

Research Article

CASE OF GEOTHERMAL ENERGY PROJECT IN KOSOVO - RENEWABLE ENERGY SOURCES TARGETS

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ABSTRACT

This paper addresses the important problem that Kosovo is facing in responding to climate change and energy sustainability; more specifically, the country's struggles towards meeting the renewable energy source and energy efficiency requirements of the "EU 20 20 by 2020" policy. The paper focuses on geothermal energy as a renewable energy source that could be utilized further in making the country greener. The applied research methodology was both qualitative and quantitative. Different primary and secondary research activities were undertaken, including: literature review, legal and regulatory review, and interviews. The paper provides background information on the current energy supply, demand, and sources in the country. The document also presents the country's current level of applying alternative energy sources and its standing against the "EU 20 20 by 2020" RES and EE targets. An analysis is provided on how to approach the aforementioned targets through investments in geothermal energy. Economic and environmental implications of investing in geothermal energy projects are elaborated. Finally, recommendations and conclusions, for future action, are derived and addressed to relevant stakeholders, primarily policy-makers and government representatives.

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INTRODUCTION

Kosovo declared its independence, on February 2008, and since then the vision of the GK was to create a prosperous and democratic state and a society with European values. Throughout this period of transition, the GK did highlight the importance of the "EU 20 20 by 2020." The "20- 20- 20" targets of the "EU 20 20 by 2020" policy refer to a series of demanding climate and energy targets set forth by the EU Heads of State and Government, which have to be met by 2020, which are:

- A reduction in EU greenhouse gas emissions of at least 20% below 1990 levels.
- 20% of EU energy consumption to come from renewable resources.
- A 20% reduction in primary energy use compared with projected levels, to be achieved by improving energy efficiency.

Directive 2009/28/EC (RES Directive) sets a target of 20% renewable energy in gross final consumption of energy for 2020.

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In regards to climate change, in January 2008 the EC proposed binding legislation to implement the 20-20-20 targets – the 'climate and energy package', which was approved by the European Parliament and Council in December 2008 and became law in June 2009. This law creates pressure to improve EE but does not address it directly: EE is addressed¹ through the EU's energy efficiency action plan. In the case of Kosovo, we find out that the country is not obliged to adhere to the EU's 2020 energy and climate targets because it is not a member of neither EU nor UN (thus not a member of UNFCCC). However, the country signed² the EnCT: therefore, the GK has moral responsibility against its people and the world to deal with climate change. Furthermore, the EU requirements in the energy sector are mandated in the Treaty establishing the EnCT³ where Kosovo adheres as a Contracting Party.

¹ According to Republic of Kosovo Heating Strategy 2011 – 2018, the contribution of individual EU member countries in the listed three general targets varies on their current situation of factors such as the energy intensity, GDP, access and use of RES, and their overall possibility to contribute in the general targets.

² In 2005 Kosovo, through UNMIK (United Nations Mission in Kosovo), signed the Energy Community Treaty (Athens process).

³ According to "Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH and its Kosovo Discussion Material on Energy (December 2012), in 18 October 2012, the Ministerial Council of the Energy Community (EnC) adopted the Energy, Transport and Regional Development regional Energy Strategy of the Energy Community.

In addition, the country’s aspiration to join the EU requires serious work and commitment in addressing climate change and energy sustainability. A strategic approach addressing climate change and energy sustainability, for the next ten to twenty years, is in place. It incorporates the energy sector, transportation, deforestation, EU 2020, and UNFCCC. In October 2012, the GKset an ambitious RES target at 29.4% of its total energy consumption by 2020. This in line with the country’s commitment to become a member of the UNFCCC and to ratify the Kyoto Protocol. Continuing, Kosovo will need to comply with the EU energy acquis in areas of RES, EE targets, climate change, and environmental protection. A key component in addressing this challenge is strengthening the existing regulatory framework and institutional capacities. Kosovo’s NEEAP 2010-2018 highlights a target of 9% for EE by 2018 (based on 2010 consumption levels). The Report on the Implementation of the First National Energy Efficiency Action Plan 2010 – 2012 (2012, June) highlights that around 2.2% energy savings have been achieved during the period of the NEEAP, against the 3% indicative saving target.

