MASTER THESIS

Perspectives for Renewable Energies in selected Contracting Parties of the Energy Community

executed to obtain the academic degree of a graduate engineer under the direction of

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List of Abbreviations

AKBN	National Agency of Natural Resources of Albania
ANRE	National Energy Regulatory Agency of Moldova
CCGT	Combined Cycle Gas Turbine
CEER	Council of European Energy Regulators
CHP	Combined Heat and Power Plant
CP	Contracting Party
DH	District Heating
EBRD	European Bank for Reconstruction and Development
EC	European Commission
EnC	Energy Community
EPBD	Energy Performance of the Buildings Directive
EU	European Union
EUROSTAT	European Statistical Office
FEC	Final Energy Consumption
FIP	Feed in Premium
FIT	Feed in Tariff
GFEC	Gross Final Energy Consumption
HPP	Hydropower Plant
H&C	Heating and Cooling
IEA	International Energy Agency
IRENA	International Renewable Energy Agency
LCOE	Levelised Cost of Electricity
LPG	Liquid Petrol Gas
MEI	Ministry of Energy and Industry of Albania
MoSEFF	Moldovan Sustainable Energy Financing Facility
NREAP	National Renewable Energy Action Plan
PPA	Power Purchase Agreement
P-PPA	Preliminary Power Purchase Agreement
RE	Renewable Energy
RED	Renewable Energy Directive
RES	Renewable Energy Source
RES-E	Renewable Energy Source in Electricity
RES-H&C	Renewable Energy Source in Heating & Cooling
RES-T	Renewable Energy Source in Transport
SHPP	Small Hydropower plant
SHW	Solar Heated Water
SLED	Support for Low-Emission Development in South-Eastern Europe
TPES	Total Primary Energy Supply
USA	Unites States of America
WACC	Weighted Average Cost of Capital

Abstract

The goal of this thesis is to analyse the renewable energy progress of selected Contracting Parties (CP) of the Energy Community, namely Albania, Moldova and Serbia, up to 2020. This progress has been researched in three sectors: electricity, heating & cooling, transport. The analysis builds on a literature research and a comparison of indicative data, published in CPs National Renewable Energy Action Plans (NREAP), with actual data, published by EUROSTAT and IRENA. Based on the above, an outlook about expected future renewable energy progress of each selected CP is conducted.

There is a relationship between the consumption of renewable energy and the energy price which has been compared for each selected CP exemplarily in the electricity sector. The results show that the cheapest technologies have more electricity capacities in each selected CP.

The progress concerning the policy framework was investigated in each CPs and all sectors. The results of this work show that all CPs have some similar problems to reach their indicative targets. However, due to their political structure and available renewable energy sources, assessed solutions are different in each other. Albania has sufficient renewable energy progress in the electricity sector. After a revision of statistical data for the energy consumption of biomass, Moldova had achieved sufficient renewable energy progress in the heating & cooling sector. Although Serbia has sufficient renewable energy potentials, it has not yet reached any indicative renewable energy target in any sector.

Kurzfassung

Ziel dieser Arbeit ist es, den Fortschritt der erneuerbaren Energien in ausgewählten Vertragsparteien der Energiegemeinschaft (CP), nämlich in Albanien, Moldawien und Serbien, bis 2020 zu analysieren. Dieser Fortschritt wurde in drei Sektoren untersucht: Strom, Wärme und Kälte sowie Verkehr. Um den Fortschritt der erneuerbaren Energien bis 2020 zu analysieren, wurden Literaturrecherchen und ein Vergleich der indikativen Ausbaupfade für erneuerbare Energien, veröffentlicht in den nationalen Aktionsplänen für erneuerbare Energien der untersuchten Länder, mit den tatsächlichen statischen Daten, veröffentlicht von EUROSTAT und IRENA, durchgeführt. Tatsächliche Daten und indikative Pfade wurden verglichen, um einen Ausblick auf den erzielten Fortschritt zum Ausbau erneuerbaren Energien in jedem der ausgewählten Länder zu erhalten.

Es besteht ein Zusammenhang zwischen dem Verbrauch erneuerbarer Energien und dem Energiepreis, der für jedes untersuchte Land beispielhaft im Elektrizitätssektor verglichen wurde. Die Ergebnisse zeigen, dass die billigsten erneubaren Technologien in jedem der untersuchten Länder mehr installierte Leistung erreichen konnten.

Die Fortschritte in Bezug auf den politischen Rahmen wurden in jedem der untersuchten Länder jeweils in allen Sektoren untersucht. Die Ergebnisse dieser Arbeit zeigen, dass jedes Land ähnliche Probleme hat, um seine indikativen Ziele zu erreichen. Aufgrund ihrer politischen Struktur und der verfügbaren erneuerbaren Energiequellen unterscheiden sich die bewerteten Lösungen jedoch voneinander. Albanien hat im Elektrizitätssektor ausreichende Fortschritte bei erneuerbaren Energien erzielt. Nach der Überarbeitung der Biomasse-Datenerhebung verfügte Moldawien über einen ausreichenden Anteil erneuerbarer Energien im Wärmesektor. Serbien verfügt zwar über ausreichende Potenziale für erneuerbare Energien, hat jedoch in keinem Sektor ihr indikatives Ziel für erneuerbare Energien erreicht.

Acknowledgement

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1 Introduction

1.1 Motivation

The climate change in the world is influenced by human activities such as energy production, transport, industry and agriculture (European Council, 2020). According to the European Council, 2020, energy and transport sectors have a key role in global warming within 68% share of world greenhouse gas emission. Fossil energy is not a sustainable and environmentally friendly option to produce energy. Global warming crisis, reasons of energy security and the idea of depletion of fossil fuels in the years to come have led people to turn to renewable energy. To minimize the concerns about energy security and environment, there are still establishments and efforts needed.

The Energy Community (EnC) is an international organization established between the European Union (EU) and a number of third countries to extend the EU internal energy market to South-East Europe and beyond. With their participation, the Contracting Parties (CPs) commit themselves to implement the relevant EU energy acquis communautaire, to develop an adequate regulatory framework and to liberalize their energy markets in line with the acquis under the Treaty. The EnC Treaty was signed in October 2005 in Athens to implement the objectives and establish an integrated energy market in Europe to provide energy market unity among the EU countries and its neighbours. It also aims for optimizing energy use, fostering the uptake of renewable energies and increasing energy efficiency across its geographical scope. Therefore, South-East European Countries as EU candidate countries have joined this group to regulate their energy markets as Contracting Parties (CPs). The European Parliament approved the treaty on 29 May 2006. According to EnC Treaty, Parties of the EnC are the European Union and 9 CPs. These CPs are respectively Albania, Bosnia & Herzegovina, Kosovo*, North Macedonia, Moldova, Montenegro, Serbia, Ukraine and Georgia[1] (EC, 2011).

The purpose of this thesis is to compare the progress of 2020 RES targets in each energy sector (electricity, transportation, heating and cooling - Chapter 1.2) of three selected CPs namely Albania, Moldova and Serbia, to assess how much they progressed in reality compared to their indicative targets and to make an outlook on future renewable energy source (RES) targets and developments. Figure 1.1.1 shows on the map EnC Member countries, CPs and observers[2].

[1] The deadline for Georgia's adoption was 31 December 2018. Georgia is not obliged to set a binding 2020.
[2] Observers are Turkey, Norway and Armenia. Observers may attend the institutional meetings of the EnC.

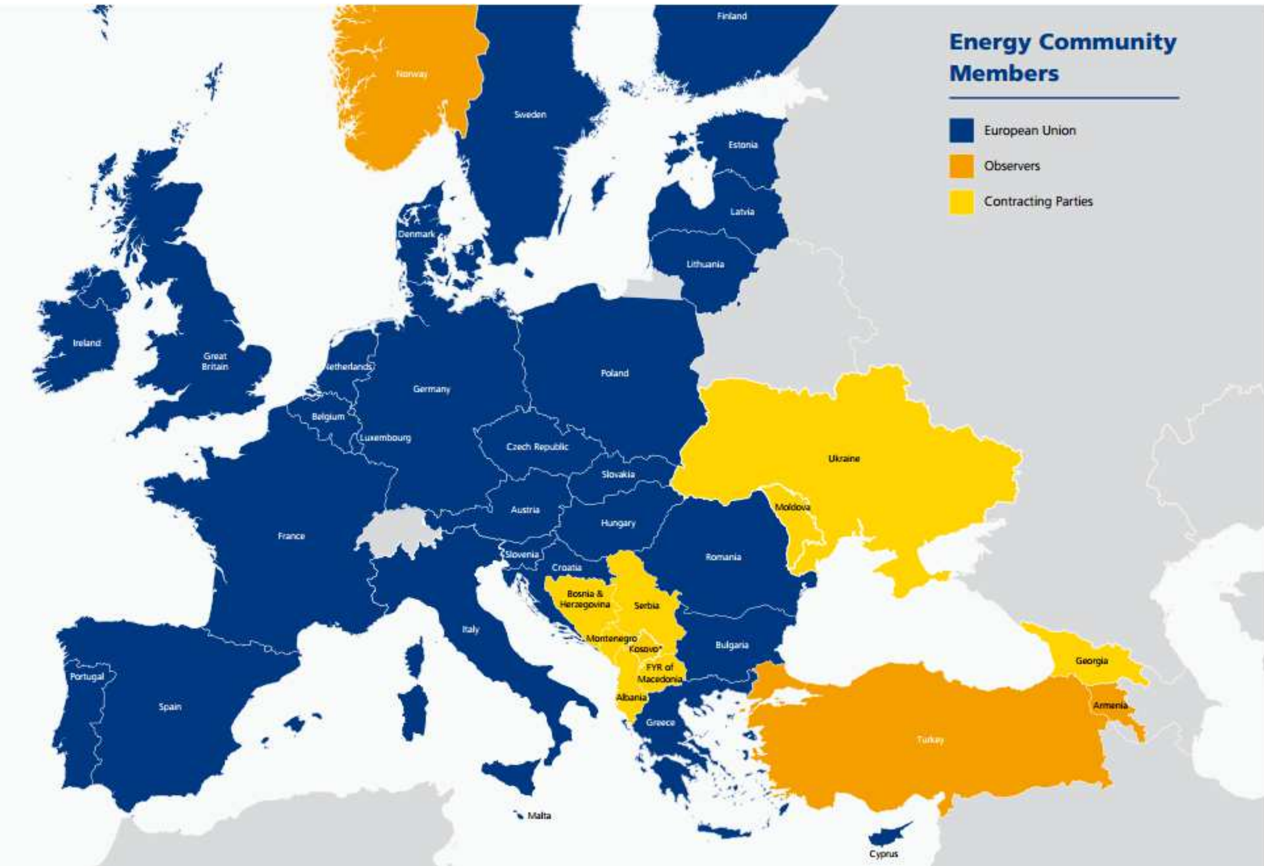

Figure 1.1.1 – Energy Community Countries, Source: EnC, 2018

1.2 Objective and Methodology

This thesis aims for providing a survey on 2020 RES targets and achieved progress to reach the given RES targets for 2020 and beyond for the assessed CPs of the Energy Community. The aim of the thesis is explained in four steps which are clarified below in this chapter.

The Ministerial Council of the EnC implemented Decision 2012/04/MC-EnC in 2012 according to the Renewable Energy Directive 2009/28/EC and amending Article 20. Article 20 referred to the other Articles as an obligation for the CPs to implement the Renewable Energy Directive. CPs have to implement Energy Directive under three main energy sectors:

1. Electricity
2. Heating & Cooling
3. Transportation

The following research topics shall be tackled within this thesis:

- Assessment of historical progress of RES in each sector
- Potential of renewable energy for the electricity sector

- Policy framework for RES
- Identification of recommendations on the way forward

Four steps are followed for seeking answers to the study questions:

Firstly, for the selected three CPs 2020 RES targets and their historical RES progress will be elucidated. The targets and the steps to achieve these targets in each sector are the selected CPs RES perspectives. The contribution of RES in gross final energy consumption (GFEC) will be documented for each sector.

Secondly, selected three CPs RES capacity and RES potentials will be documented since selected CPs start to implement EnC Directives.

Thirdly, the implementations of EnC Directives to the countries' policies are assessed. Three selected CPs annual reports for EnC and EUROSTAT data are used to find the developments on their progress.

Fourthly, the final assessments of achieved 2020 RES energy targets for each country and recommendations based on qualitative analysis to achieve 2020 RES energy targets will be conducted.

The methodology of this work is based on literature research, comparison of indicative data, which published in CPs National Renewable Energy Action Plans (NREAP) with actual data, which published by EUROSTAT and IRENA and explanation of these data, supported by graphical illustrations. With this methodology, the CPs actual RES deployments are compared with the indicative RES trajectories according to their NREAP. That aims to identify the CPs RES implementation performance. Cost-competitive RES potentials of CPs are estimated with the help of different RES technologies' Levelised Cost of Electricity (LCOE) comparisons. Data that are used in the thesis were obtained from related scientific articles and report of national and international organizations (like EUROSTAT, EnC, IRENA, related ministries of countries, etc.).

1.3 Structure of the Thesis

Chapter 2 begins with the information about RES limitation in EU. Subchapter 2.1 explains the term renewable energy perspective. Subchapter 2.2 has an overview of three selected CPs RES progress and their current status. Subchapter 2.3 explains the cost-competitive RES potentials. The subchapters 2.3.1 and 2.3.2 are utilized to make the subchapter 2.3 clear. The barriers against the RES progress are determined in the last subchapter 2.4.

All selected CPs renewable energy perspective in each energy sector is studied in chapter 3. Their 2020 indicative RES targets, current status, historical progress, RES potential, policy framework, assessed 2030 RES scenarios in the electricity sector and final RES assessment of the country are explained in subchapters of chapter 3.

Chapter 4 is the last chapter of the thesis and presents the key conclusion and findings of achieved RES progress and prospects for the assessed countries.

2 General Overview

Although fossil energy is a convenient type of fuel, for the time being, it is not useful in the future due to its contribution to the global warming crisis and because of concerns on security of fuel supply. Therefore, fossil-fuelled energy is often classified as unsustainable and many countries and regions have started attempts to replace it by renewable energy or other forms of sustainable energy supply or to increase energy efficiency.

Within Europe, the Energy Union has been established by the European Commission (EC) to coordinate energy and climate policy and energy supply within the European Union (EU) and neighbouring countries, i.e. the Contracting Parties (CPs) of the Energy Union. The aim is to provide consumers (households and businesses) secure, sustainable, competitive and affordable energy within an integrated continent-wide energy system where energy flows freely across borders (EC, 2015). EU countries and CPs are therefore developing renewable energy strategies, as the goal of energy policies of the Energy Union is to achieve the following.

- Energy security, solidarity and trust
- A fully integrated European energy market
- Energy efficiency contributing to moderation of demand
- Decarbonising the economy
- Research, innovation and competitiveness (EC, 2015)

Renewable energy sources are according to Directive 2009/28/EC energy from renewable non-fossil sources and can be classified as:

- wind,
- solar,
- aerothermal,
- geothermal,
- hydrothermal and ocean energy,
- hydropower,
- biomass,
- landfill gas,
- sewage treatment plant gas and biogases.

Wind, solar, hydropower and biomass appear of key relevance within the assessment undertaken within this thesis. The reason behind is that they are currently the most used renewable energy sources in each sector of the assessed three CPs (i.e. Albania, Moldova and Serbia) and that they predictably maintain the same role in the near future.

2.1 Perspectives of Renewable Energy within the Energy Union

In general, the substantial problems of the selected three CPs are technical and non-technical electricity losses due to their inadequate or outdated infrastructure of power plants/energy transmission lines, illegally electricity consumption and rising electricity demand (MEI, 2015; MME, 2017; IRENA, 2017, CASE, 2019). As a result of technical and non-technical electricity losses of the selected three CPs which is between 15-24% in 2014 according to World Bank (2019), the selected three CPs loose tremendous amount of their electrical energy. With the recent investments and legal arrangements, the CPs try to make their energy potentials more useable. At this point, the importance of renewable energy perspective is confirmed. Renewable energy perspective includes; RES priority, support, incentives to the RES systems over time and long-term plans to increase the RES share.

Although the types of energy that can be used by the countries and applied laws differ according to the political and geographical structures, the basic rules to be complied with are listed in the Energy Committee 2009/28/EC Directives. The most essential and the fundamental change that needs to be made is the establishment of day-ahead electricity markets within the CPs as a key step towards market liberalisation as established in EU countries Today the energy sector and markets are still controlled by state authorities in all CPs. However, this is not an easy transformation. Therefore, the policies, decisions and financing conditions are very important to improve RES deployment progress and streamline the RES development.

2.2 General Overview of Historical Progress and Current Status of all CPs

Ukraine was the largest electricity exporter, due to nuclear power plants and Bosnia and Herzegovina was the second largest electricity exporter in 2017 compared to all other CPs. On the other hand, net electricity importers were Albania, Georgia, Kosovo*, FYR of Macedonia, Moldova, Montenegro and Serbia in 2017 (IEA, 2020a). Considering the electricity transmission and distribution losses of countries up to 24% (World Bank, 2019), the first measures to be implemented are the renewal of transmission and distribution lines and the renewal of old power plants.

2017/2018 RES trajectories and 2020 RES national targets of CPs are shown in Table 2.2.1 (EUROSTAT, 2020). In Table 2.2.1, the second column indicates actual RES share in-between 2017-2018. Third and fourth columns indicate respectively RES trajectory in 2017/2018 and 2020 RES share target in GFEC. Fifth and sixth columns indicate the percentage difference between second-third columns and second-fourth columns respectively. Due to the lack of 2017-2018 data in Moldova, it has been replaced with data in 2013-2014 in Table 2.2.1. Percentage point (pp) shows the difference in percentage between indicative and actual RES share.

Only the 2017/2018 trajectories of Albania, Kosovo*, FYR of Macedonia, Montenegro and Serbia are declared. Due to Table 2.2.1, it is clear that Albania, Kosovo* and Montenegro have performed above their 2017/2018 overall RES trajectories and also Montenegro has exceeded its 2020 national RES target already. On the other hand, FYR of Macedonia and Serbia are far behind of not only their 2020 national RES targets but also their 2017/2018 overall RES trajectories.

Table 2.2.1 – Comparison of actual and RED indicative RES share trajectories with 2020 RES national targets each CPs, Source: EUROSTAT, 2020

The median RES share in gross final energy demand by 2017/2018	RES share as of EUROSTAT	RED indicative trajectory (RED)		Percentage points [pp] deviation of the indicative trajectory (RED)	
Contracting Party	Actual Median 2017/2018	Indicative Median 2017/2018	2020 Target	Median 2017/2018	2020 Target
Albania	34.7%	35.6%	38.0%	0.9%	-3.3%
Bosnia & Herzegovina	n.a.	37.9%	40.0%	n.a.	n.a.
Georgia	n.a.	n.a.	n.a.[3]	n.a.	n.a.
Kosovo*	24.0%	22.9%	25.0%	1.1%	-1.0%
FYR of Macedonia	18.8%	21.3%	23.0%	-2.5%	-4.2%
Moldova	n.a.	15.2%	17.0%	n.a.	n.a.
Montenegro	39.2%	30.7%	33.0%	8.5%	6.2%
Serbia	20.3%	25.0%	27.0%	-4.7%	-6.7%
Ukraine	n.a.	9.1%	11.0%	n.a.	n.a.

RES implementation ratios[4] of CPs are demonstrated in Figure 2.2.1 by EnC (2018). Montenegro has the highest implementation ratio for electricity and also the highest overall score in 2018. The last member of EnC Georgia has the lowest implementation ratio in each area and also the lowest overall score in 2018.

[3] The deadline for Georgia's adoption was 31 December 2018. Georgia is not obliged to set a binding 2020 RES target.

[4] 37 key implementation indicators are used to calculate implementation ratios by the EnC Secretariat. As it has been described in EnC (2018), "the implementation indicators are based on a methodology quantifying the CPs success in transposing and implementing the acquis and having in place effective institutions. It is based on standardised assumptions and evaluations, cases under the Energy Community's dispute settlement mechanism, country missions, review of legislation, market analysis, expert interviews and desk research" (Page 197).

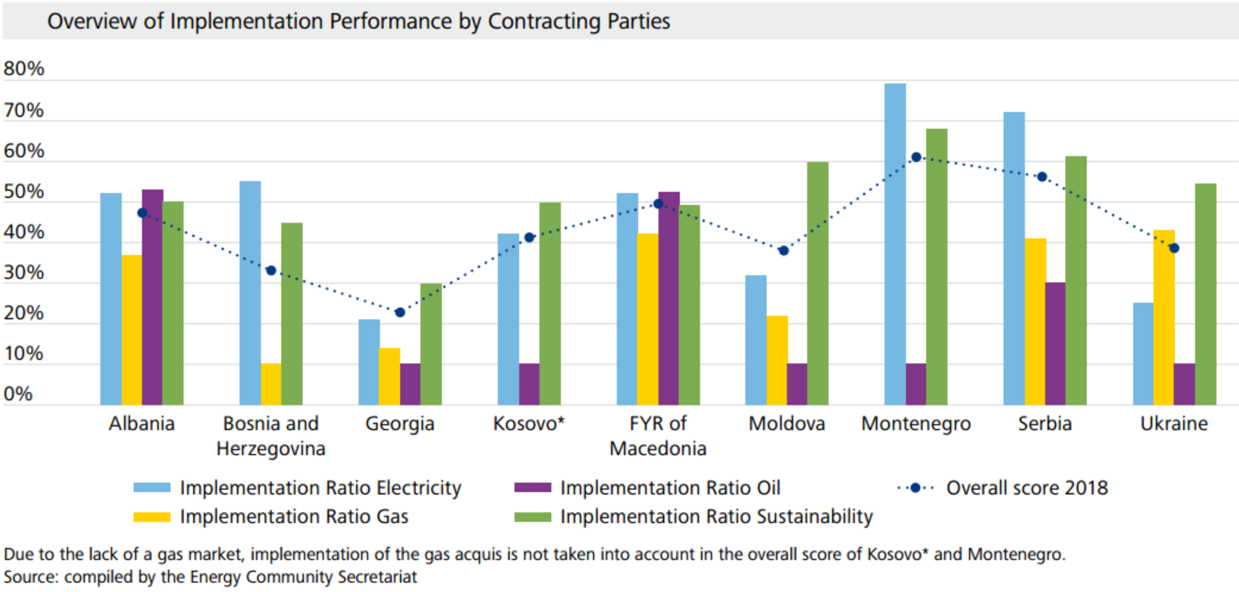

Figure 2.2.1 – Overview of Implementation Performance by CPs, Source: EnC, 2018

Figure 2.2.2 shows the total primary energy supply (TPES) of all CPs by source. Table 2.2.2 shows the detailed TPES of all CPs by source and it indicates TPES per capita. Figure 2.2.2 and Table 2.2.2 help to understand CPs primary energy supply by sources and energy supply per capita.

Fossil fuels hold still the highest share in total primary energy supply as shown in Figure 2.2.2. On the other hand, renewable energy sources have a lower ratio compared to other energy supply sources. There is a significant gap between fossil and renewable energy ratios. A closer look at RES indicates that solid biofuels, waste and hydropower constitute together 97.8% of the primary renewable energy supply in Table 2.2.2. The total percentage of biofuels & waste in total RES supply is 65% in all CPs.

If we compare the CPs by TPES, Ukraine has the highest and Montenegro has the lowest TPES due to the large differences in population and country size across CPs. However, if we compare the CPs by TPES per capita, Serbia has the highest supply per capita and Albania has the lowest supply per capita.

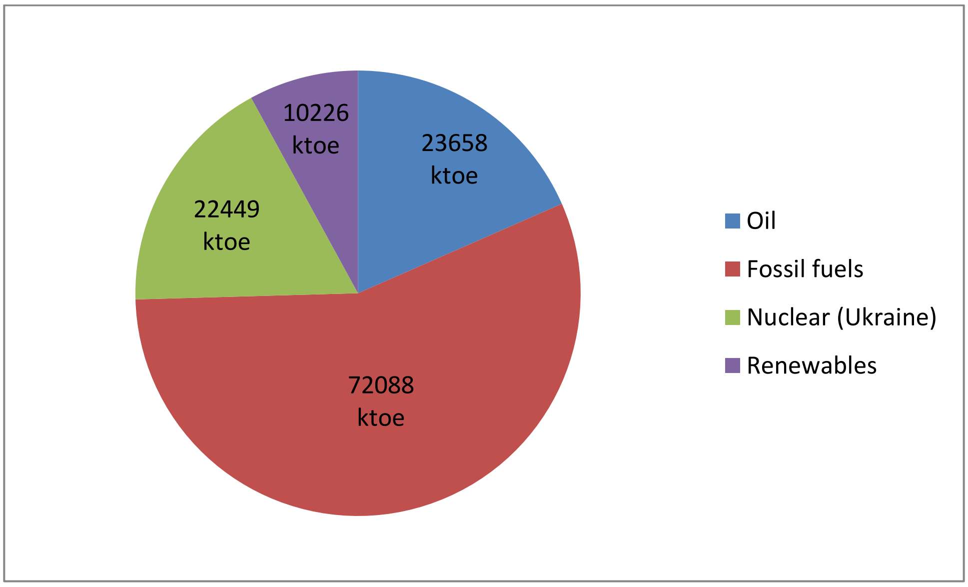

Figure 2.2.2 - Total primary energy supply (TPES) of all CPs by sources in 2017, Source: IEA, 2020b

Table 2.2.2 - Detailed total primary energy supply (TPES) of all CPs by sources in 2017, Source: IEA, 2020b

Total primary energy supply (TPES)[ktoe]/Country	Oil	Hydro	Biofuels & waste	Coal	Natural gas	Wind, solar, etc.	Nuclear	TPES per capita
Albania	1304	389	243	116	37	13	-	0.8
Bosna & Herzegovina	1720	343	464	4189	200	2	-	1.9
Georgia	1303	792	363	292	1959	28	-	1.3
Kosovo*	733	15	371	1418	-	-	-	1.4
FYR of Macedonia	1012	95	233	968	226	17	-	1.3
Moldova	888	25	762	101	1976	1	-	1.1
Montenegro	340	88	181	304	-	9	-	1.6
Serbia	3662	787	1087	7874	2117	11	-	2.2
Ukarine	12696	769	2989	25757	24554	149	22449	2.0
Total	23658	3303	6693	41019	31069	230	22449	

Actual overall RES shares of all CPs in 2016 according to EnC (2018) are shown in Figure 2.2.3. As can be seen therein with 41.5% Montenegro has the highest overall RES share in all CPs. On the other hand with 5.5%, Ukraine has the lowest overall RES share in all CPs. Georgia is excluded from Figure 2.2.3 because it is the newest member of EnC (since 2017) and their annual reports and further information are not declared. Albania has the second-best ratio due to its rich hydropower energy sources.

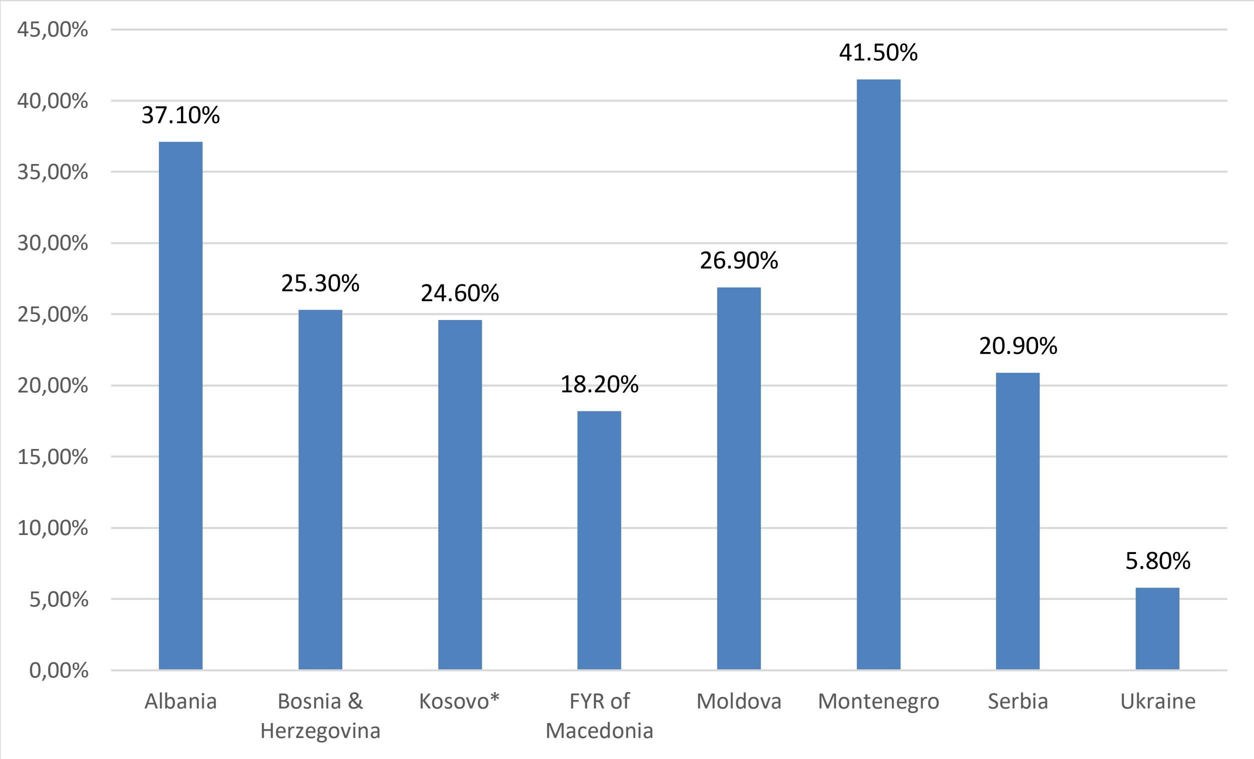

Figure 2.2.3 – RES share of all CPs in GFEC in 2016, Source: EnC, 2018

2.3 Cost-Competitive Renewable Energy Potential

A comparison between the cost of electricity generation for RES and fossil fuel supply (coal, gas, lignite) is needed to establish the cost-competitive RES potential. RES potential is, from today's perspective (as of 2017), considered cost-competitive only if its Levelised Cost of Electricity (LCOE) is the same or lower than the most efficient fossil fuel option which is the Combined Cycle Gas Turbine (CCGT) technology with the lowest LCOE 90€/MWh (including the CO_2 price) according to IRENA (2017).

2.3.1 Levelised Cost of Electricity (LCOE)

LCOE is a measure of the average net present cost of electricity generation for a generating plant over its lifetime which is calculated by the formula below.

$$LCOE = \frac{Lifetime\ Costs}{Energy\ Generation}$$

LCOE consist of three main components which can be calculated by the following formulas (Monnin, 2015):

- Capital costs (the costs of repaying the initial investment cost to build the plant) ($LCOE_K$)

$$LCOE_K = \frac{K * CRF}{8760 * CF}$$

K = Initial investment

CRF = Capital recovery factor

8760 = Hours in 1 year

CF = Capacity factor

$$CRF = \frac{r(1+r)^N}{(1+r)^N - 1}$$

r = Interest rate over the N

N = lifetime of the power plant

- Operation and maintenance costs (the non-fuel costs of running and maintaining the plant) ($LCOE_{OM}$)

$$LCOE_{OM} = \frac{FC_{OM}}{8760 * CF} + VC_{OM}$$

FC_{OM} = Annual fixed costs of power plant

VC_{OM} = Annual variable costs of power plant per kWh

- Fuel costs (the costs of fuel to produce power) ($LCOE_F$)

$$LCOE_F = P_F * HR$$

P_F = Price of fuel per million British Thermal Unit (MMBtu)

HR = Heat rate

$$LCOE = LCOE_K + LCOE_{OM} + LCOE_F$$

We also need to take into consideration that the LCOE calculation of RES lacks the fuel cost except for the biomass- and biofuel-based technologies. Furthermore, the total costs of biomass power generation technologies differ by technology and country according to IRENA (2017).

Cost-competitive solar photovoltaic (PV) / wind potential figures (Potential/LCOE figures) in each of the assessed CPs as shown in chapter 3 (i.e. c.f. Figure 3.1.11, Figure 3.1.12, Figure 3.2.10, Figure 3.2.11, Figure 3.3.11 and Figure 3.3.12) have green and red vertical lines. The green vertical line indicates the LCOE values of fossil generation including CO_2 and the red one without CO_2 price in cost-competitive RES potential figures in sections 3.1.2.3, 3.2.2.3 and 3.3.2.3.

