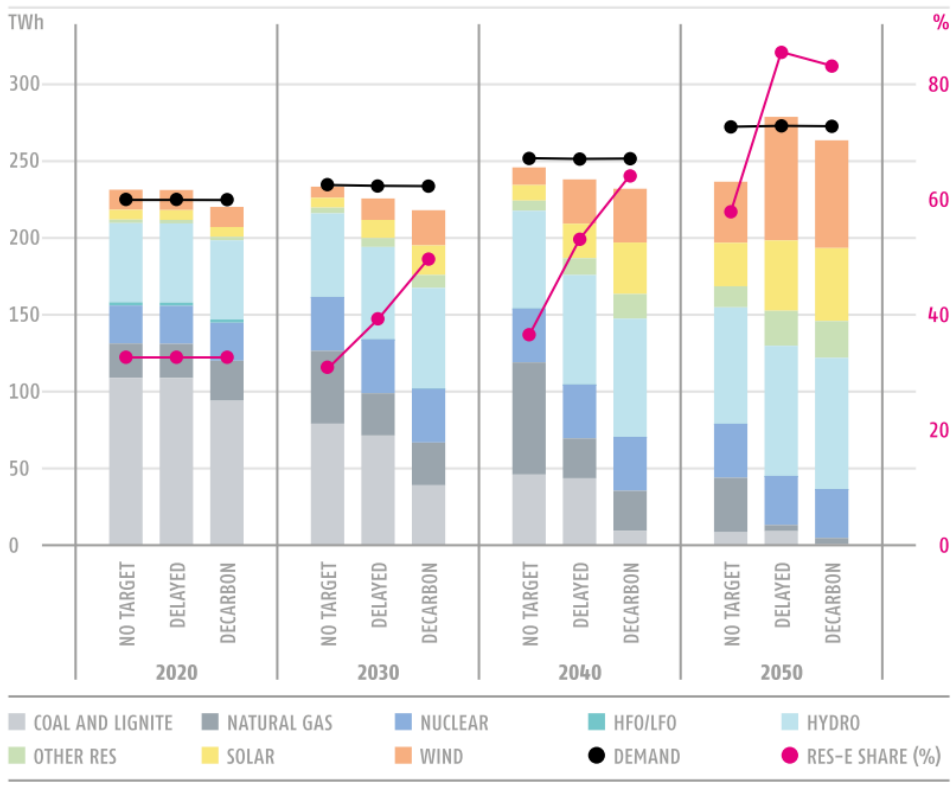

FIGURE 54 - ELECTRICITY GENERATION AND DEMAND (TWh) AND RES SHARE (% OF DEMAND) IN THE SEERMAP REGION, 2020-2050. SOURCE: SEERMAP REGIONAL REPORT SOUTH-EAST EUROPE.

In all scenarios most gas-based electricity is produced in the EU countries covered by the SEERMAP project (Greece, Romania and Bulgaria, where gas infrastructure already exists) during the middle of the modelled time horizon. In these countries, the short-term uptick in gas-based electricity generation in a decarbonisation scenario can be achieved without a significant increase of natural gas capacities, as the generation increase is due in large part to higher utilisation rates. Two countries in the Western Balkans, Bosnia and Herzegovina and Montenegro, have no gas-based electricity generation in any of the scenarios. Since natural gas will play only a marginal role in the long-term and have a limited bridging role, the investment in gas distribution networks connecting to the Transadriatic (TAP) pipeline[17] should be reviewed in light of long-term decarbonisation targets.

The 2017 Energy Union Choices (Energy Union Choices, 2017) report confirms this result. Natural gas-based electricity generation will dramatically decline by 2030 even with large shares of coal retiring. Due to the better grids and flexible demand, system balancing can be achieved with demand side response measures at a lower cost than with natural gas turbines, the role of natural gas in the generation mix therefore declines over time. According to the report, “this demonstrates that a phase-out of coal and reduction in nuclear capacities does not necessarily imply a higher gas demand (and thus import dependency) for the power sector compared to today, as long as adequate policies and measures are put in place to facilitate the partial replacement of baseload generation by renewable power generation.”

[17] In the modelled scenarios, they are assumed to be built between 2016 and 2021, and are bringing alternative natural gas supply from the Shah Deniz II gas field to the region.

MYTH D5: Increased interconnectivity has mostly negative impacts

"The increased interconnection is designed by the EU countries which have difficulties to achieve their national RES target and want to use our resources to help them achieve it."

FACT:

Increased interconnectivity saves money, increases security of supply and helps to integrate RES.

Increased electricity connection has advantages not only to countries which have difficulties in achieving their RES target, but to all countries. Increased interconnectivity allows for achieving higher shares of renewable energy in those countries which have a high intermittent renewable potential as geographic smoothing effects on the supply side and complementarities in electricity systems make balancing supply and demand easier and less costly on a European level. For example, Redl (2018) claims that investing more in interconnectivity rather than storage in flexible energy systems is cheaper.

A study of the European Climate Foundation found that a more interconnected European market would lead to increased system efficiencies that could help to achieve even a total cost saving of 426 billion EUR by 2030 in the EU. At a ratio of one to two, the smaller part of the saving potential comes from capital investment costs, the bigger comes from reduced operational costs as well as fuel costs. European market integration presents opportunities for countries of the SEE region. Power systems that are better interconnected make cost savings possible from lower capital investment needs for generation as well as from reduced operational costs connected to better system optimization. (Bergamaschi & Gaventa, 2014). The SEERMAP study also showed that if countries would like to ensure that domestic generation capacity is adequate to satisfy demand in all hours of all years rather than relying on imports in certain high demand/low supply hours, then the additional cost of investing in the necessary balancing capacity can be prohibitively high in some countries. (see myth D1)

INSIGHTS FROM MONTENEGRO:

Increasing interconnections, including Italy, will enable Montenegro to export surplus (renewable) energy and provide higher energy security for Montenegro. Interconnection with neighbouring countries will therefore help to support the planned wind capacity expansion: "the new 400 kV interconnection to Serbia to the planned pump storage plant Bistrica will also provide the country with additional balancing capacities for its planned wind expansion" (Tuerk et al., 2015). In general, increased interconnection will help Western Balkans countries to integrate their energy markets, diversify their energy sources and resolve their energy isolation.

Increased interconnectivity may also have a down side in the specific case of Montenegro. The Montenegro-Italy undersea cable is indeed not necessarily advantageous in terms of its impact on energy poverty, as it is expected to result in an increase in wholesale electricity prices in Montenegro due to the significantly higher wholesale prices in Italy.

MYTH D6: Market coupling will result in revenue losses

"Market coupling would lead to loss of revenue from selling NTC."

FACT:

The price of transmission capacity is included in the implicit auctions.

Market coupling implies that the auctioning of transmission capacity is implicitly included in the auctions of electrical energy in the market. Market coupling results in lower transaction costs as a whole as the separate auctioning of interconnector capacity is avoided and only power is traded.

Market coupling has several additional advantages. It can increase transparency through automated allocation of interconnector capacity. It can contribute to decreasing market power of a particular TSO to manipulate the market by restricting NTC and thereby protecting its market from competition, which is advantageous to domestic suppliers, but this is at the detriment of consumers as it results in higher electricity prices.

The lowering of both transaction costs and abuse of market power results in a more efficient market with lower electricity prices.

The supply security issues in myth D.1. demonstrate the importance of regional markets and interconnections as a way of reducing costs in the 'delayed' scenario.

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