Renewable Energy Sources - Geothermal Energy

As defined by the Renewable Energy Sources - RES Directive 2009/28/EC, geothermal energy is the energy stored in the form of heat beneath the surface of the solid Earth. Geothermal energy is a widely available, low carbon, sustainable, strategic resource capable of producing continuous base-load energy. It has the potential for much more widespread use and to make a significant contribution to the 2020 renewable energy targets established in the EU. The current use of geothermal energy resources varies between countries but it has been established that suitable regulatory, financial, and technical regimes are important positive factors in the development of the geothermal energy sector.

Benefits of geothermal energy perfectly match to the well-known European goal 20:20:20

- It is renewable and sustainable;
- It generates continuous and reliable power;
- It provides clean and safe energy;
- It conserves fossil fuels to be used for other applications; and
- It avoids importing energy.

In addition, suggestions are provided on how to increase geothermal energy production in Kosovo to levels that is comparable to that of EU. The papers goals are:

- Forecast the usage of geothermal energy in Kosovo for the period 2014 – 2024.
- Demonstrate how geothermal energy contributes towards fighting climate change by analyzing one locally developed geothermal project.
- Show how central level and local level governments can use public-private partnerships to develop geothermal energy projects.

The above listed goals were addressed through a research methodology that was both qualitative and quantitative in nature. Secondary research was performed through desk research, which included the following research activities:

- Laws and regulations were reviewed and evaluated in respect to the project goals.
- A number of documents were reviewed, such as: government strategies, academic writings, and specific Kosovo energy efficiency related reports published by different international governmental and non-governmental organizations operating in Kosovo.
- A number of best practices of developing geothermal energy projects were reviewed and analyzed. Relevant lessons learned were derived from the identified cases.

Energy Efficiency Targets and Renewable Energy Sources Targets

The indicative target set at 9% for the NEEAP covers the period 2010-2018 and it amounts to energy savings of 91.89 ktoe (out of 1021.08 ktoe). The objective of 9% was calculated based on the EC Directive 2006/31/EC Annex 1. The energy forecast was made based on a scenario of average annual GDP growth of 3.1%.

Table 1. Forecasted EE targets

Sector	Target for 2012 (ktoe)	Target for 2018 (ktoe)
Residential	12.8	30.64
Services	9.8	12.26
Industry	8.15	24.84
Transport	1.4	24.15
Total	31.95	91.89
%	3	9

Source: Report on the implementation of the first NEEAP 2010 – 2012.

By Annual Report (2012, April) reported that the objective of 9% EE target by 2018 set forth by the GK does not correspond to the European Directive 2006/32/EC, which foresaw for this objective to be achieved no later than 2016. The proposal for the new Directive of the European Union for Energy Efficiency 2011/017217 states that by 2020 the objective is 17%. If this directive is approved, then Kosovo, with the existing planning, will not be able to meet the EE targets. The national mandatory overall target for the share of energy from RES in gross final energy consumption in the year 2020 is 25%. This target is determined in the Ministerial Council of the Energy Community Decision D/2012/04/MC-EnC on the Implementation of the Directive 2009/28/EC and Amendment of Article 20 of the Energy Community Treaty. Administrative Instruction No. 01/2013 on Indicative Targets of Renewable Energy Sources determines annual and long-term targets for energy generated from renewable energy sources and consumed in the electricity, heating, and transport sectors by 2020. According to Report (2013, May) Kosovo will aim at a higher target which corresponds to 29.47% of expected gross final energy consumption in 2020, see appendix 1:

Target 1: Electricity generation: 5.66% or 10.13% (Administrative Instruction No. 01/2013 on RES targets)

Target 2: Transport: 2.1%

Target 3: Heating and Cooling: 17.24%

NREAP defines targets for three sectors (electricity generation, transport, and heating and cooling sector):

Target 1: 25.64% of RES in gross final consumption of electricity (Administrative Instruction No. 01/2013 on RES targets)

Target 2: 10% of RES in final consumption of energy in transport

Target 3: 45.65% of RES in gross final consumption of heating and cooling

Table 2: Forecasted RES targets (Detailed targets are presented in Appendix 1).

