Kosovo's Potential for Renewable Energy Production: An Analysis

Dije Rizvanolli
University of Twente
MEEM

August 2019

Abstract

Kosovo has been lagging quite far behind with meeting its renewable energy targets within the Energy Community, the main reasons for which have been an almost-complete reliance on lignite coal for electricity, the associated impacts of both this type of coal and the Yugoslav-era power plants, as well as a lack of data and studies on renewable energy sources and their utilization – either for self-consumption or connection to the electric grid. This research project attempts to gather reliable information regarding RES-based power generation and assembles them into a single, comprehensive analysis. By consulting online literature, research reports, and national and international laws and strategies, a foundation on the current energy system and situation (as well as future plans) is laid. Thereupon, secondary data is used as well in analyzing renewable energy production in the country, namely solar energy, wind and hydropower, and biomass. Knowledge gaps on RES are supplemented by contributions from three relevant, local stakeholders. The analysis finds that Kosovo withholds more RES-based energy production potential than is officially claimed by governmental bodies and representatives, and that it could easily surpass the capacities that the New Kosovo coal-fired power plant is to bring to the market. The analysis also looks into the governmental and institutional perspective towards both RES potential and thermal power plants, and it parallelly describes the standpoints of Kosovo civil society and EU's Energy Community. A chapter is also dedicated to the impacts and tradeoffs of continuing to rely on a fossil fuel-based system for energy as opposed to what renewable energy production might entail for the country's future – politically, socio-economically, and environmentally – which shows that either of the options carry their own benefits and downsides.

Table of Contents

List of Tables

List of Figures

List of Acronyms

ASK	Kosovo Agency of Statistics
CFPP	Coal-fired power plant
DNI	Direct normal irradiation
EBRD	European Bank for Reconstruction and Development
EU	European Union
EIA	Environmental Impact Assessment
EnC	Energy Community
EC	European Commission
ERO	Energy Regulatory Office
ENTSO-E	European Network of Transmission System Operators for Electricity
GHG	Greenhouse gases

GHI	Global horizontal irradiance
GIS	Geographic information system
HPP	Hydropower plant
IRENA	International renewable energy agency
KEDS	Kosovo Electricity Distribution and Supply Company
KESCO	Kosovo Electricity Supply Company
KEK	Kosovo Energy Corporation
KOSID	Kosovo civil society consortium for sustainable development
KOSTT	Transmission, System and Market Operator
KPPM	Independent commission for mines and minerals
LCOE	Levelized cost of energy
NIMBY	“Not In My Backyard”
PV	Photovoltaic
PLC	Public limited company
RES	Renewable energy sources
SHPP	Small hydropower plant
TPP	Thermal power plant
VAT	Value-added tax
WB	World Bank
WPD	Wind Power Density

Acknowledgments

Sincere gratitude for University of Twente professors Maarten J. Arentsen and Joy Clancy, whose lectures on Energy Management and focus on the global South have sparked genuine interest in me, ultimately guiding my decision towards the specialization in energy management, for which I will be deeply indebted.

Thanks are extended to RIT Kosovo professor, Shqipe Neziri Vela, and interviewees Pellumb Gjinolli, Lulzim Syla, and Rhedon Begolli, for their selfless advice, guidance, support, and motivation.

I would also like to acknowledge my friends and family, both in Prishtina and Leeuwarden, for their understanding and enormous love throughout this project (as well as for pressuring me into writing by setting up deadlines for me!).

Last but not least, thank you to the Government of Kosovo and EU Office in Kosovo for awarding me with the YCS study grant, without which I would not have been able to complete studies on a master level.

Introduction

1.1. Background Information

Spanning in an area of 10,908 km² in South East Europe, Kosovo is a parliamentary republic that declared independence in 2008 (UNDP). It has a population of approximately 1.8 million, the average age of which is 26, making it the youngest in Europe (World Bank, 2018). Although not yet recognized by all European Union state members, Kosovo is a potential candidate for EU accession, which is one of the reasons behind the government's focus on compiling strategies that align well with those of EU (World Bank, 2018). Despite its economic growth in the last decade, Kosovo still remains one of the poorest countries in Europe, with a high unemployment rate, large gender gap, and high migration rates (World Bank, 2018). Power shortages have been a major obstacle to keeping the economy going and providing better education and health services (World Bank, 2012).

Lignite is the main resource for electricity generation in the country, accounting for 97% of Kosovo's total generation, with the remaining 3% being supported by hydropower plants and electricity imports (The Independent Commission for Mines and Minerals). The former is generated through two infamous thermal power stations: 'Kosovo A' and 'Kosovo B', commissioned in a period of almost 20 years, from 1962 through 1984 (KEK). These power plants have neither been rigorously maintained nor technically upgraded ever since they became fully operative, a problem which led to significant operations and cost losses as well as large environmental and health impacts – not only during the Yugoslav regime or after its breakup, but also in the post-independent Kosovo from 2008 and onwards (KOSID, 2017).

As national governments throughout the world take the necessary steps for a climate-neutral future, Kosovo is remaining closely attached to its main fossil fuel for meeting the electricity demand, while also aiming at becoming more energy secure and independent. Coupled with the fact that the country lies in lignite-rich land, the Government of Kosovo has been prompted to invest on the construction of yet another coal-powered power plant: 'Kosova e Re' ("New Kosovo"). Its construction has been a subject of debate for more than 10 years – at a time when organizations like the World Bank and EBRD (European Bank for Research and Development) claimed to be willing to support the project (Bankwatch Network). Now, however, since the commercial agreements were signed in 2017 between the Government and ContourGlobal, both WB and EBRD have opted out of financing coal-based projects of such a scale (Bankwatch Network, 2018), pushing thus for renewable energy in

Kosovo, coupled with a large emphasis on energy efficiency and market liberalization and reforms.

1.2. Problem Statement

Comparing 2018's last quarter of the year with that of 2017 alone, according to the Kosovo Agency of Statistics, electricity consumption has increased by 6% in a matter of 12 months only (Berisha et al., 2019). As Kosovo becomes denser in terms of population (it experiences approximately a 1.06% annual growth) (Kastrati et al., 2018), coal use will increase as well. As of the first quarter of 2019, households represent the largest consumer of electricity in Kosovo (59%), followed by commercial (21%), industrial (8%), and 220-110 kV (8%) consumers, whereas mines and public enterprises stand at only 3% and 1% respectively (ASK, 2019). As such, the country must find an alternative to the latter not only to meet the demand for electricity, but to also provide it in such a way that neither the environment (as opposed to the current high air pollution levels) nor the people are affected (financially and health-wise). Moreover, if Kosovo is to ever welcome any foreign investment to put the economy in motion again and accelerate its accession into the European Union, it must first improve its image in spite of having one of its two coal-fueled power plants dubbed "the worst single-point source of pollution in Europe" (World Bank). The background information provided above implies that Kosovo's energy system relies on lignite not because renewable energy sources have no potential, but because the country has rich deposits of lignite, which are easily accessible, and the entire infrastructure around them is already well-established. Nevertheless, the limited number of studies regarding RES in Kosovo as well as country-wide strategies that focus on efficient coal use have played a role in postponing their integration into the grid or to even harvest them at a small, individual scale.

1.3. Research Objective

The external goal of this research project is to provide a comprehensive and impartial analysis regarding Kosovo's potential for renewable energy production, in terms of the country's technical and economic capacities, which can serve as a basis for environmentally- and renewable energy-committed policy makers, entrepreneurs, and businesses. This objective will be achieved by analyzing Kosovo's energy strategies and action plans,

consulting scientific literature, studying research reports carried out by local and international organizations, and interviewing relevant stakeholders and experts in the field.

1.4. Research Questions

The *main* research question for this project is:
"What is the technical and economic potential of renewable energy production in Kosovo and what are the advantages and disadvantages compared to the current fossil-based energy production?"
This question has led to the formulation of the following questions and their sub-questions, based on which the thesis project will be constructed so that a full picture of the current situation is provided:
Q1: "What type of technology and resource is utilized for electricity generation in Kosovo?"
Q2: "What is Kosovo's potential and what are the obstacles for renewable energy production?"
Q3: "What is the social debate for Kosovo's future energy system?"
Q4: "What are the impacts (socio-economic and environmental) of renewable energy production versus continuing to rely on coal?"

1.5. Research Method

The analysis in this research project mainly includes secondary data, obtained through online sources, such as governmental portals, research reports, studies by local and international organizations, and so forth. This data has served for the purpose of understanding and compiling each chapter, excluding the conclusions chapter. Data gathering took place throughout the entire writing process, and was, as such, the most time-consuming one, from April through July. Knowledge gaps between the information were filled by 5 interviewees, two of whom are not included (not even anonymously) in the final project due to confidentiality issues. Upon their approval, two interviewees were recorded, namely Lulzim Syla and Pellumb Gjinolli. Moreover, the request (no. 190733) for ethical considerations was approved by the Ethics Committee of the University of Twente. Additionally, the interviewees received both a written and verbal note prior to the interview regarding the way the information will be used. The retention period of the data gathered is limited to the research period and will not be released to third parties.

1.6. Research Outline

Due to the fact that this research project aims to provide an analysis for Kosovo's potential for renewable energy production, its second chapter provides an overview of the current energy situation in the country. The chapter describes and delves into the following: the energy system, coal production and use, coal-fired power plants (both the two currently operating ones and the new planned one), and hydropower in Kosovo. Additionally, the chapter covers a description of what the national and EU-relevant laws, strategies, and action plans withhold, seeing how EU integration is on top of the list in Kosovo's agenda. As such, this chapter sets the basis upon which the analysis, and one of the most important sections of the research project, is carried out: renewable energy production. The chapter (3) looks into those with the highest potential, both in technical and economic terms, namely biomass, solar, wind, and hydropower. The analysis focuses on data found online and an interview. The subsequent chapter (4) is based on the previous three and it analyzes the trade-offs and the respective impacts between electricity generation by coal and by renewable sources of energy. The final chapter provides a recapitulation of each chapter, answers the research questions, and describes the opportunities and limitations of this research project.

Current Energy Situation

2.1. Kosovo's Energy System

The Kosovo Energy Corporation (KEK) is responsible for *coal production* and power *generation* in the territory of Kosovo, being thus responsible for the coal mines and the coal-fired power plants. Under state ownership, it is a vertically integrated company that employs 4700 people in different working sectors of KEK (KEK, 2019). Distribution and supply used to be integral divisions within KEK, until their privatization in 2014. Their privatization came as a result of numerous reasons, the most important being: the lack of investments in the distribution systems which led to large technical and commercial losses, at 17.19% and 30.31%, respectively; the necessity of large subsidies to support the company (11% of the total annual state budget); and as a consequence of both, in addition to low production capacities, increasing electricity imports (IFC, 2017). The Government of Kosovo exercises control over KEK (Energy Community).

The divisions of *distribution* and *supply*, referred to as KEDS (Kosovo Electricity Distribution and Supply Company J.S.C) and KESCO (Kosovo Electricity Supply Company J.S.C), are now privately owned by two Turkish companies, Calik Holding and Limak (KEDS, 2013). This joint consortium (Limak-Calik) is responsible for the distribution and supply of electricity to the consumer (commercial, industrial, and household), while also administering its own assets, which include both low- and medium-voltage lines (0.4 kV, 6 kV, 10 kV, and 35 kV) and their substations, substations of 0.4 and 10 kV, and almost 500,000 individual meters (KEDS, 2013). Apart from the maintenance and operation of the distribution and supply system, the KEDS is obliged to prioritize electricity from renewable energy sources when dispatching it (Assembly of Kosovo, 2016). KEDS is dispersed throughout the country, covering seven cities and thirty sub-districts (KEDS, 2013).

KOSTT J.S.C. is another entity within Kosovo's energy system, certified by the independent Energy Regulatory Office (ERO) (ERO, 2018). It represents the electricity *transmission, system, and market operator* and the Republic of Kosovo is the sole shareholder of the company. It is responsible for the transmission of electricity to the distribution system by operating the high-voltage transmission lines (110, 220, and 400 kV) (KOSTT J.S.C). Additionally, it enables access to the system to encourage competition in the electricity market by setting tariffs to the users upon connection or use of the system (KOSTT J.S.C). As such, it also fosters relationships with neighboring countries in terms of interconnection capacities and electricity trading, among others (KOSTT J.S.C). The Parliament of Kosovo exercises control over KOSTT (Energy Community).

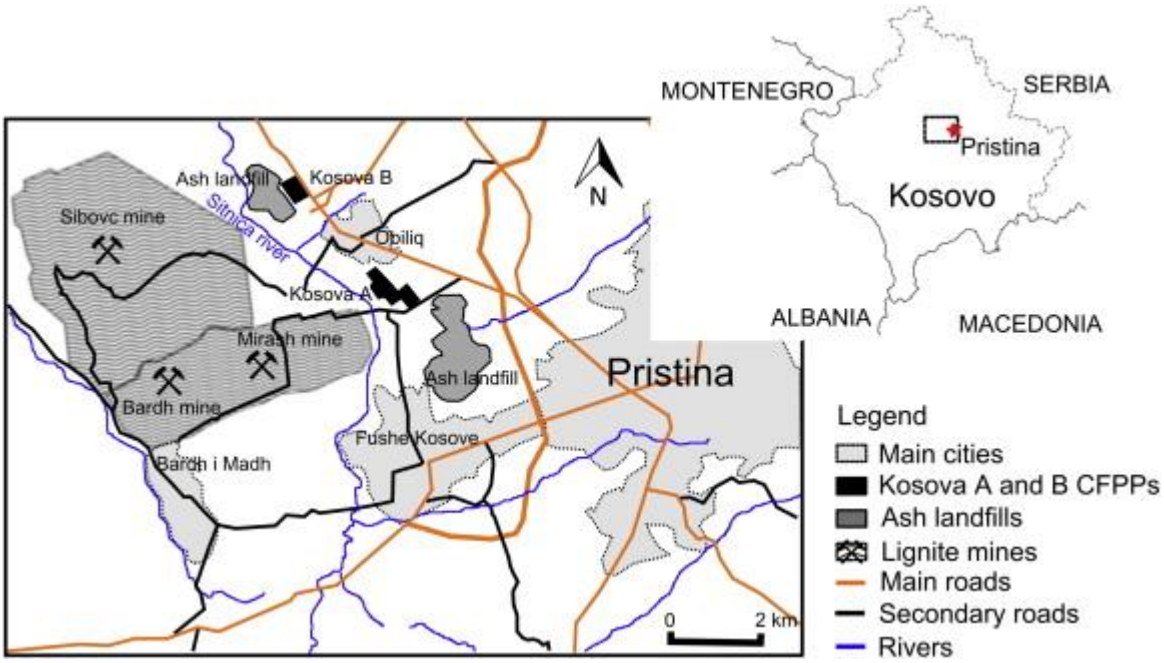
2.2. Coal Reserves, Production, and Use

Ranking fifth in the world, Kosovo's largest natural reserves are those of coal, specifically lignite, which are estimated to be at an amount of 14.7 billion tonnes (Rizaj et al., 2018; Hoxha et al., 2018). A nonrenewable energy source, lignite is a type of coal with a calorific value lower than 6000 kcal/kg, meaning that it constitutes a low-energy content fossil fuel and that it ranks lowest among other types of coal (bituminous, subbituminous, and anthracite) (Thielemann, Schmidt, & Peter Gerling, 2007; EIA). As a result, larger quantities of lignite are burned to produce the desired amount of electricity (AirClim, 2014). Differently referred to as brown coal, lignite has a carbon content of 25%-35% and it is a source of large carbon emissions upon combustion (National Geographic, 2012). Besides carbon, the combustion of lignite generates particulate matter (PM), sulphur oxides (SOx), nitrogen

oxides (NOx), greenhouse gases (GHG), and total organic compounds (TOC), amongst others (EPA, 1998).

In Kosovo, lignite can be found in three main basins: Kosovo (which is located in the northeastern part of the country), Dukagjini, and Drenica basins (both of which can be found in southwestern Kosovo). The Kosovo basin is located in the town of Obilic, in close vicinity to the coal-fired power plants (CFPPs) and, as shown in *Figure 1*, it is home to three main lignite mines: Mirash, Bardh, and Sibovc (Hasani et al., 2014). Large-scale exploitation of the first two mines started in 1958 and 1969, respectively (KPMM); whereas the Sibovc mine was subject to mining only in 2010 (KEK, 2018). Coal (lignite) production falls under the responsibility of the Coal Division of the country's Kosovo Energy Corporation J.S.C. (KEK) (KEK; Ramaj, Kukaj, & Januzaj, 2017).

