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Co-ordination of Research Policies with the Western Balkan Countries

NATIONAL BACKGROUND REPORT ON ENERGY FOR KOSOVO*

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* This designation is without prejudice to positions on status, and is in line with UNSC 1244 and the ICJ Opinion on the Kosovo declaration of independence.

List of abbrevations

AUK	American University in Kosovo
DH	District Heating
EEA	Energy Efficiency Agency
EI	Energy Intensity
ERO	Energy Regulatory Office
ESD	Energy Service Directive
EU	European Union
FEE	Faculty of Electrical Engineering
FME	Faculty of Mechanical Engineering
FMM	Faculty of Mining and Metallurgy
FP7	The EC Seventh Framework Programme
HERD	Norwegian Programme for Higher Education Research and Development
HPP	Hydropower Plant
IMF	International Monetary Fund
KEEP	Kosovo Energy Efficiency Plan
KEK	Kosovo Energy Corporation
KOSTT	Kosovo Transmission System and Market Operator
MED	Ministry of Economic Development
MEM	Ministry of Energy and Mining
MEST	Ministry of Education, Science and Technology
NRC	National Research Council
NRP	National Research Programme
RES	Renewable Energy Sources
Tempus	EU Trans-European Mobility Programme for University Studies
TPP	Thermal Power Plant
UNDP	United Nations Development Programme

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Executive Summary

The main objective of the current report is to provide an overview of research activities in the field of energy in Kosovo* and identification of national research priorities in order to facilitate the interaction between the WBC INCO-NET, and EU member states in the European Research Area (ERA).

In the first sections, the report provides a brief description of entire energy policy. The focus is given to the electricity supply service, which despite large lignite reserves, is still poor performing. Due to inadequate maintenance of existing power capacities, higher losses and dramatic increase of demand, electricity outages are very frequent. The financial assistance from government to the KEK for electricity import was a common practice in the past couple of years.

In order to change this situation, government was active in drafting and promulgation of legal documents and upgrading of institutional capacities required to cope with this problems. The report shows that a solid legal and institutional framework in the field of energy is already in place. The report, further describes the government activities to upgrade the existing power capacities and the associated discussions.

As far as research in the field of energy is concerned, the report underlines the insufficient and inadequate institutional treatment of this issue. It shows that the budgetary appropriation for research and development in general was far below the strategic objectives set in relevant documents. The major research activities, performed so far were basically driven by the needs for emergency interventions and for the further development of the energy sector.

The report shows that for upgrading of existing research capacities and stronger integration of research and development in the ERA, a long term planning and consistency of institutional engagement is indispensable.

Furthermore, the country specific SWAT analysis shows that apart of certain potentials such as solid legal framework, the institutions must dial with numerous weaknesses and challenges in order to establish a sustainable system for research and development in the energy sector.

Based on the analysis of the current needs in the energy sector, existing research potential and assessment of perspective developments, last section of the current report, provides the immediate and future priorities in the field of energy.

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Introduction

Energy sector along with mining and agricultural sector have been traditionally basic pillars of Kosovo economy. All these sectors are currently far from performing adequately. Consequently large rate of unemployment and poverty continues to be regularly reported.

Kosovo has significant potentials for electricity production. The lignite reserves of Kosovo with ca. 12.5 billion tones of which 10.9 billion are exploitable are considered to belong to largest lignite reserves in Europe[1],[2]. Nevertheless, Kosovo is facing serious problems in meeting electricity demands for entire last decade even though since 1999 some improvements have been noted. Despite a yearly increase of ca. 6 %, the electricity production does not yet meet the consumer's demands. The poor electricity supply has been considered as one of major obstacles preventing economical growth of the country over the past decade. The lack of the electricity contributes to bypassing the foreign investments towards other countries of region and makes the local companies to operate under very difficult circumstances und very often on the limit of economical feasibility. The electricity sector was in the past years the major drain on the public budget due to persistent subsidies and the need for electricity imports.

Negative impact of the unreliable and deficient electricity supply, is reflected not only to the normal development of the economy but also to other sectors like public health, education system and daily activities of the people. Because of all this reasons, the electricity supply is considered the poorest performing service publically provided. A recent UNDP publication[3] shows that only 14 % or respondents are satisfied with electric power supply.

1. Purpose of the national background report and methodology/summary of the consultation process

Current national report is prepared within the framework of WBC-INCO.net with the primary objective to highlight the existing situation, weaknesses and potentials for participation and contribution of Kosovo in regional R&D projects and activities in the field of energy. The report intends also to describe the overall state of the energy sector including the related socio-economic aspects in order to provide the background of the current developments in the R&D in the field of energy.

[1] MEM, Energy Strategy 2009-18
[2] R. P. Stoll et. al (Hrsg): Der Braunkohlentagebau, Springer, 2009
[3] UNDP: Public Pulse Pull, Fast Facts III, March 2012

Furthermore, the report aims to identify the R&D priorities in the field of energy which would support the establishing of a sustainable energy sector and hence contribute to boost the overall economical development.

The specific data, statements and conclusions in the report are based on the extensive analysis of available studies, reports, existing legal framework and strategic documents. The report reflects also the opinion of key stakeholders among public institutions, energy companies, donators and non-governmental organizations.

2. The Energy S&T System in Kosovo

Setting the research as one of priorities, the government has contributed to a limited progress related to establishing of well design and functional scientific research system. The National Research Council established in 2007, drafted the National Research Programme (NRP) which has been approved by the Parliament in 2010. Research in the field of Energy has been identified as one of top priorities in the NRP. However, there are still many barriers which prevent the implementation of identified priorities in NRP. Although the Government, initially allocated 1 million € for financing the projects within the 6 identifies priority areas, due to public budget shifts, only 0.4 million were invested in research projects. On the other hand, participation in the 7th European Research Framework Program (FP7) has slightly increased in terms of submissions, but was very limited in successful and funded projects. There have been implemented some small research projects financed by public budget or donators but they aim to support primarily the development of energy sector. In general, the scientific research is to a wide extend still based on voluntary and individual basis, with little or no technology transfer to the economy.

2.1. The Kosovo and Energy policy framework

On 17th of February 2008, the Assembly of Kosovo declared Kosovo an independent and sovereign state. When it declared independence, Kosovo pledged to implement the Comprehensive Proposal for the Kosovo Status Settlement, drafted by U.N. envoy Martti Ahtisaari. The provisions of the plan have been incorporated into Kosovo's new Constitution, which went into effect on 15 of June 2008. Meanwhile a considerable number of laws and strategic documents have been approved by the Parliament. The entire institutional and in particular legal framework of Kosovo is being upgraded in the line with EU's Acquis. In the past four years Kosovo has been recognized by 89 countries, joined the International Monetary Fund (IMF) and the World Bank and is aspiring to become a full member of the European Union (EU).