2.3.2 Weighted Average Cost of Capital (WACC)

WACC is the average cost of financing the investment which is weighted proportionally. It is a calculation to know how much interest the investor owes for each euro it finances (Investopedia, 2019). WACC is the most important input parameter to calculate LCOE (apart from location). For instance, increasing nominal WACC from 2 to 10% doubles the LCOE (Vartiainen, 2019). WACC is calculated according to the formula below (Luçi et al., 2016):

$$WACC = W_E.K_E + (1 - t).W_D.K_D$$

W_E = the weight of equity in the company's total capital

W_D = the weight of the debt component in the company's capital structure

K_E = the discount rate of the capital of the company

K_D = the cost of debt for the company

t = the rate of income tax to businesses

According to IRENA (2017), WACC rate for non-EU countries varies between 8% to 12%. In this case, 8% represents the best, 10% the middle and 12% the worst WACC scenario.

Please note that as explained in section 2.3.2, LCOE of assessed RES technologies is shown for three Weighted Average Cost of Capital (WACC) scenarios in the corresponding figures. According to WACC scenarios, the lowest WACC scenario is the most suitable for RES which has the lowest LCOE value. Contrarily, the highest WACC scenario is the least suitable for RES which has the highest LCOE value. If not stated otherwise, the middle WACC scenario is used when cost-competitive potentials are compared to CCGT with the given CO_2 price (90€/MWh) (IRENA, 2017).

2.4 Barriers

The RES deployment barriers can be classified under economical, technical, social and regulatory barriers (Seetharaman et al., 2019).

Unstable economies and lack of legal sanctions to enforce the laws result in doubt in RES support by the banks. Due to high-risk perceptions and difficult access to the capital, capital costs in non-EU countries are higher than capital costs in EU countries. Another economical barrier is that if external costs are not considered RES is more expensive than fossil fuels. Most important from an economic perspective is however that wholesale electricity prices, reflecting the operating cost of the existing (excessive) power plant stock, are at a comparatively low-level today. This makes investments in any new generation facility in the electricity sector highly unattractive. There is consequently a need for financial support to overcome this barrier, and to bring RES into the market (Bachhiesl, 2004; Seetharaman et al., 2019).

In addition to the above, RES such as wind or solar cannot be stored – their availability depends on weather conditions and consequently fluctuates over time. That means the availability of the energy source is an obstacle to generate electricity when needed. The uncertainty of availability leads to complication of network management (Bachhiesl, 2004). On the other hand, fossil fuels can be stored, transported and transformed/used when energy is needed (Seetharaman et al., 2019).

Moreover, as a non-technical issue acceptance of new energy technologies and utilization rate is a social barrier.

Lack of legal sanctions to enforce the laws, insufficient amount of budget for RES deployment, complex bureaucratic progress and unclear standards and certificates for new technologies can be classified under regulatory barriers (Seetharaman et al., 2019).

Furthermore, the lack of sufficient interaction between research institutes and commercial institutions is still an obstacle. To make innovations and overcome the problem of knowledge transfer into real-life applications financial support is essential. Even though the innovative character of these research projects is associated with high risks, they should be supported by investors or government. (Bachhiesl, 2004).

3 Analysis of CPs

In chapter 3, the historical RES progress in each energy sector and current status of selected three CPs, namely in Albania, Moldova and Serbia, are reviewed. To make an outlook for RES potential in the electricity sector, not only the cost-competitive RES potential in each of the selected three CPs but also LCOE for each RES technologies[5] are assessed. Moreover, policy framework development in each sector is reviewed in the selected CPs. In this chapter, investments in the selected three CPs, boundaries of investments and energy sector related policies are investigated. In addition to that, prospects for RES in the electricity sector until 2030 is investigated with RES budget in the electricity sector up to 2030. At the end of the chapter, the overall assessments regarding each of the selected three CPs are presented.

2009 and 2020 data are used generally by NREAP of CPs. Data on recent progress are taken from EUROSTAT, Implementation Report of the EnC, IRENA and related scientific papers and reports.

[5] Solar PV and wind energy technologies are based on comparison of cost-competitive LCOE in this thesis due to mostly new planted RES technologies.

3.1 Albania

Albania has been a member of the EnC as a CP since 1 July 2006. According to Law No. 138/2013 "On Renewable Energy Sources", the preparation and approval of National Renewable Energy Action Plan (NREAP) of Albania has been obligated the establishment of 2020 targets and the providing relevant measures on renewable energy within EU Directives 2009/28/EC (that defines the RES framework until 2020). Albania is obliged to document plans for 2020 RES targets and progress in its NREAP, like the other CPs.

According to the Decision of the Council of Ministers of Energy Community 2012/04/MC-EnC, 38% of GFEC of Albania would be provided from Renewable Energy Sources (RESs) in 2020. To reach 38% RES usage in GFEC, 2020 national targets for renewable energy in each sector are (MEI, 2015):

- 82% RES share in the electricity sector (RES-E)
- 10% RES share in the transport sector (RES-T)
- 30% RES share in the heating and cooling sector (RES-H&C)

3.1.1 Assessment of Historical Progress of RES

According to MEI (2015), Albania has significantly high energy losses due to its distribution- and transmission grid for electricity and illegally electricity consumption. Albania has been receiving 100% of domestic electricity consumption from hydropower since 2012. While much of its electricity supply infrastructure is based on hydropower, it must still import an enormous amount of energy in some sectors (MEI, 2015; IEA, 2020b)

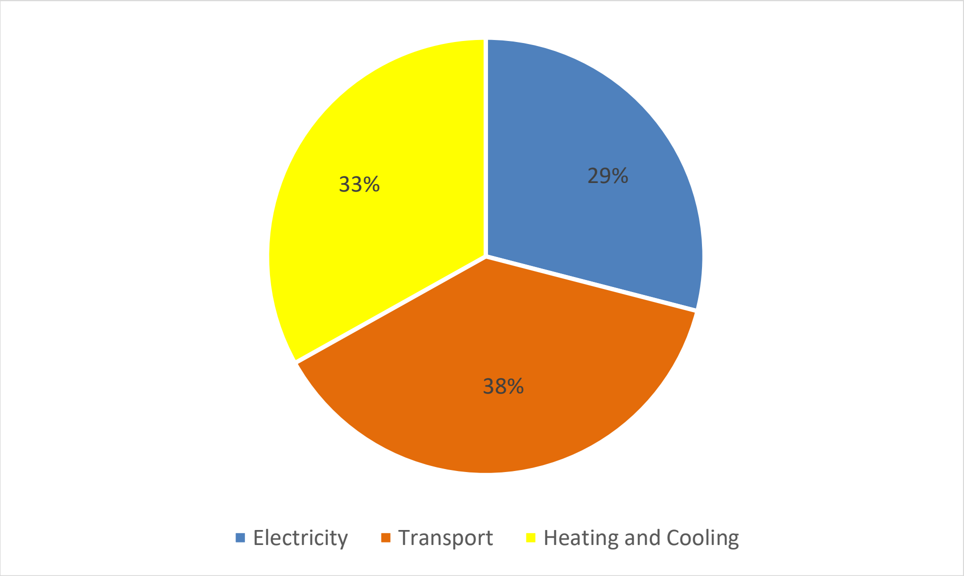

Figure 3.1.1 – Gross final energy consumption share in each sector of Albania in 2017, Source: EUROSTAT, 2019

The transport sector has the highest energy consumption percentage (38% of GFEC) in 2017, followed by heating and cooling (33%) and electricity (29%), as it has been described in Figure 3.1.1.

Table 3.1.1 and Figure 3.1.2 explain the RES share of each energy sector in GFEC in-between 2009 and 2017.

Table 3.1.1 – RES consumption share in each sector and GFEC of Albania between 2009 and 2017, Source: EUROSTAT, 2019

Renewable energy shares in	2009	2010	2011	2012	2013	2014	2015	2016	2017
Electricity Consumption [%]	70.71	74.62	66.13	72.43	62.67	70.98	79.22	85.97	90.68
Heating & Cooling Consumption [%]	34.37	31.26	31.43	39.10	37.77	30.98	34.55	33.83	24.87
Transportation Consumption [%]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gross Final Energy Consumption [%]	31.44	31.87	31.19	35.15	33.17	31.48	34.39	37.09	34.57

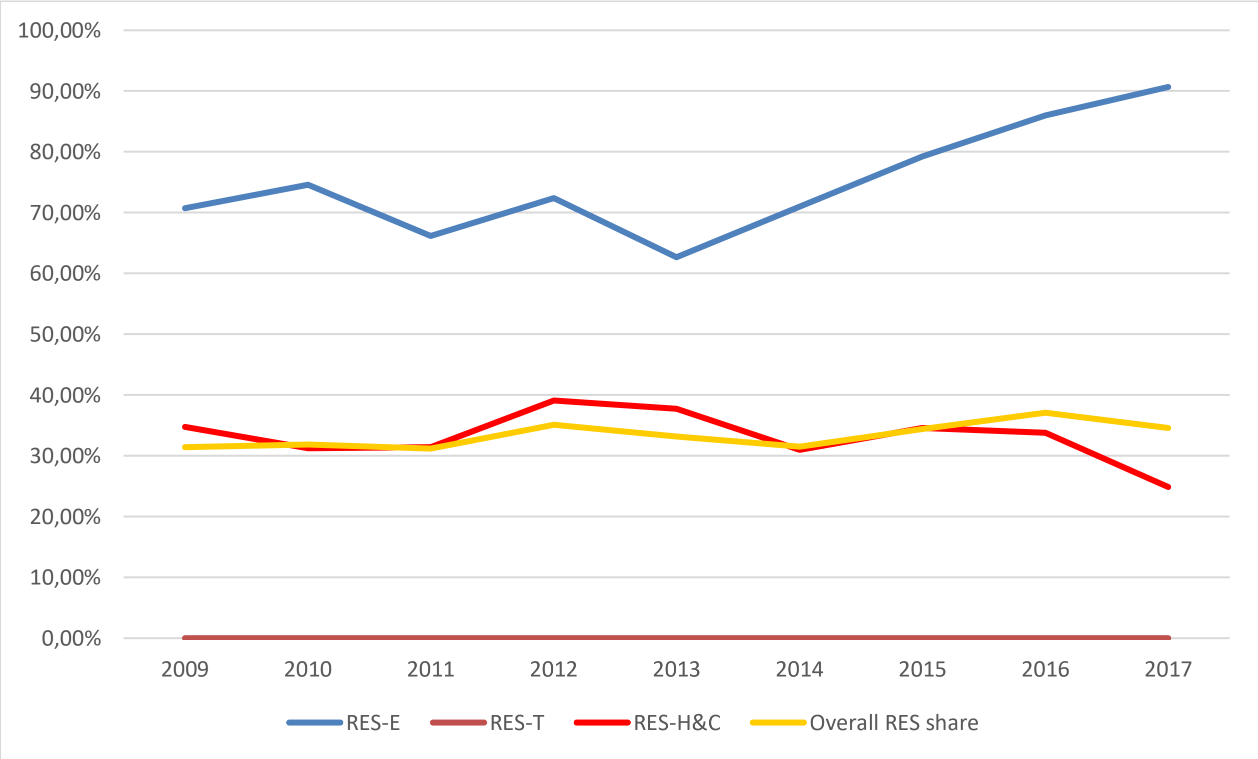

Figure 3.1.2 – Overall RES share progress and RES share progress in each sector of Albania between 2009 and 2017, Source: EUROSTAT, 2019

RES-E has always the significantly highest RES share in Albania. It has a stable increase since 2013 and RES-T has stable inertia since the Albania NREAP began. RES-H has, unfortunately, unstable progress.

Even though Albania has fluctuations in the overall RES share values, there has been a consistent incline which is predominantly over the interim targets for their overall RES share except for 2014 and 2017 (Figure 3.1.3). Despite that the RES-T share is 0%, Albania has a positive overall RES share progress due to the significantly higher than planned RES-E progress.

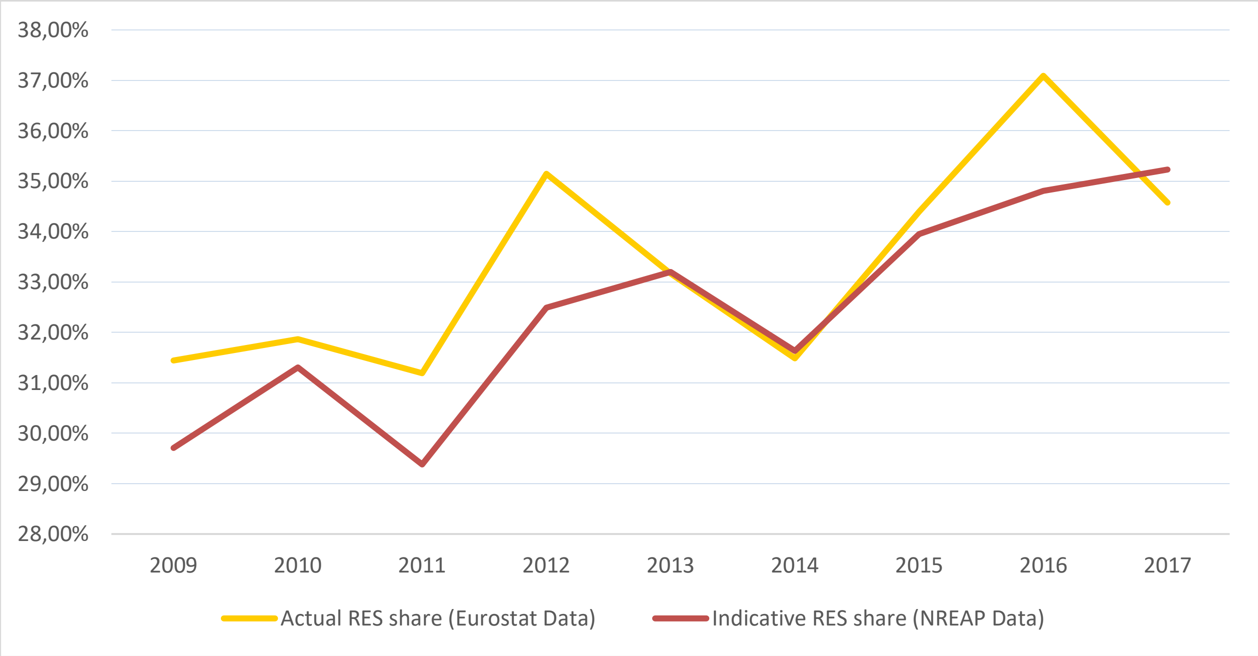

Figure 3.1.3 – Actual RES share and national RES objective share of Albania between 2009 and 2017, Source: EUROSTAT, 2019; MEI, 2015

Figure 3.1.4 shows the comparison between Albania's 2015/2016 actual overall RES trajectory, 2015/2016 indicative overall RES trajectory according to NREAP and 2020 overall RES target. The last two columns on the right side of the Figure 3.1.4 describe the difference between real progress and planned progress which shed light on the overall RES progress of Albania. The fourth column shows the deviation between the actual median 2015/2016 overall RES share of GFEC and indicative median 2015/2016 overall RES share of GFEC. According to Figure 3.1.4, Albania had 1.4 percentage points (pp) better overall RES share of GFEC progress than indicative overall RES share of GFEC progress. If we compare actual median 2015/2016 overall RES share of GFEC and 2020 overall RES target, it is obvious that the deviation between actual median 2015/2016 overall RES share of GFEC and 2020 overall RES target is -2.3 pp as it seems in the fifth column of Figure 3.1.4.

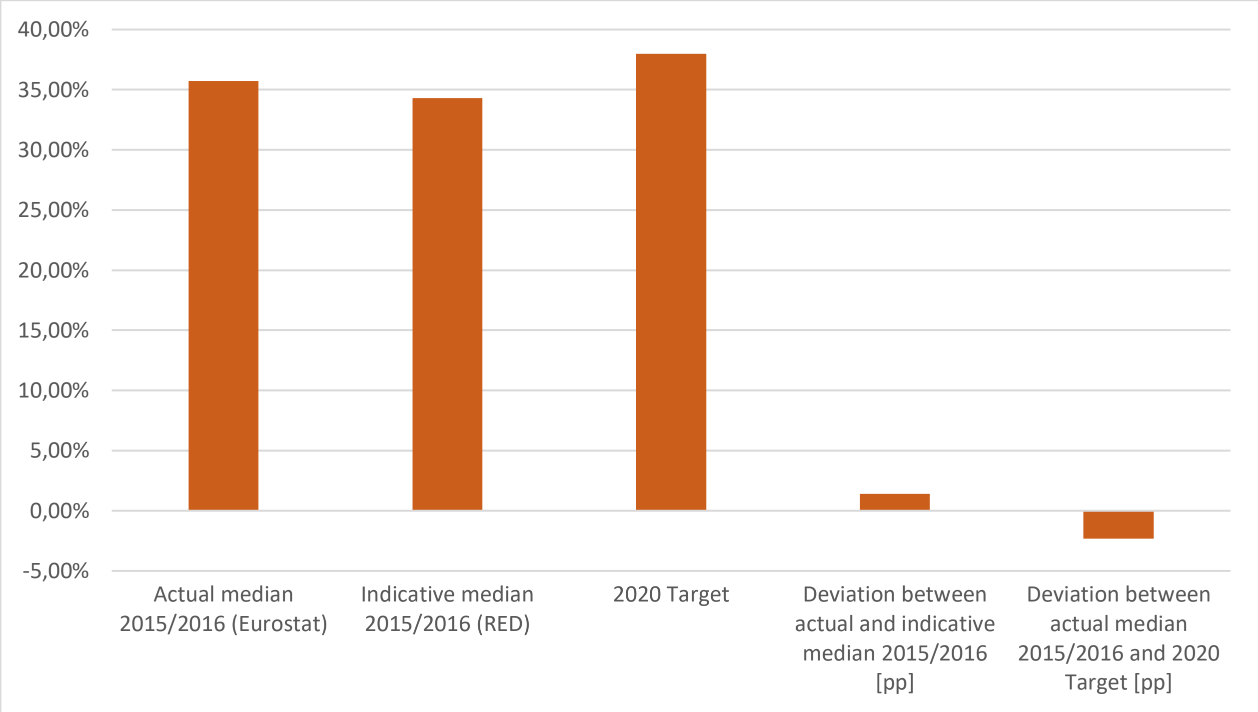

Figure 3.1.4 – Actual and indicative median 2015/2016 overall RES share of GFEC, 2020 overall RES share target and the deviation of the actual median 2015/2016 RES shares of GFEC from the renewable energy directive (RED), indicative median 2015/2016 and 2020 NREAP RES target in percentage points of Albania, Source: EUROSTAT, 2018; MEI, 2015

3.1.1.1 Electricity

The total installed electricity capacity is approximately 1.8 GW in Albania (MEI, 2016). Electricity generation from three large hydropower plants (HPPs) on the Drin River corresponds to 88% of the country's total electricity generation capacity (Tuerk et al., 2013). As it is shown in Figure 3.1.5, HPPs and small HPPs (SHPPs) (which both sum up to 2.047 MW) correspond to more than 99.9% of the total capacity of RES-based power plants in the electricity sector.

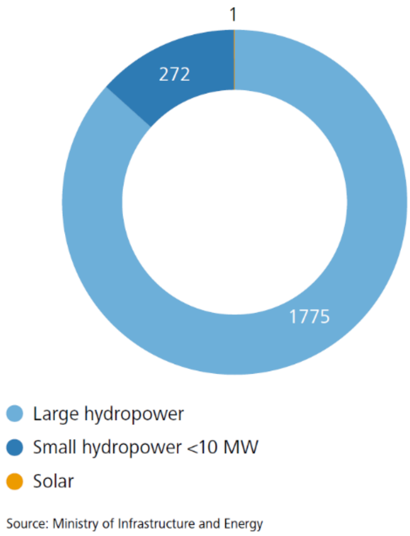

Figure 3.1.5 – Total capacity of RES-E in Albania (2017) [MW], Source: EnC, 2018

Figure 3.1.6 shows electricity generation from RES and total electricity consumption between 2009 and 2017 in Albania. RES-E has a consistent increase between 2009 and 2017. Decline in electricity consumption in 2017 and incline in electricity production from RES explains the 90% RES-E share. In addition to that, Albania has a RES-E share higher than the average of the EU-Zone.

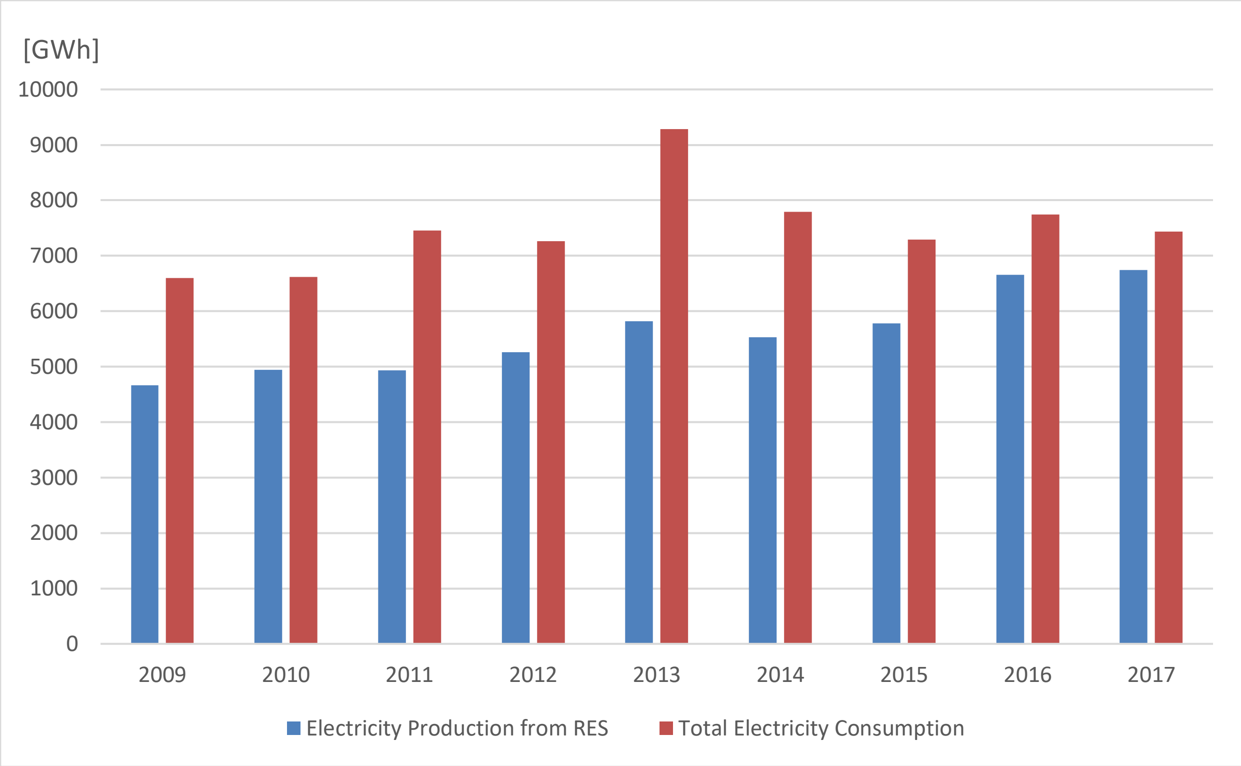

Figure 3.1.6 – Total electricity consumption and electricity generation from RES in Albania between 2009 and 2017 [GWh], Source: EUROSTAT, 2019

3.1.1.2 Transport

Although the 2020 RES share target of Albania in the transport sector is 10%, its share in 2017 was still 0%. According to Figure 3.1.7, although the RES share target would be 3% due to the Biodiesel Law between 2010 and 2014, the real contribution of RES in transport was still 0% in 2012. The forecasted contribution of RES-T was approximately 6% for 2017. Even the transport sector has the vast majority of consumption share in GFEC, as it is illustrated in Figure 3.1.2, the real contribution of RES-T is still 0% in Albania (Figure 3.1.8). According to IRENA (2017), without further investment or improvement, reaching the 2020 RES-T and overall RES target seem not feasible.

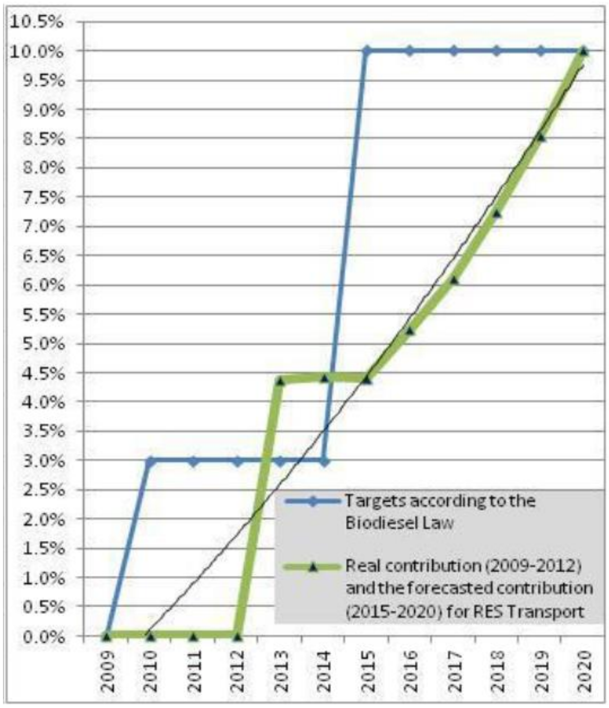

Figure 3.1.7 – Indicating objectives of RES which are used in transport pursuant to the requests of the law for bio-fuel and the objectives of RES-T of Albania, Source: MEI, 2015

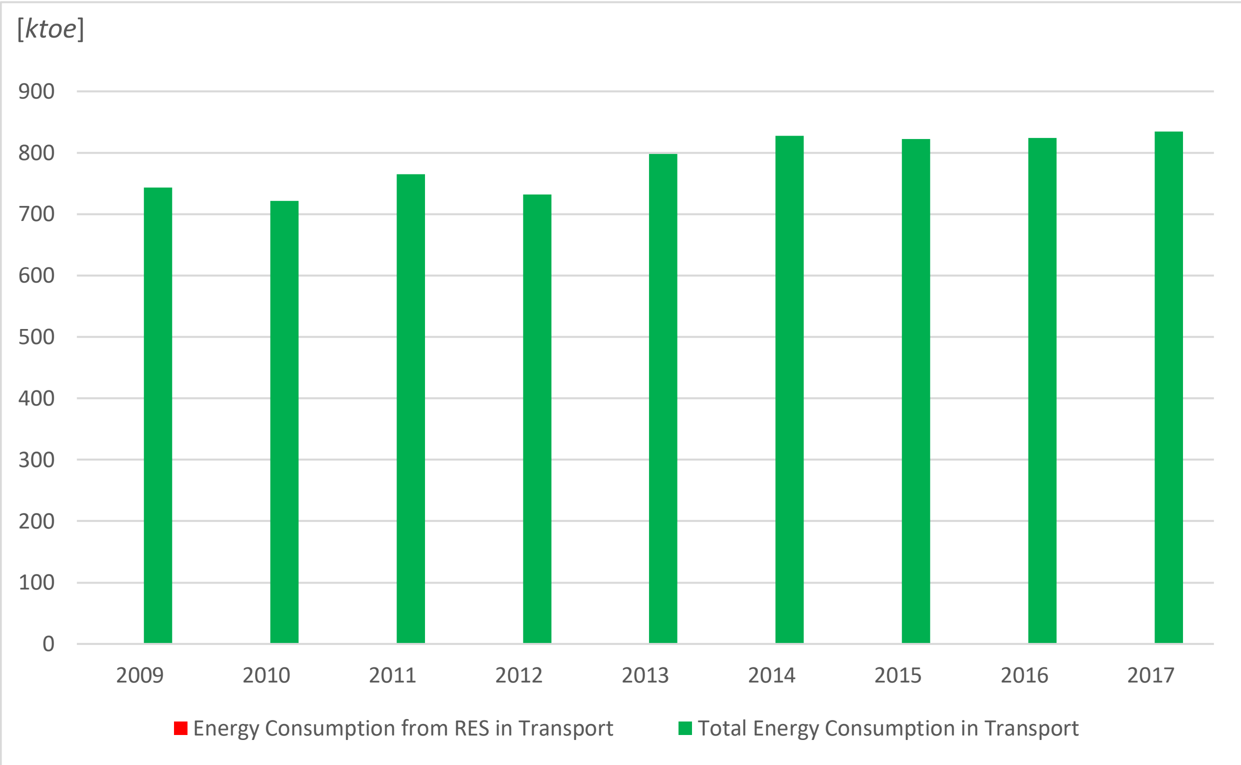

Figure 3.1.8 – Total energy consumption and energy consumption from RES in the transport sector of Albania between 2009-2017 [ktoe], Source: EUROSTAT, 2019

3.1.1.3 Heating and Cooling

In general, electricity, liquid petrol gas (LPG) and firewood are used for heating in Albania. According to data from National Agency of Natural Resources (AKBN), Albania provides 36.4% of energy for heating from electricity, 49.6% from wood, 12% from LPG and 2% from other sources (OeEB, 2015). Biomass plays an essential role in Albania in the heating and cooling (H&C) sector (mainly in the form of firewood). Due to its significantly lower price, firewood is mostly used for heating. Also, biogas is not a reliable option due to insufficient resources. Furthermore, the old H&C equipment has energy (heat) losses up to 40-50% and local systems are underdeveloped due to lack of efficient heating through the radiators according to Ministry of Energy and Industry of Albania (MEI) (MEI, 2015).

According to data by AKBN, Albania provides 62% of energy for hot water supply from electricity, 23% from wood, 10% from LPG and 5% from solar energy. Thereby, solid biomass and solar-heated water (SHW) count towards the RES contribution in H&C, from which electricity-driven supply is excluded to avoid double-counting.

Table 3.1.2 – Energy consumption and RES share in GFEC of Albania in the H&C sector between 2009 and 2017 [*ktoe*], Source: EUROSTAT, 2019

Energy Consumption in H&C/Year	2009	2010	2011	2012	2013	2014	2015	2016	2017
Solid Biomass [*ktoe*]	216.7	211.7	219.7	218.3	213.4	205.6	216.7	205.5	181.4
Total Energy Consumption in H&C [*ktoe*]	623.8	677.3	699.0	558.3	565.0	663.7	627.1	607.4	729.7
RES Share in Total H&C Demand [%]	34.73	31.26	31.43	39.10	37.77	30.98	34.55	33.83	24.87

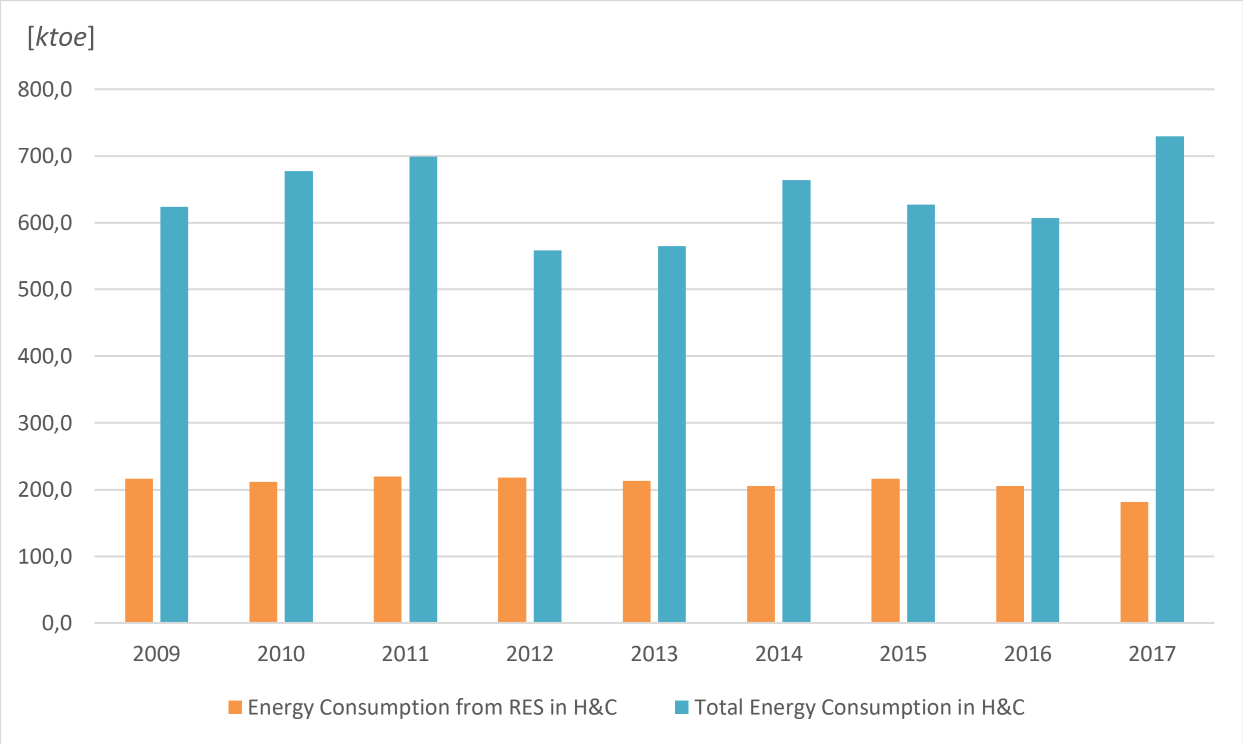

Figure 3.1.9 – Energy consumption from RES and total energy consumption in the H&C sector of Albania between 2009 and 2017 [*ktoe*], Source: EUROSTAT, 2019

In Figure 3.1.9, total energy consumption in the H&C sector and energy consumption from RES in H&C demonstrated below year by year (EUROSTAT, 2019).