Figure 1. Locations of Kosovo A and Kosovo B CFPPS and northeastern Kosovo lignite mines and dumps



(source: Hasani et al., 2014)

Mines throughout Kosovo are subject to surface mining, specifically open-pit mining, for the production of lignite (KPMM). As such, it signifies that this resource is either already exposed or that it is to be found underground but very close to the surface (which then continues deeper under it) (Haldar, 2018). When the pit is dug, it is expanded until the coal is extracted or until it is economically viable to do so in terms of the stripping ratio (National Geographic, 2012). In Kosovo's case, pits are dug using bucket wheel excavators, machineries that are suitable for this type of mining (KPMM; Haldar, 2018). Data gathered

from 2002 through 2018 show that lignite coal has been mainly utilized for electricity production for the country's two thermal power plants, which has varied insignificantly for the past decade, with the highest amount of electricity being produced in 2016 at approximately 6248 GWh, decreasing to 5600.5 GWh in 2018 (ASK, 2019).

2.3. Coal-Based Power Generation

2.3.1. Kosovo A and Kosovo B Thermal Power Plants

Kosovo A TPP was commissioned in series, from 1962 through 1975, and is composed of 5 units: A1 (65 MW), A2 (125 MW), A3 (200 MW), A4 (200 MW), and A5 (210 MW). Currently, units A1 and A2 are out of operation, and the remaining three units are responsible for an annual electricity production of 1500 GWh (KEK).
In 2014, an explosion in the Kosovo A power plant left two workers dead, 13 others injured, and led to electricity imports of 250 MWh to make up for the lack of production the explosion had caused. The explosion is assumed to have occurred as a result of a negligent replacement of the coolant (hydrogen) canisters (Al Jazeera, 2014).

Kosovo B is comprised of two units, B1 and B2, which have been in operation since 1983 and 1984 respectively. Each unit has an installed capacity of 339 MW and they are both operative, adding to an annual electrical energy production of 3.750.000 MW (KEK). In 2010, the generation capacity of both blocks reduced to 240 MW for B1 and 280 B2 due to damages in the turbines of low-pressure rotors (Ministry of Energy and Mining, 2009).

Although the combined installed capacity for the country's TPPs is higher, as of 2014, the generation capacity has declined to approximately 915 MW as a result of TPPs nearing their end life, lack of maintenance and technical upgrades, and damages (CEE Bankwatch Network, 2018; Hasani et al., 2014).

2.3.2. Kosova e Re (New Kosovo) Thermal Power Plant

The construction of a third coal-fired power plant has been in the country's agenda for more than a decade. In 2005, the power plant, Kosovo C, was proposed to have a capacity of 2100 MW, in line with the Kosovo Energy Strategy (2005-2015) (GAP Institute, 2018). Three years later, the project was re-named to Kosova e Re (New Kosovo) and its proposed generating capacity decreased to 1000 MW, only to eventually decline to 600 MW. In 2015, only one bidding company was announced by the government, Contour Global, and the

project was subject to change once more, now with an even lower capacity of 500 MW (GAP Institute, 2018).

ContourGlobal is an international public limited company (PLC), headquartered in London, with both a renewable and thermal generation group (Contour Global, 2017). The latter is responsible for the Kosova e Re project, the commercial agreement for which was signed between the company and the Government of Kosovo in 2017 (GAP Institute, 2018). As a PLC, the company will own the power plant for its 20 years of operation, after which period it will be transferred to Kosovo, "at no cost" (Ministry of Economic Development). Out of four bidders for the construction of the plant, Contour Global has chosen General Electric as the preferred one, which are expected to begin their operations later this year. Overall, the project is estimated to be $1.3 billion (Reuters, 2019).

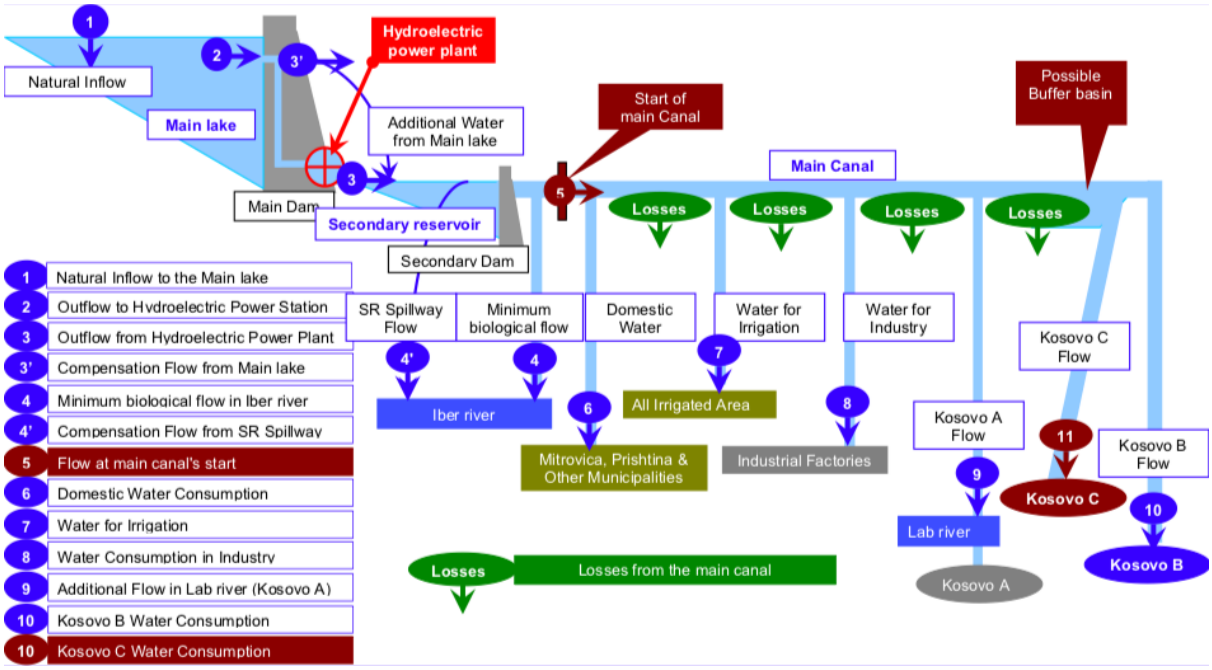
According to the Ministry of Economic Development (MED), which is the ministry responsible for the energy sector in the country, the purpose and goal of the new power plant is to replace the polluting 'Kosovo A' and play an overall positive role on economic development and the environment, while also ensuring that EU standards are met, a minimum of efficiency of 40% is realized, and that Kosovo becomes an energy-secure country (Ministry of Economic Development).

2.4. Hydropower Generation

With regards to the remaining 3% of electricity produced through hydropower, responsibilities fall upon the Hydro-Economic enterprise "Iber-Lepenc" J.S.C, as well as other independent producers. The shares of this enterprise are under the full ownership of the Republic of Kosovo (HE "Iber-Lepenc"). Besides power generation, it also supplies industries (KEK, Feronickel, and Trepca), regional water companies (Prishtina and Mitrovica), households (in Prishtina and Mitrovica, as well as other smaller municipalities), and agricultural producers with water (HE "Iber-Lepenc").

The "Ujmani" hydropower plant is part of the "Iber-Lepenc" hydro system and has an installed capacity of 35 MW (2 x 17.5 MW) (HE "Iber-Lepenc"). As seen in *Figure 2*, the water from the Ujman (Gazivoda) lake is accumulated into the main dam, where the hydroelectric plant is also located, turning the turbines into motion and producing electricity, which is afterwards sold to KEK. By the end of the Iber-Lepenc canal, "Kosovo A" and "Kosovo B" are supplied with water as well (Baudry, 2011).

Figure 2."Iber-Lepenc" Hydro System



(source: European Agency for Reconstruction, 2008)

The majority of the smaller hydropower plants throughout Kosovo produce electrical energy independently but are connected to the transmission and/or distribution networks. "Lumbardhi" hydropower plant has an installed capacity of 8MW and is located in western Kosovo, on Decan's Lumbardh river (Kelag, 2016). Along the same river, "Decan" hydropower plant is situated, with an installed capacity of 9.9 MW (Kelag, 2016). The generation capacities of the rest of the (small) HPPs, among which are HPP "Belaja", "Brodi II", "Brezovica", "Radavc", and so forth, are shown on the *Tables 1* and *2*, compiled by KOSTT and grouped based on their connection to the transmission or distribution network, respectively. The total hydro energy available for consumption in 2018 amounted to 28.84 ktoe (ASK, 2019).

Table 1. HPPs and air energy connected to the Transmission Network

HC	Generator	year of operation	MVA	Installed Capacity MW	Neto (MW)	Kuota minimale e ujit
HPP Ujmani	G1	1981	19,5	17,5	16	638
	G2	1981	19,5	17,5	16	
Total of Ujmani			39	35	32	
HPP Lumbardhi 1	G1	1957/2005	5,05	4,04	4,00	cosφ=0,8
	G2	1957/2005	5,05	4,04	4,00	cosφ=0,8
EGU Belaja	G1	2015	5,88	5,29		cosφ=0,9
	G2	2015	3,11	2,79		cosφ=0,9
EGU Decani	G1	2015	11,24	10,11		cosφ=0,9
	G2	2015	5,47	4,92		cosφ=0,9
HPP- Lumbardhi's Cascade			35,8	31,19	8,00	
Air-Energy -KITKA L.L.C	9*G	2018	36,00	32,40	32,40	
Total HPP and air energy connected to Transmission			110,80	98,59	40,00	

(source: KOSTT)

Table 2. HPPs connected to the Distribution Network

HPP	Gjeneratori	Viti i lëshimit në punë	Fuqia e dukshme MVA	Fuqia aktive (MW)	Nr. i rrotullimeve n/min	H e bazenit të presionit
HPP Radavci	G1	1934/rindertimi 2010	0,5	0,45	1000	34,44m
	G2	1934/rindertimi 2010	0,5	0,45	1000	34,44m
Total HC Radavci			1	0,9		
HC Burimi	G1	1948/rindertim 2011	0,475	0,427	1000	29,5m
	G2	1948/rindertim 2011	0,475	0,427	1000	29.5m
Total HPP Burimi			0,95	0,854		
HPP Dikanci	G1	1957/riparim faza 1-2010	0,55	0,5	1000	115m
	G2	1957/riparim faza 1-2010	0,55	0,5	1000	115m
	G3	Shkurt 2013/ i ri	2,921	2,34		
Total HPP Dikanci			4,021	3,34		
Total Brodi 2	G1	Tipi i turbines Fransis, 2015		2,8		
	G2	Tipi i turbines Pelton, 2015		2,2		
Total HPP Brodi 2			0	5		
HPP Restelica 1&2	G1	Tipi i turbines Pelton, 2015		1,2		
	G2	Tipi i turbines Pelton, 2015		1,2		
Total HPP Restelica 1&2			0	2,4		
HPP Hydroline-Albaniku III	G1	Hitzinger, fundi i vitit 2015	3,6	3,147		
	G2	Hitzinger, 2016	1,4	1,068		
Total HPP Hydroline-Albaniku III			5	4,215		
Total HPP connected to Distribution			10,971	16,709		

(Source: KOSTT)

The total generating capacity of power systems in the country is shown on *Table 3* below, as presented on ERO's Annual Report 2017:

Table 3. Generation capacities in the electricity system

Generating unit	Unit capacity (MW)			Commissioning
	Installed	Net	Min/max	
A1	65	Not operational		1962
A2	125	Not operational		1964
A3	200	144	100-130	1970
A4	200	144	100-130	1974
A5	210	144	100-135	1975
TPP Kosova A	800	432		
B1	339	264	180-260	1983
B2	339	264	180-260	1984
TPP Kosova B	678	528		
HPP Ujmani	35.00	32.00		1983
HPP Lumbardhi	8.08	8.00		(1957) 2006
HPP Dikanci	4.02	3.34		(1957) 2013
HPP Radavci	1.00	0.90		(1934) 2010
HPP Burimi	0.95	0.85		(1948) 2011
Total HPP	49.05	45.09		
EGU Belaja	8.06	7.50		2016
EGU Deçani	9.81	9.50		2016
HPP Hydroline-Albaniku III	4.27	4.27		2016
HPP Brod II	4.80	4.80		2015
Wind Power	1.35	1.35		2010
LedLight	0.10	0.10		2015
Photovoltaic plant ONIX	0.50	0.50		2016
Restelica 1&2	2.28	2.28		2016
HPP Brezovica	2.10	2.10		2017
Total RES	33.27	32.40		
Total	1,560.32	1,037.50		

(Source: ERO, 2017)

2.5. Institutional Review

2.5.1. Kosovo Law on Energy (Law No. 05/L – 081)

The Kosovo Law on Energy, which entered into force in 2016, presents the general principles that direct the activities, policies, and strategies within the country's energy sector, with the ultimate goal of providing reliable and high-quality energy supply to the consumers, while also aiming to increase the share of renewable energy sources and co-generation. According to the law, the energy strategy must include an analysis of the current challenges

and introduce policies that would make the energy sector a sustainable one so that environmental protection is ensured, private investments are enabled, and the energy sector is integrated into European and regional systems (Assembly of Kosovo, 2016).

Chapter 3 of the law provides information concerning energy efficiency, co-generation, and renewable energy sources. It stresses the importance of the formulation of their respective policies for the purpose of undertaking and implementing energy efficiency measures, encouraging co-generation, and utilizing renewable energy sources for making the energy supply reliable. To ensure the implementation of the policies for renewable energy utilization, an action plan should be drawn by the Ministry of Economic Development, applicable for the 10 following years, which establishes the renewable energy targets (in line with EU directives on RES), lists the necessary measures for the realization of those targets, and arranges agreements for international cooperation. With regards to the provision of electricity, the law notes that RES shall be given priority over electricity generated by other sources (Assembly of Kosovo, 2016).

The last part of this law that addresses RES (Article 15) and determines the above-mentioned renewable energy targets that touch upon energy production, co-generation, and consumption. It states that the Government of Kosovo will be responsible for implementing a National Renewable Energy Action Plan, which sets forth the target of "25% share of renewable sources in gross final energy consumption" by 2020. The significance of this target, according to the law, is that it enables Kosovo's cooperation with the Energy Community and/or EU member states (Assembly of Kosovo, 2016).

2.5.2. Kosovo Law on Electricity (Law No. 05/L – 081)

The Kosovo law on electricity contains rules for the generation, transmission, supply, and trade of electricity, among others. Article 18 explains the incentive whereby energy enterprises producing electricity through renewable sources can receive a certificate of origin, which is at a size of 1 MWh. This certificate will indicate the following: the type of energy source; whether it will be used for electricity, heating or cooling; information on the installation used to produce that energy; whether it has been subject to investment, national, or other types of support programs; and, lastly, where and when it was issued (Assembly of Kosovo, 2016). The law then delves into other aspects about the structure of Kosovo's energy system, which, as described previously, is comprised of the Transmission System and Market Operator (KOSTT) and the Distribution System Operator (KEDS), in addition to its power utility (KEK) (Assembly of Kosovo, 2016).

2.5.3. The National Development Strategy (NDS) 2016-2021

This strategy, considered to be a document of highest importance, was funded by the EU (Strategy and Development Consulting Kosovo, 2016) and sets a concrete plan for Kosovo's sustainable development vis-à-vis European integration. The strategy is divided into four main topics, covering human capital, rule of law and governance, re-industrialization, and infrastructure improvements. The penultimate pillar elaborates on mining and the revitalization of the largest industrial complex of mines (Trepca), whereas the last pillar addresses energy security and electricity generation, whereby extensive focus is given to generation capacitates and the lack of a diverse energy mix (Government of Kosovo, 2016).

As was mentioned previously, Kosovo is a mineral-rich country, with lignite heading the list of resources. The strategy points out that the Trepca company must be restructured in order for its capacity to be realized (currently operates at 29% of its previous capacity) and mineral extraction (of not only lignite) to become a source of job prosperity and economic development. This pillar is closely related to the following one regarding infrastructure, as it addresses the utilization of lignite resources as well as opening a new coal mine. For other solutions to the frequent power outages the strategy supports the construction of the 'New Kosovo' power plant and the gradual decommissioning of Kosovo A, meanwhile maintenance operations and rehabilitation of Kosovo B takes place. Additionally, the strategy proposes that transmission lines between Kosovo and Albania, whose electricity is based on hydropower by 98%, should be constructed so that the country meets the demand in peak hours without high import costs. These costs are high due to similar coal-based energy systems in the region, with very low levels of diverse resources (Government of Kosovo, 2016).

The last relevant point in this strategy is the utilization of renewable energy sources, which the strategy considers to be currently insufficient (as mentioned in the background information section, only 3% (46 MW) of electricity is generated through renewable energy sources. Kosovo has committed to a 29.5% renewable energy consumption by 2020, which is unrealistically high when compared to the current practices. The strategy recommends that this target should be lowered, the 'Feed-in Tariff' is applied, and that investments are made in specifically hydropower, biomass, and biogas, and less so on solar and wind power. It identifies 77 potential hydropower projects and a 120 GWh energy production from biomass (mainly forest debris and organic waste) (Government of Kosovo, 2016).