2.1.1 The overall energy policy framework

Institutional and Legal framework

The basic institutions responsible for governing of energy sector in Kosovo are Ministry of Economic Development (ex Ministry of Energy and Mining-MEM) and Energy Regulatory Office (ERO). Other important responsibilities in the field of energy lie with Ministry of Environment and Spatial Planning, Ministry of Health, Ministry of Trade and Industry, Ministry of Agriculture, Forestry and Rural Development, Ministry of Infrastructure and Kosovo Environmental Protection Agency. The Numerous legal documents drafted and implemented by these institutions tend to regulate the energy sector and to provide the basis for planning of strategic activities in the Energy field. The most relevant laws, administrative instructions, regulations and strategic documents formalized up to know are:

Laws

- Law 03/L-184on Energy
- Law 03/L-201 on Electricity
- Law 03/L-185 on Energy Regulator
- Law 03/L-165 on Mines and Minerals
- Law 04/L-016 on Energy Efficiency
- Law 03/L-133 on Natural Gas
- Law 03/L-116 on Central Heating
- Law 2004/5 on Trade of Petroleum and Petroleum Products
- Law 04/15 on Construction
- Law 03/L-025 on Environmental Protection
- Law 2003/14 on Spatial Planning
- Law 03/L-230 on Environmental Strategic Assessment
- Law 03/L-214 on Environmental Impact Assessment

Administrative Instructions

- Administrative Instruction No. 01/2012 on Energy Audits
- Administrative Instruction Nr. 07/2012 on the Rules for Energy Balance
- Administrative Instruction Nr. 01/2010 on Security of Supply in the Natural Gas Sector

- Administrative Instruction Nr. 04/2009 on Opening of the Electricity Market for all Non-household Costumers
- Administrative Instruction Nr. XX/2008 on Labeling of Electric Household Appliances
- Administrative Instruction No. 02/2011 on Rules and Procedures for the Collection of Mining Royalties

Regulations

- Regulation No. 01/2012 on Establishment and Functioning of the Commission for Certification of Energy Auditors and Managers
- Regulation No. 08/2011 on Internal Organization of the Kosovo Agency for Energy Efficiency
- Technical Regulation No. 03/2009 on Thermal Energy Saving and Thermal Protection in Buildings
- Regulation No. 04/2011 on the Mining Sector Community Treatment
- Regulation No. 02/2011 on the Content of the Geological Investigations Program and Elaboration of the Geological Survey Results

Strategy and Program documents

- Energy Strategy of the Republic of Kosovo 2009-2018
- Kosovo Energy Efficiency Action Plan 2010-2018
- Kosovo Heating Strategy 2011-2018

Apart of governmental institutions the other entities having strong influence on the energy sector are large energy companies. The dominating companies in this sector are: Kosovo Energy Corporation (KEK), Kosovo Transmission System and Market Operator (KOSTT) and District Heating Companies (in Prishtina, Gjakova and Mitrovica). Currently all relevant energy companies have a public status governed by central or local institutions. However, the government is committed to complete formal procedures for privatization of Public Supply and Distribution System Operator. The privatization is planned also for TPP Kosova B, based on a specific public private partnership for its revitalization and construction of the TPP "Kosova e Re".

Current situation on Energy Supply

The primary role of the entire energy sector infrastructure of Kosovo is the security of sufficient and uninterrupted end-use energy supply. The basic primary energy

source used in Kosovo in order to satisfy energy needs of different economic sectors is lignite. Other primary energy sources are imported oil products (mainly for transport), imported heavy fuel oil (for heating purposes), electricity import, firewood and a small amount on hydroenergy. The Kosovo primary energy mix is presented in Fig. 1.

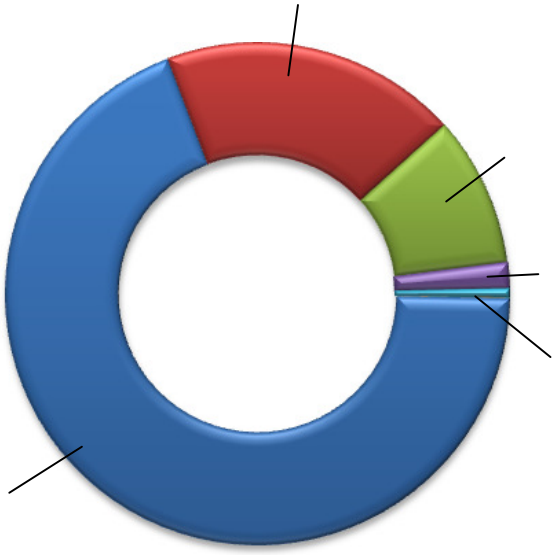


Fig. 1 Primary energy mix for Kosovo in 2010[4]

While the import of LPG and oil products are being managed without big troubles, the situation with electricity and heat supply is problematic.

The electricity generation sector is dominated by KEK which owns and operates with the two lignite fired power plants "Kosova A & B". The thermal power plant (TPP) Kosova A consists of five units with a total installed capacity of 800 MW and TPP Kosova B of two units with an installed capacity of 678 MW. Table 1 summarizes data on existing thermal power generation capacities in Kosovo.

The total installed capacity of 1478 MW of both TPP's would be sufficient to meet even the pick electricity demands amounting of ca. 1300 MW in the winter periods. But, due to the degradation and underinvestment in the lignite mines and TPP sector in Kosovo during 1990-1999, lack of maintenance, lack of necessary periodical rehabilitations and aged TPP's, the technical availability is far below installed capacities and this situation has not been substantially improved despite several major overhauls actions performed in the last 10 years. A reliable operation

[4] MEM: Republic of Kosovo's Energy Balance for the Year 2010

and production which would be sufficient to cover basics electricity demands is not possible with outdated and poor maintained TPP capacities.

Table 1: Existing thermal power generation capacities in Kosovo[5]

Power plant unit	Power plant unit capacity (MW)		Year of Commission
	Installed	Net available	
TPP Kosova A			
Unit A1	65	0	1962
Unit A2	125	0	1964
Unit A3	200	115	1970
Unit A4	200	115	1971
Unit A5	210	125	1975
TPP Kosova B			
Unit B1	339	250	1983
Unit B2	339	270	1984

The transmission system is managed by KOSTT. Kosovo is a Contracting Party to the regional Energy Community and is linked to the regional system via interconnections with Serbia, Macedonia, Montenegro, and Albania (Fig. 2).