3.1.2 Potential of Renewable Energy in the Electricity Sector

3.1.2.1 General Overview

To make an outlook for the potential of RES-E, technical and cost-competitive potentials should be considered. If the technical potential is not cost-competitive, investors do not tend to invest. In this case, cost-competitive potential has a key role for investors and also LCOE range and average LCOE in each RES technology give us information about cost-competitive price to compare the RES technologies.

LCOE ranges and weighted averages of renewable energy technologies in Albania are shown in Figure 3.1.10. As stated in the Figure 3.1.10, average LCOEs in 2016 are 100€/MWh for solar PV, 105€/MWh for wind, 55€/MWh for hydropower, 110€/MWh for biomass and 120€/MWh for geothermal energy technologies. The cheapest RES technology from today's perspective is hydropower and the most expensive one is geothermal energy due to the inefficiency of resources (IRENA, 2017).

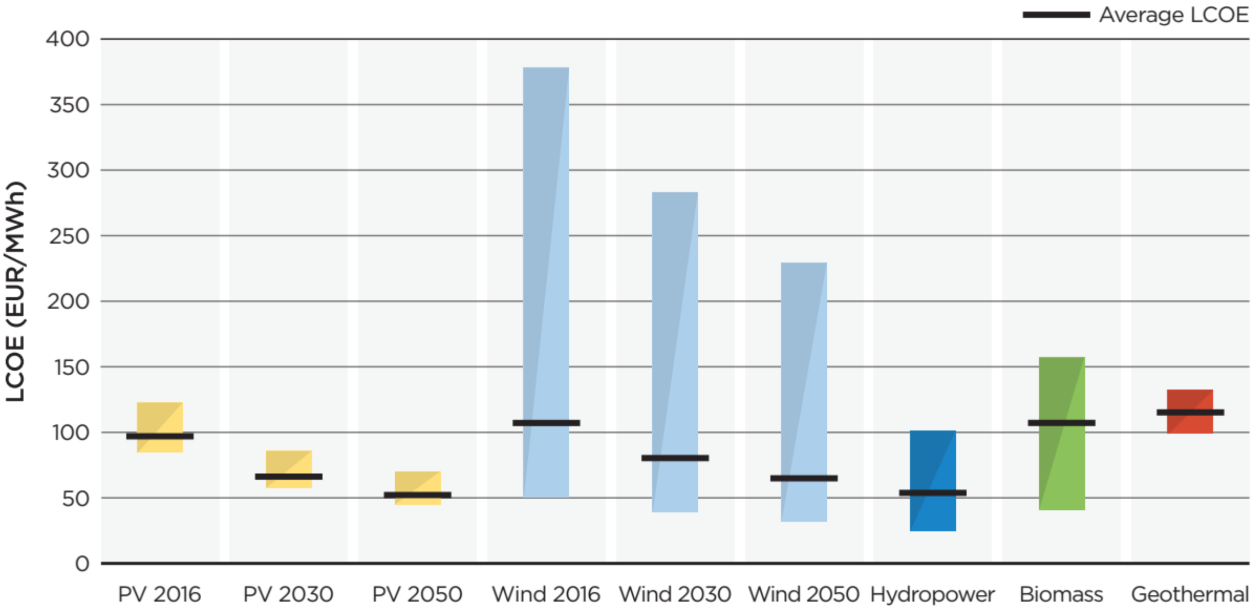

Figure 3.1.10 – LCOE ranges and weighted averages of renewable energy technologies (medium cost of capital) in Albania, Source: IRENA, 2017

Table 3.1.3 does not only show the electrical capacity in 2009 and 2015 but also electricity generation in 2015, 2020 RES capacity targets according to the NREAP, additional cost-competitive potential capacities in 2016, 2030 and 2050 and their corresponding electricity generation. Technical electricity capacity and electricity generation potentials are also expressed in this table. The low additional cost-competitive potentials correspond to the high cost of capital scenario whereas the high additional cost-competitive potentials refer to the low cost of capital scenario. As we can see in Table 3.1.3, the total cost-competitive potential is under both scenarios higher than the 2020 RES NREAP targets. As a result, according to IRENA (2017), Albania is capable of reaching its 2020 RES NREAP targets.

Table 3.1.3 – Capacity and energy potential for RES-based electricity in Albania, Source: IRENA, 2017

Technologies	2009	2015		2020 (NREAP)	Additional cost-competitive potential			Technical potential	
	MW	MW	GWh	MW		MW	GWh	MW	GWh
Solar PV	0.0	0.0	0.0	50.0	2016	0.0 - 1,917.6	0.0 – 3,001.1	2,378.2	3,706.3
					2030	2,378.2	3,706.3		
					2050	2,378.2	3,706.3		
Wind	0.0	0.0	0.0	30.0	2016	986.7 - 2,152.8	2,885.7 – 5,397.3	7,483.1	13,653.9
					2030	5,209.5 – 6,989.7	10,672.8 – 13,160.4		
					2050	7,238.1 – 7,414.1	13,437.3 – 13,604.6		
Hydro	1,488.0	1,797.0	4,916.2	2,324.0		2,169.0	7,033.7	4,813.0	15,572.0
≤ 10 MW	28.0	177.0	484.2	490.0		761.0	2,082.3	938.0	3,572.0
> 10 MW	1,460.0	1,620.0	4,432.0	1,834.0		1,408.0	4,980.8	3,875.0	12,000.0
Pumping	n.a	0.0	0.0	n.a		n.a	0.0	n.a	n.a
Biomass	0.0	0.0	0.0	5.0		83.3-788.0	504.0 – 4,989.0	1,832.0	11,195.0
Biogas	0.0	0.0	0.0	0.0		83.3-125.0	504.0 – 756.0	416.6	2,520.0
Solid Biomass	0.0	0.0	0.0	5.0		0.0 - 663.0	0.0 – 4,233.0	663.0	4,233.0
Biowaste	0.0	0.0	0.0	0.0		0.0	0.0	755.1	4,442.0
Geothermal el.	0.0	0.0	0.0	0.0		0.0 - 1.4	0.0 – 10.0	1.4	10.0
Total	1,488.0	1,797.0	4,916.2	2,409.0	2016	3,239.0 – 7,028.8	10,423.4 – 20,431.1	16,507.7	44,137.2

3.1.2.2 Hydropower

Albania has approximately 4.5 GW technical hydropower potential in total. However, only 35-40% is in use (MEI, 2015). In addition to 35-40% hydropower usage, there is still more than 2 GW cost-competitive hydropower potential. For instance, it is possible by using the rivers Drin and Vjosa and other smaller rivers. LCOE of hydropower in Albania is about 55€/MWh (Gordani, 2015). This is the cheapest renewable energy source in Albania. Because of this reason all regulations and concessions are mostly based on hydropower (Gordani, 2015; MEI, 2015; IRENA, 2017).

3.1.2.3 Solar PV and Wind

Moreover, the share of RES deployment in Albania could be increased by the enhanced use of wind and solar PV energy, which both have significant potential. These resources play an important role to reach the 2020 overall RES target. Moreover, they would increase the diversity of RES and sustainability in the electricity sector.

Figure 3.1.11 and Figure 3.1.12 demonstrate the respectively cost-competitive potential of solar PV and wind capacities. LCOE begins for solar PV technology above 70€/MWh and wind technology above 40€/MWh in the most suitable locations for both technologies. According to a study by E. Luçi et al. (2016), WACC in Albania is approximately 11%.

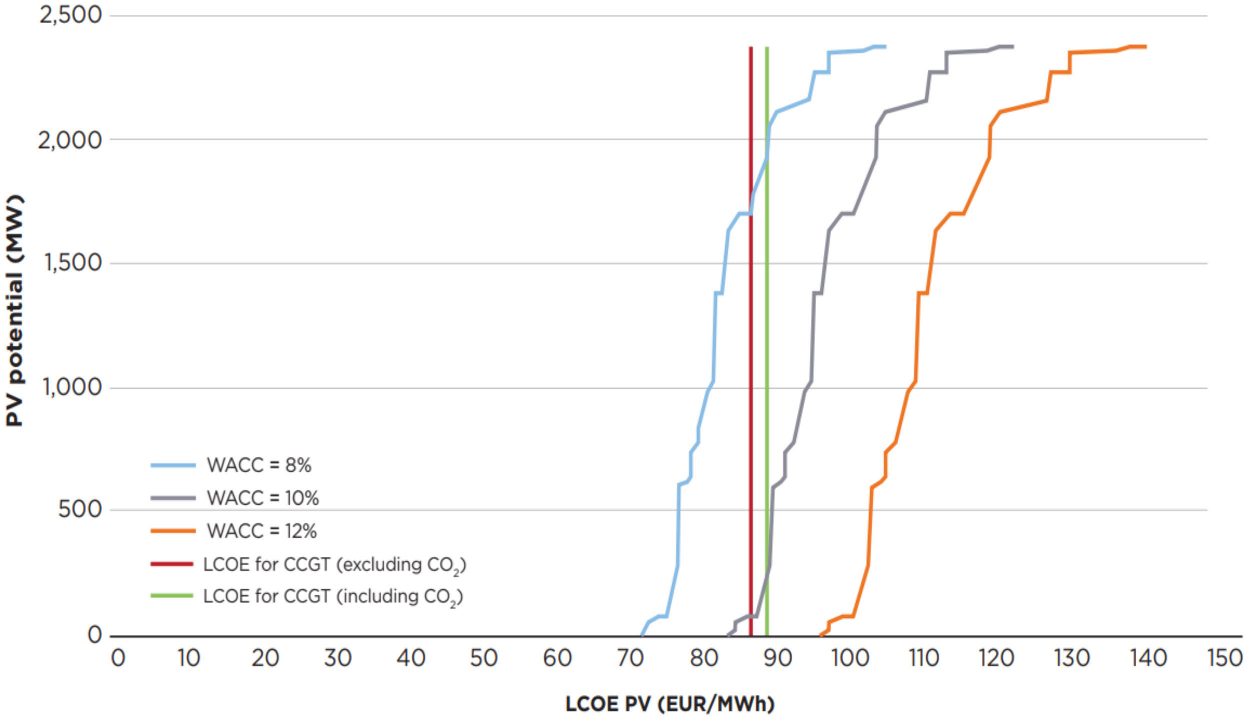

Figure 3.1.11 – Cost-competitive solar PV potential of Albania in 2016, Source: IRENA, 2017

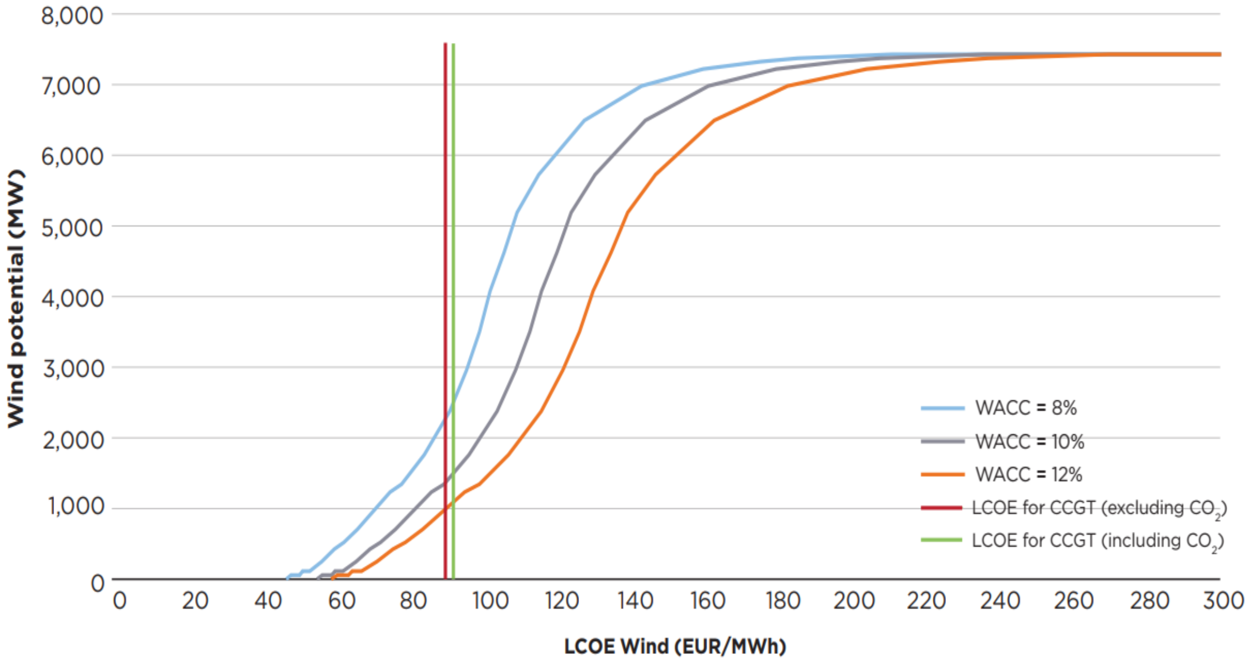

Figure 3.1.12 – Cost-competitive wind potential of Albania in 2016, Source: IRENA, 2017

As stated in Figure 3.1.11, cost-competitive solar PV potential is around 1900 MW according to the best (lowest), 150 MW according to the middle and 0 MW according to the worst (highest) WACC scenario. Furthermore, cost-competitive wind potential is around 2500 MW according to the best, 1500 MW according to the middle and 130 MW according to worst WACC scenario, as stated in Figure 3.1.12. While solar energy remains zero cost-competitive potential, wind energy has 130 MW cost-competitive potential even in the worst WACC scenario. As a result, we can deduce that wind has generally higher cost-competitive potential than solar energy. This validates if mandatory policies and supports are provided, investment in wind energy is rational even in the worst WACC scenario. Averaged LCOE and weighted average of renewable energy for different technologies and forecasted values for 2030 and 2050 are demonstrated in Figure 3.1.10. Therefore, the cheapest RES technology in Albania is hydropower.

3.1.2.4 Biomass

Biomass is an energy source mainly produced by forest/agricultural/animal/urban wastes. Forests in Albania cover approximately 50% of total biomass resources (AEA, 2013). Biomass has a cost-competitive potential when it is compared to Europe (Shamku et al. 2018). On the contrary, electricity from biomass is still two times expensive than hydropower in Albania. However, installed biomass capacity in the electricity sector does not exist (EnC, 2018)

3.1.3 Policy Framework for Renewable Energy

European Bank for Reconstruction and Development (EBRD) has invested in Albania especially infrastructure and energy sectors more than 1 billion € in 77 projects up to 2017. Albania's Minister of Energy and Industry Damian Gjiknuri and EBRD Head of Albania Matteo Colangeli signed in Tirana, 2017 a Memorandum of Understanding (MoU) to encourage the private investors in solar power generation in Albania (EBRD, 2017). In this section, progress concerning the policy framework of RES is discussed in each energy sector.

3.1.3.1 Electricity

To generate energy from renewable resources, Albania has a restricted and insufficient regulatory framework, except for hydropower. The promoting policy for SHPPs that has been declared in 2007, had a fixed feed-in-tariff (FIT). On the contrary, this has a financially detrimental effect on state-owned utility "Korporata Elekroenergjitike Shquiptare", because they had to buy the entire energy generation from private SHPPs. In between 2012-2013 the energy loss reached up to 32 Million Euro and this financial loss were covered by taxes (Zavalani, 2016). To overcome this financial unsustainability and reduce the price by approximately 30%, another formula to calculate the FIT for electricity from SHPPs has been adapted according to Frieden et al. (2015) (IRENA, 2017)

There is no FIT in Albania for wind and solar PV. However, support policy for SHPPs and related concessions has been established in 2007. According to a report by Deloitte (2015), although 501 HPPs under concessions, there is 84 power plants in construction phase and 307 power plants are (with 1,127 MW installed capacity and forecasted electricity energy at 5,288 GWh) in the project phase in 2013. 533 HPPs are on concessions, where just only 74 of them have generated power at the end of 2015 and the rest of them still not reported their constructional or project implementation (Deloitte, 2016). According to IRENA (2017), the concessions are also distributed contradictorily among inexperienced, unqualified companies. Therefore, these companies start unfeasible financial investments with inefficient technical infrastructure. Thus, the requirements of the concessions are poorly fulfilled (REC, 2015; Simaku, 2016).

The law 138/2013 "On Renewable Energy Resources" has the limited promotion of using non-hydropower RESs. Therefore, new legislations are essential to expand non-hydropower investments. In addition to that, FITs might gradually replace by the feed-in-premiums (FIPs) (which require an auctioning mechanism) for small hydro, wind (30 MW) and solar PV (50 MW) installation only to reach 2020 RES targets. However, the current FIT for SHPPs that is lower than 2 MW capacity will remain the same (Kamberi, 2016). According to RES Legal Europa (2019a) and IRENA (2017), the HPPs which are up to 15 MW and more than 10 MW capacity are eligible for the support.

Additionally, other noteworthy issues are illegal usage of electricity and technical losses. With technical infrastructural inefficiency, this leads to decrease the energy efficiency (Simaku, 2016; REC, 2015). These losses were reached in 2012 up to 44.96% according to data from Energy Regulatory Entity (ERE) which has a key responsibility to the development and adoption of rules of the electricity market and monitoring of the energy market (MEI, 2015). However, total losses fell to 26% in 2017 according to the statement of Energy and Infrastructure Minister (USAID, 2018).

Moreover, deficient transmission and distribution structure obstruct the integration of renewable energy systems because of inadequate implementation of Law on Renewable Energy (REC, 2015). Thus, until now the RES is supplied only from state-owned HPPs and private SHPPs. (IRENA, 2017).

3.1.3.2 Transport

Due to bureaucratic reasons, implementation and adoption of Directive 2009/28/EC have not been fully achieved. Law No. 9876 "On the production, transport and trade of renewable biofuels" which enacted in 2008, is compatible with Directive 2003/30/EC but not fully with Directive 2009/28/EC. According to Law No. 9876, biofuel and other renewable fuel types, which are used for transportation, should not be less than 10% of the total fuel consumption. However, there has been no enforcement about the implementation of the law and investment or progress in the transportation sector (Karakaçi, 2016).

3.1.3.3 Heating and Cooling

The Law No. 8937, dated 12.09.2002 "On Conservation of Thermal Heat in Buildings" is still in use. Albania has obligated the use of RES heating technologies in new buildings and it is mandatory to have the thermal and solar energy heating systems. Furthermore, solar energy systems and their components are exempted from tax and customs duty to deploy the use of SWH systems (GSTEC, 2013).

3.1.4 Prospects for RES in the Electricity Sector until 2030

At EU level a first edition of national energy and climate plan up to 2030 was established by EC in 2014. According to EC, at EU level the 2030 RES target should be at least 27% (EC, 2014). However, the 2030 RES target at EU level was updated and adopted by EC in 2018 with more ambitious EU target of 32.5% within the Amending Energy Efficiency Directive (EU) 2018/2002 (Resch et al., 2019).

The 2030 RES targets at CP level are not yet defined. 2030 RES targets at CP level are expected to be adopted by mid-2021 (Balkan Green Energy News, 2019). This section discusses prospects for RES-E until 2030 in Albania to make an outlook for 2030 RES deployment based on the comparison of assessed 2030 RES scenarios in the electricity sector by Mezősi et al. (2015a) and by Resch et al. (2019). Assessed scenarios by Mezősi et al. (2015a) and by Resch et al. (2019) investigate the assessed 2030 RES-E deployment and 2030 RES-E share of Albania.

The Support for Low-Emission Development in South-Eastern Europe (SLED) Project (Mezősi et al., 2015a) suggests an approach to set decarbonisation targets for the electricity sector up to 2030 in Albania. There are three decarbonisation scenarios to assess the decarbonisation potential: Reference (REF), Currently Planned Policies (CPP), Ambitious (AMB) as illustrated briefly below and as shown in detail in Annex I – Table 3.31 (Mezősi et al., 2015a). Although energy capacities for each scenario until 2020 are the same, they are significantly different from each other in 2030 scenarios.

RES-E capacity deployments between 2020 and 2030 for each scenario are demonstrated in Figure 3.1.13. According to these capacity increases and estimated economic conditions, support budgets differ in each scenario and year.

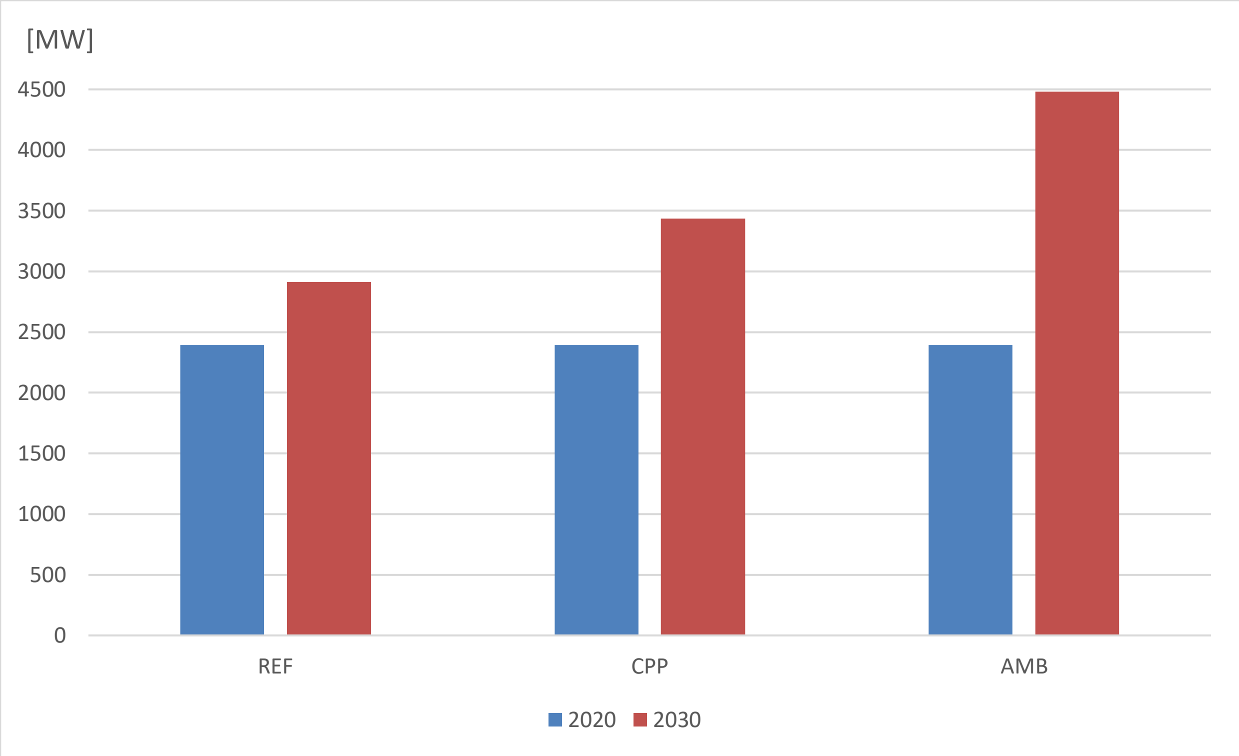

Figure 3.1.13 – Total RES-E capacity deployment in Albania according to assessed scenarios [MW], Source: Mezősi et al., 2015a

According to assessed scenarios, the calculated electricity generation mix in each scenario is shown in Figure 3.1.14. As illustrated therein electricity generation from RES in 2030 amounts approximately to:

- 7500 GWh in REF scenario,
- 8750 GWh in CPP scenario,
- 11400 GWh in AMB scenario.

Table 3.1.4 shows the development of gross electricity consumption according to assessed scenarios over time. With the information given in Figure 3.1.14 and Table 3.1.4, the RES-E share for 2030 can be estimated;

- REF scenario: 58%
- CPP scenario: 80%
- AMB scenario: 105%.

RES-E share at AMB scenario is around 105%, which means the country generates more electricity from RES than consumed domestically. The oversupply can consequently be exported to neighbouring countries with less promising RES potentials.

Table 3.1.4 – Gross electricity consumption in Albania according to assessed scenarios [GWh], Source: Mezősi et al., 2015a

GWh	2015	2016	2017	2018	2019	2020	2025	2030
REF	8,229	8,493	8,757	9,021	9,286	9,550	11,138	12,990
CPP	8,153	8,145	8,363	8,616	8,895	9,165	9,165	10,918
AMB	7,909	7,857	8,084	8,319	8,703	9,121	9,095	10,857

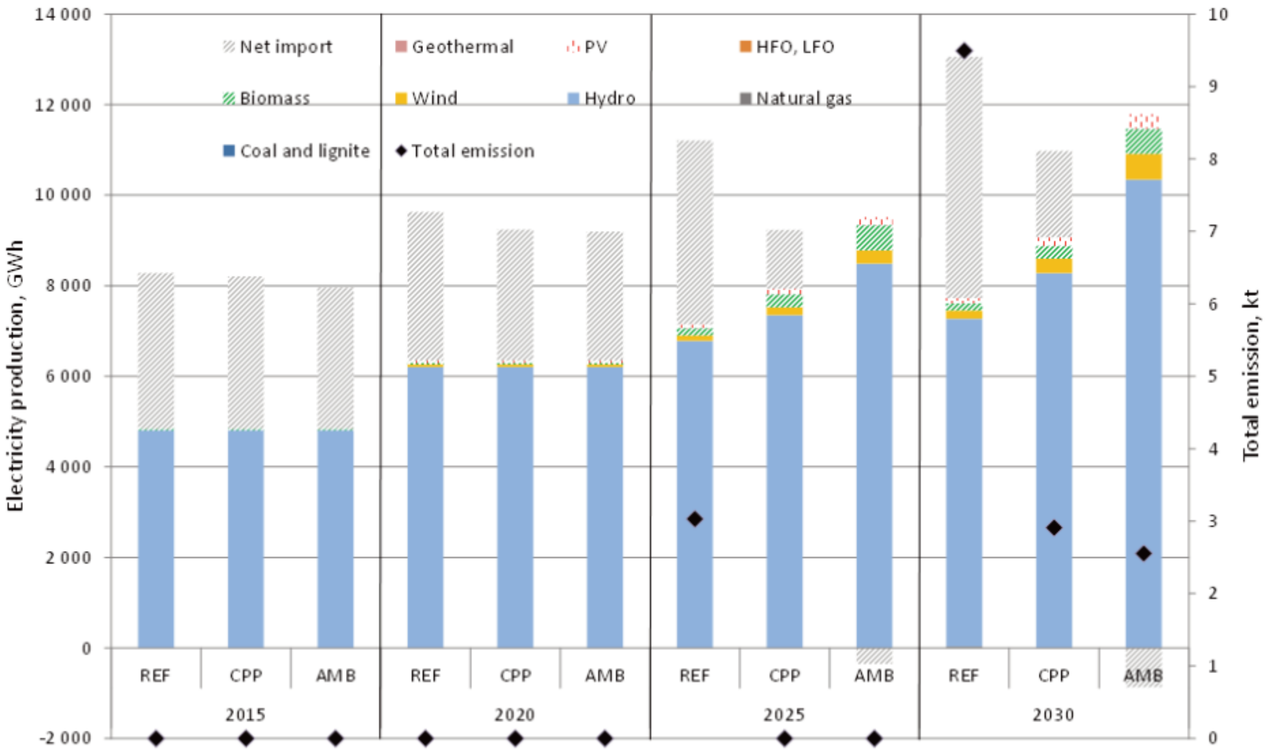

Figure 3.1.14 – Generation mix, net imports and CO_2 emissions in Albania according to assessed scenarios[6], Source: Mezősi et al., 2015a

On the other hand, Resch et al. (2019) provides suggestions for establishing overall 2030 RES share and RES targets and indicates corresponding prospects for RES developments within each sector. Assessed RES-E share until 2030 by Resch et al. (2019) is used in this thesis to make a comparison with assessed RES-E share until 2030 according to Mezősi et al. (2015a). Within Resch et al. (2019), three scenarios have been derived for assessing the 2030 RES-E potential: "No Policy", "RE[7] target fulfilment - without RE cooperation" and "RE target fulfilment - with RE cooperation" (Resch et al., 2019, Page156-160) as explained in further detail in Annex III.

The scenario "RE target fulfilment - with RE cooperation" shows the highest 2030 RES deployment whereas the scenario "No Policy" shows the lowest one. Differences between assessed electricity generation from RES in 2030 and assessed 2030 RES-E share according to

[6] Figure 3.1.16 has been estimated by actual RES share in 2015 (Mezősi et al., 2015a).
[7] Renewable Energy (RE)

scenarios are shown in Figure 3.1.15. Assessed 2030 RES-E share has a range between 107 and 149% and their corresponding electricity generation are between 8.7 and 12.1 TWh. "No Policy" scenario has the lowest 2030 RES-E share (107%) and "RE target fulfilment - with RE cooperation" has the highest 2030 RES-E share (149%).

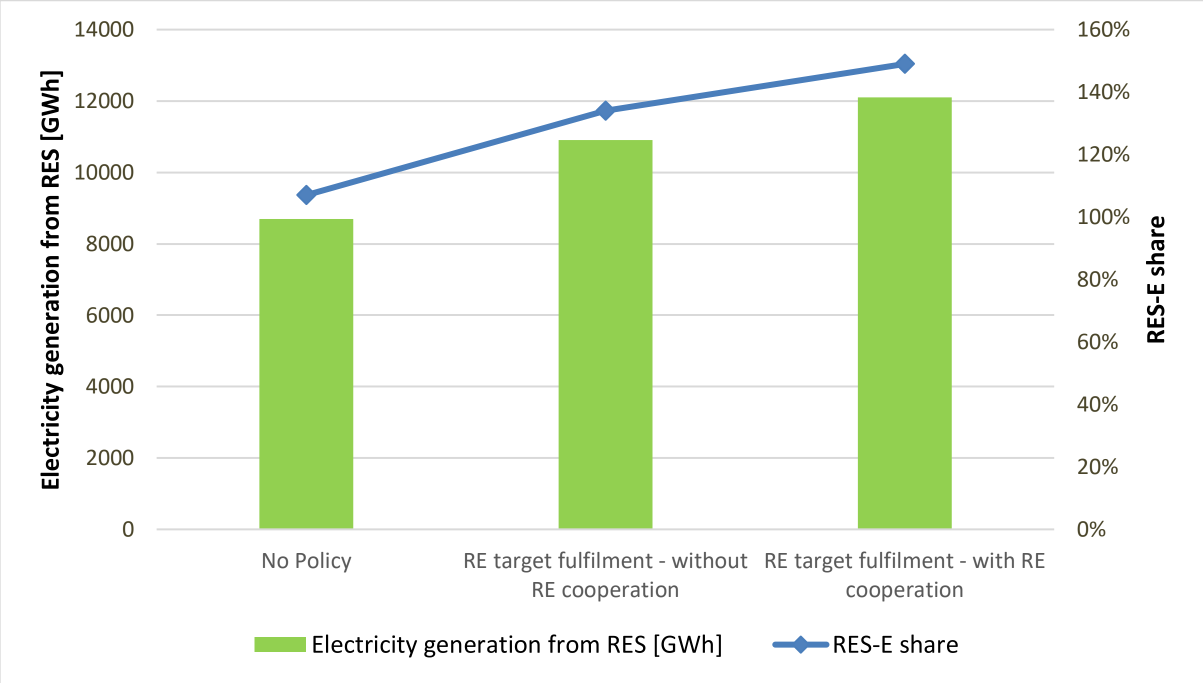

Figure 3.1.15 – 2030 RES-E share and electricity generation from RES in Albania according to assessed scenarios, Source: Resch et al., 2019

Figure 3.1.16 compares the assessed RES deployment in 2030 according to assessed scenarios by Mezősi et al. (2015a) and Resch et al. (2019). Moreover, Figure 3.1.17 compares the assessed RES-E share deployment in 2030 according to assessed scenarios by Mezősi et al. (2015a) and Resch et al. (2019). As applicable from this graph, Albania has an assessed 2030 RES-E share range between 58 and 105% according to Mezősi et al. (2015a) and between 107 and 149% according to Resch et al. (2019). Generally, assessed scenarios by Resch et al. (2019) assume stronger energy efficiency measures than assessed scenarios by Mezősi et al. (2015a). Consequently, electricity demand according to the assessed scenario by Resch et al. (2019) is lower than electricity demand according to the assessed scenario by Mezősi et al. (2015a). As a consequence of the above, assessed 2030 RES-E share range by Resch et al. (2019) is significantly higher in comparison to Mezősi et al. (2015a) despite the only small difference in RES-E generation (cf. Figure 3.1.16) between both studies and the therein analysed scenarios. Thus, if we consider the actual RES-E share in 2018 (92.5%), feasible 2030 RES-E share could be estimated as more than 100%.