	2020	
RES	ktoe	%
Heating & Cooling	298.24	45.65
Electricity (baseline scenario)	97.89	14.33
Electricity (EE scenario)	175.13	25.64
Transport	36.33	10.00
Overall RES Share (baseline scenario)	432.46	25.00
Overall RES Share (EE scenario)	509.70	29.47

Legal and Regulatory Action – RES Kosovo

Work is ongoing for developing and adopting legislation and regulation relevant for supporting and promoting expedited development of RES – Renewable Energy Sources. To begin with, the Law on Energy Efficiency was approved by the Assembly on June 23, 2011. In addition, a number of related laws and secondary legislation have been and are being drafted⁴, and continuing with developed a number of strategic documents which are in line with the EU acquits⁵.

The Energy Strategy 2009 – 2018 is the core document that sets the basis for creating an appropriate legislative framework and favorable market for promotion and development of RES in Kosovo. The document is in line with the EU acquits and it aims at achieving effective management of existing energy resources and protection of the environment. It focuses on enhancing the security of energy supply according to the European standards, as well as on the diversification of energy resources.

The Strategy aims at stimulating rational utilization of energy, promoting energy efficiency, promoting development of renewable energy resources, and introducing of new technologies that do not cause irreparable damage to the environment; thus respecting the application of internationally accepted environmental standards. The document covers hydropower, wind energy, geothermal energy, solar, biomass and gas from processing of urban and rural waste. This policy paper provides no comprehensive analysis related to geothermal energy. It only identifies the need to implement a detailed study on the potential of this type of energy source.

⁴ Law on Energy, No. 03/L-184, 2010; Law on Electricity, No. 03/L-201, 2010; Law on Energy Regulator, No. 03/L-185, 2010; Law on Natural Gas, No. 03/L-118, 2009; Law on Energy Efficiency, No. 04/L-016, 2011; Law on District Heating, No. 03/L-116, 2008; Law on Environmental Protection, No.03-L-025, 2009; Law on Strategic Environmental Assessment, No. 03/L-230, 2009 and Administrative Instruction No. 01/2013 on Indicative Targets of Renewable Energy Sources.

⁵ Energy Strategy of the Republic of Kosovo 2009-2018; Heating Strategy of the Republic of Kosovo 2011-2018; Energy Strategy Implementation Program 2009-2011 and Kosovo National Energy Efficiency Action Plan 2010-2018.

Energy Consumption Forecasts

Ministry of Economic Development of Kosovo (2013) forecasted energy consumption for 2022 to be 1701.84 ktoe⁶. This amount is calculated based on three targets: economic growth (GDP), number of households, and consumption of energy (past three years).

The following tables and figure provide a detailed data for: Forecasted energy consumption for all sectors (ktoe); Forecasted total energy consumption by energy product (ktoe); Forecasted consumption of various energy products in the household sector (ktoe); Gross final energy consumption - difference between two scenarios and RES targets related to heating and cooling⁷.

Table 3: Forecasted energy consumption for all sectors (ktoe)

Sector	2013		2022	
	Ktoe	%	Ktoe	%
Industry	356.20	27	442.37	26
Household	503.93	38	658.35	39
Services	114.51	9	163.95	9
Agriculture	21.18	2	28.02	2
Transport	342.36	26	409.15	24
Total	1338.19	100	1701.84	100

Ministry of Economic Development of Kosovo (2011, September) foresees two scenarios related to final energy consumption: the 'baseline scenario' and 'energy efficient scenario' – EE Energy Efficiency. The average annual growth rate of energy consumption is calculated at 3.88% for the first scenarios, and 2.89% for the second scenario.