2.5.4. Kosovo Energy Strategy 2017-2026

Drafted upon the *National Development Strategy 2016*-2021 and based on the Law on Energy elaborated above, this strategy is perhaps one of the most important ones that discusses the current and future energy situation, as published by the Ministry of Economic Development. This strategy acknowledges that there are numerous pressing issues in the country's energy sector, and it identifies the following as being the main ones: the lack of generation capacities; delays in initiating the 'Kosova e Re' project and the rehabilitation of the current ones; lack of natural gas infrastructure; large technical and commercial losses; lack of energy saving measures; underutilization of renewable energy sources; and lack of a competitive market (Ministry of Economic Development, 2017). Respective objectives for each of these issues have been established. For the purpose of this chapter, objective 3 ("Enhancement of existing thermal system capacities and construction of new capacities") and objective 5 ("Fulfillment of targets and obligations in energy efficiency, renewable energy sources, and environmental protection") will be elaborated.

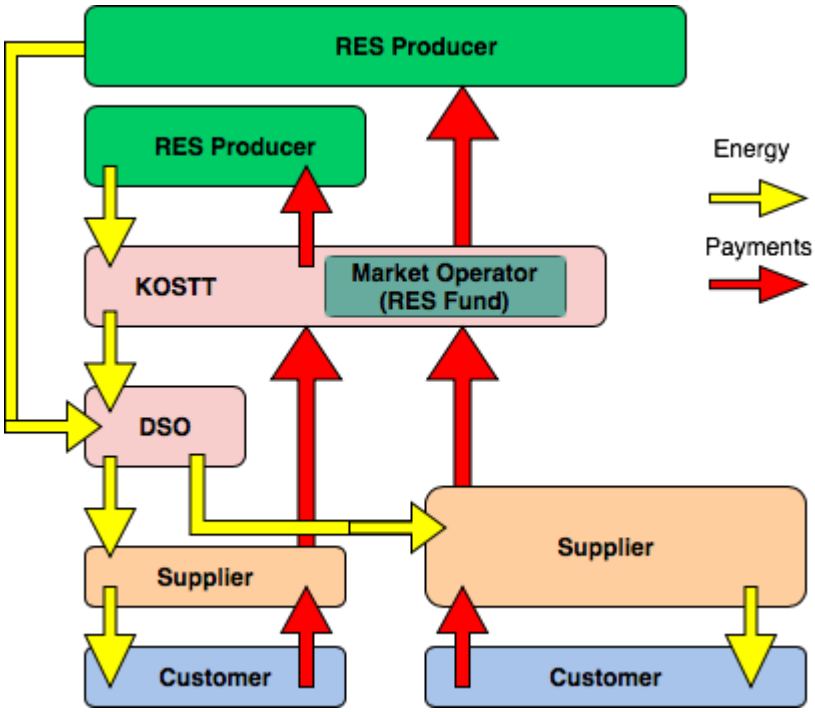
Objective 3 emphasizes the fact that the reliance on electricity for residential heating puts much pressure on the country's energy system. This problem is further exacerbated when coupled with the other challenges facing the energy sector, such as losses in the distribution networks, underutilization of combined heat and power facilities ("Termokos"); and so forth. As such, it suggests that district heating systems should be much largely present in Kosovo, especially in dense areas where collective residences have been built. Concretely, the strategy lists a few measures that must be undertaken to achieve this objective. Besides for the one where the expansion of the co-generation network, "Termokos", is recommended, the other measures concern reducing losses, conducting feasibility studies, and so forth (Ministry of Economic Development, 2017).

Objective 5 mainly concerns the reaching of renewable energy targets as derived from various EU directives and setting new ones for the next period. In this strategy, the target has been reduced to a 25% RES share in the gross final consumption by 2020, which is lower than that of the previous strategy by 4.5%). Moreover, it accentuates Kosovo's position in the Energy Community as a contracting party, implying that all European directives regarding the environment/energy in Kosovo are obligatory. The main problem that the strategy lists in achieving this objective is the lack of funding, besides the state budget for the integration mechanisms of energy efficiency and renewable energy sources (Ministry of Economic Development, 2017).

So far, the country has taken minor steps in encouraging RES utilization. For biomass and hydro, wind, and solar energy the 'Feed-In Tariff' (explained on the National Development Strategy above) has been applied. However, the strategy categorizes RES as necessary for thermal energy generation, whereby solar energy and municipal and wood waste are taken into consideration as replacement for wet lignite and "unsustainable wood"; as such, it has been elaborated in the Heating Strategy (solar for sanitary water heating) and the Forestry Development Strategy (2010-2020) (Ministry of Economic Development, 2017). According to the Energy Regulatory Office (ERO), renewable energy sources that are given priority in support schemes, like the 'Feed-In Tariff', are water, wind, biomass, and photovoltaics: (a) small hydro power plants: 67.3 EUR/MWh; (b) wind power plants: 85 EUR/MWh; (c) biomass power plants: 71.3 EUR/MWh; (d)Photovoltaics: 136.4 EUR/MWh. For achieving the other goals of Objective 5, the strategy states that the Government of Kosovo will implement the relevant action plans for achieving the target of 25% RES-based gross final consumption; implementation of applicable EU policies; providing support schemes for thermal energy systems that use RES; and the establishment of "One Stop Shops" for RES (Ministry of Economic Development, 2017).

ERO has established another support scheme, the Renewable Energy Fund (REF), whereby the market operator (KOSTT) purchases the electricity generated by RES producers and supplies the distribution system operator (which distributes the energy to suppliers and the end-consumer with electricity). The reference price for RES-produced electricity is paid for by customers and suppliers, whereas the difference between the reference price and the one offered by REF as part of the support scheme is paid for by all suppliers (a visual representation of Article 26 from ERO's Rule on Maximum Allowed Revenues of Transmission System Operator and Market Operator (including large RES producers) can be seen below) (ERO, 2017; ERO, 2018).

Figure 3. Renewable Energy Fund



2.5.5. National Renewable Energy Action Plan (NREAP) 2011-2020

According to the action plan, it has been estimated that Kosovo will not be able to reach its targets from its own renewable energy sources only; instead, it presents the prospect of cooperating with countries, like Albania and Montenegro, in fostering agreements for imports (Ministry of Economic Development, 2017). Besides the 25% national mandatory RES target mentioned previously, this action plan sets forth three other targets with more specific information on how to attain them:

1. 25.64% RES in the gross final electricity consumption, to be achieved by: Small hydro power plants (240 MWe); Zhur hydro power plant (205 MWe); Wind power station (150 MWe); Biomass power station (14 MWe); Photovoltaic power station (10 MWe)
2. 10% RES in the final transport consumption to be achieved by the use of biofuels
3. 45.65% RES in the final heating and cooling consumption via: Solar energy (70 MWth); Geothermal heat pumps (10 MWth); Biomass.

With regards to the available potential for renewable energy-based electricity, the action plan provides information about two different periods: 2009-2014 and 2015-2020. For the former, it notes that only hydropower and onshore wind are representative of any potential for renewable energy production; increasing gradually from a combined total of 40 MW in 2009, to a total of 44 MW in 2014. Whereas for the latter, photovoltaics are also

added into the mix, and the total reaches a potential of 371 MW in 2020, after a five-year period in 2020 (Ministry of Economic Development, 2017).
As far as the potential for RES technologies in heating and/or cooling for 2009-2020 goes, the report highlights the utilization of solar heat, solid biomass, and renewable energy from heat pumps, adding to 288 ktoe in total by 2020. Whereas, the available potential for transport-related renewable energy technologies, the action plan identifies a low potential at 29.7 ktoe in 2020, to be supported by biofuels and minor imports when necessary (Ministry of Economic Development, 2017).

2.5.6. Kosovo vis-a-vis EU Integration (EU Enlargement Policy & Renewable Energy Directive & EU Energy Treaty)

As a potential European Union candidate, the Government of Kosovo is required to meet the conditions for EU accession as soon as possible (European Comission, 2018). These conditions stretch from making improvements in the rule of law, human rights protection, and maintaining democracy to acquiring and implementing all EU rules, some of which specifically address the environment and energy (European Commission, 2016). According to the Stabilisation and Association Agreement between the EU and Kosovo, which entered into force in 2016 (EEAS, 2016), the country may receive assistance for renewable energy production and sustainable consumption, specifically tackling energy efficiency and reducing the environmental impacts of the current modes of electricity generation in line with the EU acquis (the binding rights and obligations of all EU member states) (EU Council, 2015; European Commission, 2016).

A Contracting Party to the Energy Community since 2006, Kosovo is responsible for implementing the EU acquis on electricity, renewables, energy efficiency, among others (Task Force on European integration, 2012). A specific requirement is drafting a report that tracks the national developments in renewable energy use and production every two years, pursuant to the European Commission's Renewable Energy Directive. The latest report, which concerns the 2009/28/EC Directive, addresses Kosovo's progress in renewable energy, policy- and production-wise, for 2016 and 2017 (Energy Community, 2018). In terms of policy making, the report lists the regulatory measures, i.e., applicable laws (explained in the previous section) that have entered or were already into force since the compilation of the report, as well as financial and soft measures, such as customs and VAT exemptions for RES equipment/technologies and their use or informational campaigns for promoting RES in the country, respectively. Additionally, it describes the procedures for connecting to the transmission network, developed by KOSTT in accordance with those laws and the

Renewable Energy Directive as well as the feed-in tariff scheme, the purpose of which is to facilitate an easier process for connection and to encourage RES production and consumption by small businesses (SMEs) and farmers (Ministry of Economic Development, 2018).

As far as consumption on a country-wide level goes, the report provides information on the RES share and consumption with respect to heating and cooling, electricity, and transport, as shown on the table below following that order:

Table 4. RES share by sector

	2017	2016
RES-H&C[2] (%)	51.16%	51.79%
RES-E[3] (%)	3.18%	4.34%
RES-T[4] (%)	0.0%	0.0%
Overall RES share[5] (%)	23.59%	24.58%
Of which from cooperation mechanism[6] (%)	**0**	**0**
Surplus for cooperation mechanism[7] (%)	**0**	**0**

(source: Ministry of Economic Development, 2018)

The table shows that renewable energy production is represented with only 3.18% in electricity as of 2017, which is even lower than that of the previous year, which the report attributes to “worsened hydrological conditions” (Ministry of Economic Development, 2018).

Table 5. Total contribution from each renewable energy technology towards meeting 2020 targets in electricity

	2017 [based on ERO annual 2017]		2016	
	MW	GWh	MW	GWh
Hydro[12]:		41.898[13]		50.765[14]
non pumped				
<1MW	0.95[15]		0.95[17]	
1MW–10 MW	44.42		41.19[18]	
>10MW	35		35	
pumped	0	0	0	0
mixed[16]	0	0	0	0
Geothermal	0	0	0	0
Solar:				
photovoltaic	0.6[17].	880	0.602	0.603
concentrated solar power	0	0	0	0
Tide, wave, ocean	0	0	0	0
Wind:				
onshore	1.35	173	1.35	0.370
offshore	0	0	0	0
Biomass[18]:				
solid biomass	0	0	0	0
biogas	0	0	0	0
bioliquids	0	0	0	0
TOTAL	**82.32**	**42.951**	**79.09**	**51.739**
of which in CHP	0	0	0	0

(source: Ministry of Economic Development, 2018)

Kosovo's Potential for Renewable Energy Production

Due to the country's geographical position, this section will focus on four types of renewable energy: solar energy, onshore wind power, hydroelectric energy, and biomass. They will be analyzed below based on their theoretical and technical potential in the current economic situation in Kosovo.

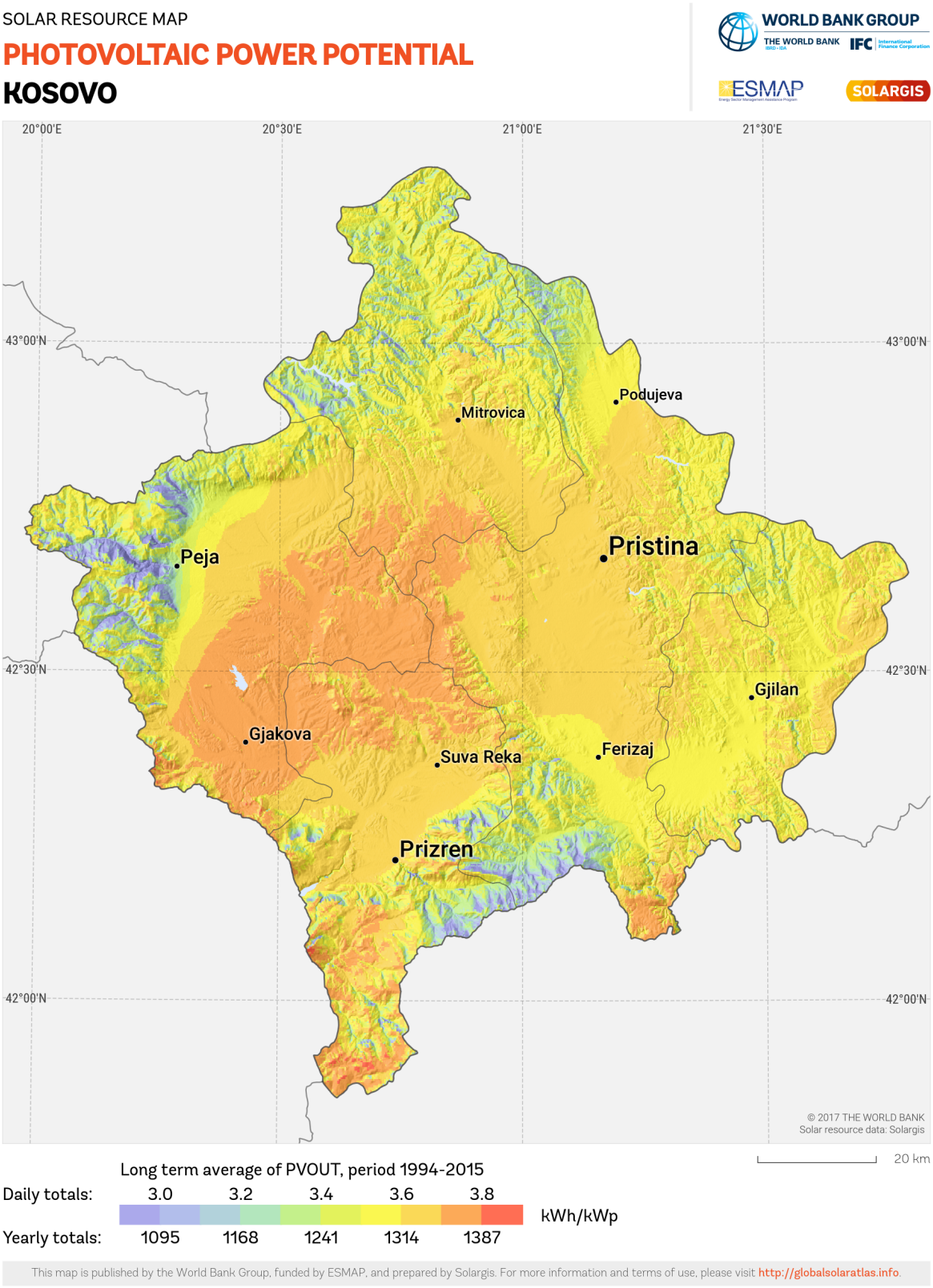
3.1. Solar Power

According to a study conducted by the International Renewable Energy Agency (IRENA) in 2017 regarding RES potential in South East Europe, Kosovo does not only have a large technical potential for PV-based renewable energy, but that a large portion of it is already economically feasible and that it could be realized entirely by 2050. The report identifies 581.3 MW (834.5 GWh) of technical solar PV potential, 436 of which is considered to be cost-competitive at a levelized cost of electricity (LCOE) of EUR 80/MWh (IRENA,

2017). LCOE represents the cost of a kilowatt hour of electricity produced by a plant by taking into account construction, operation, and maintenance costs, return of investment and risks associated with it, plant efficiency, and capacity factors (Govindan, Al-Ansari, Korre & Shah, 2018; Ragheb, 2017).

The Global Solar Atlas is a compilation of GIS and poster maps, put together by WB and IFC, which provides information on the theoretical photovoltaic energy potential (in addition to the GNI and DNI values) on any location over the interactive, online map (World Bank Group, 2016). This atlas includes Kosovo as well, and it analyzes a period of approximately 22 years, from 1994 to 2015, from which it extracts daily and annual average totals of photovoltaic potential in kWh/kWp. The map below (*Figure 4*) shows that an annual average potential of 1314 kWh/kWp dominates the central and southwestern areas of the country, in which some of the main cities lie (World Bank Group, 2016).