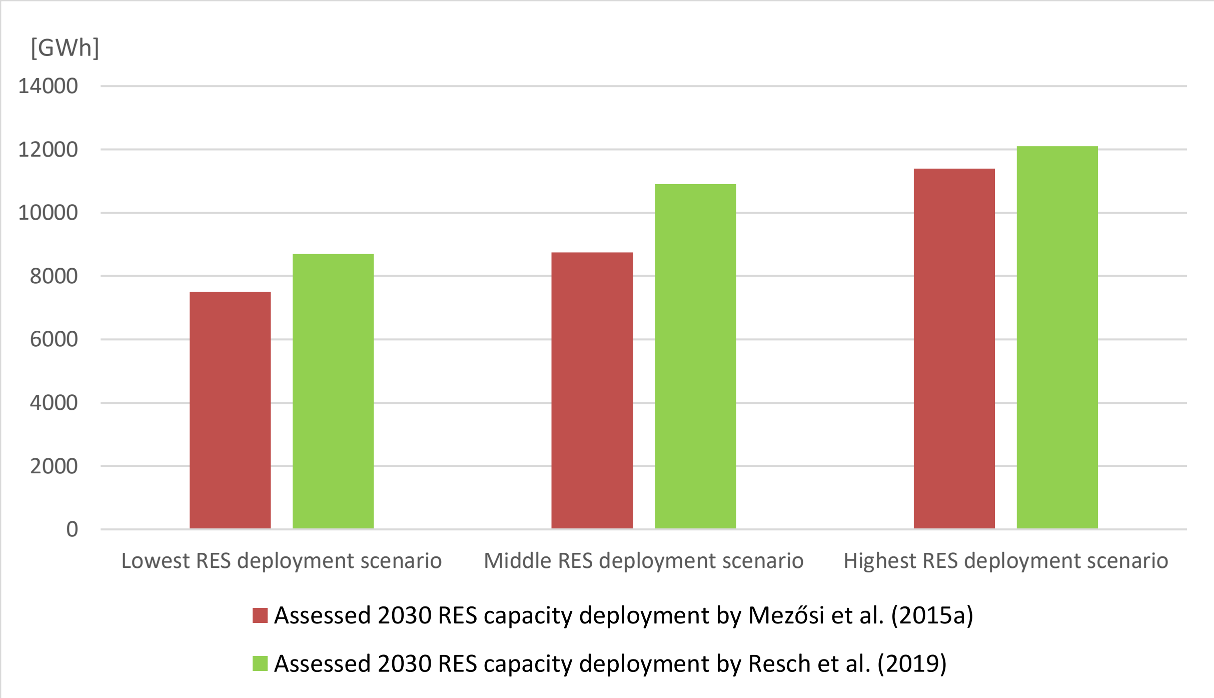

Figure 3.1.16 – Comparison of the assessed RES deployment for Albania in 2030 by Mezősi et al. (2015a) and Resch et al. (2019), Source: Mezősi et al., 2015a; Resch et al., 2019

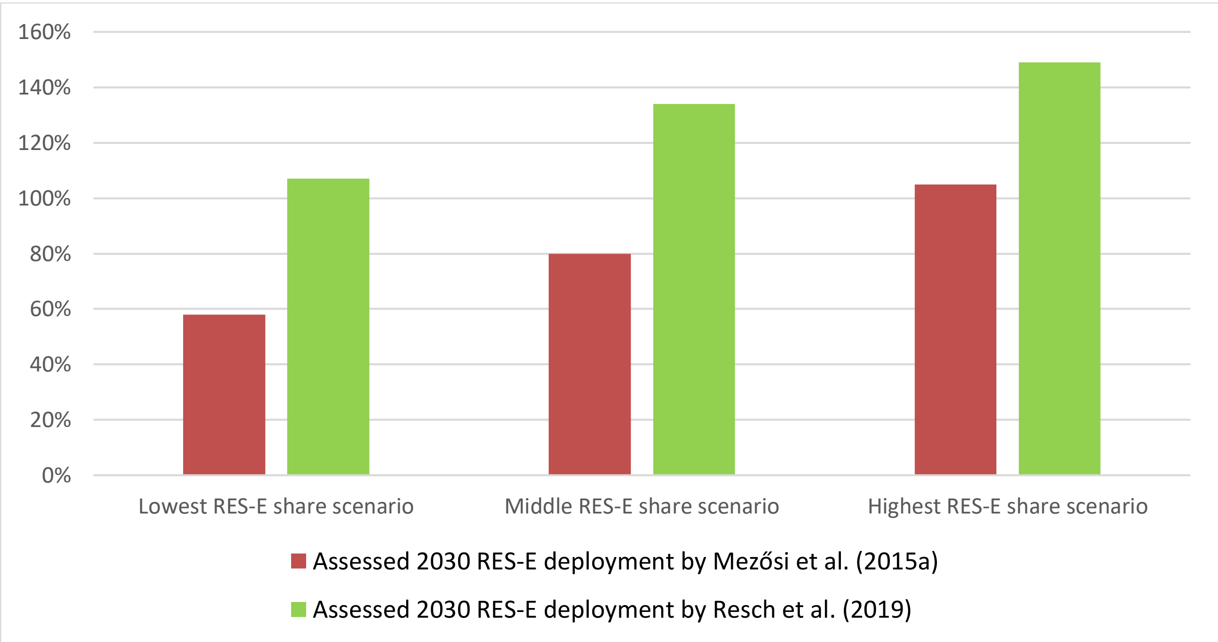

Figure 3.1.17 – Comparison of the assessed RES-E deployment for Albania in 2030 by Mezősi et al. (2015a) and Resch et al. (2019), Source: Mezősi et al., 2015a; Resch et al., 2019

Support Levels for RES-E up to 2030

To invest in RES technologies support policies are required today. According to Mezösi et al. (2015a), the support budget should be calculated with the formula below:

$$SupportBudget = (LCOE - P) * GeneratedElectricity$$

• P = Modelled base-load electricity price (except PV, where peak-load electricity prices are taken into account)

The difference between the LCOE value and the market price (P) gives the support need for 1 MWh of RES-E which can be divided into total generated electricity to obtain the total support budget. The major factor of the support budget is generated by electrical energy.

FIT support level of existing plants up to 10 GW is around 60€/MWh. Besides, new plants up to 15 MW have FIT support around 70€/MWh. Average LCOEs indicate that the present FIT support level in Albania will be sufficient to cover hydropower technology.

The RES support can be provided mainly from two sources; either from the state budget or from a fee that the end-users have to pay. The average RES support fee that should be paid by each end user according to their consumption, can be calculated by dividing the RES-E support budget to the total electricity consumption (considering all consumers have to pay for RES-E support) (Mezősi et al., 2015a). Estimated RES-E support fees according to assessed scenarios are shown in Figure 3.1.18.

In current status (REF scenario) there is no extra fee reflected the end consumers. However, this fee is estimated at around 10€/MWh for 2020. Also, the peak value of the AMB scenario in 2025 should be around 12€/MWh, which is the highest extra charge for costumers. The support level of EU was an average of 13.68€/MWh in 2012 according to the Council of European Energy Regulators (CEER) on EU renewable support schemes report in 2015. Therefore, the level of the financial support burden in 2020 is corresponding to the level of support in the Czech Republic, Greece or Portugal in 2012 despite the significant RES-E support budget increase (Mezősi et al., 2015a).

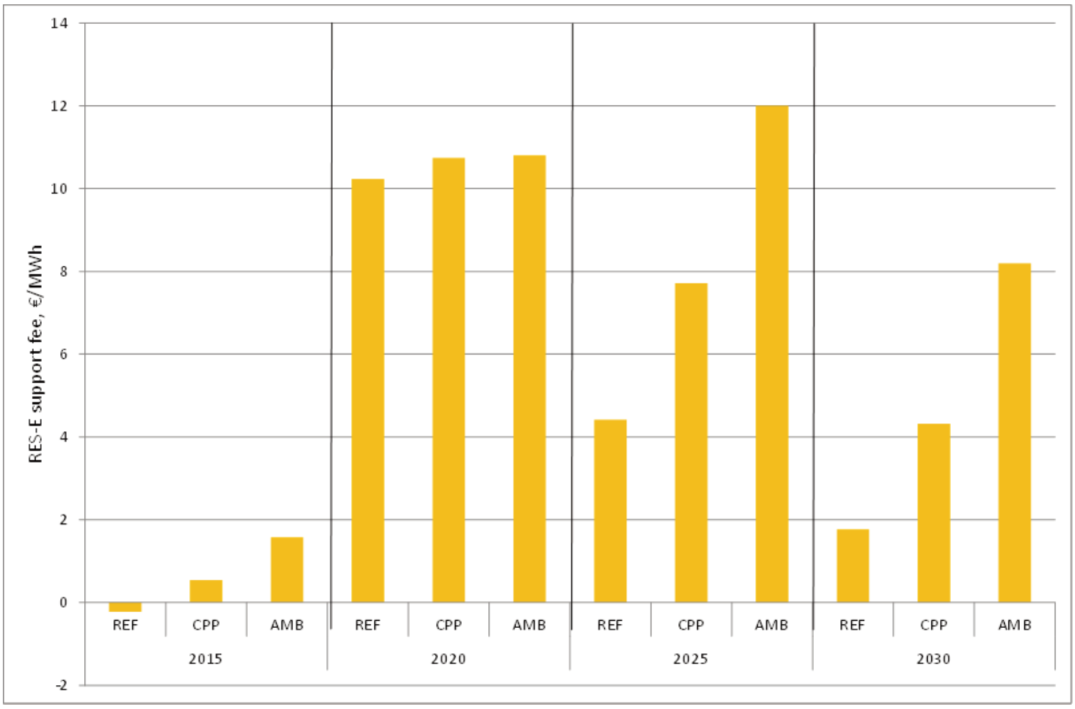

Figure 3.1.18 – Average support for RES-E from end consumers in Albania according to assessed scenarios [EUR/MWh], Source: Mezősi et al., 2015a

As a consequence, there is a relationship between RES-E capacity deployment and RES-E support budget. Figure 3.1.13 and Figure 3.1.18 obtain an analogy. Since the AMB scenario has the highest RES capacity compared to other scenarios, it has the highest value of the budget.

3.1.5 Lessons learned

The main obstacle is according to IRENA (2017) not only the concessions that are given to inexperienced and ineligible institutions but also, Albania has not yet implemented plans or has not yet prepared progress reports to monitor achieved progress sufficiently. These are the main handicaps together with insufficient energy infrastructure.

In addition to that, laws, regulations and concessions must be consistent and transparent. The regulations about wind, solar energy systems, biofuels and biomass are insufficient compared to hydropower. In conclusion, most of the regulations are about hydropower technology, other technologies fall behind.

Solar PV and wind potential of Albania could still not be benefited as expected. Considering that the hydropower provides the cheapest RES technology from today's perspective, interest in hydropower is higher than for other RES technologies. LCOE of hydropower technology is lower than FIT support of hydropower. That makes the investment in hydropower technology reasonable. RES-E support budget of Albania was close to zero due to the high deployment of

RES-E (mainly hydropower) in 2015. On the other hand, it is essential that Albania should increase the variety of RES and raise the support budget for that since a focus on only one RES technology induces other problems. For instance, RES-E generation in Albania depends on precipitation. When the electricity generation from hydropower plants is not enough in dry seasons, the needed electricity must be imported. Despite the high RES potential of the country, in the worst case, the country will be depended on other countries. To maintain the sustainability, diversity of RES is fundamental.

As a result of the comparison of assessed 2030 RES-E targets in Section 3.1.4, Albania has sufficient potential for achieving a RES-E share (in consumption) higher than 100%.

The overall RES share in GFEC, which has been on the increase since 2014, was 37.1% in 2016 but then decreased to 34.6% in 2017 (Figure 3.1.2). In this case, part of RES-H&C plays an important role between 2016 and 2017. In 2017, RES-H&C share decreased by 11.7% compared to the year 2016, while the total energy consumption in the H&C sector increased by 20% (Table 3.1.2).

Although the highest share and highest increase rate in consumption were observed in the transport sector, Albania has not yet obtained robust RES progress in the transport sector. Thus, achieving the 2020 RES-T target should gain a priority. However, an increase in the RES-T share from 0% to 10% until 2020 seems not feasible.

Based on the data above, even though Albania has an enormous renewable energy potential, necessary legal regulations and inspections have not been implemented. Subsequently, reaching the overall 2020 RES target seems unrealistic. While Albania is currently in the process of proposing or establishing 2030 RES targets, the Albanian government ought to prepare the regulations, proper concessions and inspection mechanism more importantly, specifically for the transport sector.

3.2 Moldova

Moldova has been a member of the Energy Community as a CP since 1 May 2016. The country first met with the RES in 2007 and the same year, the Renewable Energy Law (No. 160-XVI dated 12 July 2007) came into force. Subsequently, Moldova revised RES Law according to the EU Directives 2009/28/EC. Ministry of Economy is the responsible institution for the development and implementation of energy policies and legislation in Moldova.

According to the Decision of the Council of Ministers of Energy Community 2012/04/MC-EnC, 17% of Gross Final Energy Consumption (GFEC) of Moldova would be provided from RES in 2020. In this context, according to National Action Plan for Renewable Energy Resources in Moldova, 2020 national targets for renewable energy in each sector to reach 17% RES usage in GFEC are (ANRE, 2013):

- 10% RES share in the electricity sector (RES-E)
- 7% RES share in the transport sector (RES-T)
- 20% RES share in the heating and cooling sector (RES-H&C).

3.2.1 Assessment of Historical Progress of RES

Moldova has significantly high energy losses due to its poor infrastructure, for example old power plants, like the other southeastern European countries. Moldova is a country that imports almost 70% of its total primary energy supply (IRENA, 2019).

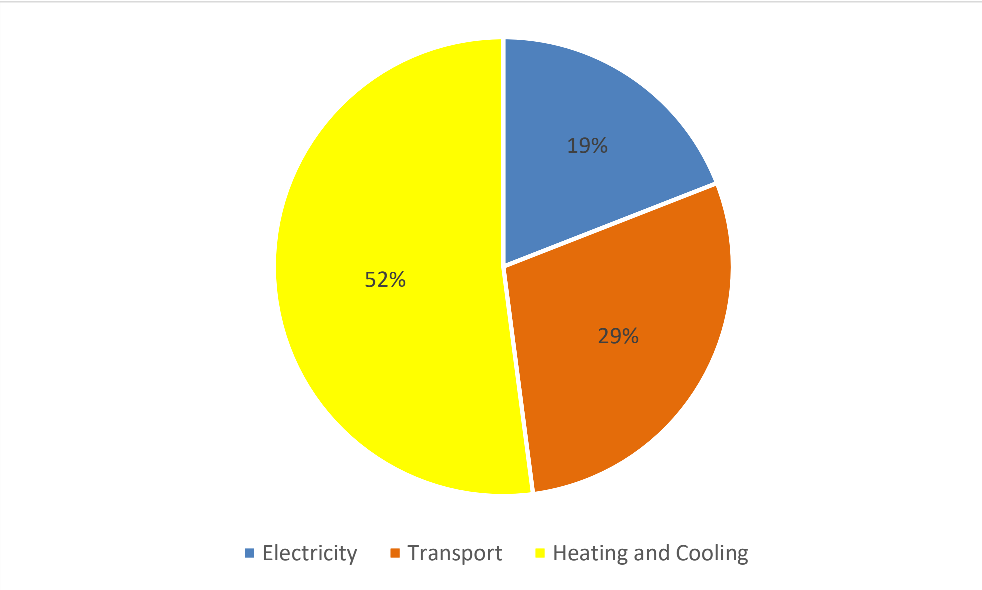

Figure 3.2.1 – Gross final energy consumption share in each sector of Moldova in 2015, Source: EUROSTAT, 2016

Heating and cooling sector has the highest energy consumption percentage (52% of GFEC) in 2015, followed by transport (29%) and electricity (19%) in 2015, as it has been shown in Figure 3.2.1

Table 3.2.1 and Figure 3.2.2 explain the RES share of each energy sector in GFEC between years 2009 and 2015. Unfortunately, EUROSTAT data on Moldova are available until 2015 only. Therefore, reviews and evaluations about Moldova are up to 2015.

Table 3.2.1 – RES consumption share in each sector and GFEC of Moldova between 2009 and 2015, Source: EUROSTAT, 2016

Renewable energy shares in	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Electricity Consumption [%]	4.38	4.66	5.56	5.56	6.16	5.96	7.13
Heating & Cooling Consumption [%]	6.43	12.08	14.64	15.92	20.23	20.37	27.67
Transportation Consumption [%]	0.14	0.12	0.14	0.17	0.20	0.17	0.17
Gross Final Energy Consumption [%]	4.40	7.61	9.29	10.15	12.29	12.35	15.76

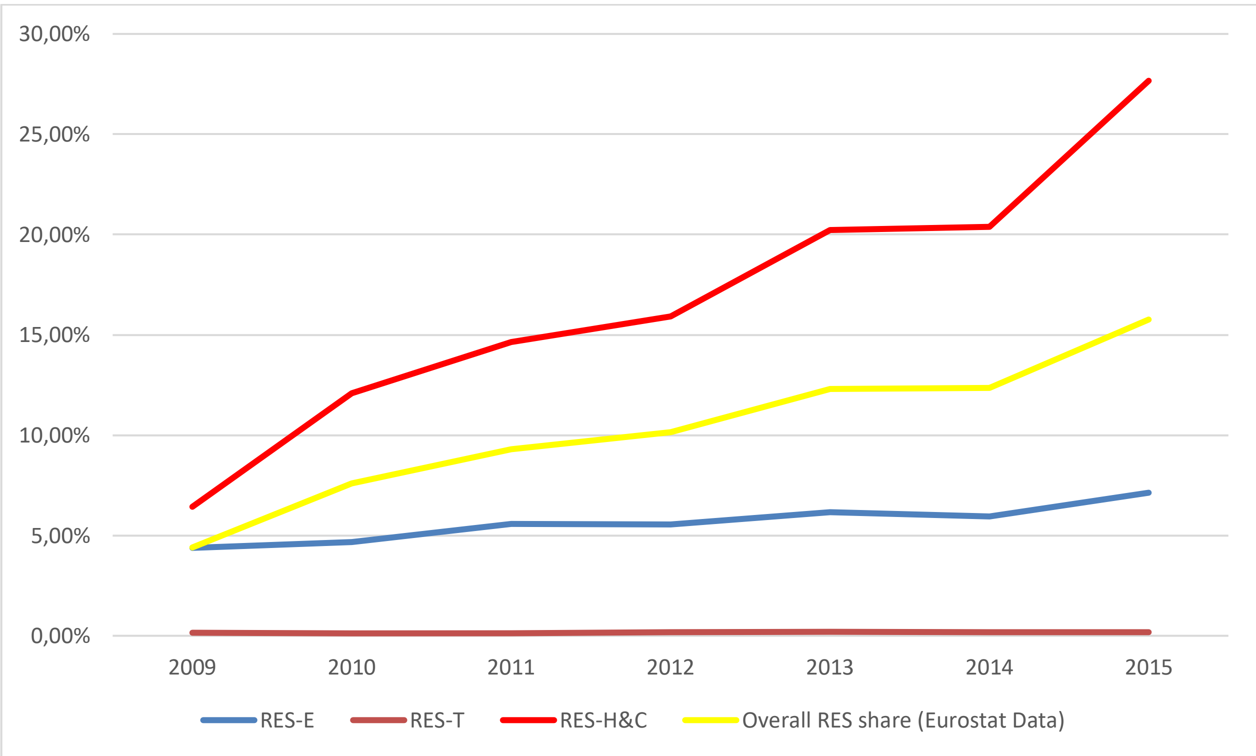

Figure 3.2.2 – Overall RES share progress and RES share progress in each sector of Moldova between 2009 and 2015, Source: EUROSTAT, 2016

RES-H&C and RES-E progress in Moldova have directly proportional progress to Final Energy Consumption (FEC) of each sector. The H&C sector has relatively high consumption in Moldova and RES-H&C has always the significantly highest RES share and increase. Although RES-E has achieved an increase, it appears insignificant. RES-T remains at zero, indicating that Moldova has failed to trigger the envisaged RES-T deployment.

Moldova has a steady increase in overall RES share since they begin their NREAP program (since 2009) and has outreached its indicative overall RES target in 2015 (Figure 3.2.3). Despite the significantly low RES-T share (close to 0%) and insignificant rise in RES-E, Moldova has a positive overall RES share progress due to significantly high RES-H&C share.

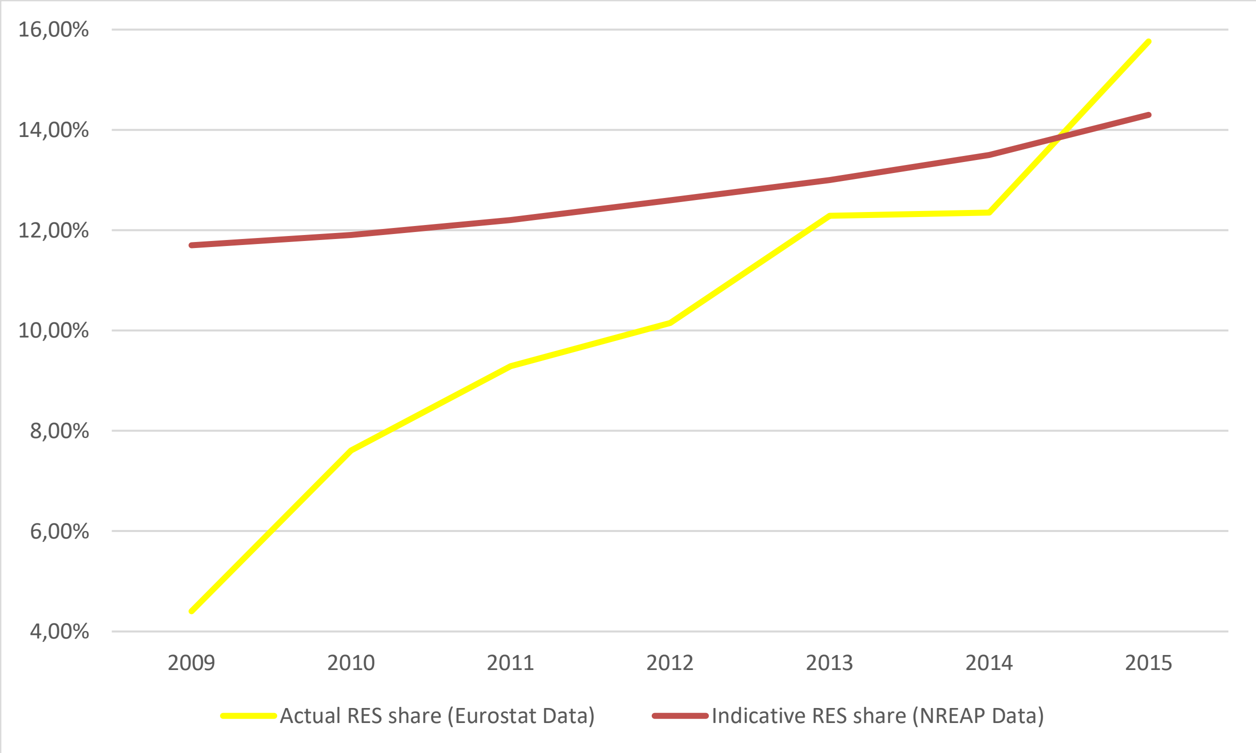

Figure 3.2.3 – Actual RES share and national RES objective share of Moldova between 2009 and 2015, Source: EUROSTAT, 2016; ANRE, 2013

Figure 3.2.4 shows the comparison between Moldova's 2013/2014 actual overall RES trajectory, 2013/2014 indicative overall RES trajectory according to NREAP and 2020 overall RES target. The last two columns on the right side of the Figure 3.2.4 describe the difference between real progress and planned progress which shed light on the overall RES progress of Moldova. The fourth column shows the deviation between the actual median 2013/2014 overall RES share of GFEC and indicative median 2013/2014 overall RES share of GFEC. According to Figure 3.2.4, Moldova had 1.1 percentage points (pp) lower (-1.1 pp) overall RES share of GFEC progress than indicative overall RES share of GFEC progress. If we compare actual median 2013/2014 overall RES share of GFEC and 2020 overall RES target, it is obvious that the deviation between actual median 2013/2014 overall RES share of GFEC and 2020 overall RES target is -4.7 pp as it seems in the fifth column of Figure 3.2.4.

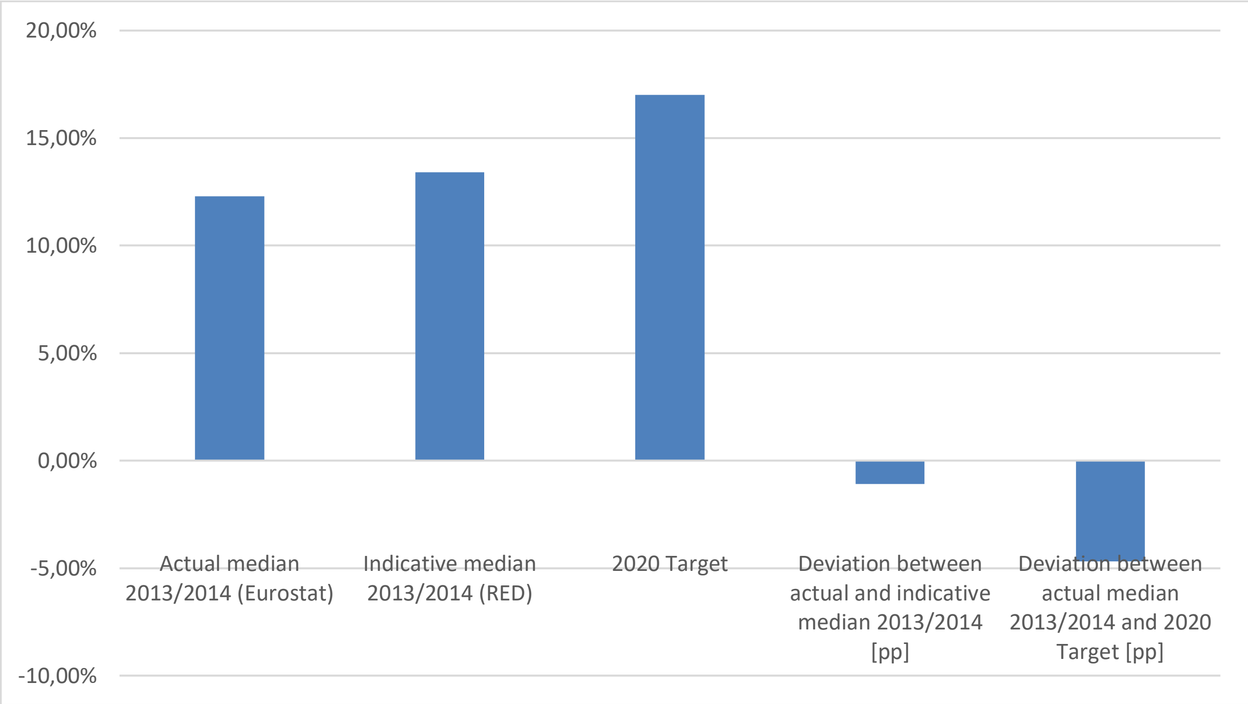

Figure 3.2.4 – Actual and indicative median 2013/2014 overall RES share of GFEC, 2020 overall RES share target and the deviation of the actual median 2013/2014 RES shares of GFEC from the renewable energy directive (RED), indicative median 2013/2014 and 2020 NREAP RES target in percentage points of Moldova, Source: EUROSTAT, 2016; ANRE, 2013

3.2.1.1 Electricity

National Energy Regulatory Agency (ANRE) is responsible for regulating the electricity market, defining conditions for the approval of tariffs, licensing for activity in the power market, e.g. for energy production. The total installed electricity capacity in 2017 is approximately 383 MW in Moldova and electricity is generated mainly by gas-burning combined heat and power plants (CHPs), which account for 86% of total installed capacity (IRENA, 2019). Until 1995 Moldova was a regional exporter of electricity, however today the electricity production in Moldova is very limited and mostly generated by 3 CHPs (both producing heat and electricity) and one HPP. Therefore, Moldova is a country that imports 70% of its primary energy supply (IRENA, 2019). Indeed, domestic electricity production typically covers less than 20% of demand, with this mostly provided by local, gas-fuelled CHPs (330 MW capacity) and renewable-based power plants (52 MW capacity). As it is shown in Figure 3.2.5, wind power plants (which are 27 MW) correspond to more than 50% of total installed RES capacity in electricity. The remaining part has been supplied by HPP with 16 MW, biogas-based power plants with 6 MW and solar PV power plants with 3 MW.

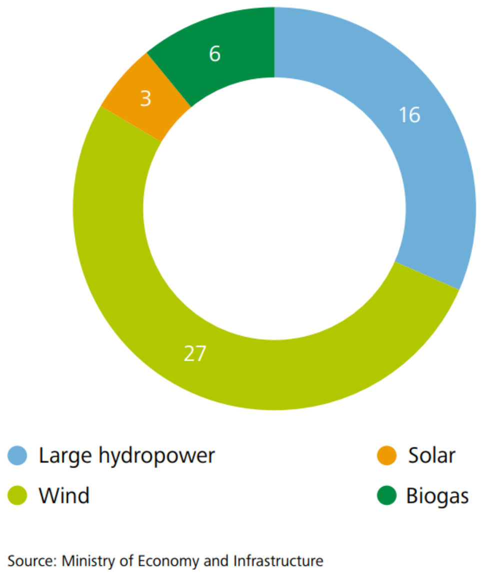

Figure 3.2.5 – Total capacity of RES-E in Moldova (2017) [MW], Source: EnC, 2018

Figure 3.2.6 shows electricity generation from RES and total electricity consumption between 2009 and 2015 in Moldova. RES-E has constant progress between 2009 and 2015, although electricity consumption has fluctuating progress. The decline in electricity consumption in 2015 and stagnation in electricity generation from RES explains the increase in RES-E share.