Overview of Kosovo Energy Generation – Consumption

Coal, petroleum products, and biomass represent the primary energy products in Kosovo. Petroleum products and electricity present the most consumed energy products. Households represent the sector that consumed most of the energy. The following tables provide a detailed picture on Primary energy products available; Consumption of all energy products; Utilization of energy sources in all sectors; Forecasted consumption of all energy products in 2014 (ktoe) (The information used to form the tables was taken from MED's Annual Energy Balance 2014). In terms of electricity, about 97% of power generation capacity in Kosovo is located in two lignite fired thermo-power plants: 50 year old Kosovo A – 5 units and 30 year old Kosovo B – 2 units.

GEOTHERMAL ENERGY PROJECTS IN EUROPE AND IN KOSOVO

Geothermal Energy Projects in Europe

Among all energies, geothermal is the most reliable, with a load factor of more than 90%. However, it is a capital-intensive technology that needs 5-7 years to become operational from the start of the permitting process until commissioning.

⁶ The projected demand in the Draft Strategy is slightly different from the ones in NEEAP and NREAP.

⁷ Source: MED's (2013), Energy Strategy of the Republic of Kosovo 2013 – 2022 (Draft).

Table 4. Forecasted total energy consumption by energy product (ktoe)

	2013	2015	2017	2019	2020	2021	2022
Coal, ep ¹	100.40	107.12	114.30	121.97	126.00	130.16	134.47
Coal, nep ¹	0.52	0.54	0.56	0.59	0.60	0.61	0.62
Petroleum products, ep	530.71	549.72	561.03	567.98	571.07	583.36	595.90
Petroleum products, nep	38.99	50.53	40.83	32.99	33.32	33.66	33.99
Biomass	246.39	256.45	266.94	278.22	284.05	290.02	296.14
Electricity	411.97	455.46	488.65	522.45	537.24	555.47	572.16
Bio-fuels	0.32	3.44	14.60	31.04	40.00	40.00	40.00
Geothermal energy	0.00	0.06	0.52	1.03	1.29	1.34	1.40
Derived heat	7.59	9.63	0.34	0.78	1.01	13.19	3.36
Solar energy	1.29	3.22	2.84	10.96	12.90	13.35	13.81
Total	338.19	1436.18	1500.62	578.01	1617.48	1661.16	1701.84

Source: Ministry of Economic Development. 2013. Energy Strategy of the Republic of Kosovo 2013 – 2022

Table 5. Forecasted consumption of various energy products in the household sector (ktoe)

	2013	2015	2017	2019	2020	2021	2022
Coal	24.98	27.01	29.22	31.60	32.87	34.18	35.55
Petroleum products	22.56	23.48	24.42	25.41	25.92	26.44	26.97
Biomass	225.93	235.05	244.55	254.43	259.52	264.71	270.00
Electricity	225.14	248.91	267.05	285.52	293.60	303.57	312.69
Solar Energy	0.39	0.97	2.13	3.29	3.87	3.96	4.04
Geothermal Energy	0.00	0.02	0.16	0.31	0.39	0.40	0.42
Derived Heat	4.94	6.26	6.72	7.01	7.15	8.57	8.68
Total	503.93	541.70	574.25	607.57	623.32	641.82	658.35

Table 6. RES targets related to heating and cooling

RES	MW _{th}	MWh	Ktoe
Thermal Solar Energy	70	150,000	12.9
Biomass	-	-	284.05
Geothermal Energy (Heat Pumps)	10	15,000	1.29
TOTAL	80	165,000	298.24
Total Renewable Energy (%) – Baseline Scenario	-	68.9	-
Total Renewable Energy (%) – EE Scenario	-	58.51	-
Contribution of Renewable Energy in the GFEC (%)	-	17.24	-