The electricity transmission system is interconnected with all neighboring systems at the 400 kV level, except of the interconnection with Albania which currently is at 220 kV level. However, the construction of a new 400 kV interconnection with Albania is ongoing and according to the plans the line should be ready in 2013. By the new line Kosovo current capacities for electricity exchange will be substantially upgraded. On the other hand the line will contribute towards optimization of the cooperation between Kosovo's thermal power based system and Albania's hydropower based one. The 400 kV line will also evidently enhance electricity exchanges in the region. Apart of upgrading their transmission capacities, KOSTT is actively working in reducing the transmission losses which actually are in the range of 2-2.5 %[6].

[5] MED: Energy Strategy of the Republic of Kosovo

[6] ERO: Statement of Security of Supply for Kosovo, 2011

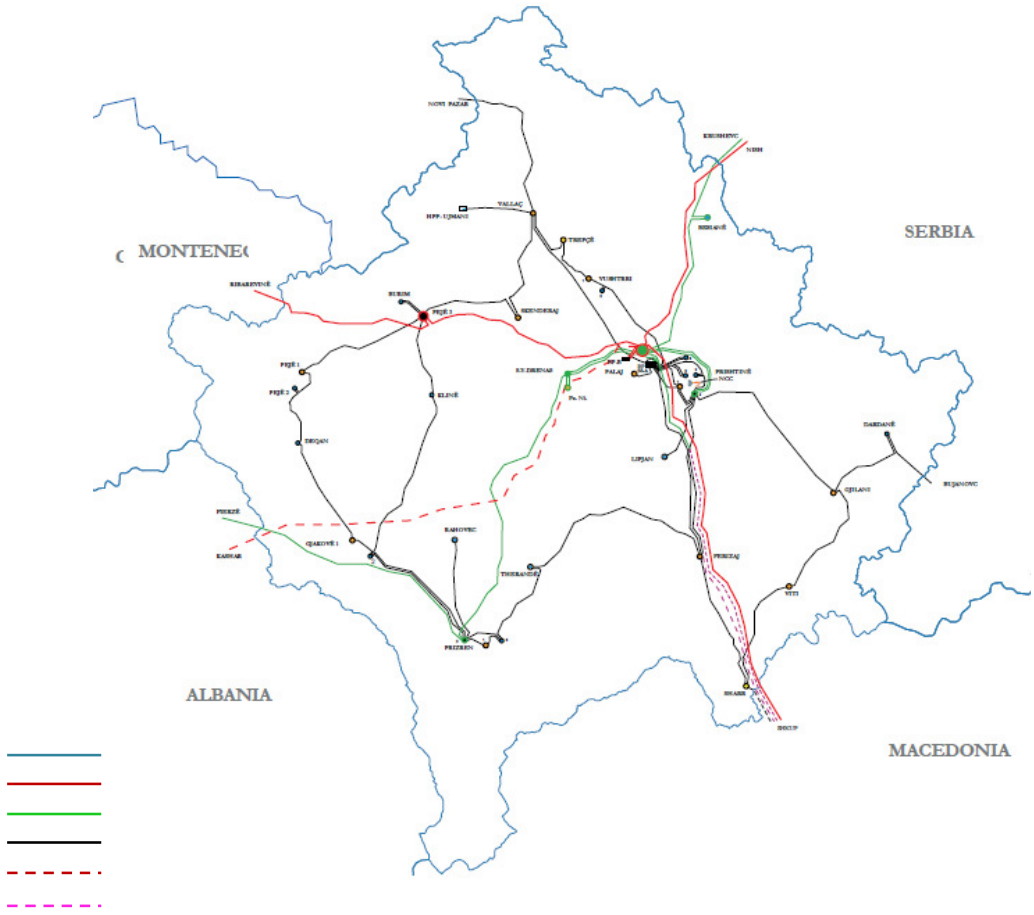


Fig. 2 Kosovo Transmission System 400/220/110 kV[7]

One of major problems in Kosovo's electricity system in the past decade is high level of losses in the distribution system, currently managed by KEK. The distribution losses consist of technical and commercial (non technical) loses. Even though a slight reduction of such losses is recorded recently, they still represent ca. 38 % of total supplied electricity. Particularly concerning issue for the distribution system of the KEK remains the high part of commercial losses which represent over 21 % of total distribution loses. Such losses have also a technical background (metering problems) but primarily are generated due to electricity theft and non-payment of electricity bills[8].

Kosovo has no other fossil fuel sources (oil, gas) than lignite and hence no TPP based on such sources. However Kosovo has certain potential on **renewable energy sources (RES)**. Currently, there exists very limited generation capacities

[7] KOSST: Annual Report 2009
[8] UNDP: Energy for Development, 2007

based on RES which consists of the hydro power plant (HPP) Ujmani/Gazivoda (=32 MW a. c.), Lumbardhi (=8 MW a. c.) and some small HPP (= 2 MW a. c.) with a total of 42 MW available generation capacity[9]. There have been build also three small wind power units of very limited capacity (ca. 1.3 MW) which are currently out of operation due to some divergences with the Energy Regulatory Office related to the feed-in tariffs. Other generation capacities on wind, solar and geothermal with exception of few cased in household and small enterprise level are not yet developed.

In relation to the development of renewable energy, MED implemented a number of pilot projects for sanitary hot water by using of solar energy in public buildings. In addition, solar energy was promoted through a number of demonstrating projects (installation of solar panels in the Kosovo Clinical University Centre and Students Centre in Prishtina). In this context, solar energy can become a source of hot water supply, regardless of the high cost of the equipment and the scarcely developed market.

Agricultural biomass has high energetic potential, however, the agricultural sector in Kosovo is insufficiently prepared to develop this commercial potential[10].

Important conclusions in relation with addressing problems and challenges of energy sector in Kosovo can be derived based on the analysis of sector-based breakdown of energy consumption.