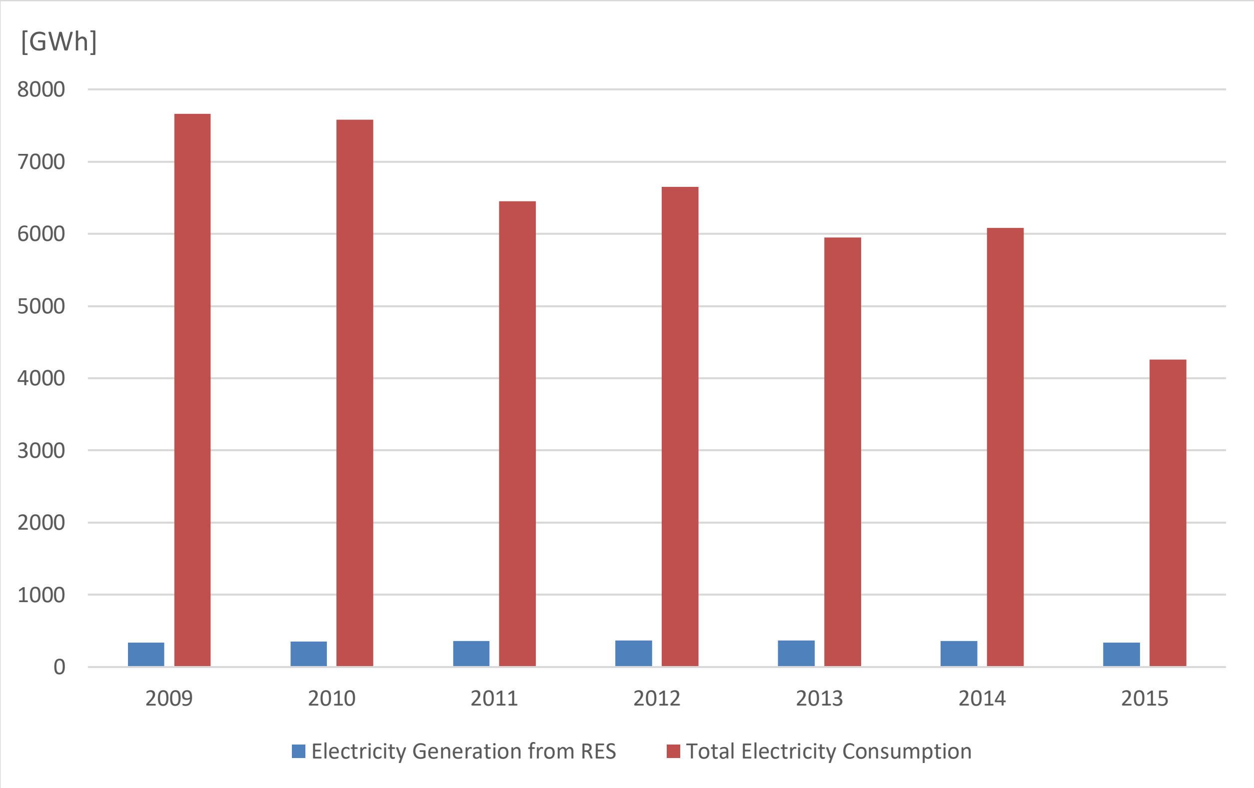

Figure 3.2.6 – Total electricity consumption and electricity generation from RES in Moldova between 2009 and 2015 [GWh], Source: EUROSTAT, 2016

3.2.1.2 Transport

Although the 2020 RES share target of Moldova in the transport sector is 7%, its share in 2015 was still 0%. According to 2009's base year information, the transport sector in Moldova did not use any renewable energy resources. Import of biofuels and domestic production of electricity from RES planned to be the main sources to reach the indicative RES-T target (ANRE, 2013). Figure 3.2.7 shows the total energy consumption in the transport sector and energy consumption from RES in the transport sector of Moldova between 2009 and 2015. Although the energy consumption in the transport sector was 30% of GFEC in 2015, the share of RES in this sector was approximately 0%.

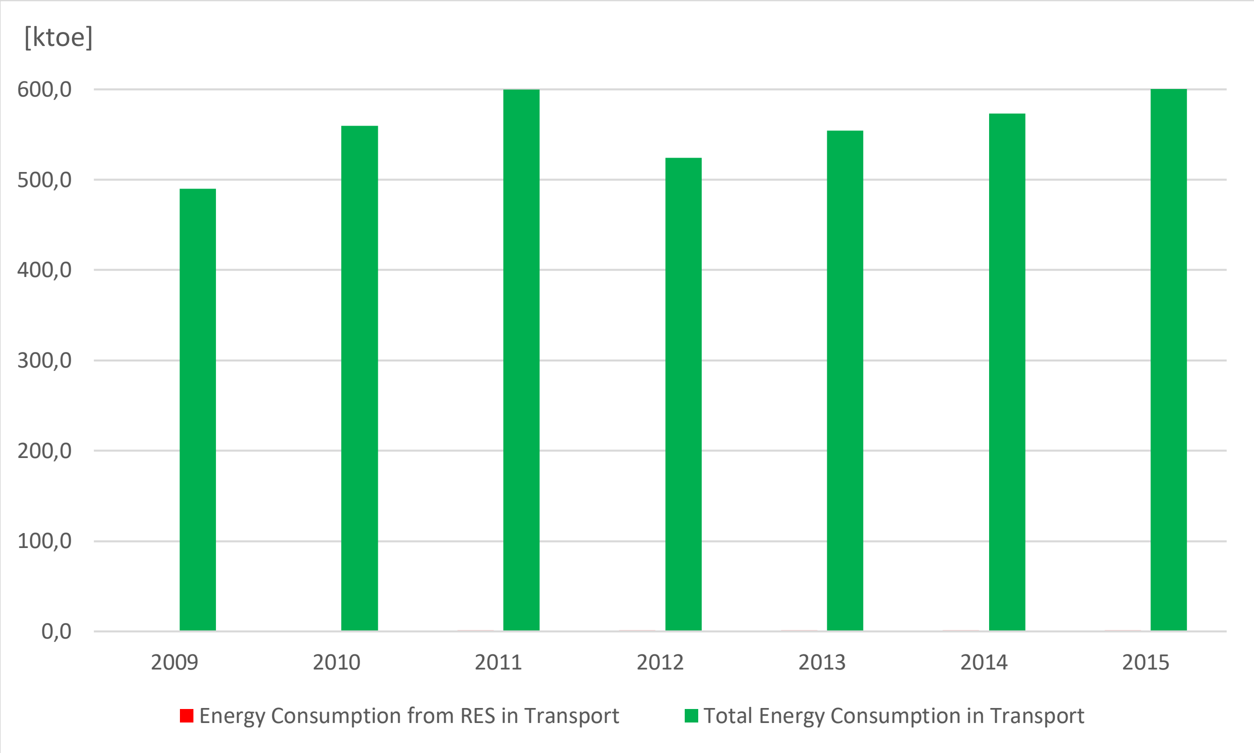

Figure 3.2.7 – Total energy consumption and energy consumption from RES in the transport sector of Moldova between 2009 and 2015 [ktoe], Source: EUROSTAT, 2016

3.2.1.3 Heating and Cooling

Moldova's energy profile is largely determined by the H&C sector due to the highest energy consumption compared to other energy sectors. According to NREAP of Moldova, the country's traditional fuel for heating is biomass. With the major changes in the H&C sector of Moldova between 1990 and 2000 (sharp collapse of the centralised heat supply systems), heat generation and supply in Moldova had a relatively high decrease. Therefore, the share of heat plants in the country decreased and CHPs were producing about two-thirds of the total heat supplied by centralised networks in 2015 (Energy Charter Secretariat et. al., 2015).

According to IBRD (2017), although the total available (theoretical) biomass potential of Albania for heating is 865 ktoe, the sustainable technical biomass potential is 694 ktoe. According to the report by IRENA (2019) and NBS (2018), the total biofuels & waste consumption in 2017 reached up to 733 ktoe. The vast majority of current RES-H&C share (27.8%) reached through consumption revision of biomass between 2010 and 2016 (IRENA, 2019; NBS, 2018). This data revision was accomplished through household biomass consumption data. In this context, the importance of biomass in the H&C sector and GFEC is revealed (IRENA, 2019).

Total energy consumption in the H&C sector and energy consumption from RES in H&C sector of Moldova between 2009 and 2015 are shown in Figure 3.2.8 (EUROSTAT, 2016). Table 3.2.2 shows the used RES in H&C sector and their amounts between 2009 and 2015 and the RES share in total energy consumption in the H&C sector of Moldova. Table 3.2.2 and Figure 3.2.8

show that the total energy consumption in the H&C sector decreases in almost every consecutive year except 2011 and 2014. However, RES usage in H&C sector has a continuous increase. This has led to an increase in RES-H&C share every year. In 2013, Moldova reached already its 2020 RES-H&C target (20%).

Table 3.2.2 – Energy consumption and RES share in GFEC of Moldova in the H&C sector between 2009 and 2017 [*ktoe*], Source: EUROSTAT, 2016

Energy Consumption in H&C/Year	2009	2010	2011	2012	2013	2014	2015
Liquid Biofuels/Solid Biomass [*ktoe*]	70.7	169.4	212.2	223.8	264.2	276.9	307.6
Total Energy Consumption in H&C [*ktoe*]	1099.7	1402.2	1449.4	1405.8	1306.2	1359.1	1111.8
RES Share in Total H&C Demand [%]	6.43	12.08	14.64	15.92	20.23	20.37	27.67

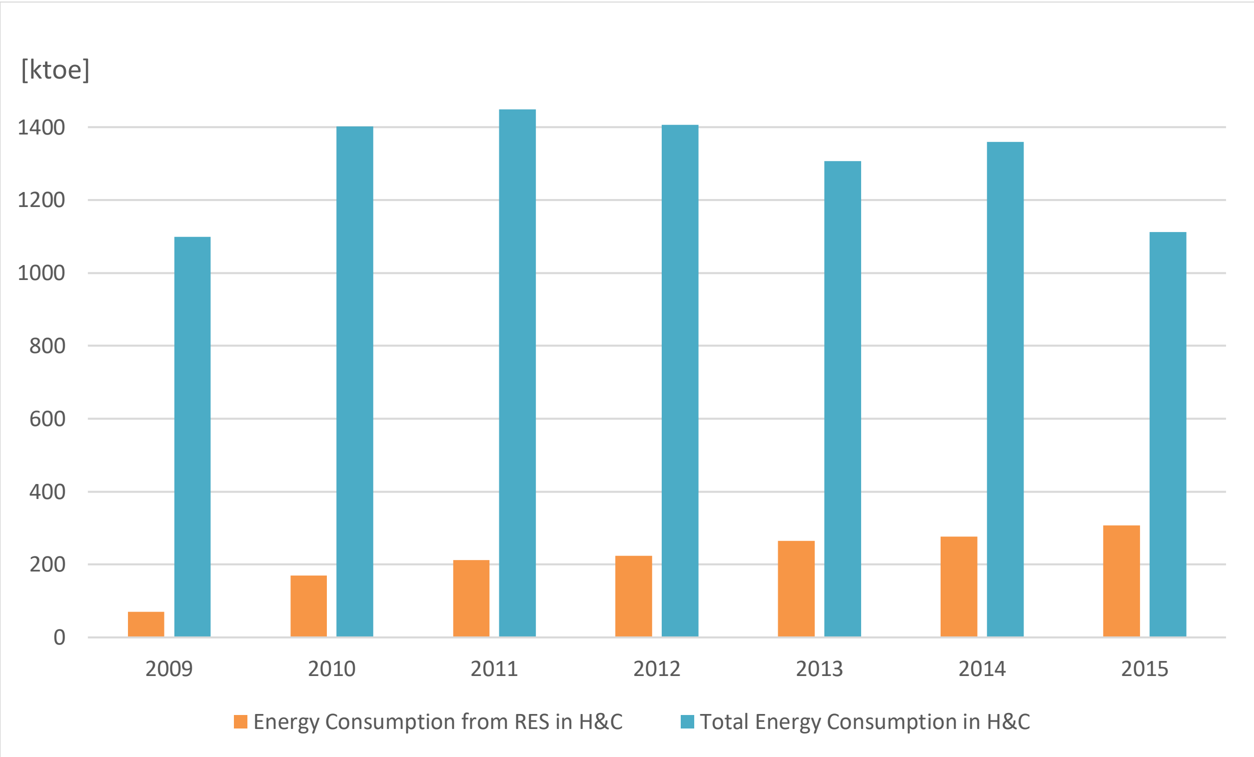

Figure 3.2.8 – Energy consumption from RES and total energy consumption in the H&C sector of Moldova between 2009 and 2015 [*ktoe*], Source: EUROSTAT, 2016

3.2.2 Potential of Renewable Energy in the Electricity Sector

3.2.2.1 General Overview

To make an outlook for the potential of RES-E, technical and cost-competitive potentials should be considered. If the technical potential is not cost-competitive, investors do not tend to invest. In this case, cost-competitive potential has a key role for investors and also LCOE ranges and average LCOE in each RES technology give us information about cost-competitive price to compare the RES technologies.

LCOE ranges and weighted averages of renewable energy technologies in Moldova are shown in Figure 3.2.9. As stated in Figure 3.2.9, average LCOEs are 108€/MWh for solar PV, 80€/MWh for wind, 70€/MWh for biomass and 118€/MWh for geothermal energy technologies. Since there is insufficient information about hydropower technology, cost estimations for HPP technology are not available. The cheapest RES technology from today's perspective is wind and the most expensive one is geothermal energy (IRENA, 2017).

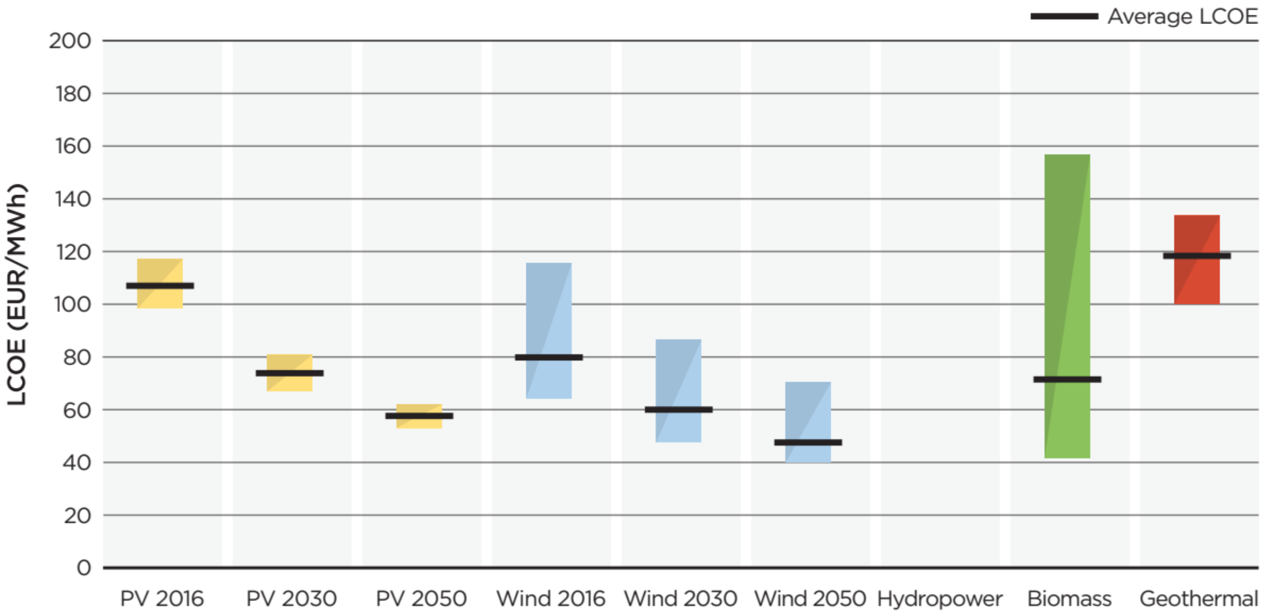

Figure 3.2.9 – LCOE ranges and weighted averages of renewable energy technologies (medium cost of capital) in Moldova, Source: IRENA, 2017

Table 3.2.3 does not only show the electrical capacity in 2009 and 2015 but also electricity generation in 2015, 2020 RES capacity targets according to the NREAP, additional cost-competitive potential capacities in 2016, 2030, 2050 and their corresponding electricity generation. Technical electricity capacity and electricity generation potentials are also expressed in this table. The low additional cost-competitive potentials correspond to the high cost of capital scenario whereas the high additional cost-competitive potentials refer to the low cost of capital scenario. As we can see in Table 3.2.3, the total cost-competitive potential is under both scenarios higher than the 2020 RES NREAP targets. As a result, according to IRENA (2017), Moldova is capable of reaching its 2020 RES targets.

Table 3.2.3 – Capacity and energy potential for RES-based electricity in Moldova, Source: IRENA, 2017

Technologies	2009	2015		2020 (NREAP)	Additional cost-competitive potential			Technical potential	
	MW	MW	GWh	MW		MW	GWh	MW	GWh
Solar PV	0.0	1.3	0.3	0.0	2016	0 – 1,030.0	0 – 1,370.2	4,648.0	6,044.0
					2030	4,646.5	6,043.6		
					2050	4,646.5	6,043.6		
Wind	0.0	1.1	1.5	149.0	2016	11,894.5 – 20,799.0	29,939.6 – 50,110.5	20,869.1	50,235.7
					2030	20,868.0	50,234.2		
					2050	20,868.0	50,234.2		
Hydro	11.0	16.0	58.3	16.0		n.a	n.a	840.0	3,361.0
≤ 10 MW	0.0	0.0	0.0	0.0		n.a	n.a	275.0	1,100.0
> 10 MW	11.0	16.0	58.3	16.0		n.a	n.a	565.0	2,261.0
Pumping	n.a	n.a	n.a	n.a		n.a	n.a	n.a	n.a
Biomass	0.0	2.8	13.9	10.0		24.0 - 753.4	147.2 - 4,810.6	850.0	5,388.0
Biogas	0.0	2.8	13.9	10.0		24.0 - 34.4	147.2 - 227.6	134.0	805.0
Solid Biomass	0.0	0.0	0.0	0.0		0.0 - 716.0	0.0 – 4,583.0	716.0	4,583.0
Biowaste	0.0	0.0	0.0	0.0		0.0	0.0	n.a	n.a
Geothermal el.	0.0	0.0	0.0	0.0		0.0	0.0	n.a	n.a
Total (2016)	11.0	21.2	74.0	175.0	2016	11,918.5 – 22,579.4	30,086.8 – 56,291.3	27,207.1	65,028.7

3.2.2.2 Hydropower

Hydropower technology shows a slow development in Moldova compared to other selected CPs. There is only one operating HPP (HPP Stanca-Costesti) in Moldova that has 16 MW capacity, and it was built in the 1970s. There are inadequate research and data on HPP in Moldova and there is no plan to build new HPP (IRENA, 2017).

3.2.2.3 Solar PV and Wind

Wind energy is a fundamental RES in Moldova. According to the best WACC scenario of wind energy, Moldova has the third-highest cost-competitive wind energy potential in all CPs with more than 20 GW potential. However solar PV potential is not as much as wind energy potential. Moreover, the share of RES deployment in Moldova could be mainly increased within the use of wind (12-20 GW) and also solar PV (up to 1 GW) potential. The additional cost-competitive potential of solar PV is around 5% to 8% of wind energy potential. These resources play an essential role to reach the 2020 RES-E target by inducing the diversity of RES and increasing grid security. The usage of geothermal energy is not feasible due to the low temperature of resources (Table 3.2.3).

Figure 3.2.10 and Figure 3.2.11 demonstrate the respectively cost-competitive potential of solar PV and wind capacities. LCOE begins for solar PV technology just above 85€/MWh and wind technology just below 60€/MWh in the most suitable locations for both technologies (Figure 3.2.10 and Figure 3.2.11). WACC in Moldova is approximately 14% (Ondraczek et al., 2013; WACC Expert, 2019).

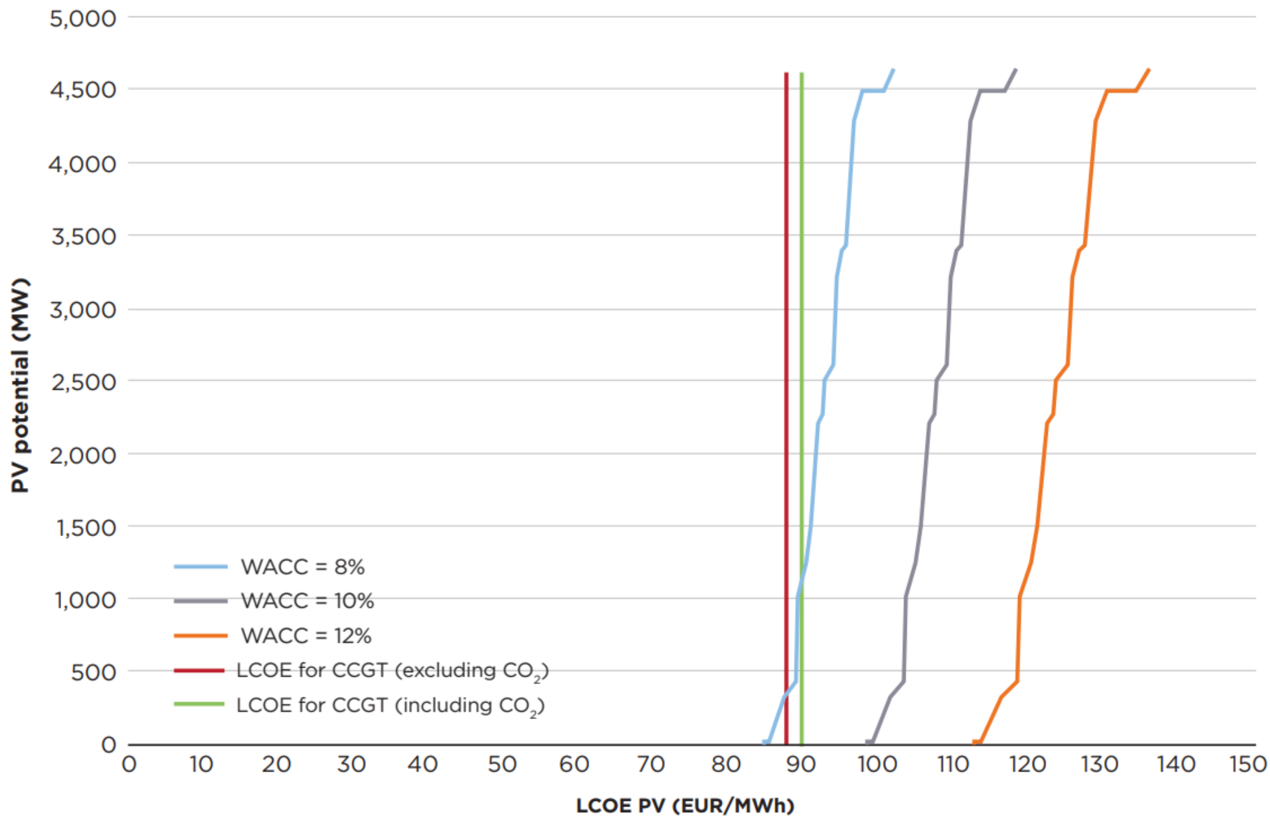

Figure 3.2.10 – Cost-competitive solar PV potential of Moldova in 2016, Source: IRENA, 2017

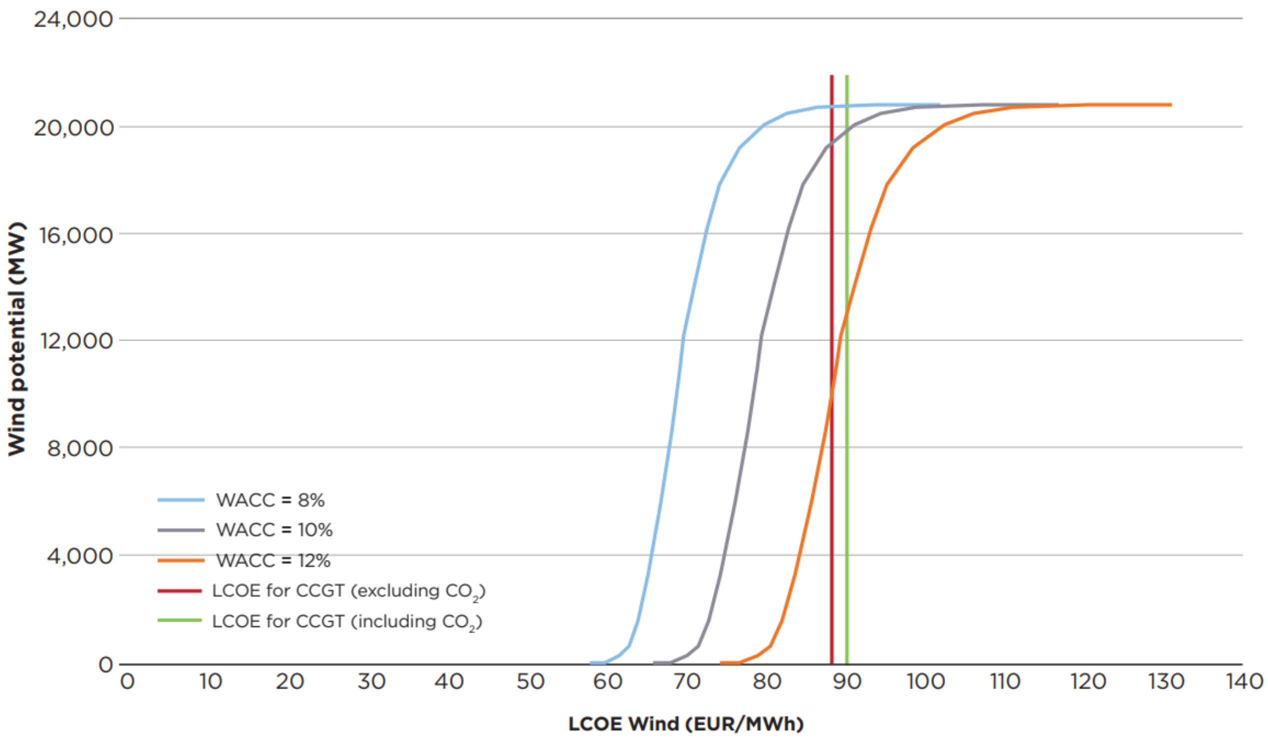

Figure 3.2.11 – Cost-competitive wind potential of Moldova in 2016, Source: IRENA, 2017

As stated in Figure 3.2.10, cost-competitive solar PV potential is around 400 MW according to the best (lowest) WACC scenario and 0 MW according to the middle and worst (highest) WACC scenarios. Furthermore, cost-competitive wind potential is around 21 GW according to the best WACC scenario, 19 GW according to the middle and 10 GW according to the worst WACC scenario. While the cost-competitive potential of solar PV remains zero, the cost-competitive potential of wind has 10 GW even in the worst WACC scenario. As a result, it can be deduced that wind has higher cost-competitive potential than solar PV. This validates if mandatory policies and supports are provided, investment in wind energy is rational even in the worst WACC scenario. Averaged LCOE and weighted average of renewable energy for different technologies and forecasted values for 2030 and 2050 are also demonstrated in Figure 3.2.9. In conclusion, the cheapest RES technologies in Moldova are wind and biomass energy.

3.2.2.4 Biomass

Biomass consumption in the electricity sector is limited to 6 MW capacity in Moldova. According to IEA (2020b), electricity generation from biofuels was 23 GWh in 2017. If it is compared with the total electricity generation by source in 2017, it takes 0.004% share in total electricity generation in Moldova. The significant part of biomass has been used in H&C sector (IRENA, 2019).

3.2.3 Policy Framework for Renewable Energy

Since Moldova has not published the third progress report 2016-2017, information and studies on Moldova are limited. According to IRENA (2017), the current RES legal infrastructure and laws are still at an insufficient level to attract investors. FIT tariffs, which are only applicable to the electricity sector, are also set year by year.

Moldova has a high-risk perception of renewable energy projects. This affects the capital cost of the projects negatively. Despite the government's practices until 2018, the current situation is still unsatisfactory which cause high risk for investments (IRENA, 2019). In this section, progress concerning the policy framework of RES is discussed in each energy sector.

3.2.3.1 Electricity

Law on RES support “RE Law of 2007 (No.160-XVI of 12.07.2007)” remained enacted until March 2018 and was reformed by the law of 2016 (Law No. 10 of 26.02.2016) (approved by National Energy Regulatory Authority). According to this law, the FITs that are described and approved by the National Energy Regulatory Authority (ANRE), are fixed for 15 years and has a cost-close principle[8]. FITs are determined according to power plant capacity and each technology has a quota (Table 3.2.4). Power plants that have a capacity between 10 kW and 4 MW (for wind technology) / 1 MW (for other technologies) benefit from FITs. For self-consumption producers

[8] Tariffs are calculated based on project costs plus a relevant return

which have a capacity below 200 kW will benefit from net-metering[9] support. 2-year quotas for FIT (2018-2020) are determined by the Government and shown in Table 3.2.4 (RES Legal Europe, 2019b; IRENA, 2019).

Table 3.2.4 – RES capacity quotas of Moldova in electricity under the supporting scheme, Source: RES Legal Europe, 2019b; IRENA, 2019

Type of Technology	Quotas (MW)	
	Classic FIT	Auctions
Wind	20	80
Solar PV	15	25
Biogas	12	8
CHP	5	-
SHPP	3	-
TOTAL	**55**	**113**

Threshold capacity for small installations in auctions is 4 MW for wind and 1 MW for other RES technologies. According to EnC (2018), the first auction is expected to accomplish in 2019. Auctions will be carried out by the Tendering Commission, which consists of:

- the Ministry of Economy and Infrastructure
- the Ministry of Agriculture
- Regional Development and Environment
- Agency of Land Relations and Cadastre
- Energy Efficiency Agency
- Public Property Agency.

Companies must have pre-qualification criteria to participate in the auction. These are (IRENA, 2019):

- Financial credibility
- Connection to grid
- Technical credibility
- Eligibility of location

3.2.3.2 Transport

Moldova's 2020 RES-T target by NREAP is 7%. However, there has been no actions and legal regulations promoted in the transport sector to stimulate the consumption of biofuel. And also, there has been lack of infrastructure for biofuel production. Therefore, Moldova has to import

[9] "Net metering allows residential and commercial customers who generate their own electricity from solar power to sell the electricity they aren't using back into the grid." (SEIA, 2020).

fossil fuels to supply its fuel demand (IRENA, 2019). The current legislative framework does not include a law concerning the regulation of biofuel production under sustainability requirements, as well as the introduction of an obligation on the use of blended fuels and biofuels in the transport sector.

3.2.3.3 Heating and Cooling

Moldova has enacted the "Law on heat and promotion of cogeneration, No. 92 of May 29, 2014" to regulate the H&C sector. "Article 1. Subject of the law" defines this law: "This law regulates specific activities of systems of centralized heat supply for the purpose of increase in energy efficiency in the economy in general and decrease in a negative impact of the energy sector on the environment, including by means of the use of cogeneration technologies." (ERRA, 2019).

Moldova aims to avoid inefficient buildings and increase the efficiency of buildings by "Energy Performance of the Buildings Directive (EPBD)". Local authorities should employ action plans energy efficiency measures to increase the energy performance of the buildings in their local programs according to EPBD. The government of Moldova has set up heating and hot water systems in public buildings (schools, kindergarten, medical facilities, etc.) by EPBD. This project financed by international organizations (e.g. EBRD). Furthermore, approximately 1000 small residential boiler (41.2 MW thermal capacity) were installed through government grants for RES heating. Many inefficient coal/gas-fired boiler systems have been reconstructed by biomass heating units (straw, pellets, briquettes and firewood) (IRENA, 2019).

3.2.4 Prospects for RES in the Electricity Sector until 2030

At EU level a first edition of national energy and climate plan up to 2030 was established by EC in 2014. According to EC, at EU level the 2030 RES target should be at least 27% (EC, 2014). However, the 2030 RES target at EU level was updated and adopted by EC in 2018 with more ambitious EU target of 32.5% within the Amending Energy Efficiency Directive (EU) 2018/2002 (Resch et al., 2019).

The 2030 RES targets at CP level are not yet defined. 2030 RES targets at CP level are expected to be adopted by mid-2021 (Balkan Green Energy News, 2019). This section discusses the prospect for RES-E until 2030 in Moldova.

Resch et al. (2019) provides suggestions for establishing overall 2030 RES share and RES targets and indicates corresponding prospects for RES developments within each sector. Within Resch et al. (2019), three scenarios have been derived for assessing the 2030 RES-E potential: "No Policy", "RE target fulfilment - without RE cooperation" and "RE target fulfilment - with RE cooperation" (Resch et al., 2019, Page156-160) as explained in further detail in Annex III.