Figure 4. PV Power Potential in Kosovo



(source: World Bank Group, 2016)

As a receiver of applications from renewable energy producers for new construction capacities and the support scheme, ERO's register of applications may also serve as a source

for looking into RES potential in the country.[1] Its register lists the applications based on their phase of authorization with respect to solar panels: 1) final authorizations in operation: a combined total of 7.002 MW in Klina, Istog, Labjan (Peja District), Kusar (Gjakova District); 2) final authorization: 3 MW in Kamenica (Gjilan District); 3) preliminary authorization: a total of 102.3 MW in Klina, Sverrke, ZK Peja (Peja District), Kusar (Gjakova District), Llapashtica (Prishtina District), Skenderaj (Mitrovica District). The total number of new generating capacities is 41 to represent 112.3 MW energy produced through solar panels (ERO, 2019).

ERO has also published the list of applicants for generators for self-consumption. The list comprises 15 applicants, 12 of which have already received their authorization for solar generators in 2018 and 2019, whereas the remaining applications are in the process of being issued an authorization. 6 of the applicants are natural persons and the rest are companies. The applications for solar self-consumption totals an installed capacity of 459.08 kW, which is less than 1 MW (0.45908 MW). The biggest share of installed capacities is represented by companies "Agro Trade" at 55.2 kW, "Shqikos-Aralco" at 67.2 kW, "Besiana-G" at 69 kW, "N.T. Liridoni" at 95 kW, and "Carshia" at 100 kW (ERO, 2019).

For the 2019-2028 period, KOSTT plans to add new renewable energy capacities to its transmission network. According to KOSTT's base scenario, there is a potential of at least 85 MW of solar energy, whereas its high scenario identifies a planned capacity of 121 MW to be integrated into the transmission system during the next decade (KOSTT, 2018).

Elen Gmbh, one of the leading private companies in the field of electrical energy RES, and sustainability in Kosovo[2], has installed 1.5 MW of solar panels and/or applied relevant energy efficiency measures so far on three customer segments: businesses/industry by 70%-80%, 10% in the residential sector, and the remaining 10% in state institutions (L. Syla, personal communication, August 5, 2019). Lulzim Syla, managing partner at the company, notes that Kosovo has the potential to support (and even exceed) its demand for energy through renewable energy sources. According to Syla, the state institution and

[1] According to Krenar Bujupi, former Board Member at ERO, final authorizations in operation refer to those projects that have met all the necessary conditions, have received ERO's authorization, are connected to the electricity grid, and are already producing energy. Final authorization points to those applications that are finalized in terms of ERO's requirements, but their capacities are either currently under construction or the applicants are still on the search for funds/investments to support their projects. Applications that have received preliminary authorization represent those that cannot vazhdu due to the fact that the targets for the feed-in tariff have already been reached by the other projects; as such, these applications either await for MED to raise the feed-in tariff targets or for one of the projects with a final authorization not to fall through (K. Bujupi, personal communication, July 27, 2019)..

[2] A private company with a central office in Prishtina, focused on providing products and services for electrical energy and RES.

industry segments could play a key role in realizing that potential if they are incentivized by the government and are subject to lower interest rates and more RES-promotion campaigns. Syla places an emphasis on the fact that there are at least 1300 educational institutions, 10,000 houses, and 1000 businesses where solar energy systems could be installed on the rooftops and produce electrical energy for self-consumption, with the latter two producing a combined total 200-300 MW within the next 5-10 years (personal communication, August 5, 2019).

Based on a study that analyzes the global horizontal irradiance (GHI) and direct normal irradiation (DNI) globally, both measured in kWh/m2, Kosovo shows to have 'fair' GHI and DNI solar resources in 40% and 80% of the total area respectively. GHI refers to "direct and diffuse radiation", whereas DNI measures the "solar radiation that reaches Earth's surface directly". As such they play a crucial role in determining the suitable technologies for the geographical areas in question, with the former proving to be necessary for flat-plate photovoltaics and the latter for concentrated photovoltaics and concentrated solar thermal technologies. Given this information, it can be concluded that the country could utilize both flat-plated and concentrated PVs for solar power generation, considering a 1419.7 to 1641.8 kWh/m2 annual GHI and a 1255.7 to 1546.8 kWh/m2 annual DNI in approximately 40% and 80% of the total area respectively (Prăvălie, Patriche, & Bandoc, 2019).

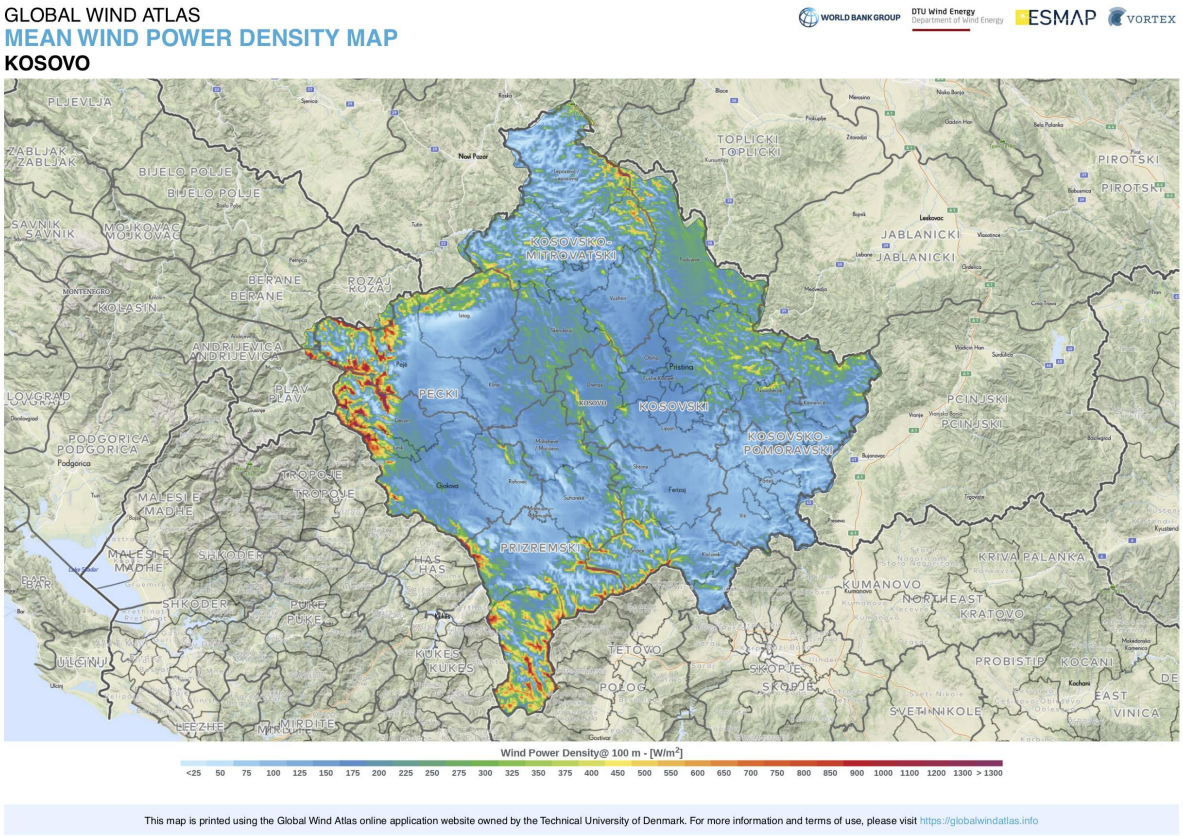
3.2. Wind Power

The Global Wind Atlas (which operates the same way as the Solar Atlas) has been put together by the World Bank Group and the Technical University of Denmark in an attempt to provide information on windy areas throughout the world (World Bank Group). The atlas shows the wind power density (WPD) in the form of a mean annual energy density at 100m above surface level. WPD's unit of measure is W/m2, and a larger value implies that the resources of wind are better (World Bank Group, 2018). It includes the following layers to provide more wholesome information on the potential: wind speed, orography, roughness, and ruggedness.

The map below points to the fact that the areas with the highest potential are located in southern and western Kosovo, and, to a lesser extent, in the north-eastern part as well. These areas are mainly mountainous regions, which signifies that the roughness of the area is higher, a factor that affects the wind speed (Van Eckere et al., 2015). Looking more closely into each of the three largest regions by potential, values are even higher than what the color legend shows, with a wind power density of more than 1300 W/m2. The atlas has calculated

an average mean WPD and wind speed for the 10% windiest areas of each region, listing the following: 655 W/m2 and 7.49 m/s in the city of Peja district (denoted as Pecki on the map); 626 W/m2 and 7.5 m/s in Prizren (Prizremski); 365 W/m2 and 6.6 m/s in Mitrovica (Kosovsko-Mitrovatski); 389 W/m2 and 6.87 m/s in the district of Prishtina; and 292 W/m2 and 6.46 m/s in Anamorava of Gjilan's district (Kosovo-Pomoravski). The atlas also provides the total mean of WPD throughout the 10% windiest areas of the country, at 389 W/m2 WPD and 6.87 m/s wind speed.

Figure 5. Mean Wind Power Density in Kosovo



(Source: World Bank Group, 2018 (Global Wind Atlas))

The study conducted by IRENA finds Kosovo to have a large technical potential, at 2328.8 MW (3849.5 GWh). However, it also accounts that due to the country's mountainous regions, a much smaller fraction of that potential can be fully utilized to generate power, with an LCOE of approximately EUR 60/MWh (IRENA, 2017). This report has removed the factor of location suitability from the LCOE calculation, meaning that depending on the actual favorable location of the wind turbines and their proximity to the grid, the final LCOE may result in a lower price than EUR 60/MWh (IRENA, 2017).

For wind power, ERO's register lists the following: 1) final authorizations in operation: a total of 33.77 MW in Golesh (Prishtina District); 2) final authorizations: a total of 103.4 MW in Selac (Mitrovica District); 3) preliminary authorizations: a total of 246.1 MW in Novoberde and Marevc (Prishtina District), Suhareka and Rahovec (Prizren District), and Kamenica (Gjilan District). The total of all wind turbine applications, publicly available on ERO's website, amounts to 383.3 MW to be generated by 13 new capacities, two of which (33.75) are already in operation (ERO, 2019).

With respect to integrating the electricity generated by wind farms in the Kosovo transmission system, KOSTT identifies a potential of 180 MW in its base scenario and 250 MW in its high scenario during the 2019-2028 period (KOSTT, 2018).

3.3. Hydro Power

On a pre-feasibility study on hydropower in Kosovo in 2006, all the potential locations were analyzed based on the flow of the rivers, dropping, geology, hydrology, meteorology, and environmental and social impacts, among others, in order to assess the potential for small and medium hydropower plants in the country. Based on these factors, the study focuses on four specific areas, ranked from those with the highest potential to the lowest: Area 1 (covering the north-western part of the area between Peja and Junik), Area 2 (south-east Dragash-Prizren), Area 3 (northern Mitrovica), and Area 4 (east of Llap). Area 1 is considered to have the highest potential, and it includes the rivers of Lumbardhi of Peja, Lumbardhi of Decan, Lumbardhi of Llocan, and Erenik. The potential for each is assessed to equal 79 million kWh/year, 64 million kWh/year, 14 million kWh/year, and 37 million kWh/year respectively, presenting a cumulative 194 million kWh/year (approximately 22.1 MW). Area 2 includes the rivers of Plava, Lumbardhi i Prizrenit, and Lepenci, each with a potential of 36 million kWh/year, 7 million kWh/year, and 26 kWh/year, totaling a potential of 69 million kWh/year (approximately 7.87 MW). Area 3 comprises the Bajska and Bistrica rivers with a total capacity of 7 million kWh/year (approximately 0.79 MW), whereas Area 4 includes Kacandoll river only, with a 3 million kWh/year potential (roughly 0.34 MW) (AAEESD, 2006).

The table below (*table 6*), put together from the same study in 2006, shows the list of all SHPPs that were deemed to have the potential for hydropower generation at each location, as well as their power capacity and electricity generation.

Table 6. Potential HPPs in Kosovo, 2006

HPP Name	**River**	**Power Capacity (MW)**	**Electricity Generation (million kWh)**
Kuqishte HPP	Lumbardhi of Peja	3.9	17
Drelaj HPP		6.2	27
Shtupeq HPP		7.6	35
Bellaje HPP	Lumbardhi of Decan	5.2	25
Decan HPP		8.3	39
Llocan HPP	Lumbardhi of Llocan	3.1	14
Mal HPP	Erenik	4.0	18
Erenik HPP		2.0	9
Jasiq HPP		1.9	9.7
Dragash HPP	Plava	2.2	10
Orcush HPP		5.6	25.6
Recan HPP	Lumbardhi of Prizren	1.5	6.7
Brezovice HPP	Lepenc	2.1	10
Lepenc HPP		3.5	16
Banjske HPP	Banjske	0.3	1.4
Batare HPP	Bistrica (Batare)	1.1	5.8
Majanc HPP	Kacandol	0.6	2.9
Mirusha HPP	Drini i Bardhe & Decani	4.6	22
Total		63.7 MW	294.1 million kWh

(source: AAEESD, 2016)

A much greater potential is shown on an IRENA report, emphasizing that small hydropower plants (SHPP) could generate power at a total amount of 137.4 MW at an average LCOE of roughly EUR 59/MWh, which is lower than that of the neighbouring countries. It also adds that the technical potential is represented by 494.8 MW of hydropower, which includes the SHPPs, Zhur hydropower plant, and pumping. Nonetheless, the report

does not provide details on the location and number of hydropower plants that could realize either the cost-competitive potential or the technical one (IRENA, 2017).

With regards to Zhur hydroelectric power plant, IRENA classifies it as having the greatest potential for power generation, at a capacity of 305 MW and an annual electricity output of 400 GWh (IRENA, 2107; World Bank, 2011). If constructed, the plant will be located in the southwestern part of Prizren and consist of HPP Zhur I (in close proximity to the village of Zhur) and HPP Zhur II (on the Drini i Bardhe river), with the former having a capacity of 246 MW and the latter 46.8 MW (Ministry of Energy and Mining, 2009). The entire plant will be used as a storage facility, and its generated electricity will be utilized for peak demand (World Bank, 2011). Based on Kosovo's Energy Strategy 2009-2018, for the project to result profitable, the estimated price of electricity would be EUR 87.2/MWh during the first 15 years and drop to EUR 39.5/MWh for the next 34 years (plant life is 50 years) (Ministry of Energy and Mining, 2009). According to the strategy, Zhur HPP was planned to be in operation by 2016 and play a crucial role in meeting the overall demand for electricity in the country (Ministry of Energy and Mining, 2009). Having been on the agenda since the 1980s, the project only remains as a signifier of the largest identified hydropower potential to date (World Bank, 2011).

ERO has published the list of numerous entities that have filed an application for new generating hydropower capacities and the response they have received from ERO: 1) final authorizations in operation: a total of 50.01 MW in the following HPPs: Belaje, Decan, Brodi II, Brodi III, Restelica I & II, Albaniku 3, Orqusha, Lepenci 3; final authorizations: a total of 57.54 MW in HPP Lumbardhi II, Sharri, Vica, Shterpca, Lepenci, Binqa, Brodosan, Soponica, Brodi I, Restelica III, Albaniku 1, 2 & 4, Dragash, Kotlina; 3) preliminary authorization: 3.3 MW in HPP Lepenci 2. As such, 26 new hydropower capacities with a total of 111 MW have undergone review by ERO, with 50.01 MW already in operation (ERO, 2019).