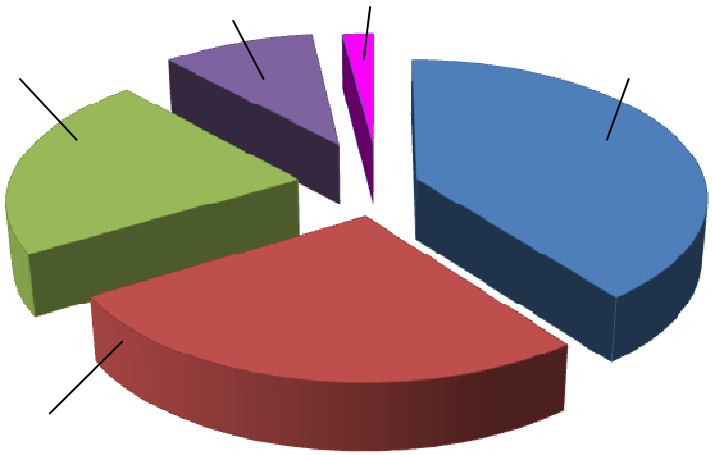


Fig. 3 Breakdown of energy consumption by sectors in 2010[11]

[9] ERO: Statement of Security of Supply for Kosovo, 2011
[10] MED: Heating Strategy of Kosovo 2011-2018
[11] MEM: Republic of Kosovo's Energy Balance for the Year 2010

As presented in Fig. 3 the largest energy consuming sector is household sector. On the other hand, electricity takes place with ca. 30 % in the total energy consumed by households. Therefore a substantial improvement in electricity supply system is only possible, if electricity consumption by households is reduced. This can be achieved primarily by reducing of commercial losses, since addressing the non-metered electricity, theft and non-payment of bills will considerably reduce the consumption. Another issue to be addressed is the extensive use of electricity for space heating. Analysis shows that over 50 % of electricity consumption in households is used for heating purposes[12],[13]. Fig. 2 also shows that households and services sector accounts for 50 % of the total energy consumption in Kosovo with largest part, ca. 66 %, being used for heating purposes[14].

The high level of energy consumption indicates the high potential for rationalization of energy consumption in residential and public buildings. In this respect, the government was quite active in addressing **energy efficiency** primarily in the buildings of public sector as recommended in the EU Energy Service Directive (ESD)[15]. The aim of such activities was establishing of a legal basics in the line with EC directives, upgrading of human capacities and establishing of the institutional framework able to address all relevant aspect of energy efficiency. The revised version of the Law on Energy and the promulgation of the Law on Energy Efficiency in 2011, including some bylaws recently formalized, have substantially improved the legal basis for energy efficiency. Following the Energy Strategy goals and based on the requirements of the Energy Community, Government of Kosovo prepared the Kosovo Energy Efficiency Plan 2010-2018 (KEEP) as an implementation platform for energy efficiency improvement measures. Pursuant to ESD and taking into consideration the three EU targets to be achieved by 2020, namely to improve energy efficiency by 20%, to reduce greenhouse gases by 20% and to have 20% of the total energy consumption covered by Renewable Energy Sources (RES), Kosovo set in KEEP an indicative target of 9% reduction of energy consumption until 2018, thus accomplishing an improvement of energy efficiency in the range of 1% per year. Meanwhile a methodology for monitoring, verification and evaluation of energy savings based on EU harmonized methods has been established.

Regarding human capacities, different programs on building of energy auditors have been implemented resulting in 59 certified energy auditors. Two programs, on building energy auditing have been completed and the implementation of energy

[12] ERO: Statement of Security of Supply for Kosovo, July 2011
[13] WB: Development and Evaluation of Power Supply Options for Kosovo, December 2011
[14] MEM: Energy Consumption in Kosovo, 2010
[15] EC: Directive 2006/32

efficiency measures recommended by energy auditors is running. A further improvement of institutional framework is going to take place next week's by establishing of Energy Efficiency Agency (EEA). One of basic activities of the EEA is planned to be providing of support to local authorities in relation with preparation of energy efficiency local plans and reporting.

The background of extensive use of electricity for heating in single family houses is assumed to be primarily in abusing of electricity. However, many of households in multi-story buildings do not have other alternatives, since many of such buildings neither have an own heating system nor have access to a district heating system. Furthermore, the electricity is extensively used for heating even by households living in multi-story buildings which are connected to a district heating since the district heating systems, actually are facing also serious problems and therefore the heat supply is much under demands.

District heating (DH) exists in four cities (Prishtina, Gjakova, Mitrovica and Zvecan) and meets only 5 % of the total head demand of Kosovo. The operational capacity of DH in Prishtina is 134 MW, in Gjakova 20 MW, in Mitrovica 16.9 MW and in Zvecan 1.6 MW[16]. The DH systems are operated by public companies under the responsibility of corresponding municipality authorities. All DH plants are equipped with boilers which operate mainly by using of imported heavy fuel oil (mazut) and provide space heating only. Since the DH systems provide no hot water, they are operational only in winter periods. The existing DH are quite obsolete, not well maintained and characterized with high generation and distribution losses. The generation losses are estimated between 20 and 30 % while the distribution losses in the primary network between 15 and 20 %. Billing of costumers is still based on heated area with exception of few cases which are charged with costs accounted based on metered heat. This form of billing does not motivate consumers to change their behavior in order to rationalize their energy usage for heating purposes. Furthermore, the poor quality and not stable heat supply impacts negatively the bill payment which is reported to be ca. 57 %[17].

Development perspectives

As described above, the current power generation capacities are limited, some of them very outdated (TPP Kosova A), not well maintained and therefore not reliable in the operation. On the other hand, as might be expected the total electricity consumption has been continuously increased during the past decade resulting in

[16] ERO: Annual Report 2007
[17] ERO: Annual Report 2010

an average yearly increase of 8.6 %[18]. Consequently the electricity imports (ca. 10 % of the total electricity consumption) often under very unfavorable conditions were inevitable all the time.

Due to the critical situation in the energy sector, Kosovo currently is in front of difficult strategic choices which will influence the future development of this sector for at least next 40 years. Different scenarios for development of the energy sector proposed by government, international institutions, civil society and independent experts, differs with the regard to which of factors like large lignite reserves, environmental and social impact, existing potential on renewable energy sources and eventually electricity export should be given the priority. Discussions are also driven from different viewpoints regarding the financing of new generation capacities, capacity of new generation units, maintenance of existing power capacities and managing of existing and new lignite mines. Several studies have been performed in order to assess the potential of Kosovo on energy resources and to find the best option to overcome the energy crisis[19,20,21,22]. The World Bank study[23] tends to synthesize all studies and evaluations made in the past in order to provide the lower costly option for a sustainable energy sector while keeping all actual provisions on environmental protection. According to that study, the best option for Kosovo would be to upgrade the current generation capacities based on lignite by construction of new TPP with a total capacity of 600 MW supported by a HPP of ca. 300 MW and power generation capacities based on renewable energy sources with a firm capacity of ca. 170 MW. The scenario recommended by the WB study is in the line with government projections for consolidation of the energy sector namely building of a lignite based TPP named "Kosova e Re" with two units x 300 MW, developing of a new lignite mine near the new TPP and refurbishment of Kosovo B power plant which is going to be included within the privatization package offered to the investors. The operation of "Kosova e Re" should start by the end of 2017 and meanwhile the activities related to building of a new HPP with a capacity of 305 MW should be continued. In spite of strong opposition of civil society[23] which claims that the government plans will monopolize the electricity market, the government is committed to keep their plans. The civil society is in favor of promoting the power plant unit based on RES. According to government plans, the tendering procedures for the new TPP should be finalized in coming months and

[18] ERO: Statement of Security of Supply for Kosovo, July 2011
[19] NEK: Wind Resource Assessment-Kosovo, December 2010
[20] KIPRED&FIQ&GAP Institute: Energy Projects in Kosovo, September 2011
[21] WB: Development and Evaluation of Power Supply Options for Kosovo, December 2011
[22] University of California: Sustainable Energy Options for Kosovo, January 2012
[23] KIPRED, FIQ and GAP Institute: Energy Projects in Kosovo, September 2011

before the end of 2012 the responsible consortium for developing of new lignite TPP should be formally selected.