The scenario "RE target fulfilment - with RE cooperation" shows the highest 2030 RES deployment whereas the scenario "No Policy" shows the lowest one. Differences between assessed electricity generation from RES in 2030 and assessed 2030 RES-E share according to scenarios are shown in Figure 3.2.12. Assessed 2030 RES-E share has a range between 14 and 16% and their corresponding electricity generation are between 1.7 and 1.8 TWh. "No Policy" scenario has the lowest 2030 RES-E share (14%). "RE target fulfilment - with RE cooperation" and "RE target fulfilment - without RE cooperation" have the highest 2030 RES-E share (16%).

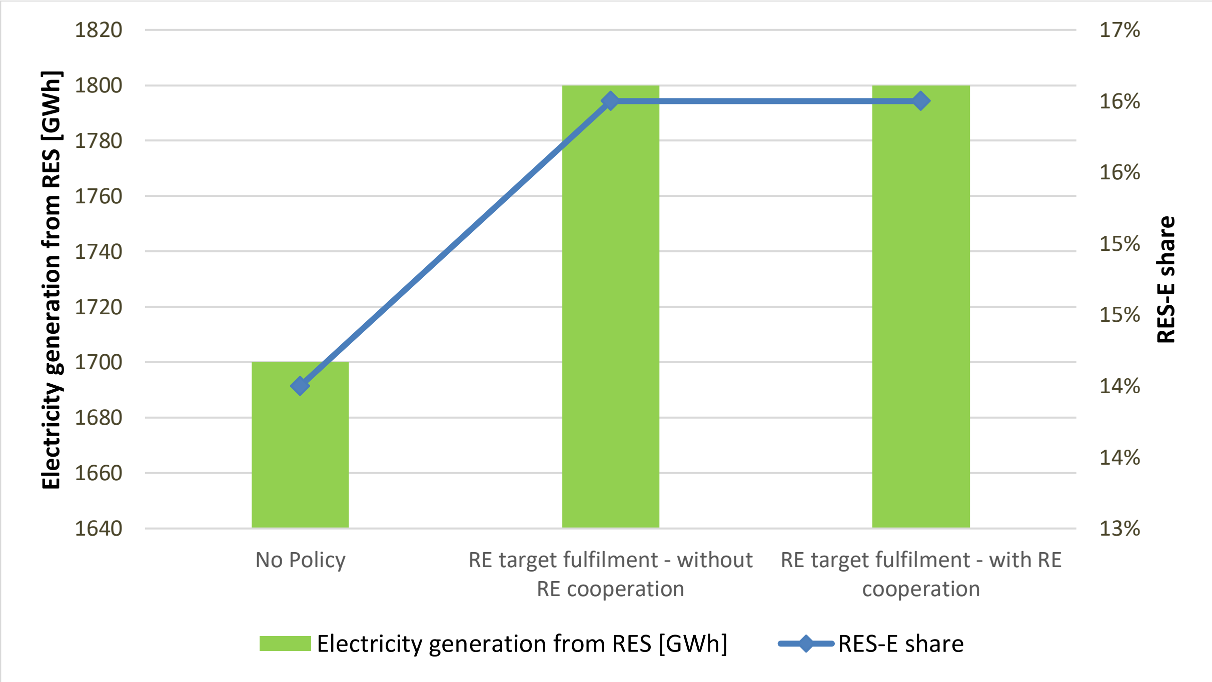

Figure 3.2.12 – 2030 RES-E share and electricity generation from RES in Moldova according to assessed scenarios, Source: Resch et al., 2019

There is no SLED report for Moldova. As a consequence, we cannot compare the assessed RES-E share by Resch et al. (2019) with the SLED report. According to Resch et al. (2019), assessed RES-E share in 2030 is between 14 and 16%.

Support Levels for RES-E

Moldovan Sustainable Energy Financing Facility (MoSEFF) was established in September 2009 by EBRD to support investments in energy efficiency (MIA, 2019). MoSEFF's task is to provide credit and grants, as well as to provide technical assistance for energy efficiency investments enterprises (Build Up, 2016)

Furthermore, Moldova Government has decreased value-added-tax (VAT) to 8% for biomass and 0% for wind and solar PV energy by Law No. 281 of 16.12.2016. FIT support for wind energy is around 103.5€/MWh and for big wind investments around 70€/MWh. FIT support for solar PV is around 70€/MWh and for biogas 91.8€/MWh (MIA, 2019).

3.2.5 Lessons learned

Moldova is an energy-dependent country with a moderate amount of natural resources as described in section 3.2.1. Steps taken by the Moldovan Government according to the EU Directives in RES have been partially effective. However, actual RES progress was still below expectations. The lack of legislation and limited regulations on RES support can be considered as the main reasons for this result.

Moldova has valuable primary energy sources of electricity. In particular, wind energy potential has an enormous part in these sources. Although Moldova has a high potential, the lack of necessary and sufficient legal infrastructure and regulations, and a variable FIT definition for each project, weaken the RES development in the electricity sector.

Although FITs are calculated according to the criteria determined by ANRE, the producers determine FIT themselves and send it to ANRE and receive approval from ANRE. FITs are not specifically determined for each technology and it appears as a negative application for investors. Therefore, more assurance to improve the bankability of RES projects should be provided by financial institutions in the market to increase the reliability of RES projects.

RES share in the H&C sector, which constitutes 52% of Moldova's GFEC, has surpassed the 2020 target in 2015 even without correction of biomass data between 2010 and 2016. “Law No 92” and “Law No 128/2014” have enabled the use of RES and increased energy efficiency in the H&C sector which has the highest energy consumption across all energy sectors.

Although the second-highest consumption was observed in the transport sector, Moldova has not obtained robust progress and legislation in the transport sector for RES share. Thus, RES-T share 2020 target should have a priority. However, the increase in RES-T share from 0% to 10% until 2020 seems not feasible.

Consequently, Moldova does not seem to be able to achieve its 2020 targets despite its moderate natural resources. The lack of regulations in the transport sector and the invariability of technology in the electricity sector are the main problems. The use of natural resources according to the needs in each sector and making legal arrangements, sanctions and incentives for them will be the main issues to be addressed to achieve the country's future targets.

3.3 Serbia

Serbia has been a member of the Energy Community as a CP since 1 July 2006. According to "Law on Rational Use of Energy" and the "Energy Law, which was adopted in December 2014 (Official Gazette of the RS, no. 145/2014)", the preparation and approval of NREAP (the establishment of 2020 targets and the providing relevant measures on renewable energy within EU Directives 2009/28/EC) obligated for Serbia.

According to the Decision of the Council of Ministers of Energy Community 2012/04/MC-EnC, 27% of Gross Final Energy Consumption (GFEC) of Serbia would be provided from Renewable Energy Sources (RESs) in 2020. In this context, according to National Action Plan for Renewable Energy Resources in Serbia, 2020 national targets for renewable energy in each sector to reach 27% RES usage in GFEC are (MEDEP, 2013):

- 36% RES share in the electricity sector (RES-E)
- 10% RES share in the transport sector (RES-T)
- 30% RES share in the heating and cooling sector (RES-H&C)

3.3.1 Assessment of Historical Progress of RES

2020 overall RES share target of Serbia is 27%. However, Serbia has not reached installed RES capacity target in 2015 (IRENA, 2017). According to IRENA (2017), the deployment of RES technologies has been negatively affected due to legal and financial obstacles.

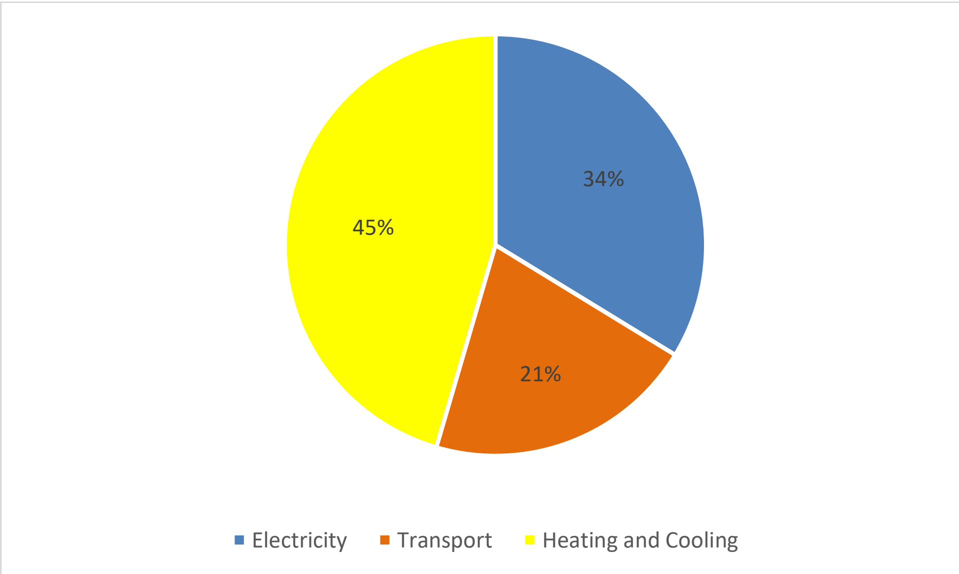

Figure 3.3.1 – Gross final energy consumption share in each sector of Serbia in 2017, Source: EUROSTAT, 2019

H&C sector has the highest energy consumption percentage (45% of GFEC) in 2017, followed by electricity (34%) and transport (21%), as it has been shown in Figure 3.3.1.

Table 3.3.1 and Figure 3.3.2 explain the RES share of each energy sector in GFEC in-between 2009 and 2017.

Table 3.3.1 – RES consumption share in each sector and GFEC of Serbia between 2009 and 2017, Source: EUROSTAT, 2019

Renewable energy shares in	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
Electricity Consumption [%]	28.25	28.18	27.53	28.51	27.97	30.28	28.92	29.16	28.72
Heating & Cooling Consumption [%]	26.50	23.20	21.09	23.20	25.15	28.85	26.54	24.65	24.43
Transportation Consumption [%]	1.46	0.67	1.88	2.00	1.68	1.17	1.18	1.23	1.18
Gross Final Energy Consumption [%]	21.02	19.76	19.12	20.79	21.10	22.87	21.85	20.99	20.61

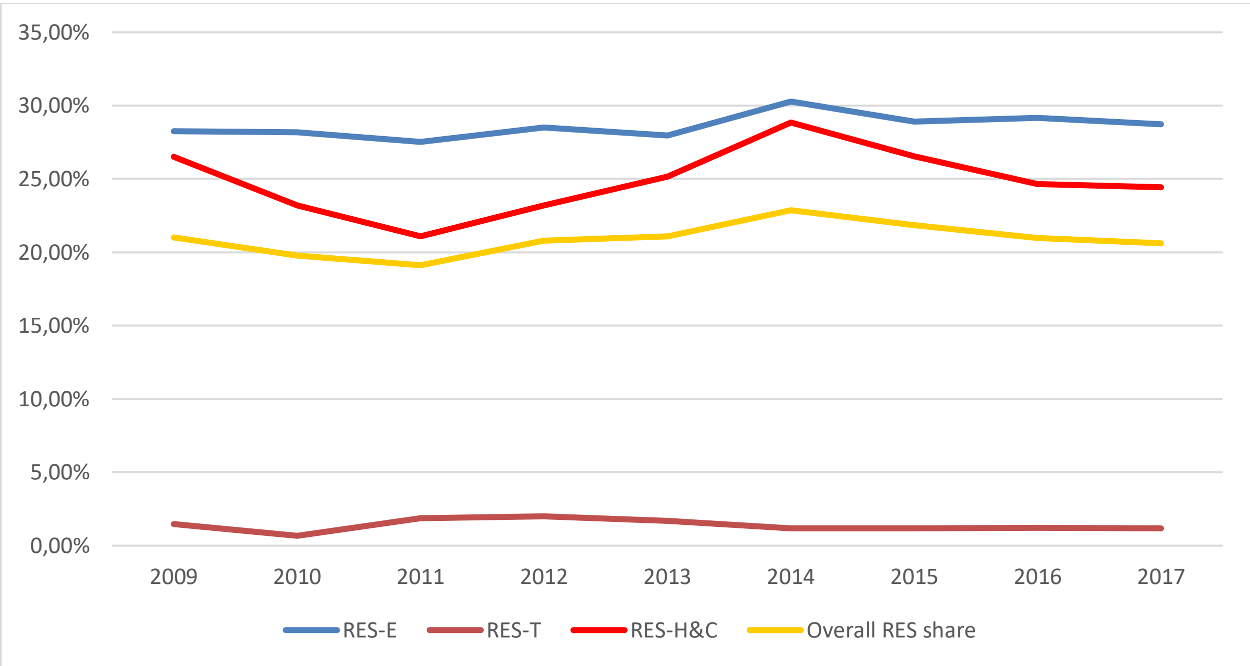

Figure 3.3.2 – Overall RES share progress and RES share progress in each sector of Serbia between 2009 and 2017, Source: EUROSTAT, 2019

The H&C sector is responsible for the vast share of GFEC in Serbia. RES-E has always the significantly highest share when compared to the RES share of other sectors. RES-E, RES-T and overall RES share have stable inertia since the beginning of NREAP Serbia. RES-H has unstable progress.

If we look at actual overall RES share and indicative overall RES share according to NREAP, actual overall RES share has decreased since 2014, although indicative overall RES share demonstrates an increase since 2011. Actual overall RES share was 2.5 percentage point (pp) lower than indicative overall RES share in 2017. In addition to that, the overall RES share in 2017 was 6.4 pp lower than the 2020 overall RES target (27%) (Figure 3.3.3). This is the case due to the increased final energy consumption and limited investments in newly added renewable energy capacities (EnC, 2018, Page 167).

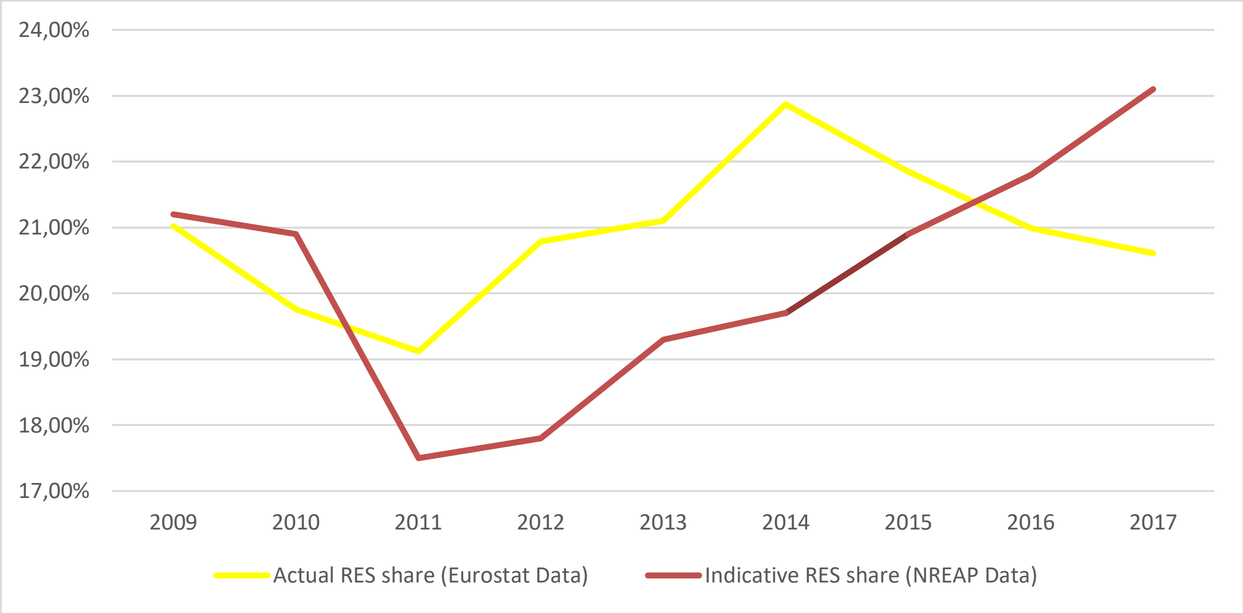

Figure 3.3.3 – Actual RES share and national RES objective share of Serbia between 2009 and 2017, Source: EUROSTAT, 2019; MEDEP, 2013

Figure 3.3.4 shows the comparison between Serbia's 2015/2016 actual RES trajectory, 2015/2016 indicative RES trajectory according to NREAP and 2020 overall RES target. The last two columns on the right side of the Figure 3.3.4 describe the difference between real progress and planned progress which shed light on the overall RES progress of Serbia. The fourth column shows the deviation between the actual median 2015/2016 overall RES share of GFEC and indicative median 2015/2016 overall RES share of GFEC. According to Figure 3.3.4, Serbia had 2.4 percentage points (pp) lower (-2.4 pp) overall RES share of GFEC progress than indicative overall RES share of GFEC progress. If we compare actual median 2015/2016 overall RES share of GFEC and overall 2020 RES target, it is obvious that the deviation between actual median 2015/2016 overall RES share of GFEC and 2020 overall RES target is -5.38 pp as it seems in the fifth column of Figure 3.3.4.

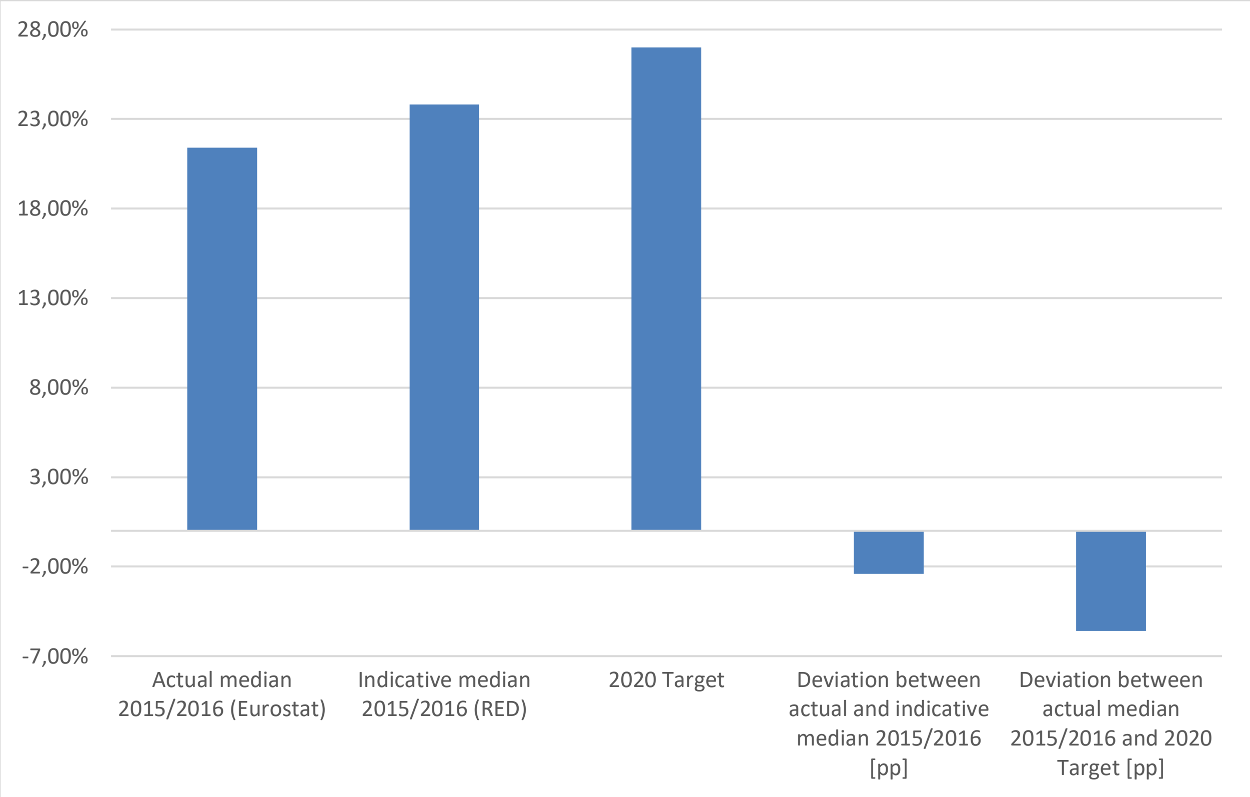

Figure 3.3.4 – Actual and indicative median 2015/2016 overall RES share of GFEC, 2020 overall RES share target and the deviation of the actual median 2015/2016 RES shares of GFEC from the renewable energy directive (RED), indicative median 2015/206 and 2020 NREAP RES target in percentage points of Serbia, Source: EUROSTAT, 2019; MEDEP, 2013

3.3.1.1 Electricity

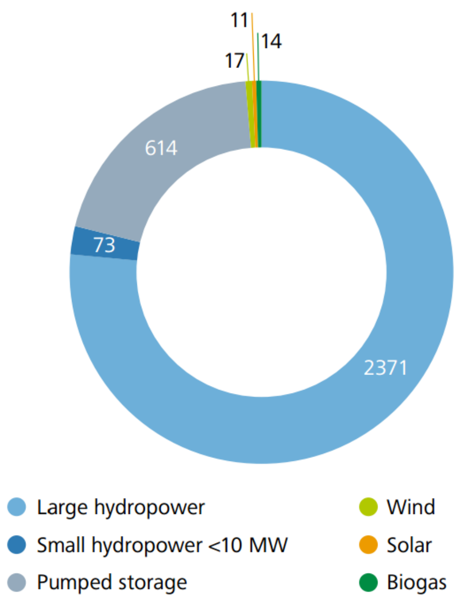

Figure 3.3.5 – Total capacity of RES-E in Serbia (2017) [MW], Source: EnC, 2018

The national power utility Elektroprivreda Srbije (EPS – Power Industry of Serbia) dominates the vast majority of the electricity market in Serbia (Emergingeurope, 2018). The total installed electricity capacity is approximately 7.7 GW and total installed electricity capacity from RES is 3.1 GW in Serbia (EPS, 2019; EnC, 2018). As it is shown in Figure 3.3.5, the RES capacity from HPPs (which is 2,371 MW) corresponds to more than 75% of the total capacity of RES-based power plants in the electricity sector.

70% of electricity generation of Serbia is coal-based (with 3.9 GW capacity) (due to abundant coal reservoirs), followed by HPPs (with 2.4 GW capacity) and gas power plants (with 353 MW capacity). Figure 3.3.5 shows RES technology capacities of Serbia to generate electricity in 2017. Serbia has approximately 2.4 GW hydropower, 0.6 GW pumped storage, 11 MW solar, 14 MW biogas and 17 MW wind energy capacities in 2017.

Serbia has approximately 12% transmission and distribution losses due to its lack of infrastructure (i.e. old and inadequate) (SOSS, 2017; EnC, 2016). Furthermore, according to "Official Gazette of the RoS" No. 122/12 in 2013, electricity import in 2011 was 30.28% (MEDEP, 2013). According to IRENA (2017), “despite the country’s plans, however, only 10.4 MW of wind energy had been developed by early 2016, including a 9.9 MW wind farm that was commissioned in November 2015”.

Figure 3.3.6 shows electricity generation from RES and total electricity consumption between 2009 and 2017 in Serbia. Electricity production from RES is almost a steady-state between 2009 and 2017.

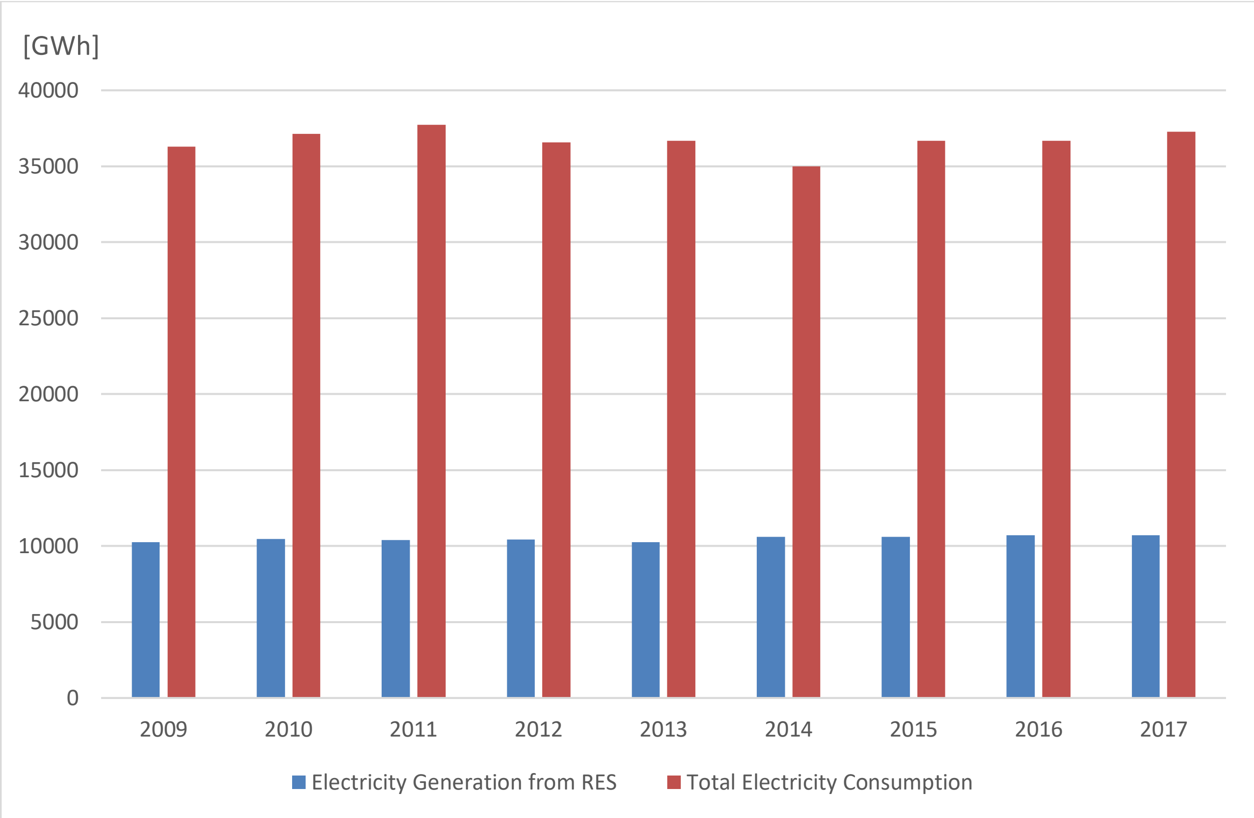

Figure 3.3.6 – Total electricity consumption and electricity generation from RES in Serbia between 2009 and 2017 [GWh], Source: EUROSTAT, 2019

3.3.1.2 Transport

Although the 2020 RES share target of Serbia in the transport sector (RES-T) is 10%, its share in 2017 was still 1.18%. According to Figure 3.3.7, although the RES-T share target would have a regular increase between 2014 and 2017, the real contribution of RES-T had no noteworthy progress since 2014. The indicative RES-T share according to NREAP was approximately 5% in 2017. Due to energy consumption in the transport sector has an increase, RES-T had no noteworthy increase (Figure 3.3.8).

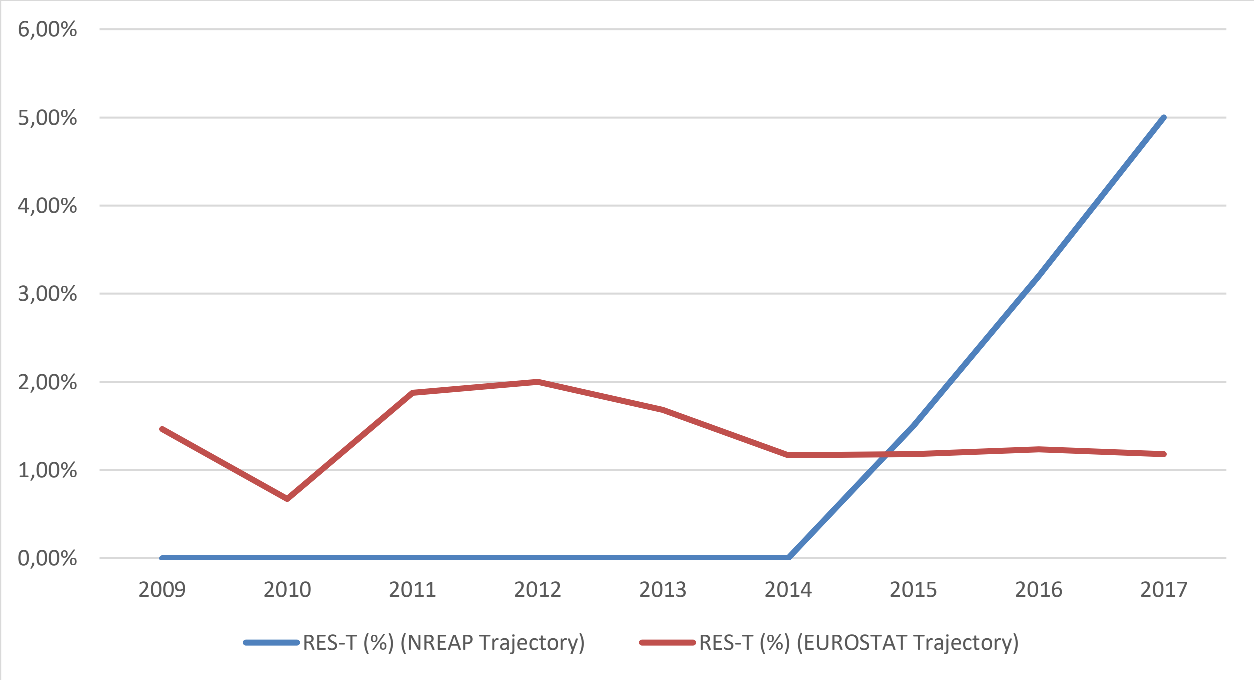

Figure 3.3.7 – The indicative trajectory and actual trajectory of RES-T in Serbia between 2009 and 2017, Source: MEDEP, 2013; EUROSTAT, 2019

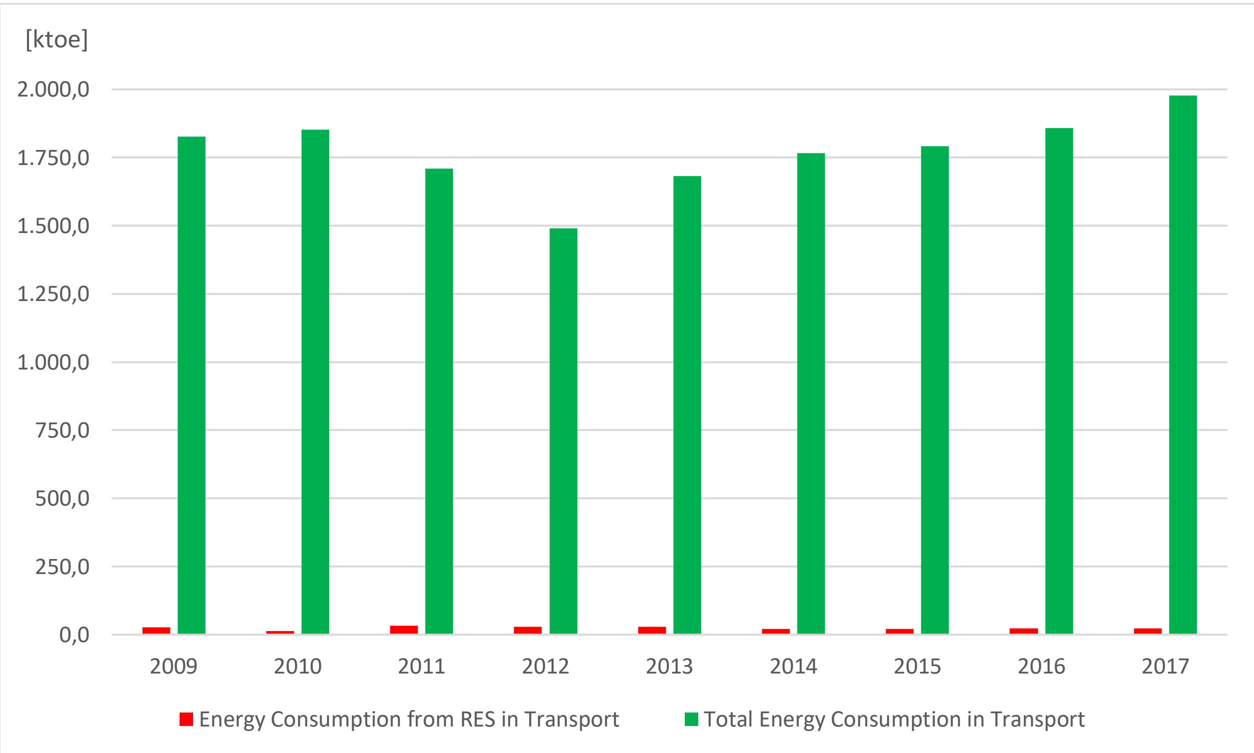

Figure 3.3.8 – Total energy consumption and energy consumption from RES in the transport sector of Serbia between 2009 and 2017 [ktoe], Source: EUROSTAT, 2019

3.3.1.3 Heating and Cooling

The major used energy sources for H&C are respectively wood (34%), electricity (20.1%), coal (10.5%) and natural gas (9.6%). Furthermore, district heating (DH) has more than 25% share of household heating (KeepWarm, 2020). Geothermal heat pumps play an important role as a competitor to DH and DH preferred when DH and natural gas connection exist (E&P, 2017).