Table 7. Primary energy products available¹

Source	2011		2012		2013	
Coal	1623.49	64.81%	1528.10	64.80%	1624.30	65.28%
Petroleum products	591.56	23.61%	560.65	23.77%	586.78	23.58%
Biomass	241.93	9.66%	247.49	10.49%	253.19	10.18%
Electricity	38.27	1.53%	13.09	0.56%	11.47	0.46%
Hydropower	9.00	0.36%	8.22	0.35%	11.18	0.45%
Solar energy	0.63	0.03%	0.69	0.03%	1.29	0.05%
Total (ktoe):	2505.03	100.00%	2358.24	100.00%	2488.21	100.00%

Table 8. Consumption of all energy products¹

Source	2011		2012		2013	
Coal	86.56	6.49%	68.17	5.39%	99.70	7.39%
Petroleum products	605.14	45.35%	561.18	44.34%	574.88	42.63%
Biomass	241.93	18.13%	247.50	19.56%	253.19	18.77%
Electricity	396.80	29.74%	384.54	30.39%	411.97	30.55%
Solar energy	0.63	0.05%	0.69	0.05%	1.29	0.10%
Gained energy	3.04	0.23%	3.44	0.27%	7.59	0.56%
Total (ktoe):	1334.23	100.00%	1265.52	100.00%	1348.62	100.00%

Table 9. Utilization of energy sources in all sectors

Coal	Petroleum	Biomass	Electricity	Solar	Bio-fuel	Geothermal	Total
107.38	602.39	259.02	403.95	1.93	3.34	0.01	1386.11
7.75%	43.46%	18.69%	29.14%	0.14%	0.24%	0.00%	100%

Table 10. Forecasted consumption of all energy products in 2014 (ktoe)

Sector	2011		2012		2013	
	Value	%	Value	%	Value	%
Industry	315.64	24.58%	272.98	22.26%	301.95	23.02%
Household	490.51	38.19%	473.73	38.63%	504.25	38.45%
Services	119.57	9.31%	117.09	9.55%	125.60	9.58%
Agricultural	19.95	1.55%	19.85	1.62%	20.78	1.58%
Transport	338.58	26.36%	342.65	27.94%	358.99	27.37%
Total (ktoe):	1284.25	100.00%	1226.30	100.00%	1311.57	100.00%

Table 11. Generation Capacity of Kosovo A and Kosovo B

Generation unit	Capacity of Units (MW)			Set in operation
	Installed	Net	Min/Max	
A1	65	Non-operational	-	1962
A2	125	Non-operational	-	1964
A3	200	182	100/130	1970
A4	200	182	100/130	1971
A5	210	187	100/135	1975
TPP Kosovo A	800	551		
B1	339	310	180/260	1983
B2	339	310	180/260	1984
TPP Kosovo B	678	620		

Source: Energy Regulatory Office, Annual Report 2012.

Table 12. Generation Capacity of Hydro Power Plants and Wind Power Plant

Generation unit	Capacity of Units (MW)		Set in operation
	Installed	Net	
HPP Ujmani	35.00	32.00	1983
HPP Lumbardhi	8.80	8.00	1957 (2006)
HPP Dikanci	1.00	0.94	1957 (2010)
HPP Radavci	0.90	0.84	1934 (2010)
HPP Burimi	0.86	0.80	1948 (2011)
Total HPP	46.56	42.58	-
Wind Power	1.35	1.35	2010
Total Wind Power	1.35	1.35	-

Table 13. Generation Capacity of District Heating Systems in Kosovo

Company	Energy from fuel (MWth)	Heat generation (MWth)	Generation losses (MWth)	Heating plant (%)	Distribution losses (%)	Supply (MWth)
DH Prishtina	57,073	50,025	7,048	87.65	20.51	39,766
DH Gjakova	11,075	7,858	3,217	70.96	17.99	6,445
DH Gjakova	68,147	57,883	10,264	84.94	20.17	46,211