The arguments that Kosovo primarily should develop lignite based power generation capacities to cover basic energy demands, and quasi parallel start with development of capacities based on RES, seems to be widely accepted from the major part of key players. Even though currently underdeveloped, in Kosovo exists sufficient potential on RES to support basic energy needs and also to reach the announced targets on reduction of green house gasses and in parallel increase the share of RES in the overall energy production. Up to now, the authorities were mostly active in studying the hydro potential for electricity production. A feasibility study for construction of a HPP with capacity of ca. 305 MW in location Zhur (near Prizren) is finalized and the authorities are currently planning to commence procedures for construction of that HPP. There exists also a feasibility study which shows that Kosovo has the potential for construction of additional 77 small HPP with a total capacity of 128 MW.

With exception of some basic studies, there are no detail and reliable data and wind map of Kosovo potential for utilization of wind energy. Preliminary top-down assessment conducted by Mercados[24] shows that Kosovo has a wind generation potential of more than 1000 MW installed capacity with a capacity factor of 25%. However, another study carried out by consultants NEK Technologies (Zürich)[25] concluded that Kosovo has moderate wind resources with very few areas characterized by wind speeds exceeding 6 m/s, a minimum needed for commercial utilization of wind energy. The composition of wind map based on detailed field measurements and derivation of corresponding data is one of the objectives of MED for developing of power capacities based on wind energy.

In relation to RES, the public perception is that Kosovo has a considerable potential on solar energy. Nevertheless, currently there exist no solar map and the available data based on measurements are very scarce. Mercados estimated a potential equivalent to about 77 MW installed capacity with a capacity factor of 22-25%.

In order to reduce the demand for electricity in the winter pick periods, institutions were active in upgrading the heat generation capacities particularly in Prishtina which owns the largest district heating system. A feasibility study to support the district heating in Prishtina with co-generation of energy in TPP Kosova B is finalized. According to the study the co-generation will provide up to 120 MW

[24] Mercados Energy Markets International, Kosovo - Regulatory Framework for RES – Procedures and Methodology for RES Electricity Pricing Task 1 Report, May 2009.
[25] NEK UMWELTECHNIG AG: Wind Resource Assessment -Kosovo, December 2010

thermal energy and thus will substantially improve the capacity and heating quality of existing district heating. The project is financed by EC with 13.8 million, by KfW with 11 million € and by Prishtina Municipality with 2 million €. The selection of the company for supervision of works is in the final phase and the tendering procedures for selection of implementing company are expected to commence fairly soon. The finalization of the project is expected within 2 years.

2.1.2 The elements of Energy research policy making

The background of the research policy in Kosovo is provided by the Law Nr.2004/42 on Scientific Research Activity, Strategy for Development of Higher Education in Kosovo 2005-2015 and The National Research Programme of the Republic of Kosovo (NRP). According to the Law on Scientific Research Activity, public institutions (Academy of Science and Arts, Scientific institutions and Universities) and private organizations are entitled to carry research works and obtaining funds to do this. The article 7 of the Law, states that up to 0.7 % of public budget shall be allocated for research activities. Further, the Law promotes upgrading of scientific human capacities by training of new R&D personnel in order to reduce the lacking of young scientific researchers.

Advancing of capacities of research and scientific work has been identified as one of strategic objectives also in the Strategy for Development of Higher Education in Kosovo 2005-2015. Identifying the low budget as primary reason for an unsatisfactory level of scientific research activities, the Strategy foresee for the increase of budget for scientific research and transfer of knowledge up to 3.5 % of GDP in the line with Bologna Process objectives. However, the allocated budget practically is usually under 0.1% of GDP and thus far below to the EU average.

The key institution for establishing and implementation of the overall research policy in Kosovo is Ministry of Education, Science and Technology (MEST) respectively its department for Science and Technology. Pursuant to the Law on Scientific Research Activity, based on recommendation of MEST respectively government of Kosovo, Kosovo Assembly established in 2007 the National Research Council (NRC). In the line with its primary obligations, NRC drafted a National Research Programme (NRP)[26] which has been approved by Kosovo Assembly in 2010. The two outmost important outcomes of the NRP are indentifying of 6 research priorities and developing of the corresponding implementation plan. The priorities were selected based on the most suitable approach for Kosovo circumstances. The Environment, **Energy** and Natural Resources have been

[26] Republic of Kosovo: The National Research Programme, 2010

identified as first priority. The implementation plan describes research activities, time-schedule and the budget estimation for each activity. NRP provides also a kind of mid-term budget planning in order to implement the stipulated research activities. It is recommended an average yearly budget increase of ca. 1 million Euros, starting from 2010 so as to reach a stabilized level of budget appropriations after 2015 in the range of 4.5-6.5 million Euros. Following recommended budgetary projects by NRP, MEST allocated 1 million Euros for research activities in 2011, but due to budget shifts (reallocations) only 0.4 million were practically available for research projects. This is equivalent to 0.03 % of GDP and hence far from aspirated budget on the Law on Scientific Research Activity and in the NRP.

2.2. Overview of Energy research activities

The only institution performing typical scientific research activities in Energy is University of Prishtina, respectively the Faculty of Mechanical Engineering and Faculty of Electrical Engineering. However, most of activities with exception of few cases are of small scale nature for which no institutional support is provided. Such research activities are driven basically by the need of young researchers for their further professional development. There exists no central database of projects, results and published work in the field of energy.

As stated above, trying to remedy this situation MEST supported in 2011 with 0.5 million Euros the research activities in various fields among which also a project on Analysis of Renewable Energy Sources with 25.000 Euros.

There have been noted an increased interest from institutions to participate on large scale projects such as FP7, but so far the application were not successful.