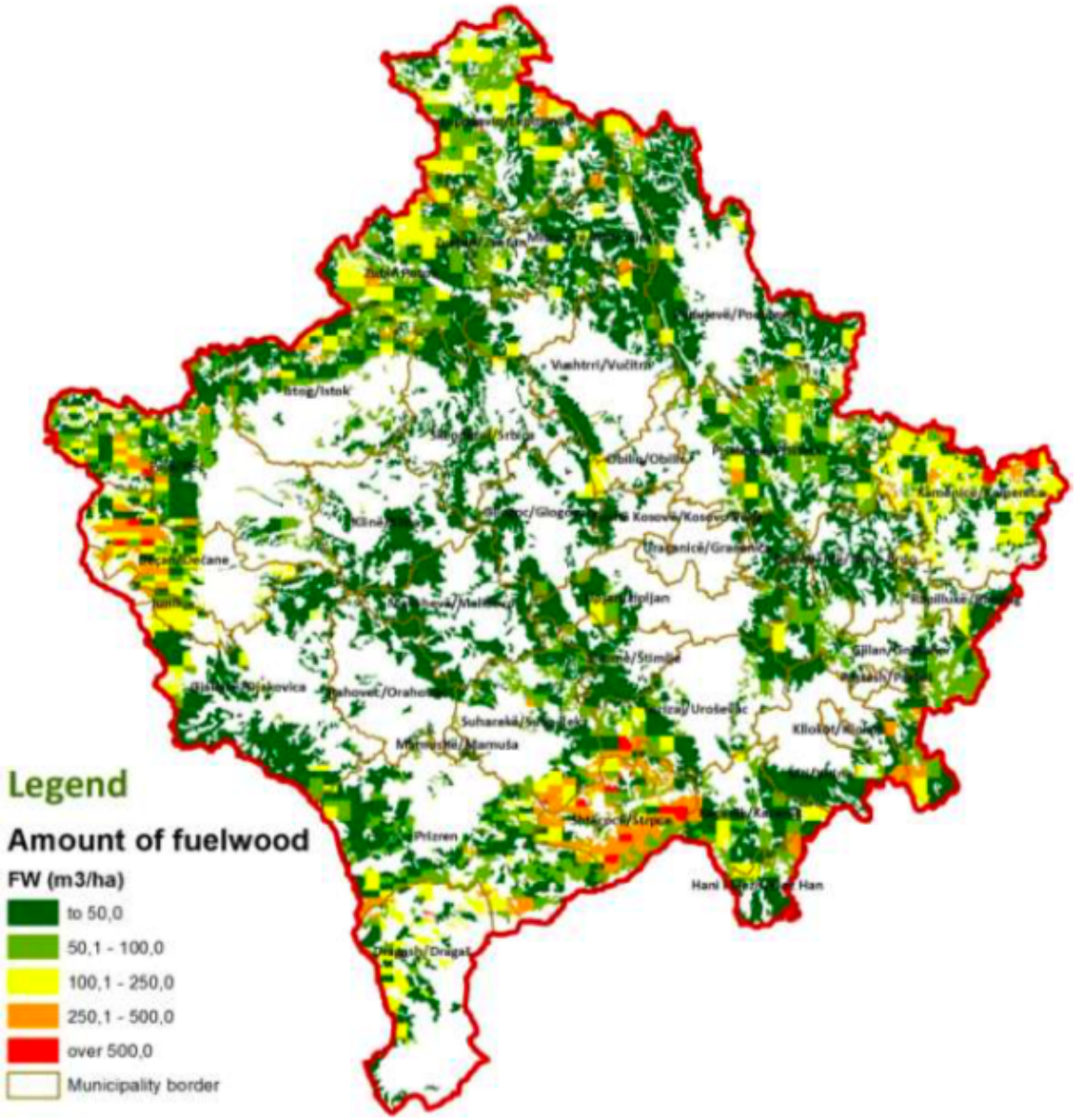
Both of KOSTT's base and high scenario identify a 240 MW planned capacity to be added into the country's transmission system during the next 10 years via hydropower plants (KOSTT, 2018). However, it does not specify if that capacity is to be realized by small or large HPPs.

3.3. Biomass

481,000 (44.7%) of Kosovo's entire land area is covered by forests, 62% of which is classified as public forest while the rest is under private ownership. 93% of the forest area is

covered by coppice forests, with coniferous forests cover approximately 5% of the area. Forests represent a direct source of energy in the country and they are to be found in amounts of higher than 5000 m3/ha in the southern (Shterpce) and western (Decan) part of the country, as shown on the *Figure 6* below (FAO, 2015).

Figure 6. Current estimated amount of biomass for energy



(source: FAO, 2015)

Other direct sources of biomass for energy (heating) in Kosovo include vineyard and orchard residues, estimated to be 7051 tons per year. Indirect sources are represented by wood biomass stemming from the sawmill industry and producers of pellets, briquettes, and chips. Vineyard and orchard residues as well as the indirect sources present only 5% of the market. Due to large-scale illegal logging in Kosovo, only the official amount of wood processed by

registered sawmill entities is taken into account, resulting in 49520 m3 as of 2013. In the same year, the municipality of Mitrovica in the north and Peja in the west were responsible for the processing of 15000 and 20000 m3 logs, respectively. Regarding wood briquettes and pellets, the main producers were found in the municipality of Kllokot, Decan, Mitrovica, and Peja, totaling 51000 tons of briquettes and 20500 tons of pellets, while wood chips stand at 300 tons (FAO, 2015).. According to the FAO study, a combined total of approximately 1320 million tons of biomass is available to supply the biomass market (FAO, 2015).

Putting these data into perspective, a USAID study compares wood to electricity in Kosovo, showing that for 0.0014 kWh of electricity produced in a month, 1.08 m3 of fuel wood is used, with the latter coming at a price of EUR 30-46 per m3. The price per kWh produced is estimated to be EUR 0.041-0.068. With respect to wood pellets, for every 5-5.5 kW produced, 1 kg of wood pellets are required, with a price of EUR 0.35 per 2 kg.

Biomass is used for heating in 42% of urban households in the country and 58% of rural ones, whereby woody mass (mainly a part of the stem and branches) is most commonly used. Biomass accounts for more than half of the total fuel mix for heat production, at 54% (440 ktoe), 307 ktoe of which is used in firewood stoves and the remainder is used in small heat-only boilers. Electricity follows biomass as the second largest source of heat production, standing at 169 ktoe (21% of the total mix) and used in electric appliances (World Bank Group, 2017). The district heating (DH) system in Prishtina mainly relies on waste heat from the Kosovo B TPP, whereas DH in Gjakova and Mitrovica rely on heavy-fuel oil (World Bank Group, 2017).

In Kosovo, the report identifies a theoretical biomass potential of 844 ktoe, a sustainable technical potential of 665 ktoe, and an additional heating use potential (excluding energy crops) of 68 ktoe (whereby roughly 233 MW of heating capacity could be supplied if agricultural residues and woody biomass different from firewood is used). Unconsumed potential has a negative value of -157.2 ktoe due to the current unsustainable use of biomass (World Bank Group, 2017).[3]

Concerning ERO, only one application has been sent forward for authorization for new RES-based generating capacities and admission to the support scheme. The entity in

[3] The report lists different types of potential for all WB countries, in ktoe: total available (theoretical) potential; sustainable technical potential, which takes into account the available technologies, technical conditions, land use, and EU's Renewable Energy Directive criteria; unconsumed potential, which refers to the sustainable potential, but without factoring in the current use of biomass for all uses (heating, cooking, export); unconsumed potential (excluding energy crops); and additional heating use potential (excluding energy crops), which analyzes how much of that unconsumed potential can be added to the current capacities for heating after alternative uses of biomass have been taken into consideration (World Bank Group, 2017).

question is District Heating Gjakova J.S.C, which received preliminary authorization in April 2019. The application was filed for a 1.2 MW for the district heating system in the city of Gjakova (ERO, 2019).

The capacities to be integrated into the transmission system from biomass remain lower than other renewable energy sources, at 14 MW on KOSTT's base scenario and 16 MW on its high scenario (KOSTT, 2018). Nonetheless, it shows that there is a potential to increase the capacities from 0 MW in the transmission system to 16 MW within the next 10 years. Whereas a study by Mercados identifies an estimated potential of 120 GWh/year for the medium-term to be achieved by 2020; however, it notes that biomass is already being used to a large extent either for heating or as a fertilizer in agriculture and that collecting and transporting it remains a challenge (World Bank, 2011).

Societal Debate, Trade Offs, and Impacts of the Current and Future Energy System

4.1. Societal Debate

4.1.1. Legal and Governmental Aspect

Looking into Kosovo's Energy Strategy 2017-2026, as well as the other relevant strategies, laws, and action plans, all of which were elaborated in the second chapter of this analysis and that are in effect, it can be concluded that from a legal perspective RES is favorably promoted throughout those documents, in as much foreign investors, private businesses, and households are willing to generate electricity through RES for self-consumption and/or sell it to KOSTT. The push for the coal-fired power plant is even more present throughout those documents (perhaps as a result of more studies having been conducted regarding TPPs), linking the reliance on coal with the attainment of the goal of energy security in the country, avoiding power outages, and enabling economic growth.

A focus on energy security was also placed by former prime minister (as of July 2019), Ramush Haradinaj, who called upon the members of parliament to vote for the project, despite the danger that the government may collapse. According to Haradinaj, the project must be endorsed by all, in the name of the young generations, because lignite is the source of energy that the country has on a much larger scale than it does of renewable ones, and because Kosovo cannot "depend for energy on the neighbors that do not recognize us and do not love us," referring to electricity imports from Serbia (Prishtina Insight, 2019).

From an institutional perspective, the main bodies responsible for RES in the energy sector are the Ministry of Economic Development (MED), ERO, and KOSTT. On a sustainable development conference, "Energy Transition in Kosovo", held in 2018, MED's minister, Valdrin Lluka, refused to participate under the pretense that he would appear to be the only one among the panelists to support the New Kosovo TPP project (KOSID, 2018). However, the Minister of Environment and Spatial Planning, Fatmir Matoshi, who is a member of the same party (AKR) as Lluka, participated in the conference. Advised by other participants to revoke the environmental permit for the new power plant on EU EIA Directive violation grounds, Matoshi noted that if that is to be done, the country will bear a large financial penalty by the private company. Additionally, the MESP Minister stated that the new TPP project is the most fitting in the country currently (Prishtina Insight, 2019).

4.1.2. Civil Society Standpoint

KOSID (Kosovo Civil Society Consortium for Sustainable Development) has been a prominent voice for calling on an energy transition that is based on renewable energy sources, and a firm objector against the construction of the new coal-fired power plant. According to KOSID, the contract between the government and ContourGlobal for the new TPP has violated constitutional principles that set Kosovo a few steps back vis-a-vis its citizens and its European integration prospects. The principles that KOSID refers to specifically are: Article 52 (Responsibility for the Environment) and with the Law on Energy (no. 05/L-081), the former because of damages the new power plant will bring to the environment and the latter for the way the plant hinders the integration and liberalization of the energy market since the Contour Global will receive a return of investment, according to the contract (KOSID, 2017).

The consortium emphasizes that a project of such a scale and significant implications such as the "Kosova e Re" TPP should have undergone a transparent process, from the tender to the signing of the contract, and should have included "a national census and environmental impact assessment" (KOSID, 2017). In terms of both the current and future energy situation in the country, KOSID suggests that investing in energy efficiency measures and on renewable energy instead of lignite technologies would prove to be much more beneficial to the country generally, and to the environment, public health, and the socio-economic state of affairs specifically (KOSID, 2017). Haki Abazi, KOSID cofounder, notes that the Kosovo-Albania transmission line must be put into operation, which does not only respect the signed Energy Athens Treaty of 2005, but also enables reliance on and utilization of the capacities in the region, dismissing thus the need for a new coal power plant (Prishtina Insight, 2019).

In 2013, GAP Institute and KOSID filed a lawsuit against MED for the lack of transparency during the procurement process of the New Kosovo TPP project by not enabling access to the relevant public documents. In 2017, GAP requested access to the signed contract between the Government and ContourGlobal, which MED refused to provide. Although with major delays, the Basic Court in Kosovo ruled in favor of GAP and KOS, stating that MED had violated the Law on Access to Public Documents. Nonetheless, despite having been found guilty, neither MED nor its officials have been held accountable for this violation to this date (GAP, 2018). INDEP (Institute for Development Policy) director, Burim Ejupi, pointed out that during the period between the lawsuit and the finalized contract, many changes had been made, including the removal of Kosovo B TPP rehabilitation plans (Balkan Green Foundation, 2019). According to the civil society, the new TPP is not only synonymous to environmental harm and health dangers, but also to constitutional violations that could have been avoided, which would have ultimately led to a better contract for the country as a result of public and watchdog organizations participation in the process (Balkan Green Foundation, 2019; Prishtina Insight, 2019).

KOSID also complained about the Ministry of Environment and Spatial Planning (MESP) to the Energy Community Secretariat for the environmental protection section of the contract with ContourGlobal. It referenced specifically to the lack of public consultations about the environmental permit that MESP had provided the private company with, while also refusing to make the documents publicly available after their conclusion (Prishtina Insight, 2019). This instance has been classified by Bankwatch as a violation of the EU Environmental Impact Assessment Directive, and a very outrageous at that (Prishtina Insight, 2019).

4.1.3. Other Points of View

Hade is a village in Obilic, settled over a lignite-rich area, and it has been subject to coal mining for decades now. To provide the CFPPs with coal, the mines in Hade have been constantly expanding, a trend which is expected to continue because of the new power plant as well. Ragip Grajqevci is a representative of the village and he was present at the sustainability development conference held this year. Grajqevci demanded from MESP Minister to cancel the New Kosovo project due to the way his community has been affected, not only in terms of the mines' expansion, but also in terms of health impacts, stating that the majority of the people in the village suffer from respiratory diseases or different forms of cancer (Prishtina Insight, 2019).

After the same sustainable development conference mentioned previously, the Energy Community's (EnC) Secretariat gave a preliminary statement on the power purchase agreement between the Government and ContourGlobal. The Secretariat considers various sections of the agreement to appear as State aid, which is illegal under the Energy Community Law, as it disrupts the single energy market of the EU from operating in a freely and without advantages that certain private entities (as is the case with ContourGlobal) might receive from public companies or other entities. The statement specifically addresses the fact that ContourGlobal will not be subject to any risks that are normally associated with energy markets, namely: the "production risk, operational risk, market risk, regulatory and tax risks, and credit risks" (Energy Community, 2018). Additionally, the statement points to other forms that the country incurs damages by the project due to VAT and customs exemptions for ContourGlobal, a lower price for the lease or transfer of land, and constant guarantees from the country, ensuring that the private London-based company profits without bearing any of the risks and expenditures (Energy Community, 2018).

On the other hand, citizens have continuously protested against the construction of multiple hydropower plants in the country. River Bistrica has been a source of drinking and irrigation water for the villages of Bistrica, Kushtova, and Batahir, which are now receiving less water for that purpose due to the current hydropower plants on the river. The residents of those villages are concerned that the construction of two other planned ones by "Hydroline" will only exacerbate the situation. They claim that neither the company nor MED or MESP have consulted them or held a public hearing for the construction of the plants and that some of the company's pipes have even gone through their private properties without any permission and/or compensation. Representatives of these villages have petitioned against the HPP's construction, and other citizens from the municipality of Mitrovica have joined in, despite living remotely from the river or the villages. One of the residents added that the villages will also lose their tourism prospects due to the damages that have been caused to the river and its bed from the HPPs (Kallxo, 2019).

The same reaction has come from the residents of Peja for the construction of a new HPP in the Peja's Lumbardh river. Thousands of protestors have raised their concerns regarding the HPP and the impacts the previous ones have had on the environment. Peja's mayor, Gazmend Muhaxheri, has also voiced his concerns on the environmental damages and the potential economic/touristic ones, publicly stating that he is against the construction of the HPP, too (Kallxo, 2019). The residents of Shterpce have raised their voices as well, claiming that besides being located on Sharr Mountains National park, the HPPs have also affected the drinking water quality in the area (Kallxo, 2019).

4.2. Trade Offs and Impacts

4.2.1. Lignite and CFPPs

As mentioned in Chapter 2, lignite extraction in Kosovo is done through open-pit surface mining, which, from an economic perspective, is cheaper than the other types of mining (National Geographic, 2012). Coupled with the fact that the average thickness of the deposits is approximately 40 meters, surface mining is considered to be a highly economically viable option in the country for electricity production, standing at a lower price than Bulgaria, Serbia, and Montenegro, at EUR 0.62/GJ (Mining Communications, 2005). In Kosovo, this method creates, on average, 1.7m3 waste per ton of coal extracted from Kosovo mines, which, according to KPMM, translates into a much lower cost of producing energy per amount of extracted lignite when compared to the neighboring countries (KPMM). However, lignite extraction has historically come with a price: damages to the environment and communities residing in or close to those mines. With regards to the former, open-pit mining may lead to: landslides due to corrosion from land degradation; nuisance in the form of noise and vibration due to the use of heavy machinery; changes in vegetation as a result of pollutants reaching groundwater during the extraction or processing of coal; contamination of water itself with heavy metals, which in turn also affects nearby springs, lakes, rivers, agriculture (irrigation water), fresh drinking water, and so forth (Monjezi et al., 2009). Being located closest to the coal-fired power plants, the Kosovo coal basin, which lies predominantly in agricultural land, is affected to a great extent. Approximately 20 hectares of such land is destroyed every year due to mining operations generally or because it is used as an ash dumpsite. This ash makes up a large portion of the total waste generation in the country, accounting for 1 million m3 each year (World Bank, 2012). Before the mining operations, overburden for opening the mines was dumped in 1000 ha of land, deeming that land unsuitable for any other purpose. Although the land is being rehabilitated, it has been noted that the majority of it will remain unsuitable for agriculture (World Bank, 2012)
With regards to the communities living in the area, displacement and/or resettlement has been taking place for a long period of time, and not always successfully. The reason for those communities being subject to displacement once more will be due to the development of the new Sibovc mine, which had been reserved for the new coal power plant before the project received the approval of the stakeholders (Al Jazeera, 2015). Although the project is expected to provide permanent jobs to an estimated guess of 500 employees and, perhaps, thousands during construction (Al Jazeera, 2015), the downfall of it is the process of displacement

(sometimes forceful) and/or resettlement. According to an ESIA conducted in 2014, a number of 442 to 835 people will have to be displaced/resettled for mining and plant operations (Ministry of Economic Development).