The significant upfront investment is related to the drilling and to the need to cover the geological risk at the beginning of the exploration. The following figures provide a detailed: Number of geothermal power plants in Europe; GeoDH capacity installed in Europe (MWth) and GeoDH systems in Europe, Source: Geothermal District Heating Market Development V.1., 2012. With 53 systems under development, the hottest market in the next years is Germany. Promising developments are also occurring in France (27 in the pipeline) and Hungary (17). But GeoDH – Geothermal District Heating projects are being developed beyond traditional geothermal countries across Europe, including in new markets (Bosnia-Herzegovina, Croatia, Norway, and Spain). Cogeneration geothermal plants are operating in Iceland, but also in Austria and Germany with medium temperatures driving binary turbines. In the future, cogeneration can help geothermal to become more economically attractive by recovering waste heat then distributed through district systems for heating and cooling purposes.

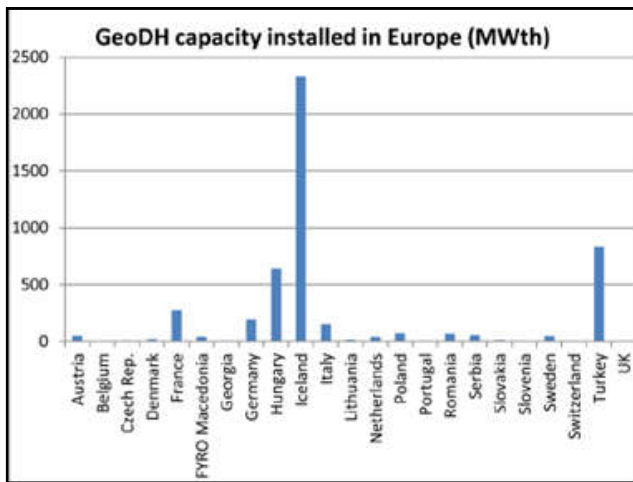
Geothermal Energy Projects in Kosovo – Education Center Kosovo (E.C.K.)

E.C.K. undertook a renewable energy project with the objective to reduce its operating expenses and to provide support to

relevant stakeholders in increasing their human capacities in undertaking EE and RES projects. E.C.K.'s 2008 expenses for heating and cooling amounted to €36,394 (this includes both Academy and Dormitory). The ten year calculated energy spending costs, using the current system – electric energy, amounted to approximate €364,000 (see Appendix 3 and 4). The cost calculation seasons, based on KEC, are: 01 October to 30 March for winter and 01 April to 30 September for summer.

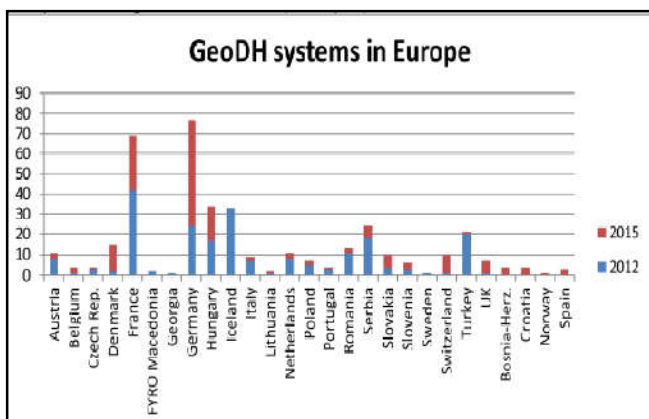
AERMEC, an Italian company that provided E.C.K. with technical and advisory services for the project, reported that geothermal systems for heating and cooling have a 3 – 5 times higher efficiency rate compared to conventional systems with condensing boilers. The ROI⁸ of such systems is 4 to 7 years, depending on installation capacity, and they are recommended for buildings that need thermal energy of minimum 50kW. Geothermal systems discharge 3.61 times less CO₂ compared to thermal power plants. E.C.K. calculated the buildings energy needs to be 155kW. It also developed analysis on the best RES alternative (see Appendix 3 and 4).