2.2.1 Energy research projects

In spite of small number of scientific research projects, there have been undertaken numerous studies, investigations and other research activities mainly driven by economical needs. Accomplishing institutions of such activities were basically MED, INKOS, Riinvest Institute, American University of Kosovo and Donators. The basic data on some of implemented or continuing R&D projects in the field of Energy are provided in Table 2.

Table 2: Energy projects

Nr.	Project Name	Status/ imp. year	Donor	Implemen. institution	Project value (€)

1	Study of Kosovo Hydropotentials	2005	KPB	INKOS	3,900
2	Prefeasibility study for identifying hydropotentials for small scale hydropower plants	2006	DANIDA	Albanian Energy and Environmental Association for Sustainable Development	50,000
3	ESTAP III-3	2006	WB	-	500,000
4	ESTAP III-4	2006	WB	-	245,702.5
5	Assessment of geological reserves of lignite in Kosovo	2007	KPB	-	50,000
6	Kosovo Energy Sector - Heat Market Study	2007	WB	ELC-Electroconsult / ERM	-
7	Energy for Development-Kosovo	2007	UNDP	-	-
8	Assessment study on renewable energy sources in Kosovo	2008	EC	COWI	350,000
9	Promotion of utilization of solar energy in UCCK and Students Centre in Prishtina	2008	KPB	TERMO	350,000
10	Preparation of politics and strategies for regional geological investigations	2008	KPB	-	44,950
11	Compilation of strategy for promotion of mineral resources	2009	KPB	-	47,000
12	Promotion of utilization of	2009	KPB	GESER	150,000

	solar energy in UCCK				
13	Evaluation of hydro energy potential for mini HC	2010	KPB		140,000
14	Application of energy efficiency measures in public buildings	2010	EC	Kantor	1,300,000
15	Study on preparation of projecting data for utilization of solar energy in Kosovo	2010	KPB	B2B Consulting	60,000
16	Study on energy consumption distribution in the industry sector in Kosovo and possibilities for improvement of energy efficiency	2010	KPB	MPR/Grou p& Euro Service	57,995
17	Application of energy efficiency measures in public institutions in framework of implementation of national program on EE in the line with EC and ECT requirements	Ongoing	KPB&GIZ	Monten,Ter momontim i and ELEN	452,494
18	Study of public building stock for energy auditing	Ongoing	KPB	Eleganca	12,296
19	Assessment of wind potential	2010	American Universit y in Kosovo	NEK Umwelttec hnik AG	-
20	Study in implementation of energy efficiency measures in municipality level	Ongoing	EC	AlaNet	15,600,00 0
21	Study on consumption distribution in the	Ongoing	KPB	INTECH	50,000

	household sector and possibilities for improvement of energy efficiency				
22	IPA 2008 - Supervision for Implementation of Energy Efficiency Measures in Public Buildings	Ongoing	EC		179,555
23	IPA 2008 - Implementation of Energy Efficiency Measures in Public Buildings	Ongoing	EC		1,163,713
24	IPA 2010 - Energy Sector Reform	Planned	EC		2,000,000
25	Renewable Energy - Kosovo	Ongoing	Norway		851,735
26	Environmental Assessment for Thermal Power Plant-Kosovo B	Ongoing	USAID		432,900
27	Center for Energy and National Resources	Ongoing	USAID		254,224
28	LIGNITE POWER TECHNICAL ASSISTANCE PROJECT	Ongoing	WB		8,118,138

2.2.2 Key competencies in Energy research field

Kosovo underwent massive institutional changes after 1990 which directly affected research and innovation sector. Due to political situation, the intensive institutional cooperation among regional R&D intuitions broke up. Individual projects on different regional institutions came fast to the end and no new actions were started. The intensive cooperation with economy and solid technology transfer was seriously damaged. The almost one decade parallel institutional development of the education system was a handicap for maintaining and further developing of existing competencies in Kosovo. Further they became partially degenerated and even not more useful. The only possibility in developing of new competences was in relation to the individual research activities of young researches in different European Countries. This situation, however start to change after the war in 1999. Thus,

during the last decade a considerable number of young researchers, came back and are contributing in various ways on upgrading of R&D of Kosovo Institutions. Meanwhile, even more young students started their Master and PhD work in cooperation with Universities abroad and some of them continued to cooperate with Prishtina University. On the other hand, Prishtina University signed over 80 cooperation agreements with different Universities all over the World. Strengthening of R&D capacities is one of major outcomes of such agreements. As far as energy field is concerned an improvement has been noted regarding the cooperation with economy.

As result of complex developments in the higher education sector in past two decades, following key competences in Energy research field can be highlighted:

1. Power generation technology
    - Improvement of energy transformation efficiency
    - Combined power generation
    - Reduction of emissions
2. Renewable energy sources
    - Upgrading of HPP potentials
    - Establishing of detailed wind map and developing of wind power plants
    - Establishing of detailed solar map, developing of solar power plants, upgrading of capacities for solar water heating,
    - Research of potentials on geothermal energy and developing of geothermal systems
    - Developing of bio-energy based systems
3. Energy Efficiency
    - Improvement of energy efficiency in all sectors of economy
    - Strengthening of system for monitoring and evaluation of energy savings
    - Analysis of interrelation between socio-economic factors and energy efficiency
4. Energy Resources
    - Research of current potentials on lignite reserves

- Integration of socio-economic and environmental aspects in opening of new lignite mines and rehabilitation of depleted mine areas
- Utilization of environmental friendly lignite production technology

5. District heating
    - Improvement of efficiency of existing district heating
    - Introducing of smart heat metering system
    - Upgrading of district heating capacities (construction of new district heating systems in larger urban areas)

2.2.3 Energy research infrastructure

Energy research infrastructure in Kosovo comprises public and private institutions. Key public institutions responsible for financing of R&D in energy field are:

- Ministry of Education, Science and Technology
- Ministry of Economical Development

Key public institution for performing research in Energy is Prishtina University with corresponding Faculties:

- Faculty of Mechanical Engineering (FIM),
- Faculty of Electrical Engineering (FEE),
- Faculty of Mining and Metallurgy (FMM).