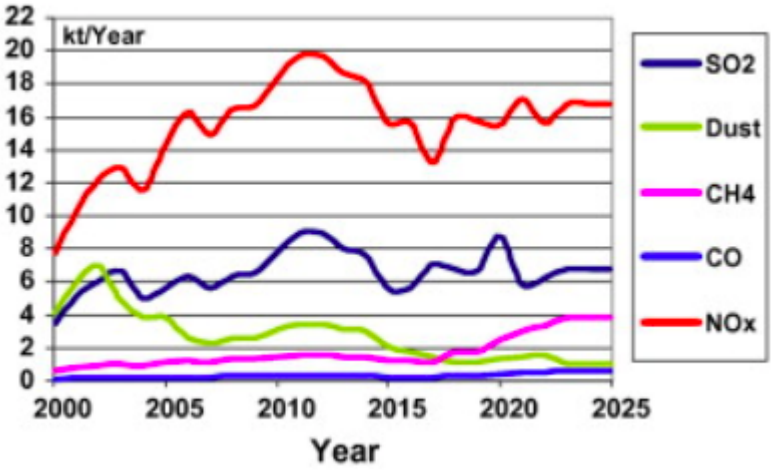
For those that are not resettled or cannot financially afford to do so on their own, the price they pay comes in the form of serious health problems, mainly as a result of concentrated air pollution in the Municipality of Obilic, where both CFPPs are located. Upon the construction of Kosovo A, the village of Dardhishte in the same municipality had become an ash dumping site for the following 50 years, earning its alternative name: the cancer village (Al Jazeera, 2015). Both a resident of the village and an employee at KEK, Avdullah Selimi-Raci had had to undergo a throat surgery because of the inhaled air pollution that had severely damaged his larynx and vocal cords (Al Jazeera, 2015). In the town of Obilic, cases of residents with respiratory problems are alarmingly high. According to the director of a health center there, at least four cases of lung cancer are identified each month, mainly affecting the elderly and endangering pregnant women (Al Jazeera, 2015). Hade, another village greatly affected by the coalfield expansion, is constantly exposed to high air pollution levels, as well as constant noise from the mine operations. Over the years, the village has seen its population reduce from 300 families to 50 only. Additionally, the number of pupils attending classes in elementary schools has reduced as well. As a result, those schools risk closing or classes are postponed, leaving the local children with short-time solutions whereby different generations of classes share a teacher and a classroom (Al Jazeera, 2015).

Due to the lack of upgrades and maintenance, the country's old power plants are constantly prone to technical issues, which have, more often than not, left the country without electricity for hours in a day, week, or month. Additionally, winter-time Kosovo is usually met with cold winters and a heavier reliance on electricity for heating, a demand (approximately 1100 MWh) that is not always met by the country's energy producer, KEK, and the two CFPPs (which can generate approximately 800 MWh of electricity at maximum) (Reuters, 2018). As energy markets operate, Kosovo must at such times import energy from the neighboring countries in order to stabilize the amount of electricity running through the grid. However, due to the political relations with neighboring Serbia, imports have either reached the country much later than planned to or not at all. This has been the case in 2018, where disagreements between the grid operators in Kosovo and Serbia risked the energy security of the region due to disagreements. Because Serbia did not export the necessary electricity to Kosovo, the grid was imbalanced, resulting in a lower frequency than 50 hertz, which is a requirement under the European Transmission System Operators for Electricity (ENTSO-E). Because a lower frequency signifies less energy in the system, digital clocks

(i.e., timers on microwaves and stoves and clock radios) connected to the grid ran late for a few weeks for approximately 6 minutes, an occurrence that affected 25 member states of ENTSO-E (DW, 2018).

Besides power outages, the old polluting TPPs release emissions which are known to have a direct impact on the environment and human health. The graph below shows the amount of greenhouse gas emissions in kt/year and shows their levels if the energy system in Kosovo is no updated and upgraded until 2025 (Kabashi et al., 2019). According to the report on KEK's environmental condition, as of 2018, no measure for the reduction of the amount of dust particles, SO2, NOx, CO, CO2 has been taken in either of the power plants (KEK, 2018). In addition to emissions, these power plants are also responsible for discharging the water into the Sitnica river without any form of treatment in advance, causing thus damage to the aquatic ecosystem of the river, which is already endangered due to untreated sewage from the houses along the river (World Bank, 2012).

Figure 7. GHG emissions from electricity generation



(Source: Kabashi et al., 2011)

Conversely, an intermittent power supply makes the New Kosovo project highly relevant. The planned construction of the new power plant is expected to be completed with the highest EU standards on such plants, not any different from those that can be found in Germany, for instance (HEAL, 2016). One of the project managers for the New Kosovo CFPP, Lorik Fejzullahu, noted that the plant that is going to be constructed in Obilic uses the most updated technologies with respect to environmental protection on both a local and global scale. Fejzullahu also stated that the latter should not be a matter for concern because Kosovo represents an insignificant economy among the true polluters and that the country is currently at the stage of development where "having or not having energy" is the actual problem (qtd. in Al Jazeera, 2015). However, because the CFPPs release a great amount of

harmful gases, which are transported to the region (and entire Europe) via winds, a global-scale impact is, in fact, a matter of concern. It has been estimated that the impact of Kosovo's current power plants, in terms of health alone, translates into costs of 70 to 169 EUR million in the Western Balkans and 144 to 352 in Europe (HEAL, 2016). Despite the state-of-the-art technologies to be found in the new power plant, it has been estimated that there will still be costs incurred by people, both in the Balkans and EU, health-wise of 6-14 EUR million and 14-34 EUR million, respectively (HEAL, 2016).

In addition to environmental and social costs, the new power plant is expected to come with a higher electricity price for the country and the consumers. The energy generated through New Kosovo will have a price of EUR 80/MWh, which is 20-30 EUR more than the prices in neighboring countries. For the consumers, the average price of electricity per kwh is expected to cost 9 cents, which, in current trends, means that the customer will pay a 50% higher price for the same amount of electricity consumed (Balkan Green Foundation, 2019).

On the other hand, New Kosovo TPP, according to the Ministry of Economic Development, will have a higher efficiency than 40%, will require almost 40% less lignite coal to produce the current amount of electricity than Kosovo A and 25% less than Kosovo B. If Kosovo A is shut down, Kosovo B is rehabilitated, and New Kosovo operates at full capacity, SO2, NOx, and dust emissions will be reduced by 25, 3.8, and 20 times, respectively, compared to the current emissions (Ministry of Economic Development). Additionally, the plant will not only produce electricity, but will produce thermal energy as well. As such, the plant will be connected to the district heating system in Prishtina and enable its expansion, anticipating to reach 20,000 consumers in addition to the 13,500 that are currently supplied with heating through DH (and Kosovo B) (Ministry of Economic Development).

4.2.2. RES-Supported Power System

The analysis on the previous chapter has shown that the country has much more renewable energy production potential than it currently utilizes, especially through solar, wind, and hydropower, and to a lesser extent through biomass as well. Additionally, it has confirmed that RES are, from a legal perspective, very well established and prioritized over other sources of energy. However, Elen's Lulzim Syla pointed out that the process of receiving the authorization from ERO and KEDS for all types of RES is a lengthy one, which ultimately discourages applicants and/or investors. According to Syla, KEDS requires 18 documents and ERO requires 2, in addition to requirements from the municipality in

question, which in total takes approximately 30-50 days (L. Syla, personal communication, August 5, 2019). Electricity generation from RES has gained momentum during the past decade, and coupled with the VAT exemptions for those technologies upon imports, Kosovo could realize the potential elaborated previously, at economically- and socially-feasible costs.

Solar energy replenishes in nature itself, enabling people and countries to attain a source of energy at no purchasing/production cost (Sampaio & Gonzales, 2017). Solar PVs is an intermittent source, which indicates that the source is not constant at all times; it varies depending on the amount of sunlight reaching the PVs and it cannot be controlled (Germanwatch, 2018). Despite fluctuations, solar energy is satisfactorily predictable (Germanwatch, 2018). Kosovo has approximately 2000 hours of sun and roughly 278 sunny days per year (Balkan Green Foundation, 2018). PVs are generally considered to have minor to no environmental impacts (unless the entire cycle from the production of the technologies to their installation on the specific location is taken into account), and their maintenance and operation does not require large efforts. However, the initial costs for installing them are quite high, especially for economies like Kosovo's, and they require large installation areas, among other drawbacks (Sampaio & Gonzalez, 2017). The reason behind the latter point posing a problem in terms of Kosovo, is that those regions that the analysis showed receive more radiation are mainly found in highly populated areas/city dwellings. As such, large open areas are not to be found easily, and even if they are, the chances that they could find alternative uses, such as agriculture, are high. On the other hand, however, just as Syla had recommended during the interview, solar panels could be installed on thousands of rooftops, whereby the households and companies could use the electricity for their own consumption needs and/or sell it to the market operator. However, this could become a NIMBY type of problem, meaning that the eligible households would potentially resist such a development and ignore the proposal. Although the technical potential for solar PVs is high according to Pellumb Gjinolli[4], it is noted that investing in them is still considered a risky undertaking for most commercial banks in the country and for foreign investors (personal communication, July 19, 2019).

Like solar energy, wind is an intermittent renewable energy source. As was shown throughout the analysis, due to long-term collection of data, average wind power density and wind speed values have been calculated, and despite fluctuations in both, they are also just as predictable (Germanwatch, 2018). The analysis concerning wind power generation showed

[4] Pellumb Gjinolli is an environmental engineer with a MSc in renewable energy and is an independent consultant in Kosovo.

that the potential is quite high even if only the economically-feasible one is taken into consideration. Based on various studies regarding wind power's LCOE, it was concluded that it is highly competitive to coal and to the New Kosovo power plant, which already takes into account the return of investment, operation and maintenance costs, equity and debt cost, and electricity generation (Germanwatch, 2018). WB's study shows that the capital costs are also the lowest, even among other types of RES (World Bank, 2011). The construction, operation, and maintenance of the wind turbines will provide employment opportunities and also keep rural areas, where those wind turbines or farms are located, from depopulating towards urban ones (Germanwatch, 2018). No extensive studies have been conducted regarding the environmental impacts of wind plants in Kosovo; however, a newly signed wind farm project of 32.4 MW, to be financed by the EBRD, in the Municipality of Kamenica has undergone ESIA. A first of its kind in Kosovo, the wind farm is located in a mountainous area, but not close to the forests. The same area is used for grazing and communities may still access it. Overall, it is located away from protected sites and although expropriation had taken place, no resettlement process was necessary, and the residents were compensated for damages to their agricultural activities. Additionally, no bird migration paths have been identified and the risk of collision by birds and bats has been estimated to be insignificant. As it will supply the grid with electricity, it will help in reducing CO2 emissions by 81,000 tons per year (EBRD, 2019).

As regards hydro power, although a renewable source of energy, the plants where this source is used as a driving force are notorious for their environmental impacts. A starting point for the operation of hydropower plants is the diversion of rivers and as a result large agricultural areas and forests are subject to flooding (Sampaio & Gonzalez, 2017). As of 2015, at least 52 hydroelectric plants that had received the authorization for construction and operation were located in protected areas, strictly protected areas, and national parks (such Bjeshket e Nemuna National Park and the Mali Sharr National Park) among others (CEE Bankwatch Network, 2015). Besides being located on such environmentally crucial locations, the extensive use of motor oil or others to cool down the turbines during operation or maintenance has severely affected the endemic species of those areas and has polluted those bodies of water (Balkan Green Foundation, 2019). The construction of new capacities that have not met all the criteria will lead to other environmental, social, and economic problems. Soil erosion has taken place to a great extent because of the expansion of pathways/roads, the installation of tubes, and general construction work. Additionally, a company that owns numerous small HPPs has failed in respecting the regulations on the minimum amount of river water (30%) that must remain on the river bed if it is redirected towards the HPP.

According to locals in the area, the Austrian company "Kelkos Energy" has completely drained the rivers by the diversion of the water stream towards the HCC tubes (Balkan Green Foundation, 2019). The problems associated with HPPs do not concern the environment only - social, political, and economic ones have arisen more often than not. As was mentioned in the previous chapter, residents have protested against numerous HPP projects that either await authorization or already in operation due to the fact that they had lost access to the water (which they use for either drinking or irrigation purposes) or they had been subject to land expropriation. Moreover, in cases where the HPPs are located in national parks, tourism is slowly becoming an activity of the past, having thus a negative economic impact as well (Balkan Green foundation, 2019). In an attempt to present itself as proactive in terms of renewable energy production, the government has been issuing licenses for certain HPP projects despite the nature of the project and the frequent protests by the locals. In Kacanik, the municipality has fully authorized the brother of a politician coming from one of the biggest political party in the country, PDK (the Democratic Party of Kosovo), to build a 4.9 MW HPP in Lepenc. Important to note is that the municipality's mayor is a member of the same party (Insajderi, 2017).

Despite the large environmental impacts, the potential that HPPs withhold could still be realized in part; however, a precondition would be to follow the rules as set in national strategies and laws, hold public hearings, and be subject to inspections during both the construction and inspection phase. Consequently, Kosovo would increase its RES-based energy production share, while also promoting environmental protection and community inclusion, both of which would make the country slightly advance in its EU integration prospects.

WB's report on biomass heating in the Western Balkans shows that forest residues are rarely used, whereby the use of woody biomass is much higher than the growth of the forests (a 56% growth increment). Additionally, its use is associated with high inefficiencies, stemming from old appliances and moist mass, which have directly played a role in high air pollution levels in the country by releasing greenhouse gases directly into the atmosphere (World Bank, 2017). Fuelwood accounts for roughly 20% of energy consumption in the country, making it a profitable business for organized crime groups (Bouriaud, 2014; EULEX, 2012). The latter are responsible for large-scale illegal logging, even more than what the market requires (Bouriaud, 2014). The main problem surrounding illegal logging (and unsustainable biomass use) in the country is the risk of deforestation, especially in public and national forests. Deforestation affects the environment in various ways. For example, many species are endangered, soil may result into a lower quality, and the area

becomes generally more prone to fires (IUCN, 2017). Additionally, according to the International Panel on Climate Change (IPCC), 18% of GHG emissions are released into the atmosphere through deforestation (Solinge, 2014). Illegal wood-cutting has also paved the way for those organized groups to put lives in danger. In 2012, officials from the EU, Kosovo police, and forestry sector were exposed to gunfires simply for collecting information on the level of illegal logging in northern Kosovo. They also added that a young, 13-year-old boy, was fatally shot while cutting wood in someone else's private property (EULEX, 2012).
Yet, considering the fact that a large portion of the electricity consumed by households is used for heating, sustainable biomass use could reduce the pressure on the electricity system of Kosovo. By doing so, the electricity that would have otherwise been destined for those areas could be utilized more efficiently and more for electrification instead of alternate uses (World Bank, 2011). Centralized heating, on the other hand, has a positive implication as well. For instance, biomass use in district heating relies less on fossil fuels (which is currently not the case with the combined heat and power plant), meaning it indirectly plays a role in reducing GHG emissions (Lamaison et al., 2019). Biomass currently stands closest to reaching the targets that the country has pledged for the total RES share in the energy mix, when compared to the other types, and it is estimated that it will reach those targets by 2020 (FAO, 2015).

Conclusion

Answering the research questions

The goal of this thesis project has been to understand and describe Kosovo's energy system and how it is regulated, describe the theoretical potential of renewable energy production, and provide an analysis of the impacts and tradeoffs of both the current energy situation and a future one where RES are more representative. This final chapter provides a summary of the main findings from each chapter, discusses the limitations of the study, and discusses recommendations for potential points of focus for the government. Overall, it will serve as a basis for other researchers studying the topic as well as for young policy makers that want to gain an insight on where the future policies in the country should be directed.