⁸ ROI Return on Investment (ROI) is the benefit to an investor resulting from an investment of some resource. A high ROI means the investment gains compare favorably to investment cost.



Source: Geothermal District Heating Market Development V.1., 2012.

Figure 2. GeoDH capacity installed in Europe (MWth).



Source: Geothermal District Heating Market Development V.1., 2012

Figure 3. GeoDH systems in Europe

The cost implications led E.C.K. to choose geothermal energy – water to water system. The project cost was €120,090.00, which included the construction of the geothermal and solar hot water system with an ROI of 4.7 years (see Appendix 5). MED contributed with €30,000 and the respective ROI was 1.3 years. The ten year total savings was forecasted to be €153,305 (see Appendix 5). The total project implementation timeline was 12 months, which included: the feasibility study, water well testing, completion of documentation, and physical work – digging wells, installing equipment, and testing the system.

In addition, E.C.K. hired AERMEC to provide trainings and seminars to the following audiences:

- Engineers and architects who design systems;
- Construction companies that drill wells and install the systems;
- Project managers who develop budgets, proposals, fundraise, and manage projects;
- Government and non-profit organizations who fund projects and are responsible for workforce development and energy development, and
- General public and students at E.C.K.
- Today, E.C.K.'s project has been going very well. The buildings operating expenses for heating and cooling are within the projections ranges: total ten year costs of approximately €85,000 (Appendix 3 and 4).

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Appendixes

Appendix 1: Scenarios of Energy Consumption By 2022

Table 14. Expected gross final energy consumption in heating and cooling, electricity and transport up to 2020 taking into account the effects of energy efficiency and energy saving measures 2010 – 2020 (ktoe)

	2009	2011	2016		2018		2020	
	Base year	ae	rs	ae	rs	ae	rs	ae
Heating -Cooling	486.48	550.36	631.25	595.52	672.05	622.27	718.65	653.32
Electricity	455.23	528.16	634.81	597.88	677.90	627.69	751.37	683.06
Transport	327.35	313.32	362.23	342.23	379.36	351.26	399.95	363.32
Gross final E.C	1301.10	1426.12	1557.63	1704.19	1758.18	1844.20	1902.81	1729.82

rs: reference scenario; ae: additional energy efficiency
Source: NREAP 2011 – 2020.

Appendix 2: RES Targets By 2022

Table 15. National target for 2020 and estimated trajectory of energy from renewable sources in heating and cooling, electricity and transport

	2009	2011	2015	2016	2017	2018	2019	2020
RES – H&C	48.37 %	44.07 %	44.77 %	44.84 %	45.24 %	45.37 %	45.53 %	45.65 %
RES – E	2.26 %	1.71 %	5.62 %	6.58 %	13.20 %	14.42 %	14.10 %	14.33 %
RES – T	0.03 %	0.04 %	2.00 %	3.00 %	4.00 %	6.00 %	8.00 %	10.00 %
Gross final E.C	18.90 %	17.56 %	19.66 %	20.33 %	23.20 %	24.20 %	24.42 %	25.00 %

Appendix 3: Energy requirements for heating

The building has a heat requirement of: 155.00 kW Energy requirements: 201,500.00 kWh/season

	Briquette	Oil	Normal gas	Natural gas	Propan-Butan
1	2	3	4	5	6
Energy	5.2 kWh/kg	9.83 kWh/lit.	kWh/m ³	kWh/m ³	kWh/lit.
Efficiency	85%	92%	95%	98%	98%
Consumption for year	56414 kg	21085 lit.	18585 m ³	17141 m ³	22999 lit.
Energy price per kWh	0.23 €	0.98 €	0.48 €	0.39 €	0.55 €
Costs for one season/year	12,975.30 €	20,662.80 €	9,634.40 €	7,219.90 €	12,649.40 €
Total costs for 10 years*	130,425.70 €	208,128.30 €	99,043.60 €	75,399.20 €	129,118.40 €