The combined heat and power plants (CHPs) increase the usability and efficiency of biomass or biogas which save the operational and total costs of power plants significantly (Energetski Portal, 2019). Furthermore, 57 towns have DH with the total capacity of boilers 6,587 GW to produce and deliver affordable prices also to provide effective usage of biomass in H&C sector (SOSS, 2017; CeSID, 2013). According to organization CoolHeating (2016), the DH in Serbia is primarily fuelled by fossil fuels such as natural gas, lignite/coal and fuel oil.

Although total energy consumption in the H&C sector is unstable, energy consumption from RES in H&C has insignificant progress between 2009 and 2017. The peak consumption in H&C was in 2011 by 4879.9 ktoe. On the contrary, the less consumption in H&C was in 2014 with 3607.7 ktoe. If we compare the base year 2009 to 2017, it is observed that there has been 0.08% increase in H&C total consumption and 0.004% decrease in H&C total consumption from RES. Therefore, RES share in H&C 2017 has been decreased by 2.07% in comparison to 2009 (Table 3.3.2).

Table 3.3.2 – Energy consumption and RES share in GFEC of Serbia in the H&C sector between 2009 and 2017 [ktoe], Source: EUROSTAT, 2019

Energy Consumption in H&C/Year	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
Solid Biomass [*ktoe*]	1055	1027	1023	1025	1035	1031	1036	1039	n.a.
Biogas [ktoe]	4.9	5.4	6.3	6.2	4.5	5.6	6.1	5.1	n.a.
Geothermal [ktoe]	0.0	0.0	0.0	0.0	0.3	2.1	2.4	2.3	n.a.
Total RES-H&C Consumption [*ktoe*]	1060	1032	1029	1032	1035	1041	1045	1047	1055
Total Energy Consumption in H&C [*ktoe*]	4000	4449	4880	4445	4115	3608	3936	4246	4320
RES Share in Total H&C Demand [%]	26.5	23.2	21.09	23.2	25.1	28.85	26.54	24.65	24.43

In Figure 3.3.9, total energy consumption in the H&C sector and energy consumption from RES in the H&C sector of Serbia are shown between 2009 and 2017 (EUROSTAT, 2018).

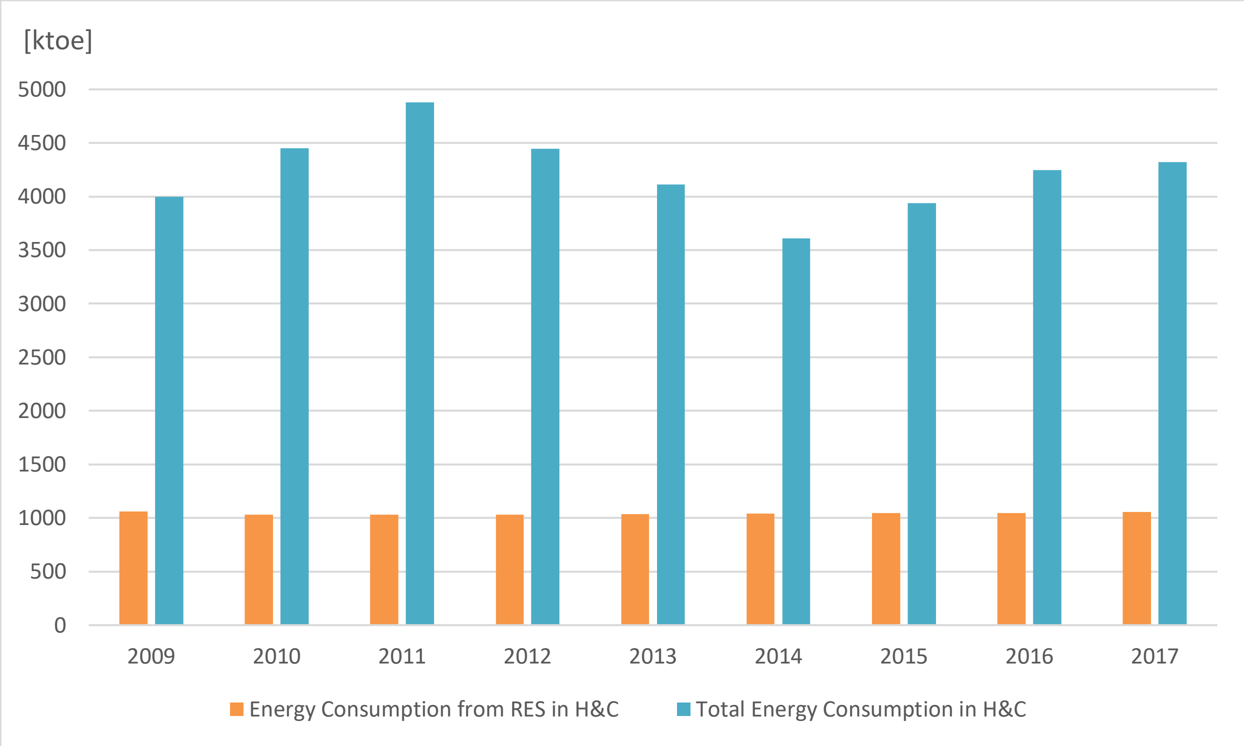

Figure 3.3.9 – Energy consumption from RES and total energy consumption in theH&C sector of Serbia between 2009 and 2017 [ktoe], Source: EUROSTAT, 2019

3.3.2 Potential of Renewable Energy in the Electricity Sector

3.3.2.1 General Overview

To make an outlook for the potential of RES-E, technical and cost-competitive potentials should be considered. If the technical potential is not cost-competitive, investors do not tend to invest. In this case, cost-competitive potential has a key role for investors. LCOE range and average LCOE in each RES technology give us information about cost-competitive price to compare the RES technologies.

LCOE range and weighted average of RES technologies in Serbia are shown in Figure 3.3.10. As stated in Figure 3.3.10, average LCOEs are 120€/MWh for solar PV, 115€/MWh for wind, 60€/MWh for hydropower, 80€/MWh for biomass and 120€/MWh for geothermal energy technologies. The cheapest RES technology from today's perspective is hydropower and the most expensive one is geothermal energy.

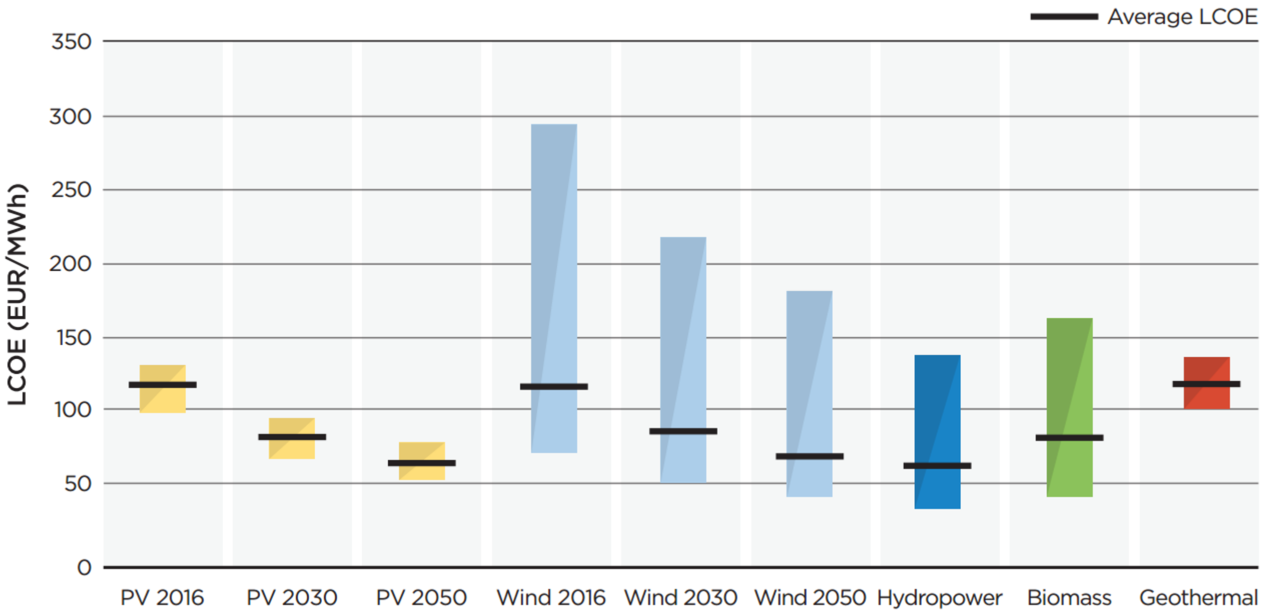

Figure 3.3.10 – LCOE ranges and weighted averages of renewable energy technologies (medium cost of capital) in Serbia, Source: IRENA, 2017

Table 3.3.3 shows the installed electrical capacity of RES technologies in 2009 and 2015, electricity generation in 2015 and planed 2020 RES capacity targets according to the NREAP. These numbers are compared to additional cost-competitive potential capacities in 2016, 2030 and 2050 and their corresponding electricity generation potential. Technical electricity capacity and electricity generation potentials are also expressed in this table. The low additional cost-competitive potentials correspond to the high cost of capital scenario whereas the high additional cost-competitive potentials refer to the low cost of capital scenario. As we can see in Table 3.3.3, the total cost-competitive potential of wind and biomass are under both scenarios higher than the 2020 RES NREAP targets. However, the total cost-competitive potential of all RES technologies is under the best scenario higher than the 2020 RES NREAP targets. Although technical hydropower potential relatively higher than the 2020 RES target, the cost-competitive potential is approximately 30% of 2020 hydropower capacity by NREAP (IRENA, 2017).

Table 3.3.3 – Capacity and energy potential for RES-based electricity in Serbia, Source: IRENA, 2017

Technologies	2009	2015		2020 (NREAP)	Additional cost-competitive potential			Technical potential	
	MW	MW	GWh	MW		MW	GWh	MW	GWh
Solar PV	0.0	10.8	9.2	10.0	2016	0 - 165.5	0.0 - 243.0	6,901.7	9,307.5
					2030	6,742.3 - 6,890.9	9,093.3 - 9,298.2		
					2050	6,890.9	9,298.2		
Wind	0.0	0.5	0.7	500.0	2016	116.8 - 5,598.9	305.7 - 11,473.9	29,670.0	52,386.4
					2030	24,387.6 - 28,748.4	45,093.7 - 51,362.5		
					2050	29,455.6 - 29,635.0	52,187.1 - 52,359.4		
Hydro	2,838.0	2,898.0	11,005.8	3,276.0		1,152.0	4,456.1	4,736.0	18,000.0
≤ 10 MW	16.0	63.2	240.0	204.0		98.0	401.2	500.0	1,900.0
> 10 MW	2,208.0	2,220.8	20,765.8	2,458.0		1,054.0	4,054.9	4,236.0	16,100.0
Pumping	614.0	614.0	0.0	614.0		n.a	n.a	n.a	n.a
Biomass	0.0	4.9	21.9	143.0		129.9-1,194.3	820.5 - 7,475.7	1,671.0	10,446.0
Biogas	0.0	4.9	21.9	43.0		129.9-197.3	820.5 - 1,241.7	674.0	4,212.0
Solid Biomass	0.0	0.0	0.0	100.0		0.0 - 997.0	0.0 - 6,234.0	997.0	6,234.0
Biowaste	n.a	n.a	0.0	0.0		0.0	0.0	109.0	651.0
Geothermal el.	0.0	0.0	0.0	1.0		0.0 - 10.0	0.0 - 70.0	10.0	70.0
Total (2016)	2,224.0	2,914.2	11,037.6	3,316.0	2016	1,398.7 - 8,120.7	5,582.3 - 23,718.7	42,988.7	90,209.9

3.3.2.2 Hydropower

Serbia has approximately 4.7 GW technical hydropower potential. However, only 50% is in use (Table 3.3.3). In addition to 50% hydropower usage, there is still more than 1 GW cost-competitive hydropower potential and this potential is enough to reach 2020 RES-hydropower target of Serbia by NREAP. For instance, it is possible by using the rivers Ibar, Morava, Danube and Drina. LCOE of hydropower in Serbia is about 60€/MWh. This is the cheapest RES technology in Serbia. Because of this reason all regulations and concessions are mostly based on hydropower technology (IRENA, 2017).

3.3.2.3 Solar PV and Wind

Moreover, the share of RES deployment in Albania could be increased by the enhanced use of wind and solar PV energy, which both have significant potential. These resources play an important role to reach the 2020 overall RES target. Moreover, they would increase the diversity of RES and sustainability in the electricity sector.

Figure 3.3.11 and Figure 3.3.12 demonstrate the respectively cost-competitive potential of PV and wind energies. LCOE begins for solar PV technology above 85€/MWh and wind technology above 70€/MWh in the most suitable locations for both technologies (Figure 3.3.11 and Figure 3.3.12).

As stated in Figure 3.3.11, cost-competitive PV potential is around 160 MW according to the best (lowest), 0 MW according to middle and worst (highest) WACC scenarios. Furthermore, cost-competitive wind potential is around 5.6 GW according to the best, 400 MW according to the middle and 110 MW according to worst WACC scenario as stated in Figure 3.3.12. While solar energy remains zero cost-competitive potential, wind energy has 110 MW cost-competitive potential even in the worst WACC scenario. As a result, we can deduce that wind has significantly higher cost-competitive potential than solar PV. This validates if mandatory policies and supports are provided, investment in wind energy is rational even in the worst WACC scenario. Averaged LCOE and weighted average of renewable energy for different technologies and forecasted values for 2030 and 2050 are demonstrated in Figure 3.3.10. Therefore, the cheapest RES technology in Serbia is hydropower.

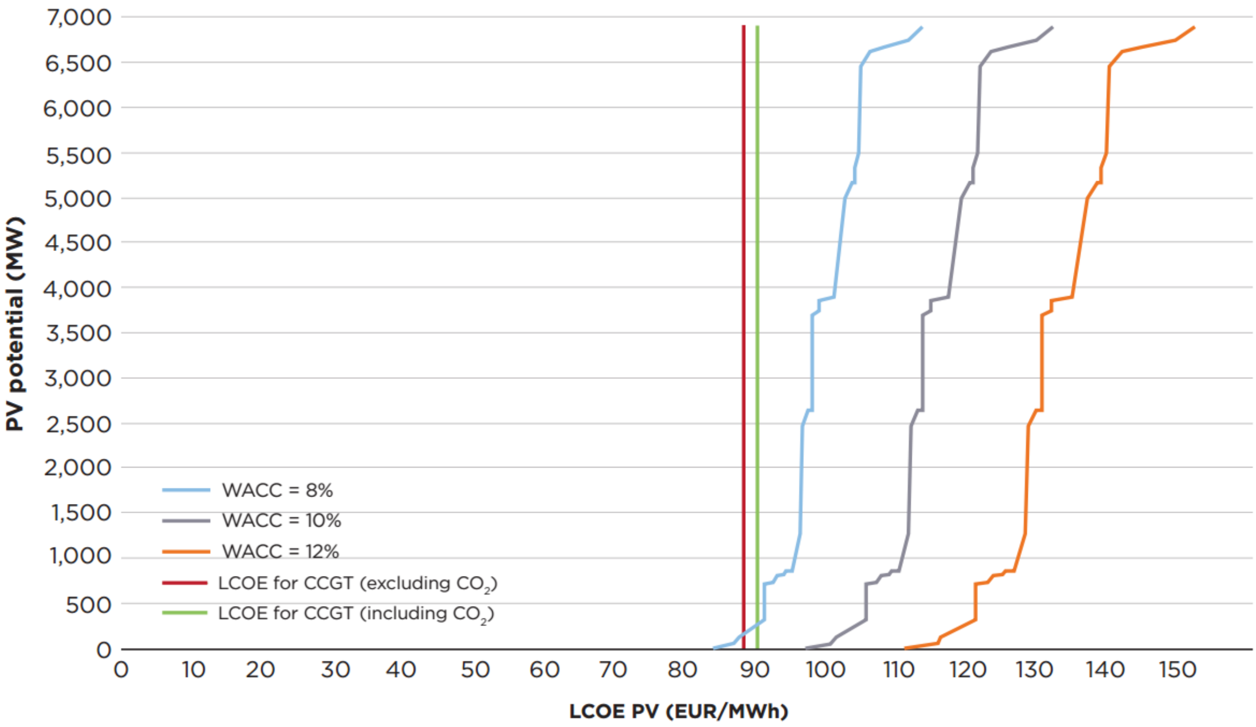

Figure 3.3.11 – Cost-competitive solar PV potential of Serbia in 2016, Source: IRENA, 2017

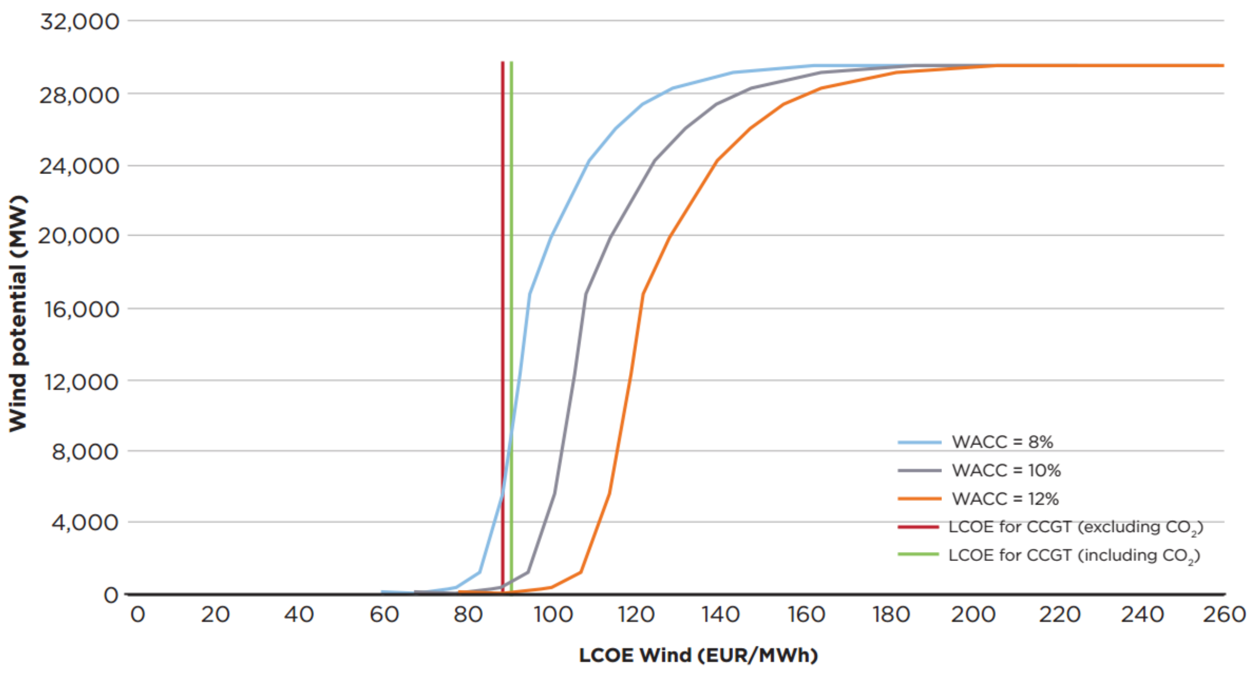

Figure 3.3.12 – Cost-competitive wind potential of Serbia in 2016, Source: IRENA, 2017

3.3.2.4 Biomass

Biomass is an essential RES in Serbia, which has the third-highest cost-competitive RES-E potential in South-East Europe (SEE) after Ukraine and Romania (IRENA, 2017). The estimated total technically available potential of RES in Serbia is 5.65 million toe per year. 1.1 million toe of this potential is already used mainly in the form of biomass (primarily wooden biomass for heating) (Banjac et al., 2013). Biomass is used mostly in H&C sector. According to data by IEA (2020b), electricity generation from waste was 5 GWh and from biofuels 75 GWh. If it is compared with the total electricity generation by source in 2017, it has 0.002% share in total electricity generation (IEA, 2020b).

3.3.3 Policy Framework for Renewable Energy

Serbia maintains significantly slower RES progress (compared to other selected CPs) which is caused primarily by lack of a bankable Power Purchase Agreement (PPA) (IRENA, 2017). Despite policy framework improvements recently, complex procedures to receive permits causes further obstacles (IRENA, 2017; Continental Wind Serbia, 2016).

Previously, investors exposed to complicated paper-work and long procedures to develop a project (Opačić, 2016). Furthermore, land ownership rights in Serbia obligates the acquisition of the property before the permit process, which decelerates the project development (Continental Wind Serbia, 2016). The Law on Planning and Construction in 2014, which started to be used in early 2016, simplifies the regulations by separating the construction (under ministry) and managing a unified procedure for permissions (under local jurisdiction). In addition to that, this law provided an electronic permit procedure, which streamlines the permission process (IRENA, 2017). In this section, progress concerning the policy framework of RES is discussed in each energy sector.

3.3.3.1 Electricity

Electricity supply and prices are regulated by Energy Agency of the Republic of Serbia (AERS) and guaranteed for all small costumers according to the Energy Law (Official Gazette of the RS, no. 145/2014), from January 1, 2015 (SOSS, 2018).

Despite the introduction 92€/MWh FIT in 2009 for 12 years, which is considered to be sufficient by the investors, wind energy demonstrated a slow expansion (IRENA, 2017). On the other hand, Čibuk-1 wind farm project consists of 57 wind turbines and corresponds 158 MW capacity, which is still in the construction phase and planned to supply the electricity demand of 113,000 houses. Adoption of new PPA before Cibuk-1 project shows the commitment of Serbia and provides the security of investors even before project construction (Masdar, 2019). Furthermore, investors are obligated to deposit 2% of the total amount of investment as preliminary PPA (P-PPA), which is non-refundable even for terminated projects. According to IRENA (2017), there are around 800 MW wind projects that have acquired the P-PPA since 2013. This might increase the possibility to reach the 2020 wind capacity target according to NREAP. In contrast, reaching the 2020 hydropower capacity target is unlikely due to projects that are still at the development phase (Continental Wind Serbia, 2016; Kalmar Kranjski Jovic, 2016).

Due to the fear of an increase in electricity price, there has been a significantly small quota for 2020 solar PV capacity (10 MW). This quota has already been reached in 2015. Subsequently, there has been a lack of further solar PV support. Furthermore, there has been a lack of promotion or local assistance for small-scale solar PV investors such as family houses (Continental Wind Serbia, 2016).

According to the Government’s Decree investors with the privileged status of biomass, biogas or landfill gas plants have been encouraged by the reassuring purchase price within 12 years, while the investment return period is between 7 to 9 years. Although biomass, biogas, landfill gas and waste power plants have a quota, the capacity is mostly still free. To support biomass usage necessary regulations and law are declared in detail in “Construction of Plants and Electricity/Heat Generation from Biomass in the Republic of Serbia – Guide for investors, 2016” (Energetski Portal, 2019).

3.3.3.2 Transport

The new Energy Law in Serbia is adopted on 29th December 2014, which includes specific regulations about biofuels such as: “the Decree on Quality of oil products and biofuels; the Decree on Biofuel blending mandates; the Decree on Sustainability criteria for biofuels; the

Decree on Incentives for biofuels" (EBTP, 2016). However, according to MME (2017), there has been a lack of robust information about biofuels consumption in the transport sector due to the belated adaptation of by-laws about biofuels.

3.3.3.3 Heating and Cooling

In the H&C sector, as in the electricity and transport sectors, regulations are specified in Energy Law and determined by by-laws. The H&C sector in Serbia was responsible for 46% of GFEC in 2016.

CHP and DH have vital importance in H&C sector of Serbia. According to Elektroprivreda Srbije (EPS), CHPs have 505 MW capacity for H&C power generation. And also, according to Bojan Bogdanovic (Deputy Director of Engineering, Public Utility Company „Beogradske elektrane"), supplying the DH system with solar energy (25-35€/MWh) will be cheaper than gas-fired district heating or coal boilers (45€/MWh) (Bogdanovic et al., 2019).

There is also no FIT for biomass usage in H&C sector, while a FIT for electricity generation from biomass is available.

3.3.4 Prospects for RES in the Electricity Sector until 2030

At EU level a first edition of national energy and climate plan up to 2030 was established by EC in 2014. According to EC, at EU level the 2030 RES target should be at least 27% (EC, 2014). However, the 2030 RES target at EU level was updated and adopted by EC in 2018 with more ambitious EU target of 32.5% within the Amending Energy Efficiency Directive (EU) 2018/2002 (Resch et al., 2019).

The 2030 RES targets at CP level are not yet defined. 2030 RES targets at CP level are expected to be adopted by mid-2021 (Balkan Green Energy News, 2019). This section discusses prospects for RES-E until 2030 in Serbia to make an outlook for 2030 RES deployment based on the comparison of assessed 2030 RES scenarios in the electricity sector by Mezősi et al. (2015b) and by Resch et al. (2019). Assessed scenarios by Mezősi et al. (2015b) and by Resch et al. (2019) investigate the assessed 2030 RES-E deployment and 2030 RES-E share of Serbia.

The Support for Low-Emission Development in South-Eastern Europe (SLED) Project (Mezősi et al., 2015b) suggests an approach to set decarbonisation targets for the electricity sector up to 2030 in Serbia. There are three decarbonisation scenarios to assess the decarbonisation potential: Reference (REF), Currently Planned Policies (CPP), Ambitious (AMB) (Mezősi et al., 2015b) as illustrated briefly below and as shown in detail in Annex II - Table 3.31. Although energy capacities for each scenario until 2020 are the same, they are significantly different from each other in 2030 scenarios.

RES-E capacity deployments between 2020 and 2030 for each scenario are demonstrated in Figure 3.3.13. According to these capacity increases and estimated economic conditions, support budgets differ in each scenario and year.

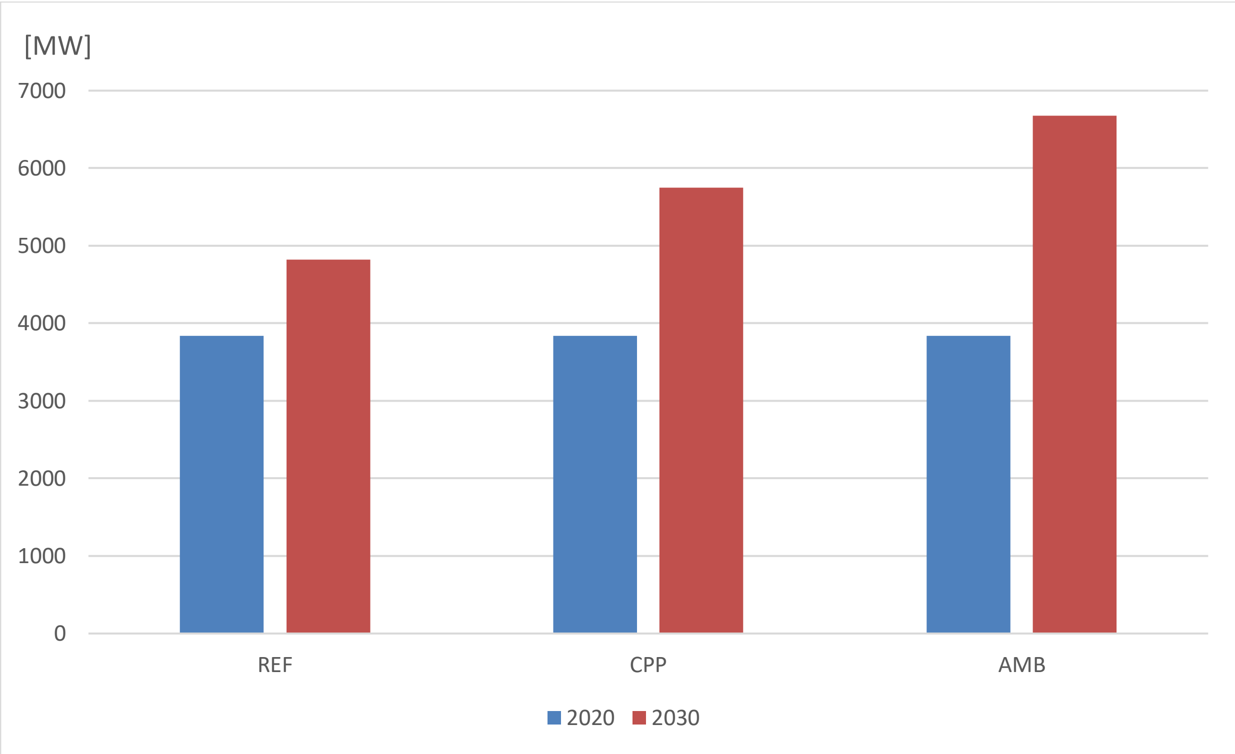

Figure 3.3.13 – Total RES-E capacity deployment in Serbia according to assessed scenarios [MW], Source: Mezősi et al., 2015b

According to assessed scenarios, the calculated electricity generation mix in each scenario is shown in Figure 3.3.14. As illustrated therein electricity generation from RES in 2030 amounts approximately:

- 14470 GWh in REF scenario,
- 17895 GWh in CPP scenario,
- 20790 GWh in AMB scenario.

Table 3.3.4 demonstrates the development of gross electricity consumption according to assessed scenarios over time. With the information given in Figure 3.3.14 and Table 3.3.4, the RES-E share for 2030 can be estimated;

- REF scenario: 33%
- CPP scenario: 43%

- AMB scenario: 53%.

Table 3.3.4 – Gross electricity consumption in Serbia according to assessed scenarios [GWh], Source: Mezősi et al., 2015b

GWh	2015	2016	2017	2018	2019	2020	2025	2030
REF	40,230	40,050	39,871	39,691	39,511	39,332	41,416	43,824
CPP	38,895	38,567	38,258	37,940	37,622	37,303	39,182	41,410
AMB	37,559	37,103	36,646	36,189	35,732	35,275	36,948	38,995

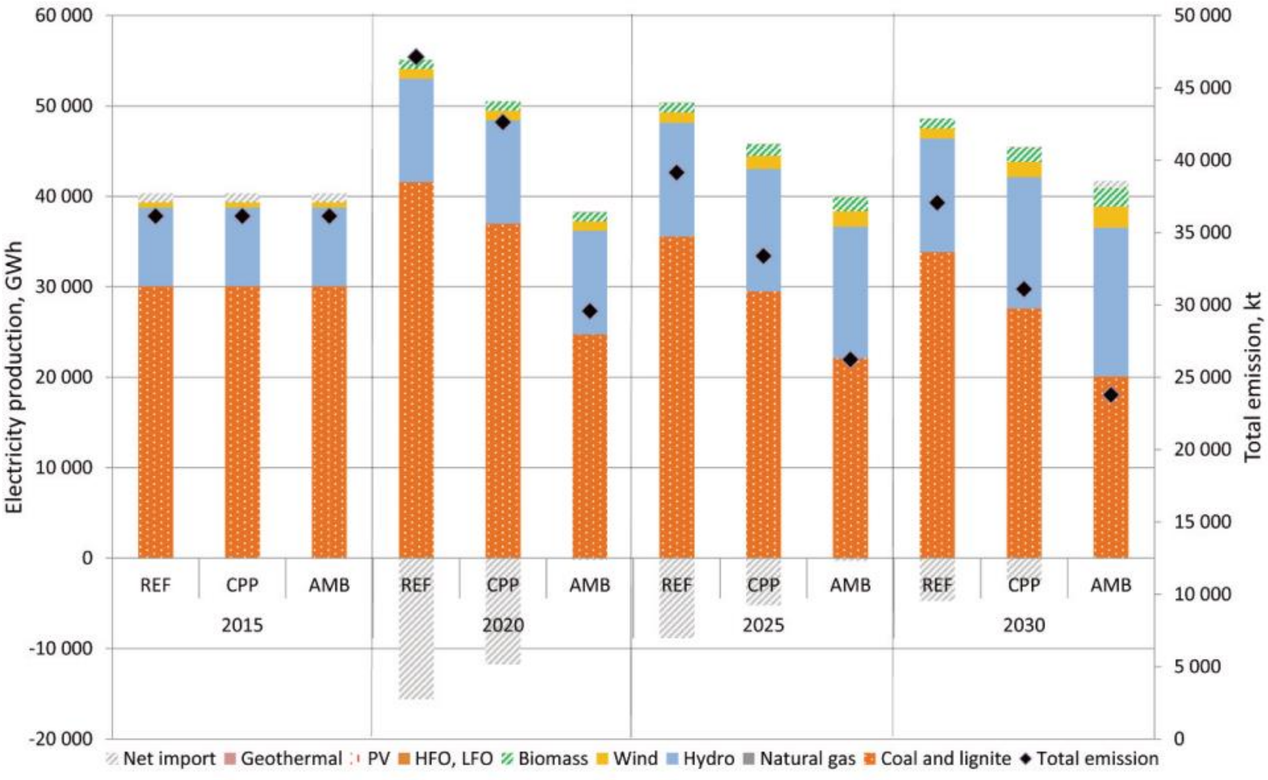

Figure 3.3.14 – Generation mix, net imports and CO_2 emissions in Serbia according to assessed scenarios[10], Source: Mezősi et al., 2015b

On the other hand, Resch et al. (2019) provides suggestions for establishing overall 2030 RES share and RES targets and indicates corresponding prospects for RES developments within each sector. Assessed RES-E share until 2030 by Resch et al. (2019) is used in this thesis to make a comparison with assessed RES-E share until 2030 according to Mezősi et al. (2015b). Within Resch et al. (2019), three scenarios have been derived for assessing the 2030 RES-E potential: "No Policy", "RE target fulfilment - without RE cooperation" and "RE target fulfilment - with RE cooperation" (Resch et al., 2019, Page156-160) as explained in further detail in Annex III.