To comprehend the energy system in the country, an overview of the main entities was provided in the second chapter of the project, which answers the first research question and consists of: KEK (the state-owned power and coal producer); KEDS and KESCO (the privately-owned divisions of distribution and supply), KOSTT (the ERO-authorized transmission, system, and market operator). These entities are responsible for approximately 97% of energy which is produced using lignite coal, the country's largest natural resource reserve (and Europe's fifth). This energy is produced through two old thermal power plants, built in series from 1962 through 1984 while Kosovo was a part of the Yugoslav country. 3% of the energy is produced through hydropower, by the "Iber-Lepenc" enterprise and private producers. The chapter also describes the New Kosovo thermal power plant project, a $1.3 billion undertaking between London's ContourGlobal and the government of Kosovo, to be constructed by General Electrics and put into operation by 2023. Subsequently, the chapter finds that there are numerous laws, strategies, and action plans that apply to renewable energy generation (which also put an emphasis on continuing to rely on lignite), some of which are: the Kosovo Law on Energy, whereby attention to environmental protection, RES prioritization, and national targets of 25% RES share in final energy consumption is given; the Kosovo Law on Electricity, which regulates the roles of the previously-mentioned entities in the energy system and describes the certificate of origin; the National Development Strategy, which specifically tackles Kosovo's EU integration aspirations, whereby the construction of transmission lines between Kosovo and Albania is proposed, the nationally-determined target of 29.5% of RES energy consumption by 2020 is reduced, and the FIT is applied; the Kosovo Energy Strategy 2017-2026, which has as an objective the improvement of the current CFPP system, the construction of a new CFPP, and reaching the RES and

energy efficiency targets; ERO's Renewable Energy Fund, a support scheme for RES producers.

The third chapter looks into the available information online, as well as interviews, to gain an insight on the country's potential for renewable energy. Because of the geographical position (land-locked and in South-Eastern Europe) as well as its terrain, only the following types of RES were analyzed: solar, wind, hydro power, and biomass. Firstly, the global solar atlas was analyzed, as well as the GNI and DNI factors, all of which showed that the potential lies predominantly on central and southwestern Kosovo, where most of the big cities are to be found (areas from Prishtina, Mitrovica, Peja, Gjakova, and Prizren). Other studies found that photovoltaics lead the list, with 581.3 MW (834.5 GWh) of technical potential, 436 of which is considered to be economically-feasible (with an LCOE of EUR 80/MWh). Applications at the Energy Regulator Office (ERO) showed that at least 112.3 MW of solar energy will be produced in the near future. Lulzim Syla, from the solar energy company in Kosovo, provides a middle value between the two, stating that 200-300 MW of solar energy could be produced within the next decade.

With respect to wind power, the Global Wind Atlas was analyzed, which showed that southern and western Kosovo prove to withhold the highest potential for wind power, followed by the north-eastern region. The windiest areas were found in the district of Peja, Prizren, Mitrovica, and Gjilan. The mean wind power density for the 10% windiest areas was 389 W/m2 and the wind speed was 6.87 m/s. Studies found that the technical potential was significant, at 2328.8 MW (3859.5 GWh); however, because of the mountainous region, much less could be utilized for power generation, with an LCOE of 60/MWh. ERO's register of applicants summed up a total of 383.3 MW to be produced by 13 new capacities. KOSTT's analysis, on the other hand, finds a 250 MW maximum for the next decade that could be potentially produced through wind.

The analysis conducted by IRENA presented a technical potential of 494.8 MW of hydro power, with only 137.4 MW being economically feasible at an LCOE of 59/MWh. Another study on hydro power showed that small and medium hydro power plants could be constructed throughout the country, especially in the north-wester and south-eastern parts. The total potential in these areas resulted in a 31.1 MW through hydro-power. A 2006 study showed that the potential of small and medium HPPs in Kosovo has a power capacity of 63.7 MW and an electricity generation of 294.1 million kWh. Except for the IRENA study, the others do not include the Zhur hydroelectric plant, which has been analyzed to have a potential capacity of 305 MW. According to ERO, new capacities with a total of 50.01 MW

have been recently put into operation, and an additional 60.9 MW have received their final authorization for hydro power generation.
The last RES type that this chapter analyzes is biomass. The research shows almost 45% of the country's land area is covered by forests, which presents a large potential for energy (heat) generation. A theoretical potential of 844 ktoe is identified, whereas a sustainable one stands at approximately 700 ktoe, which could supply 233 MW of heating capacity if agricultural residues and other types of woody biomass (not firewood) are used. ERO's register of applicants showed only the District Heating company of Gjakova, which received the authorization for 1.2 MW of heating.

The fourth chapter of the analysis delves into the impacts and tradeoffs between the options that Kosovo has for an energy production system, be that fossil fuel-dependent or RES-supported, while it also tries to encapsulate the societal stances on the topic. It finds that the New Kosovo power project is not well accepted among the public, represented by the civil society, especially in Prishtina due to its close vicinity to the TPP. The civil society has claimed that the contract between the government and ContourGlobal only harms the economy of the country, and it significantly impacts the citizens on a health and financial aspect. Nonetheless, civil society groups, village representatives, and (rarely) mayors like that of the city of Peja, have unanimously rejected various developments in the energy sector, such as the TASh, the new CFPP as well as a few hydropower plants in different parts of the country. The government, namely the Ministry of Economic Development, publicly pushes for the construction of the New Kosovo TPP in the name of energy security.

Limitations

Limitations for this analysis have been met in different steps of the project, from data gathering to data analysis. To begin with, explaining the current energy system has presented a task of its own, due to limited or outdated information online. As such, it resulted into a time-consuming process, especially with regards to confirming the credibility of information gathered. Initially foreseen to interview a higher number of relevant actors (from the public and private sector, from civil society representatives, and engineers) on the sub-topics of this thesis project, two crucial interviewees were unable to receive a security clearance, making it impossible to publicly share their expert opinions on the current and future energy system of the country due to their professional background. As such, the interviews were limited to three actors only. When diving into limitations faced on the use of secondary data for PV potential, for instance, there is no common understanding on which factors to use when

differentiating between the technical, theoretical, economic, and implementation potential; or, occasionally, they are grouped together and denote one and the same thing. As such, different units of measure are used and, in certain cases, levelized costs are included as well, making it difficult to give an exact and unvarying numerical value of the said potential. Moreover, even at the presence of potential for any renewable energy source, other factors come at play, i.e.: land use (agricultural land, nationally-protected forests, population, etc.), weather patterns (droughts that affect hydropower operations, too strong or too weak winds), battery use, level of difficulty in installing the technologies in certain areas, and so forth. Information on such factors in Kosovo is either inexistent or is simply not accessible to the public. Additionally, numerous sources are only in Albanian, which might pose as a limitation for other researchers interested in carrying out similar studies. Lastly, the goals of this research project are quite ambitious in relation to the time constraints and word limits of this final project. As such, more information could have been included to explain the situation and the options more comprehensively.

Discussion and conclusions

Having in mind the 20-25% RES share target by 2020 and the information provided on the report for the 2016-2017 period, there is a large discrepancy between what is currently being done to promote renewable energy production and consumption and what must be done to achieve those goals. Given Kosovo's lack of progress made in meeting its own renewable energy targets, especially in the electricity sector, the Energy Community has proposed that Kosovo revises and submits an updated version of its NREAP by June 2018, whereby specific steps to undertake for getting on track are listed – a task that not been carried out by the Government yet (Energy Community, 2018). As such, it has been discussed unanimously that Kosovo must firstly shift its policies towards energy efficiency measures, as changing the source of energy will not change the fact that technical and commercial losses are high and that they reflect on consumer satisfaction with electrical services. EE measures could also help in reducing GHG emissions and air pollution. Protests have been held against the high air pollution levels in Kosovo, especially in Prishtina during winter - pollution that is mainly generated from the country's aged coal-fired power plants (CEE Bankwatch Network, 2018). Nonetheless, numerous studies have shown that other factors have had a great impact on the air quality in Kosovo. For instance, a local report found that other sources of such low air quality in the country are old vehicles and traffic as well as residential use of coal and wood for heating and cooking (Balkan Green Foundation, 2019). Regardless, in addition to

energy efficiency measures, introducing a smart grid to the energy system in the country could reduce the technical and non-technical losses (which stand at approximately 30%) that occur during distribution, which, by and large, translate into energy and financial savings (Kittner et al., 2014).

Overall, 500-1000 MW of energy could be produced through these renewable sources, excluding biomass, which on its own represents an additional potential of approximately 200 MW of heating. Having said that, these sources combined surpass the capacity of the new power plant, which is used as proof for many that Kosovo must not rely on lignite for energy. However, as it was noted throughout the analysis, RES technologies also entail large space occupation, some of them (solar and wind) are intermittent (weather-dependent) sources, and they may even prove to be detrimental to the environment (as has been the case with hydropower plants and water bodies or wind turbines and bird migration paths). Both Pellumb Gjinolli and Lulzim Syla have stated in the interview that the new coal power plant will serve as a baseload for the energy system in the country, which also makes it much more convenient for alternative sources to contribute whenever possible. According to both interviewees, energy security cannot be attained without constant supply of the source for the time being, which lignite currently ensures in comparison to its renewable counterparts. Nonetheless, they both note that there has been no transparency regarding the New Kosovo TPP and that certain articles benefit the private company only, which will be reflected on the consumer's electricity bills at unaffordable prices.

As forest fires, unpredictable weather patterns, and GHG gases remain on the rise, it becomes highly relevant for even countries as small as Kosovo to play their role in combating climate change and global warming. Moreover, the RES technologies are continuously reducing in price and large-scale batteries are being implemented for storing the energy and consuming it when the weather does not enable it naturally. In short, despite the fact that the lignite baseload is necessary currently, the fact that the prioritization and promotion of RES must continue (to a much greater extent) is unquestionable. Doing so will not only put Kosovo in line with EU policies and laws, but it will also enable a sustainable development for the country and a socially and environmentally-friendly future. The sooner RES projects are implemented, the more investments may follow through and local RES companies and technology producers are incentivized. The transition to RES, not only in Kosovo but in the region as well, could be facilitated by fostering relations in the energy market so that the energy mix is diversified and the grid responds better to problems posed by one source of energy versus the other (Kittner et al.,). Political issues in terms of energy must be resolved

with Serbia so that problems like those of the previous year are not repeated and that neither country faces expulsion or sanctions from the Energy Community.

References

AAEESD (Albanian Association of Energy and Environment for Sustainable Development). (2006). Prefeasibility Study for Identification of Water Resources and Their Utilization Through Small Hydro Power Plants in Kosovo. Retrieved from https://www.academia.edu/33345156/Ministria_e_Energjisë_dhe_Minierave_Kosovë

AirClim. (2014). Lignite power provides bargain-priced pollution. Retrieved April 25, 2019, from http://www.airclim.org/acidnews/lignite-power-provides-bargain-priced-pollution

Al Jazeera. (2014). Huge explosion hits Kosovo power plant. Retrieved April 29, 2019, from https://www.aljazeera.com/news/europe/2014/06/huge-explosion-hits-kosovo-power-plant-20146613949378172.html

Al Jazeera. (2015). Life near coal mines: Kosovo's dying villages. Retrieved July 30, 2019, from https://www.aljazeera.com/indepth/features/2015/12/life-coal-mines-kosovo-dying-villages-151225111906618.html

Assembly of Kosovo. (2016). Law on Energy. Prishtina. Retrieved April 10, 2019, from https://www.kuvendikosoves.org/common/docs/ligjet/05-L-081%20a.pdf

Assembly of Kosovo. (2016). Law on Electricity. Prishtina. Retrieved April 10, 2019, from http://ero-ks.org/2016/Ligjet/LIGJI_PER_ENERGJINE_ELEKTRIKE_ang.pdf

ASK (Kosovo Agency of Statistics). (2019). Bilanci i Energjise TM1 2019. Retrieved April 22, 2019, from http://ask.rks-gov.net/media/4760/bilanci-i-energjis-tm1-2019.pdf

ASK (Kosovo Agency of Statistics). (2019). Energy Balance Q4 2018. Retrieved April 25, 2019, from http://ask.rks-gov.net/media/4666/energy-balance-in-kosovo-q4-2018.pdf

ASK (Kosovo Agency of Statistics). (2019). Bilanca Vjetore e Energjise ne Republiken e Kosoves 2018. Retrieved May 5, 2019, from http://ask.rks-gov.net/media/4885/bilanci-i-energjisë-në-kosovë-2018.pdf

Balkan Green Foundation. (2018). Energy Transition Conference: Challenges and opportunities in Kosovo and the region. Retrieved August 3, 2019, from http://balkangreenfoundation.org/file/repository/Energy_Transition_Conference_2018_Conference_Summary_Balkan_Green_Foundation.pdf

Balkan Green Foundation. (2019). NGOs win legal battle to access official documents for the New Kosovo Power Plant. Retrieved July 20, 2019, from http://balkangreenfoundation.org/news/54

Balkan Green Foundation. (2019). New Kosovo Power Plant will increase the energy price for consumers by over 50%!. Retrieved July 15, 2019, from http://balkangreenfoundation.org/news/43

Balkan Green Foundation. (2019). Joint Statement: World Environment Day. Retrieved July 30, 2019, from http://balkangreenfoundation.org/news/49

Balkan Green Foundation. (2019). Hidrocentralet ne Kosove – Problemet dhe potenciali i tyre real. Retrieved July 29, 2019, from http://balkangreenfoundation.org/file/repository/HIDROCENTRALET_NE_KOSOVE_PROBLEMET_DHE_POTENCIALI_I_TYRE_REAL_BGF_INDEP.pdf

Baudry, F. (2011). Water Security for Central Kosovo. Retrieved May 5, 2019, from http://documents.worldbank.org/curated/en/321201468292493964/pdf/718500WP00PUBL0tral0Kosovo00PUBLIC0.pdf

Bouriaud, L., Nichiforel, L., Nunes, L., Pereira, H., & Bajraktari, A. (2014). A property rights-based analysis of the illegal logging for fuelwood in Kosovo. *Biomass and Bioenergy*, *67*, 425–434. https://doi.org/10.1016/J.BIOMBIOE.2014.05.028

CEE Bankwatch Network. (2018). The energy sector in Kosovo. Retrieved April 30, 2019, from https://bankwatch.org/beyond-coal/the-energy-sector-in-kosovo

CEE Bankwatch Network. (2018). As pollution blankets Pristina, so do protests. Retrieved July 20, 2019, from https://bankwatch.org/blog/pollution-blankets-pristina

CEE Bankwatch Network. (2015). Financing for hydropower in protected areas in Southeast Europe. Retrieved July 25, 2019, from https://bankwatch.org/sites/default/files/SEE-hydropower-financing.pdf

Contour Global. (2017). About Us. Retrieved April 29, 2019, from https://www.contourglobal.com/about-us

DW. (2018). Clocks in Europe are running late because of the Kosovo conflict. Retrieved July 15, 2019, from https://www.dw.com/en/clocks-in-europe-are-running-late-because-of-the-kosovo-conflict/a-42867061

EBRD. (2019). KITKA Wind. Retrieved August 5, 2019, from https://www.ebrd.com/work-with-us/projects/psd/kitka-wind.html

EEAS. (2016). Kosovo* and the EU. Retrieved April 13, 2019, from https://eeas.europa.eu/delegations/kosovo/1387/kosovo-and-eu_en

EIA. Coal Prices and Outlook. Retrieved April 25, 2019, from https://www.eia.gov/energyexplained/index.php?page=coal_prices

Energy Community. Electricity (Implementation: Kosovo*). Retrieved April 22, 2019, from https://www.energy-community.org/implementation/Kosovo/EL.html

Energy Community. (2018). Renewable Energy (Implementation: Kosovo*). Retrieved April 22, 2019, from https://www.energy-community.org/implementation/Kosovo/RE.html

Energy Community. (2018). The contractual framework pertaining to the Kosova e Re project – the Secretariat's preliminary concerns. Retrieved July 22, 2019, from https://energy-community.org/news/Energy-Community-News/2018/06/14.html?fbclid=IwAR2ylou0FqdgIc2gKYFqhDU--45k7sSsM_eZuQdKLn4P1GMWUxdPMj_q7VE

EPA. (1998). Lignite Combustion. In *AP-42, Compilation of Air Emissions Factors*. Durham. Retrieved from https://www3.epa.gov/ttnchie1/ap42/ch01/final/c01s07.pdf

ERO (Energy Regulatory Office). (2018). Decision on KOSTT J.S.C. Prishtina. Retrieved April 23, 2019, from www.ero-ks.org

ERO (Energy Regulatory Office). (2017). Rule on Maximum Allowed Revenues of Transmission System Operator and Market Operator (Rule on TSO/MO Revenues). Prishtina. Retrieved May 20, 2019, from http://ero-ks.org/2017/Rregullat/TSO-MO%20Pricing%20Rule.pdf

ERO (Energy Regulatory Office). (2018). Annual Report 2017. Prishtina. Retrieved May 20, 2019, from http://ero-ks.org/2017/Raportet/Raporti_vjetor_2017_ZRRE_ang.pdf

ERO (Energy Regulatory Office). (2019). Register of Applications for construction of new generating capacities and Admission to Support Scheme from RES. Retrieved June 2, 2019, from http://ero-ks.org/2019/Autorizimet_Licencat/02_08_2019_Regjistri_i_Aplikuesve_per_Autorizim_dhe_Pranim_ne_Skemen_Mbeshtetese.pdf