The three faculties, responsible for research and development in the field of energy, have more than 25 years tradition in education and research activities. The studies in Mechanical and Electrical Engineering started in 1967 as sections of former Faculty of Engineering but as separate academic units FIM and FEE were established in 1988. Both of these faculties provide three levels of study programs in the line with Bologna Agreement: Bachelor, Master and Doctoral Studies. They owns few laboratories and a quite limited number of equipments dedicated mainly for basic research activities

Non public institutions involved in research activities in the energy field are:

- Institute INKOS
- Institute Riinvest
- American University in Kosovo (AUK)

INKOS Institute was established in 1979 as part of KEK responsible for research and development activities. In the process of KEK unbundling, in 2006 INKOS has been evidenced as Joint Corporation. It owns 6 units with a solid number of laboratories and equipments as well as competent and experienced research potential. However, not fully clear legal status prevents INKOS management to make long term planning necessary for their future activities, for investment in advanced research equipment and for ensuring a normal knowledge transfer to young researchers. Clarifying of the legal status and the fully reorganization of the institute seems to be emergent in order to make INKOS working as an economically feasible and effective research institution.

Two other non public institutions (Riinvest and AUK) are basically higher education institutions. Regarding the energy field they conducted several studies and analysis, mainly based on evaluation of existing data and the newly task designed questionnaires.

2.3. Key drivers of Energy research

2.3.1 Main Energy sector trends in Kosovo

One of most relevant indicators in following energy trends of a country is energy intensity (EI). Kosovo is characterized with a relatively high EI index being the highest in the region after the EI of Bulgaria[27] . In order to predict the future development of energy sector in Kosovo, two basic scenarios are assumed for the Gross Domestic Production (GDP) growth rate in the period 2009-2018 (Table 3).

Table 3: GDP grow rate assumptions (in %) in the period 2009-2018

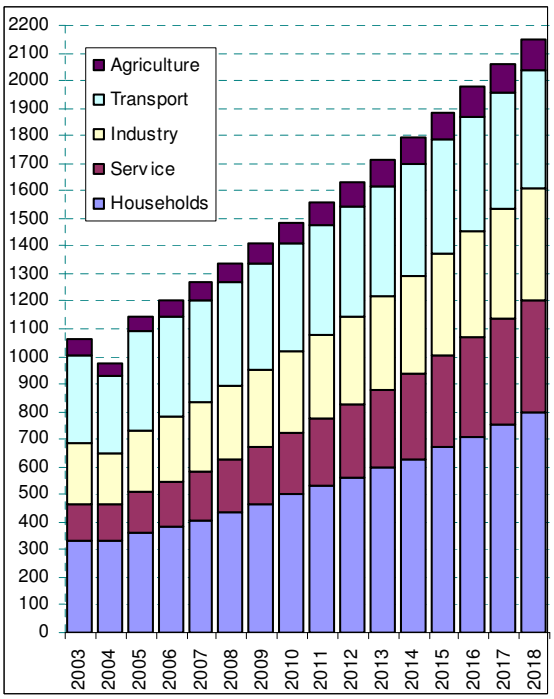
Scenario	2009-2010	2011-2014	2015-2018
Medium	3.20	3.10	3.00
High	6.20	5.29	5.00

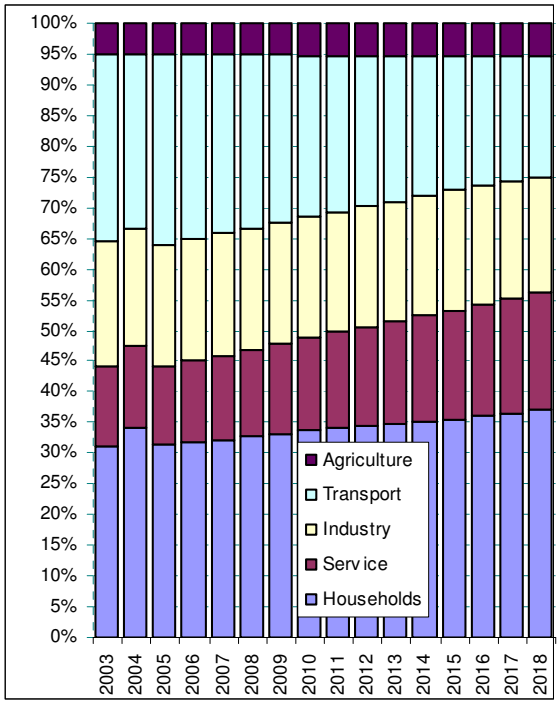
Primary energy demand: The primary energy demand forecast is based on "top-down" approach for all sectors of economy. As far as the main energy consuming sector is concerned, namely the household sector, main energy sources are electricity, firewood and oil byproducts. According to the demand forecast, the electricity consumption will increase in absolute terms, but it will undergo a relative decrease in consumption. This relative decrease will be compensated by increased consumption of LPG and firewood.

[27] MED: Energy Strategy of Kosovo 2009-2018

In the services sector, energy consumption will gradually increase, along with the increase of number of customers and improvement of services themselves. Structural changes are also envisaged, such as lower increase in coal consumption and increased role of oil products in energy consumption structure.

The primary energy demand increase is foreseen also in industry, transport and agricultural sector. Fig. 4 and 5 shows graphically the total energy demand from 2003 up to now and the energy demand forecast up to 2018.





Final energy demand: The two final energy forms influencing greatly future developments of the energy sector in Kosovo are **electricity** and **heat**. The medium demand scenario for electricity envisages a modest increase of demand in the household sector, whereas high increase of demand is projected for the services and industrial sectors. Electricity demand in 2018 is projected at 6,939 GWh/year (Table 4), associated this with a peak load of 1,543 MW in the power system. Gradual reduction of commercial losses down to 5% during the period 2009-2011 was assumed in this scenario. The high demand scenario envisages the demand of 7,431 GWh/year in 2018, with a peak load of 1,671 MW. Gradual reduction of

commercial losses down to 5% during the period 2009-2015 was assumed in this scenario.

Table 4: Electricity demand and peak load forecast for 2009 – 2018

	2009	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
GWh										
MDS	4994	5226	5418	5621	5834	6059	6295	6500	6715	6939
HDS	5299	5514	5713	5929	6164	6422	6662	6898	7153	7431
MW										
MDS	1130	1174	1212	1251	1297	1343	1403	1449	1506	1543
HDS	1210	1257	1302	1349	1389	1434	1515	1566	1618	1671

As far as the required generation capacities are concerned in order to meet the electricity demands, different analysis and scenarios are recently discussed. The study of the WB[28] on different power supply options fits more than all other options to the government plans. Based on this study Kosovo will need about 950 MW of new firm capacity by 2017. This need grows to about 1000 by 2019 and about 1500 MW by 2025. In order to fill the current gaps, WB recommends the construction of new TPP "Kosova e Re" by 2017 with a base load capacity of 600 MW, construction of HPP Zhur with an installed capacity of 305 MW and construction of generation capacities based on renewable sources with a firm capacity of roughly 170 MW. As stated in section 2.1.1, Government is committed to go ahead with necessary actions to build the TPP "Kosova e Re". Hence, these days the authorities of MED announced that the corresponding tendering pack is approved and the offers of interested companies are expected by the end of September 2012. The related works should start in 2013.