[10] Figure 3.3.14 is estimated actual RES share in 2015 (Mezösi et al., 2015b).

The scenario "RE target fulfilment - with RE cooperation" shows the highest 2030 RES deployment whereas the scenario "No Policy" shows the lowest one. Differences between assessed electricity generation from RES in 2030 and assessed 2030 RES-E share according to scenarios are shown in Figure 3.3.15. Assessed 2030 RES-E share has a range between 38 and 71% and their corresponding electricity generation are between 15.5 and 28.9 TWh. "No Policy" scenario has the lowest 2030 RES-E share (38%) and "RE target fulfilment - with RE cooperation" has the highest 2030 RES-E share (71%).

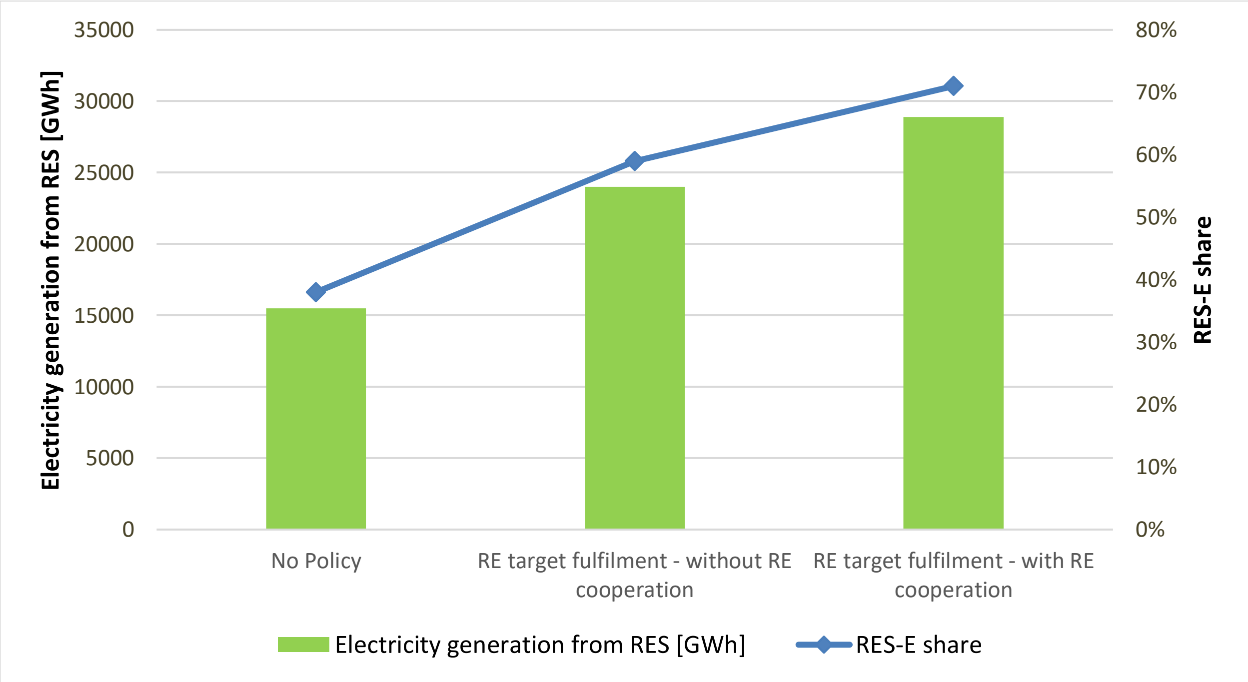

Figure 3.3.15 – 2030 RES-E share and electricity generation from RES in Serbia according to assessed scenarios, Source: Resch et al., 2019

Figure 3.3.16 compares the assessed RES deployment in 2030 according to assessed scenarios by Mezősi et al. (2015b) and Resch et al. (2019). Moreover, Figure 3.3.17 compares the corresponding RES-E shares in 2030 according to both studies. In general terms, assessed scenarios by Resch et al. (2019) assume stronger energy efficiency measures than assessed scenarios by Mezősi et al. (2015b). This implies that electricity demand according to the assessed scenario by Resch et al. (2019) is lower than electricity demand according to the assessed scenario by Mezősi et al. (2015b). As shown in Figure 3.3.16, assessed electricity generation from RES in 2030 according to each assessed scenario by Mezősi et al. (2015b) is lower than assessed electricity generation from RES in 2030 according to each assessed scenario by Resch et al. (2019). The difference in RES-E generation between both studies is however smaller than the differences in resulting RES-E shares in demand, driven by the differences in underlying demand assumptions as stated above. Thus, Serbia has an assessed 2030 RES-E share range between 33 and 53% according to Mezősi et al. (2015b) and between

38 and 71% according to Resch et al. (2019). If we consider the actual RES-E share in 2018 (28.7%), feasible 2030 RES-E shares could be estimated as more than 33%.

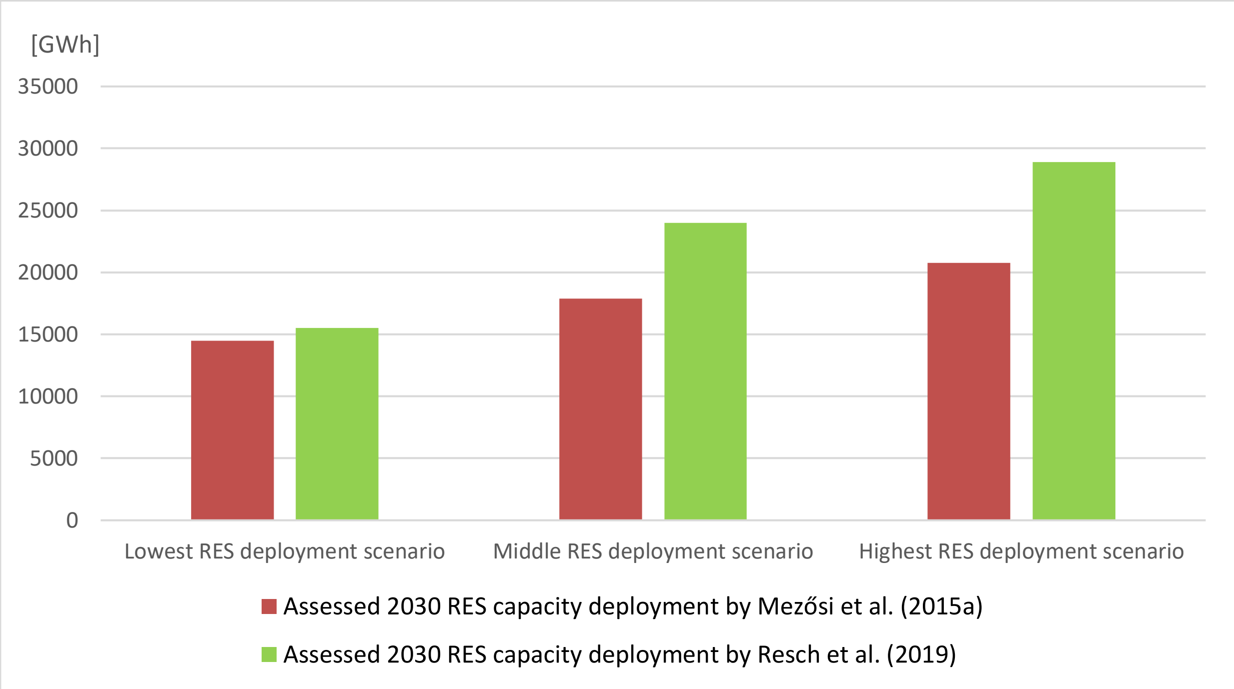

Figure 3.3.16 – Comparison of the assessed RES deployment for Serbia in 2030 by Mezősi et al. (2015b) and Resch et al. (2019), Source: Mezősi et al., 2015b; Resch et al., 2019

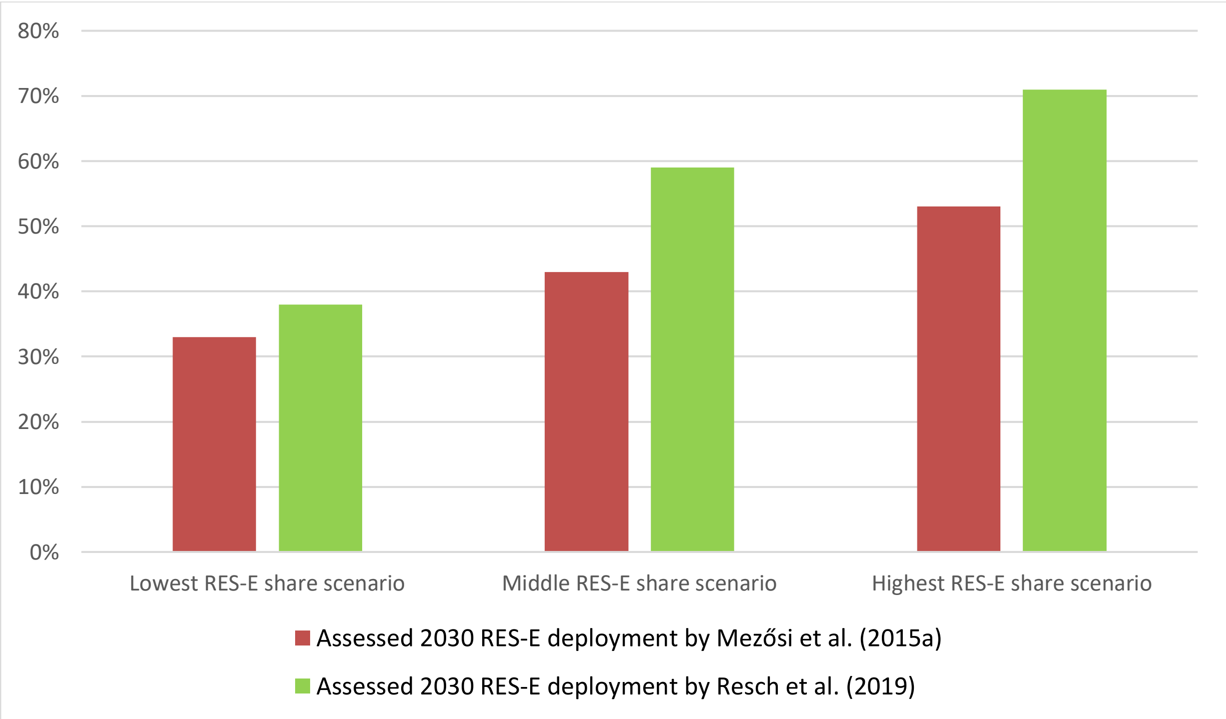

Figure 3.3.17 – Comparison of the assessed RES-E deployment for Serbia in 2030 by Mezősi et al. (2015b) and Resch et al. (2019), Source: Mezősi et al., 2015b; Resch et al., 2019

Support Levels for RES-E up to 2030

To invest in RES technologies support policies are required today. According to Mezösi et al. (2015a), the support budget should be calculated with the formula below:

$$SupportBudget = (LCOE - P) * GeneratedElectricity$$

• P = Modelled base-load electricity price (except PV, where peak-load electricity prices are taken into account)

The difference between the LCOE value and the market price (P) gives the support need for 1 MWh of RES-E which can be divided into total generated electricity to obtain the total support budget. The major factor of the support budget is generated by electrical energy.

Present FIT support in Serbia is set according to the generation capacity for different RES technologies as listed below (Mezősi et al., 2015b);

- Hydropower : between 74 – 124€/MWh for production capacities up to 30 GWh
- PV : between 132 – 206€/MWh
- Wind : 92€/MWh
- Biomass : between 82 – 132€/MWh

The RES support can be provided mainly from two sources; either from the state budget or from a fee that the end-users have to pay. The average RES support fee that should be paid by each end user according to their consumption, can be calculated by dividing the RES-E support budget to the total electricity consumption (considering all consumers have to pay for RES-E support) (Mezősi et al., 2015b). Estimated RES-E support fees according to assessed scenarios are shown in Figure 3.3.18.

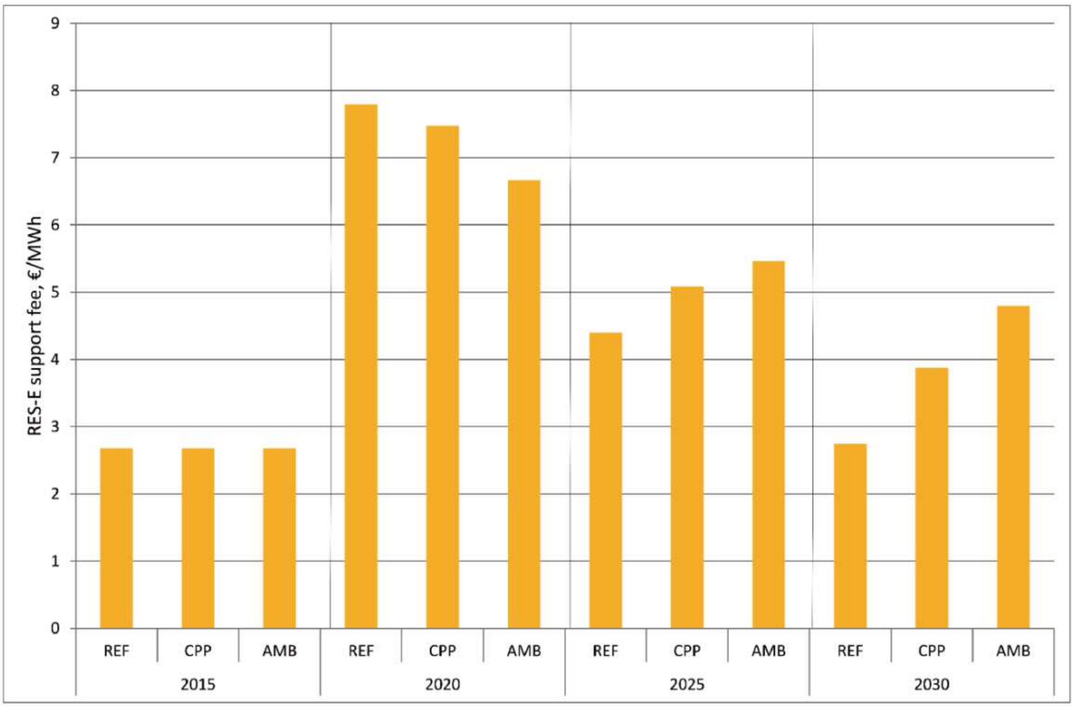

Figure 3.3.18 – Average support for RES-E from end consumers in Serbia according to assessed scenarios [EUR/MWh], Source: Mezősi et al., 2015b

There is a significant RES-E support increase between 2015 and 2020 due to overall less costly financing and a RES-E support decrease from 2020 to 2030, even though growing RES-E capacities. Although the RES-E capacity of each scenario is the same, the REF scenario has the lowest electricity price in 2020. Thus, REF scenario has the highest support budget in 2020. Due to the decrease of RES-E capacity increase rate and increase in electricity price, RES budget of each scenario has a significant decrease in 2030 (Mezősi et al., 2015b). As a consequence, there is a relationship between RES-E capacity deployment and RES-E support budget. Figure 3.3.13 and Figure 3.3.18 obtain an analogy. Since the AMB scenario has the highest RES capacity compared to other scenarios in 2030, it has the highest value of the budget.

2020 REF scenario has the estimated highest fee between 2015 and 2030 with 7.8€/MWh. This support level is lower than the 2012 support level in many EU states. The support level of EU was an average of 13.68€/MWh in 2012 according to Council of European Energy Regulators (CEER) on EU renewable support schemes report in 2015 (Mezősi et al., 2015b).

3.3.5 Lessons learned

Serbia has not arranged specific laws for each energy sector. However, arrangements have been made through by-laws under the Energy Law. Overall RES progress in Serbia remained in a steady state between 2017 and 2019.

According to IRENA (Table 3.3.3), installed solar PV capacity in Serbia is 10.8 MW in 2015, while the 2020 target is 10 MW. On the other hand, the progress in wind energy is significantly lower than for solar PV. Even though the 2020 wind energy target is 500 MW, only 0.5 MW has been installed until 2015. Although the biomass potential is significantly high, it has remained approximately around 5 MW. According to IRENA (2017), difficulties and prolonged timeline of the progress are the reason of the slow progress of wind and biomass, which has been streamlined by regulations of the Law on Planning and Construction in 2016. The assumption is that Serbia might support hydropower and biomass energy further in the electricity sector. Although the RES support is considered to be sufficient in Serbia according to SLED report for Serbia (Mezősi et al., 2015b), RES progress is still insufficient to reach 2020 RES-E target according to NREAP. The fear of electricity price increase could be a reason for that. However, cost-competitive RES-E potential could be used at full potential so that LCOEs could decrease.

As a result of the comparison of assessed 2030 RES-E targets in Chapter 3.3.4, Serbia has sufficient potential for achieving a RES-E share (in consumption) higher than 33%.

Serbia has not achieved any substantial development in the transport sector. The reason for this is that the laws do not aim to impose sanctions in this sector and as a result of this, no investment is made in the transport sector. There is still no legal sanction in this regard.

In the H&C sector in Serbia, DHs and CHPs are the most efficient methods of using heat energy. CHPs increase energy efficiency by cogeneration and allow to use of waste heat obtained from the generation of electrical energy as heating energy. On the other hand, DHs enable the efficient use of biomass in the heating sector, which is an inexpensive and environmentally friendly method. However, there is a lack of effective legislation or incentive to expand the use of these systems, such as in the electricity sector.

Serbia seems late with its legislative changes and the new PPA to reach 2020 RES targets. Although it seems challenging for Serbia to meet the 2020 RES targets. The sanctions to practice and new related regulations in each sector play an important role for Serbia to reach 2020 RES targets.

4 Summary and Conclusion

Deployment targets for RES are vital to achieving progress. Therefore, the RES targets defined by the EnC Directives have tremendous importance. The CPs can improve their progress to reach 2020 RES targets. They should also set adequate 2030 RES targets in time – for doing so, performed analysis within this thesis may provide relevant insights.

2017/2018 RES trajectories and 2020 RES national targets of CPs are shown in Table 4.1 (EUROSTAT, 2020). In Table 4.1, the second column indicates actual RES share in-between 2017-2018. Third and fourth columns indicate respectively RES trajectory in 2017/2018 and 2020 RES share target in GFEC. Fifth and sixth columns indicate percentage difference respectively between second-third columns and second-fourth columns. Due to the lack of 2017-2018 data in Moldova, it has been replaced with the recent data in 2013-2014 in Table 4.1. Percentage point (pp) shows the difference in percentage between indicative and actual RES share.

Table 4.1 demonstrates that Albania exceeded its 2017/2018 indicative RES trajectory. However, Moldova and Serbia fell behind their respectively 2013/2014 and 2017/2018 indicative RES trajectories.

Table 4.1 – Compare of indicative and actual RES share, Source: EUROSTAT, 2020

The median RES share in gross final energy demand by 2017/2018	RES share as of EUROSTAT	RED indicative trajectory (RED)		Percentage points [pp] deviation of the indicative trajectory (RED)	
Contracting Party	Actual Median 2017/2018 [%]	Indicative Median 2017/2018 [%]	2020 Target [%]	Median 2017/2018 [pp]	2020 Target [pp]
Albania	34.7	35.6	38.0	0.9	-3.3
Moldova	12.3 (2013/14)	13.4 (2013/14)	17.0%	-1.1 (2013/2014)	-4.7
Serbia	20.3	25.0	27.0	-4.7	-6.7

Among the three selected CPs only **Albania** has up to now achieved a higher RES share than the targeted one, as applicable from a comparison of the actual RES 2017/2018 Median and the targeted one shown as Indicative Median 2017/2018. More emphasis on increasing biomass usage and RES usage in the transport sector has to be taken to achieve the given 2020 overall RES target share. However, failure to comply with government regulations and lack of support in any energy sector could result in the RES targets being missed. If the legal regulations and supports in each energy sector are not accomplished this could lead to a delayed achievement of

2020 RES targets. Moreover, Albania has not yet implemented an indicative policy framework or has not yet prepared RES progress reports that monitor progress sufficiently. Although the hydropower-weighted RES in the electricity sector raises Albania's RES-E ratio and the overall RES ratio, there is a long-term energy dependency on other neighbouring countries, specifically in dry years, due to the focus on hydropower. Electricity generation from hydropower is depended on weather conditions. Thus, wind and solar PV incentive arrangements should be prepared and implemented immediately since solar PV and wind potentials of Albania could still not be used as expected.

According to EUROSTAT (2016), 2015 overall RES share in **Moldova** is slightly less than the indicative 2020 overall RES target according to the NREAP. However, according to IRENA (2019) and IRENA (2017), 2016 and 2017 overall RES share are significantly above the indicative 2020 overall RES target after the revision of the statistical accounting of biomass use in the energy sector. Although according to IRENA (2019), overall RES use in Moldova reaches a higher share than the indicative 2020 RES target thanks to the strong contribution of RES-H&C, there is still energy dependency on other countries up to 70%. Despite the fact that Moldova has cost-competitive RES-E potentials, the actual RES-E share is still below the planned indicative one. There are obstacles to accomplish the progress of RES-T, similar to the other two CPs, due to the lack of a policy framework in the transport sector that aims for supporting the replacement of fossil fuels by the RES. To avoid insufficient overall RES progress caused by a lack of legislation and limited regulations on RES support (except in H&C sector after biomass revision), the Government of Moldova should develop and implement robust legal incentives related to RES in the electricity and transport sector so that it can benefit its cost-competitive RES potentials.

Serbia has the cost-competitive technical potential to achieve the overall 2020 RES target according to IRENA (2017). Although the country has rich natural resources, due to legal difficulties and technical inconvenience, it seems not being able to achieve its intended RES development by 2020. In particular, Serbia expected to have 500 MW of wind onshore capacity installed by 2020 according to its NREAP. By the end of 2015, only 0.5 MW[11] have been installed. These legal obstacles lead to a lack of investment due to the fear of rising electricity prices. Serbia has also not achieved any concrete development in the transport sector. The H&C sector has the highest RES share compared to electricity and transport. District heating and Combined Heat and Power production units are effective ways to reach a valuable RES-H&C share. However, due to the lack of policy framework for RES and investment restrictions in the electricity sector, it seems not possible for Serbia to reach its overall RES share target in the year 2020, even if additional measures and legal arrangements are taken immediately.

[11] According to EUROSTAT, wind energy-based power plant capacity of Serbia has been reported as 25 MW in 2017 (EUROSTAT, 2020b).

RES regulations made by the EU are necessary factors that encourage the use of environment-friendly energy resources instead of unsustainable fossil fuels. Each CP improves its energy assets (e.g. power plants, buildings, transmission and distribution lines) and laws/regulations according to Decision 2012/04/MC-EnC. In this thesis, a general survey on achieved (actual) RES progress and an assessment of the effects of these regulations has been undertaken, analysing how applicable they are for Albania, Moldova and Serbia. This research shows that the common problem in each country is the transport sector. The electricity and H&C sectors have more applicable RES technologies than the transport sector. Therefore, the substitution of fuels in the transport sector due to the used technology in this sector could be more problematical than the substitution of fossil fuel use in the H&C and electricity sector.

On the other hand, a significant problem is whether countries can prepare and implement the necessary legal arrangements and support rapidly enough. For instance, The Law on Planning and Construction in Serbia, despite being enacted in 2014, has been implemented two years later (i.e. in 2016) (IRENA, 2017). These delays prevent investors from investing which indirectly causes increases in risk and corresponding WACC and LCOE.

Albania and Moldova have reached their interim RES targets due to achieved progress in hydropower in the electricity sector (Albania) or biomass use in the H&C sector (Moldova), respectively. Countries are attempting to increase RES rates by installing certain technologies in a certain sector instead of increasing energy diversity. However, although this situation increases the use of RES, it does not help in the energy import dependence on other countries due to the dependence on the weather conditions and it does not help to increase energy security.

As a result, Albania and Serbia could not achieve the 2017/2018 overall RES share indicative trajectory. To ensure that additional investments in RES technologies will be taken in the future, laws that are reliable in its applicability are necessary. A reliable policy framework for RES would give confidence to investors and at the same time encourage consumers to use RES. These are essential and needed developments for the assessed CPs according to this analysis.

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6 ANNEX I: Decarbonisation scenarios for Albania according to A. Mezősi et al. (2015a)

The Support for Low-Emission Development in South-Eastern Europe (SLED) Project suggests an approach to set decarbonisation targets for the electricity sector up to 2030 in Albania. There are three decarbonisation scenarios to assess the decarbonisation potential: Reference (REF), Currently Planned Policies (CPP), Ambitious (AMB) (Mezősi et al., 2015a). To assess the decarbonisation potential, three decarbonisation scenarios are shown in Table 3.31.

Table 3.31 – Main scenario assumptions for Albania, Source: Mezősi et al., 2015a

	Scenario assumptions	Reference GHG scenario (REF)	Currently Planned Policies GHG scenario (CPP)	Ambitious GHG policy scenario (AMB)
Taxation	Introduction of EU ETS	ETS to be introduced in 2025	CO_2 cost in 2020 is 40% of the ETS price; from 2025 ETS is introduced	ETS to be introduced in 2020
	Introduction of minimum excise duty	Year of introduction: 2020	Year of introduction: 2020	Year of introduction: 2018
Electricity supply	Enforcement of environmental standards (LCP Directive)	Due to the requirements of the LCP Directive, Fier TTP is not in operation in the modelled period.	Due to the requirements of the LCP Directive, Fier TTP is not in operation in the modelled period.	Due to the requirements of the LCP Directive, Fier TPP is not in operation in the modelled period.
	RES-E deployment	NREAPs: 2,324 MW hydro; 30 MW wind; 32 MW PV; and 5 MW biomass by 2020. By 2030: 2,710 MW hydro; 100 MW wind; 79 MW PV; and 24 MW biomass.	NREAPs: 2,324 MW hydro; 30 MW wind; 32 MW PV; and 5 MW biomass by 2020. By 2030: 3,097 MW hydro; 170 MW wind; 126 MW PV; and 42 MW biomass.	NREAPs: 2,324 MW hydro; 30 MW wind; 32 MW PV; and 5 MW biomass by 2020. By 2030: 3,869 MW hydro; 310 MW wind; 220 PV; and 80 MW biomass.
	Conventional capacity developments	CCGT Vlora I (200 MW) comes online in 2020 and CCGT Vlora II (160 MW) comes online in 2025.	CCGT Vlora I. (200 MW) comes online in 2020 and CCGT Vlora II (160 MW) comes online in 2025.	CCGT Vlora I (200 MW) comes online in 2020 and CCGT Vlora II (160 MW) comes online in 2025.
Electricity demand	Electricity demand	According to the June 2015 draft NREAP projections up to 2020. In the next period, a 3.1% growth rate is applied, which is a continuation of the trend between 2010 and 2020. 2030: 12,990 GWh.	According to the USAID Energy Efficiency–Natural Gas scenario. 2030: 10,918 GWh	According to the USAID Energy Efficiency–Renewable–Natural Gas scenario. 2030: 10,857 GWh

7 ANNEX II: Decarbonisation scenarios for Serbia according to A. Mezősi et al. (2015b)

The Support for Low-Emission Development in South-Eastern Europe (SLED) Project suggests an approach to set decarbonisation targets for the electricity sector up to 2030 in Serbia. There are three decarbonisation scenarios to assess the decarbonisation potential: Reference (REF), Currently Planned Policies (CPP), Ambitious (AMB) (Mezősi et al., 2015b). To assess the decarbonisation potential, three decarbonisation scenarios are shown in Table 3.31.

Table 3.31 – Main scenario assumptions for Serbia, Source: Mezősi et al., 2015b

	Scenario assumptions	Reference GHG scenario (REF)	Currently Planned Policies GHG scenario (CPP)	Ambitious GHG policy scenario (AMB)
Taxation	Introduction of EU ETS	ETS to be introduced in 2025	CO_2 cost in 2020 is 40% of the ETS price; from 2025 ETS is introduced	ETS to be introduced in 2020
	Introduction year of minimum excise duty	Year of introduction: 2020	Year of introduction: 2020	Year of introduction: 2018
Electricity supply	Enforcement of environmental standards (LCP Directive)	Due to the requirements of the LCP Directive, 11 lignite units are to be closed in the 2015–2030 period.	Due to the requirements of the LCP Directive, 11 lignite units are to be closed in the 2015–2030 period.	Due to the requirements of the LCP Directive, 11 lignite units are to be closed in the 2015–2030 period.
	RES-E deployment	NREAP (Serbia and Kosovo* aggregated) until 2020 then moderate growth.	NREAP (Serbia and Kosovo* aggregated) until 2020 then average capacity values of the REF and AMB scenarios.	NREAP (Serbia and Kosovo* aggregated) until 2020 then ambitious growth.
	Conventional capacity developments	New power plants: • CHP Novi Sad (2016) • CHP Pancevo (2016) • Kolubara B (2019) • Kosova e Re Power (2020) • Kostolac B3 (2025) • Nikola Tesla B3 (2020)	New power plants: • CHP Novi Sad (2016) • CHP Pancevo (2016) • Kolubara B (2019) • Kosova e Re Power (2020)	New power plants: • CHP Novi Sad (2016) • CHP Pancevo (2016)
Electricity demand	Electricity demand	REF scenario of Serbian Energy Strategy plus Kosovo*.	Average value of REF and AMB scenarios.	Energy efficiency scenario of Serbian Energy Strategy plus Kosovo*.

8 ANNEX III: RES-E share scenarios for Albania, Moldova and Serbia according to G. Resch et al. (2019)

Difference between three 2030 RES-E scenarios[12] can be derived from the following scenarios:

- **No Policy:** In this scenario, 2020 RES policy measures are not improved with any new policies and phased out step by step until 2030. This scenario is used as a base scenario to compare with the other two scenarios.
- **RE target fulfilment - without RE cooperation:** There is a "national perspective" in this scenario. According to the "national perspective", CPs aim to achieve pure domestic RES targets without / limited cooperation arising from that. This scenario is based on fulfilment national RES targets.
- **RE target fulfilment - with RE cooperation:** There is a "community perspective" in this scenario. According to "community perspective", CPs aim to achieve more efficient and effective RES targets than scenario "RE target fulfilment - without RE cooperation". Thus, the envisaged EnC level has been chosen as a target rather than to reach each national RES targets.

[12] Please look at "Study on 2030 overall targets for the Energy Community" (Resch et al., 2019, Page 160) for more detailed information.