ERO (Energy Regulatory Office). (2019). Register of Applications for Generators for Self-Consumption. Retrieved August 6, 2019, from http://ero-ks.org/2019/Autorizimet_Licencat/Regjistri_i_Aplikacioneve_per_gjeneratoret_per_VET_KONSUM_01_08_2019.pdf

European Agency for Reconstruction. (2008). Water supply from the Iber-Lepenc hydro system for the proposed Kosovo C power plant. Retrieved May 20, 2019, from https://eeas.europa.eu/sites/eeas/files/final_report_-_english.pdf

EU Council. (2015). Stabilisation and Association Agreement between the European Union and the European Atomic Energy Community, of the one part, and Kosovo*, of the other part. Brussels. Retrieved April 20, 2019, from https://eeas.europa.eu/sites/eeas/files/stabilisation_and_association_agreement_eng_0.pdf

European Commission. (2018). Enlargement Policy: Kosovo. Retrieved April 15, 2019, from https://ec.europa.eu/neighbourhood-enlargement/countries/detailed-country-information/kosovo_en

European Commission (2016). Conditions for membership. Retrieved April 15, 2019, from https://ec.europa.eu/neighbourhood-enlargement/policy/conditions-membership_en

European Commission (2016). Acquis. Retrieved April 17, 2019, from https://ec.europa.eu/neighbourhood-enlargement/policy/glossary/terms/acquis_en

EULEX. (2012). Illegal wood-cutting – one of Kosovo's most difficult rule of law issues. Retrieved August 2, 2019, from https://www.eulex-kosovo.eu/en/news/000383.php

FAO (Food and Agriculture Organization of the United Nations). (2015). Wood Biomass Sector in Kosovo. Retrieved July 15, 2019, from http://www.fao.org/3/a-i4968e.pdf

GAP Institute. (2018). The Impact of TPP "Kosova e Re" in Electricity Tariffs. Retrieved April 30, 2019, from https://www.institutigap.org/documents/2651_theimpactoofTPP.pdf

GAP Institute. (2018). Court finds that MED has violated the Constitution and the law in the process of KEDS privatization and the 'Kosova e Re' contract. Retrieved July 20, 2019, from https://www.institutigap.org/news/2098

Germanwatch. (2018). Phasing in Renewables: Towards a prosperous and sustainable energy future in Kosovo: challenges and possible solutions. Retrieved August 3, 2019, from http://balkangreenfoundation.org/file/repository/Phasing_in_Renewables_Towards_a_prosperous_and_sustainable_energy_future_in_Kosovo_challenges_and_possible_solutions.pdf

Govindan, R., Al-Ansari, T., Korre, A., & Shah, N. (2018). Assessment of technology portfolios with enhanced economic and environmental performance for the energy, water and food nexus. *Computer Aided Chemical Engineering*, *43*, 537–542. https://doi.org/10.1016/B978-0-444-64235-6.50095-4

Government of Kosovo. (2016). National Development Strategy 2016-2021. Prishtina. Retrieved April 10, 2019, from http://www.kryeministri-ks.net/repository/docs/National_Development_Strategy_2016-2021_ENG.pdf

Haldar, S. K. (2018). Elements of Mining. *Mineral Exploration*, 229–258. https://doi.org/10.1016/B978-0-12-814022-2.00012-5

Hasani, F., Shala, F., Xhixha, G., Xhixha, M. K., Hodolli, G., Kadiri, S., … Cfarku, F. (2014). Naturally occurring radioactive materials (NORMs) generated from lignite-fired power plants in Kosovo. *Journal of Environmental Radioactivity*, *138*, 156–161. https://doi.org/10.1016/J.JENVRAD.2014.08.015

HEAL (Health and Environment Alliance). (2016). The unpaid health bill – Kosovo. Retrieved July 29, 2019, from https://www.env-health.org/wp-content/uploads/2018/08/unpaid_health_bill_factsheet_kosovo_en.pdf

HE "Iber-Lepenc" J.S.C. Enterprise's History. Retrieved May 3, 2019, from http://www.iber-lepenc.org/?page=2,12#.XUgiIC2B1-V

HE "Iber-Lepenc" J.S.C. Scope of Work. Retrieved May 3, 2019, from http://www.iber-lepenc.org/?page=2,18#.XUgi7C2B1-V

IFC. (2017). Kosovo KEDS Privatization: A case study. Prishtina. Retrieved from https://www.ifc.org/wps/wcm/connect/af1332e7-10d6-4ca3-9f49-58953f60d1ce/KosovoKEDSPrivatization_Booklet_FINAL.pdf?MOD=AJPERES&CVID=m2UeE7-

Insajderi. (2017). Hidrocentrali I vellait te Shaip Mujes merr mbeshtetjen e Kacanikut te PDK-se. Retrieved July 30, 2019, from https://insajderi.com/hulumtime/hidrocentrali-vellait-te-shaip-mujes-merr-mbeshtetjen-e-kacanikut-te-pdk-se/

IRENA. (2017). Cost-Competitive Renewable Power Generation: Potential across South East Europe. Retrieved June 2, 2019 from https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2017/IRENA_Cost-competitive_power_potential_SEE_2017.pdf

IUCN. (2017). Deforestation and forest degradation. Retrieved August 3, 2019, from https://www.iucn.org/resources/issues-briefs/deforestation-and-forest-degradation

Kabashi, S., Bekteshi, S., Ahmetaj, S., Kabashi, G., Najdovski, D., Zidanšek, A., & Šlaus, I. (2011). Effects of Kosovo's energy use scenarios and associated gas emissions on its climate change and sustainable development. *Applied Energy*, *88*(2), 473–478. https://doi.org/10.1016/J.APENERGY.2010.06.023

Kallxo. (2019). Banoret kunder vazhdimit te punimeve te Hidrocentralit Albaniku ne Bistrice. Retrieved July 25, 2019, from https://kallxo.com/shkurt/banoret-kunder-vazhdimit-te-punimeve-te-hidrocentralit-albaniku-ne-bistrice/

Kallxo. (2019). Gazmend Muhaxheri kunder ndertimit te hidrocentralit ne gryken kryesore te Lumbardhit. Retrieved July 25, 2019, from https://kallxo.com/shkurt/gazmend-muhaxheri-kunder-ndertimit-te-hidrocentralit-ne-gryken-kryesore-te-lumbardhit/

Kallxo. (2019). Vjetersohet lenda ndaj kompanise qe planifikon te investoje miliona ne hidrocentrale. Retrieved July 25, 2019, from https://kallxo.com/gjate/hulumtim/vjetersohet-lenda-ndaj-kompanise-qe-planifikon-te-investoje-miliona-ne-hidrocentrale/

KEDS. (2013). About KEDS. Retrieved April 22, 2019, from https://www.keds-energy.com/en/about.asp

KEK. KEK Profile. Retrieved April 20, 2019, from http://kek-energy.com/kek/profili-i-kek-ut/

KEK. (2018). Prodhimi i Qymyrit. Retrieved April 26, 2019, from http://kek-energy.com/kek/divizioni-qymyrit/

KEK. (2018). Raporti i gjendjes mjedisore ne KEK per vitin 2018. Retrieved July 20, 2019, from http://kek-energy.com/kek/ndikimi-ne-mjedis/

Kelag. (2016). Hydropower. Retrieved May 5, 2019, from http://www.kelag-international.com/en/hydro-power-333.html#Hydropower%20Plant%20Lumbardhi

Kittner, N., Dimco, H., Azemi, V., Tairyan, D., Kammen, V. (2014). Sustainable Electricity Options for Kosovo. Retrieved June 20, 2019, from https://rael.berkeley.edu/wp-content/uploads/2015/04/kittner-et-al-sustainable-electricity-kosovo.pdf

KOSTT J.S.C (Transmission, System, and Market Operator). About KOSTT. Retrieved April 23, 2019, from http://www.kostt.com/website/index.php/en/about-kostt.html

KOSTT J.S.C. Transmission and System Operator. Retrieved April 23, 2019, from http://www.kostt.com/website/index.php/en/tso.html

KOSTT J.S.C. Market Operator. Retrieved April 23, 2019, from http://www.kostt.com/website/index.php/en/mo.html

KOSTT J.S.C (2018). Grid integration of variable renewable energy sources in the Kosovo Power System. Retrieved June 10, 2019, from https://www.irena.org/-/media/Files/IRENA/Agency/Events/2018/Nov/SEE-workshop/Session-III_Kosovo_KOSTT.pdf?la=en&hash=DF9DD58F6CDBC062AF2710B83F14396192CED0ED

KOSID. (2017). The new power plant will not only burn Kosovo's lignite, but also its future!. Retrieved July 20, 2019, from https://kosid.org/news/113

KOSID. (2018). KOSID: The focus on coal, a barrier towards energy transition in Kosovo. Retrieved July 20, 2019 from https://kosid.org/en/news/125

KPMM (The Independent Commission for Mines and Minerals). Mineral deposits. Retrieved April 26, 2019, from https://www.kosovo-mining.org/mineral-resources/mineral-deposits/?lang=en

Lamaison, N., Collette, S., Vallée, M., & Bavière, R. (2019). Storage influence in a combined biomass and power-to-heat district heating production plant. *Energy*, *186*, 115714. https://doi.org/10.1016/J.ENERGY.2019.07.044

Monjezi, Masoud & Shahriar, K & Dehghani, Hesam & Samimi Namin, Farhad. (2009). Environmental impact assessment of open pit mining in Iran. Environmental Geology. 58. 205-216. 10.1007/s00254-008-1509-4.

Mining Communications. (2005). Kosovo: Land of opportunity for European mining and energy. Retrieved May 12, 2019, from https://beak.de/beak/sites/default/files/content/7_News/020_11_Oct_2005/KosovoMiningJournal.pdf

Ministry of Economic Development. "Kosova e Re" Power Plant - General Information. Retrieved April 30, 2019, from http://mzhe-ks.net/en/general-information#.XUgafy2B1-V

Ministry of Economic Development. Energy Independence for Kosovo. Retrieved July 10, 2019, from http://mzhe-ks.net/repository/docs/Faq-ENG-Web.pdf

Ministry of Economic Development. Cogeneration. Retrieved July 11, 2019, from http://mzhe-ks.net/repository/docs/Kosova_e_Re_-_TOPIC_4_-_One_Pager-ENG.pdf

Ministry of Economic Development. (2017). Energy Strategy of the Republic of Kosovo 2017-2026. Prishtina. Retrieved April 9, 2019, from http://mzhe-ks.net/repository/docs/Kosovo_Energy_Strategy.pdf

Ministry of Economic Development. (2017). National Renewable Energy Action Plan of the Republic of Kosovo 2011-2020. Prishtina. Retrieved April 10, 2019, from https://mzhe-ks.net/repository/docs/Plani_i_veprimi2018-2020_eng.docx

Ministry of Economic Development. (2018). Renewable Energy Progress Report of the Republic of Kosovo 2016-2017. Retrieved April 20, 2019, from https://www.energy-community.org/implementation/Kosovo/RE.html

Ministry of Energy and Mining. (2009). Strategjia e Energjise se Republikes se Kosoves 2009-2018. Prishtina. Retrieved April 29, 2019, from https://mzhe-ks.net/repository/docs/STRATEGJIA_E_ENERGJISE_E_REPUBLIKES_SE_KOSOVES_2009-2018.pdf

Ministry of Energy and Mining. (2009). Review of HPP Zhur Feasibility Study Including Preparation of Preliminary Environmental Impact Assessment and Preliminary Social Assessment. Retrieved June 7, 2019, from http://www.mzhe-ks.net/repository/docs/Revized_Final_Report_Zhur_en.pdf

National Geographic. (2012). Coal. Retrieved April 25, 2019, from https://www.nationalgeographic.org/encyclopedia/coal/

Prăvălie, R., Patriche, C., & Bandoc, G. (2019). Spatial assessment of solar energy potential at global scale. A geographical approach. *Journal of Cleaner Production*, *209*, 692–721. https://doi.org/10.1016/J.JCLEPRO.2018.10.239

Prishtina Insight. (2019). Foreign financing for Kosova e Re unlawful, says KOSID. Retrieved July 15, 2019, from https://prishtinainsight.com/foreign-financing-for-kosova-e-re-unlawful-says-kosid/

Prishtina Insight. (2019). KOSID sues the government challenging Kosovo's coal investment. Retrieved July 25, 2019, from https://prishtinainsight.com/kosid-sues-the-government-challenging-kosovos-coal-investment/

Ragheb, M. (2017). Economics of Wind Power Generation. *Wind Energy Engineering*, 537–555. https://doi.org/10.1016/B978-0-12-809451-8.00025-4

Ramaj, V., Kukaj, H., & Januzaj, Y. (2017). Information Systems Management at Kosovo Energy Corporation (KEK). *Journal of Management, Marketing and Logistics-JMML*, *4*(3), 239–243. https://doi.org/10.17261/Pressacademia.2017.485

Reuters. (2018). Kosovo faces major power shortfall due to plant outages. Retrieved July 20, 2019, from https://www.reuters.com/article/kosovo-energy-outages/kosovo-faces-major-power-shortfall-due-to-plant-outages-idUSL8N1XY3NA

Reuters. (2019). GE to build Kosovo's new 500 MW coal power plant. Retrieved May 5, 2019, from https://www.reuters.com/article/us-contourglobal-kosovo-ge/ge-to-build-kosovos-new-500-mw-coal-power-plant-idUSKCN1S917R

Rizaj, M., Beqiri, E., McBow, I., O'Brien, E. Z., & Kongoli, F. (2008). The mineral base and productive capacities of metals and non-metals of Kosovo. *JOM*, *60*(8), 18–22. https://doi.org/10.1007/s11837-008-0101-4

Sampaio, P. G. V., & González, M. O. A. (2017). Photovoltaic solar energy: Conceptual framework. *Renewable and Sustainable Energy Reviews*, *74*, 590–601. https://doi.org/10.1016/J.RSER.2017.02.081

Solinge, T. (2014). Researching Illegal Logging and Deforestation. Retrieved August 2, 2019, from https://www.researchgate.net/publication/287897756_Researching_Illegal_Logging_and_Deforestation

Task Force on European Integration. (2012). Thematic Roundtable 6: Environment, Energy, Transport and Regional Development. Retrieved April 20, 2019 from http://www.mei-ks.net/repository/docs/Discussion_Material_Energy.pdf?fbclid=IwAR1Uz7NBh3aC7NEs6gXxHS7MlYrlKF9KclavMru0OmokYEKi85rYTn6TmLA

Thielemann, T., Schmidt, S., & Peter Gerling, J. (2007). Lignite and hard coal: Energy suppliers for world needs until the year 2100 — An outlook. *International Journal of Coal Geology*, *72*(1), 1–14. https://doi.org/10.1016/J.COAL.2007.04.003

USAID. (2015). Kosovo Wood Biomass Assessment. Retrieved July 16, 2019, from http://greenkosovo.com/wp-content/uploads/2019/01/Kosovo-Wood-Biomass-Assessment-FINAL-ENG.pdf

Van Ackere, S., Van Eetvelde, G., Schillebeeckx, D., Papa, E., Wyngene, K. Van, & Vandevelde, L. (2015). Wind Resource Mapping Using Landscape Roughness and Spatial Interpolation Methods, *8*, 8682–8703. https://doi.org/10.3390/en8088682

World Bank. (2011). Background Paper: Development and Evaluation of Power Supply Options for Kosovo. Retrieved June 05, 2019, from http://siteresources.worldbank.org/INTENERGY2/Resources/Kosovo_generation_options_report_12312011.pdf

World Bank. (2012). Kosovo: Country Environmental Analysis. Retrieved July 28, 2019, from http://siteresources.worldbank.org/INTKOSOVO/Resources/KosovoCEA.pdf

World Bank. (2017). Biomass-Based Heating in the Western Balkans – A Roadmap for Sustainable Development. Retrieved June 12, 2019, from http://documents.worldbank.org/curated/en/135831542022333083/pdf/Biomass-Based-Heating-in-the-Western-Balkans-A-Roadmap-for-Sustainable-Development.pdf

World Bank Group. (2016). Global Solar Atlas - Introduction. Retrieved June 3, 2019, from https://globalsolaratlas.info/about/introduction?c=42.173582,21.655819,8&s=42.472097,20.597475

World Bank Group. (2016). Global Solar Atlas - Kosovo. Retrieved June 3, 2019, from https://globalsolaratlas.info/downloads/kosovo

World Bank Group. Global Wind Atlas – Introduction. Retrieved June 5, 2019, from https://globalwindatlas.info/about/introduction

World Bank Group (2018). Global Wind Atlas – Kosovo. Retrieved June 5, 2019, from https://globalwindatlas.info/en/area/Kosovo?print=true