	Electrical energy	Thermo pump-air	Thermo pump-earth	Thermo pump water/water	Solar system
1	7	8	9	10	11
Energy	-	-	-	4.2 kWh/kg	3.55 kW/h
Efficiency coefficient (COP)	-	4.0	4.4	5.0	-
Consumption for year	192,606 kWh	36,669 kWh	37,684 kWh	141 in RM	10,820 kWh
Energy price per kWh	0.15 €	0.15 €	0.15 €	36.00 €	0.15 €
Costs for one season/year	28,890.90 €	5,500.38 €	5,652.5 €	5,069.15 €	1,623.00 €
Total costs for 10 years*	289,255.10 €	55,678.85 €	57,200.69 €	53,316.54 €	18,790.00 €

* Total costs with additional and maintenance costs.

Winter season considers 1300 effective working hours of the equipment
Energy saving using thermo pump-air (difference column 3-8): 15,244.95 €/winter season
Energy saving using thermo pump-earth (difference column 3-9): 15,092.76 €/winter season
Energy saving using thermo pump-water/water (difference column 3-10): 17,360.18 €/winter season

Source: E.C.K. 2013.

Appendix 4. Energy requirements for air conditioning

Energy requirements: 124.000 kWh/season Consumption time: 800 hours/season

	Electrical energy	Thermo pump-air	Thermo pump-earth	Thermo pump-water/water
1	2	3	4	5
Energy	-	-	-	4.3 kWh/kg
Efficiency/ COP	99 %	4.00	4.40	5.20
Consumption kWh for year	50,101 kWh	31,000 kWh	28,182 kWh	83 in RM
Energy price per kWh	0.15 €	0.15 €	0.15 €	36.00 €
Costs for one season/year	7,549.75 €	4,717.50 €	4,294.77 €	3,171.00 €
Total costs for 10 years*	75,497.52 €	47,175.00 €	42,947.73 €	31,710.00 €

* Total costs without additional and maintenance costs.

Winter season considers 1800 effective working hours of the equipment
Energy saving using thermo pump-air (difference column 2-3): 2,832.25 €/winter season
Energy saving using thermo pump-earth (difference column 2-4): 3,254.98 €/winter season
Energy saving using thermo pump-water/water (difference column 2-5): 4,378.75 €/winter season

Source: E.C.K. 2013.

Appendix 5. Project budget

Appendix 6: Return on investment for project physical infrastructure

Year:	1	2	3	4	5	6	7	8	9	10
Cash Outflow (€)	120,090	195	195	195	195	195	195	195	195	195
Energy Savings (€)	26,965	26,965	26,965	26,965	26,965	26,965	26,965	26,965	26,965	26,965
Running Net (€)	(93,125)	(66,355)	(39,585)	(12,815)	13,955	40,725	67,495	94,265	121,035	147,805

Note: €195 is cost related to annual maintenance.

Source: E.C.K. 2013

Abbreviations

CO ₂	Carbon Dioxide
E.C.K.	Education Center of Kosovo
EE	Energy Efficiency
EGECI	European Geothermal Energy Council
ERO	Energy Regulatory Office
EU	European Union
GEA	Geothermal Energy Association
GEODH	Geothermal District Heating
GEOELEC	Geothermal Electric
GHG	Green House Gases
GK	Government of Kosovo
GTRH	Geothermal Regulation Heat
KEC	Kosovo Energy Corporation
KEEA	Kosovo Energy Efficiency Agency
KEPA	Kosovo Environment Protection Agency
KP	Kyoto Protocol
MED	Ministry of Economic Development
MF	Ministry of Finance
NCEI	National Council for European Integration
NEEAP	National Energy Efficiency Action Plan
NREAP	National Renewable Energy Action Plan
RE	Renewable Energy
RES	Renewable Energy Sources
ROI	Return on Investment
UN	United Nations
UNFCCC	United Nations Framework Convention on Climate Change.