The fact that for a considerable number of households the electricity is used for heating purposes makes the prediction of the future needs for heating crucial for stabilization of the electricity sector. According to Heating Strategy of Kosovo[29] the annual net consumption of energy for space and sanitary water heating in the period 2012-2018 will increase in yearly average of ca. 3 % (Fig. 5 and 6).

Thus, if the heating energy sector does no undergo any changes, the net heating energy consumption is predicted to increase from ca. 5000 GWh/year in 2012 to ca

[28] WB: Development and Evaluation of Power Supply Options for Kosovo, December 2011
[29] MED: Heating Strategy of Kosovo 2011-2018

6000 GWh/year in 2018. At the same period of time the gross heating energy consumption is predicted to increase from 9500 GWh/year to 11500 GWh/year.

Pursuant to Heating Strategy, Kosovo will not be able to meet the indicative targets set in KEEP. Therefore, a part of measures foreseen in KEEP, additional actions are required. In case, that energy efficiency and technological improvement actions are implemented the net heating energy consumption is going to increase from 4750 GWh/year in 2012 to 5500 GWh/year in 2018. The gross heating energy consumption is going to increase from 9250 GWh/year in 2012 to 10500 GWh/year in 2018.

2.3.2 Main socio-economic challenges in Kosovo

The rapid institutional progress of Kosovo, have not been followed by adequate macro-economic changes necessary for the economical development. The steadily economic growth in a yearly average of ca. 5 %[30] was not sufficient to reduce the unemployment rate and poverty of the population. Low economic progress is reflected in the living standard of population. According to the WB reports, 34 % of Kosovo population lives below the poverty line whereas the unemployment rate lies at 45.4 %[31]. Although all groups in the working age population display poor employment outcomes, the youth unemployment rate of 74 percent is particularly anxious even though Kosovo has the youngest population in Europe. Consequently young people are concerned about their future in Kosovo, finding the migration as a promising solution.

Trying to tackle some of the main impediments to employment so as to oppose the negative development of socio-economic situation, the Government of Kosovo adopted and has begun implementation of the Employment Strategy in 2010. In labor policies, the Government launched a modernization of the Public Employment Services which could provide better integration between employment offices, vocational training centers, and social assistance offices; it also initiated a public work program to employ some of the unemployed, employing 845 workers; and it raised social assistance benefits and pensions to bring these benefits closer to the poverty line. In spite of presented governmental measures, current trends indicate that poverty and unemployment will continue to be to one of major challenging issues for the Government also in the near future.

[30] http://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG
[31] WB: World Bank-Kosovo Partnership, September 2011

3. Integration of Kosovo in the European Research Area in the field of Energy

The integration of the Western Balkan Countries in the European research area is considered of central importance for research policy, both for the region and for the European Union. As international cooperation partner, research entities of Kosovo have the possibility to apply for research projects under the Seventh research framework programme (FP7). In this relation, Kosovo has organized some information sessions and nominated contact points for FP7. The EU funded mobility programmes directed in higher education and research has contributed to increase the researcher's mobility. Researchers' mobility was significantly improved in 2011 also by implementation of NRP.

In spite of recent progress on research and innovation, no substantial improvement of Kosovo integration to the ERA has been marked so far. At present, no serious R&D project or program in the area of energy is going on in cooperation with European partners. There have been noted some applications to the FP7 or HERD, but not successfully up to the moment of writing this report.

4. SWOT analysis of energy research capacity in Kosovo

4.1. Strengths

- Consolidated legal framework in science and higher education
- Legal framework on energy in place
- National Research Programme established
- Strategy on Energy and on Heating completed
- Energy Efficiency Action Plan approved
- Active participation of Institutions in ECT meetings and other energy related events
- Setting the R&D in the energy sector within top priorities by the government

4.2. Weaknesses

- Insufficient budget for Research and Development
- Lack of national strategy on scientific research
- Poor interaction between research and economical activities
- Low level of R&D project management skills

- No experience in writing proposals for EU-funded research programs
- Dominantly an education profile of higher education institutions
- No full utilization of existing environmental research equipments
- Poor maintenance of existing research infrastructure

4.3. Opportunities

- Setting the development and research in the energy sector within top priorities by the government
- Implementation of National Research Programme in particular the recommended budget allocations
- Implementation of energy sector relevant strategies
- Implementation of Energy Efficiency Action Plan
- Increasing the awareness in institutions in respect to the impact of R&D in energy sector on the overall development
- Strengthening the capacities for successful application in EU founded projects
- Participation on EU research programs
- Advocating for active support of R&D activities in energy sector by international organizations
- Utilize all opportunities for strengthening of the regional cooperation in energy research issues

4.4. Threats

- Budgetary shortage and reallocations due to shifting of priorities
- Poor knowledge and technology transfer to the industry
- Brain drain
- Poor institutional organization and cooperation in R&D activities
- Lack of socio-economic stability

5. Energy research priorities for Kosovo

The institutional contribution in establishing of well organized and effective research conjunctures so far was mainly related in formalization of necessary legal

framework. Certain promotion campaigns for different EU R&D programs were also provided. However, in financial and practical terms, the institutional support was very low. There exists no action plan on research activities required in order to substantially improve the overall R&D policy. The occasionally promoted programs often cannot be attributed to a country designed research strategy but rather to intentions for achieving of short term political advantages.

The poor integration of Kosovo in regional and international R&D programs is consequence of primarily inadequate and insufficient research work performed in the past from relevant institutions. Hence, the R&D priorities in the energy field preferably should support the fulfillment of the priorities specified in the energy strategy and should be in the line with research framework offered by EU ore EU countries, such as FP7, Tempus, HERD etc. Based on the Kosovo strategic objectives and research fields offered in EU programs, following priorities in the field of energy can be highlighted:

1. **Energy security**
    - Optimization of existing lignite mines and existing TPP
    - Socio-economic impact of new lignite TPP and lignite mines required to cover base load
    - Promotion and advancing of co-generation systems
    - Development of centralized heating systems on urban areas
    - Development of liquid fuel sector and establishing of gas supply network
2. **Renewable electricity generation**
    - Detailed investigation of potential for solar, wind, geothermal and hidro energy and compiling of corresponding detailed maps
    - Optimal utilization of hydro potential for electricity generation
    - Development of large scale wind power systems
    - Promotion of decentralized photovoltaic systems
    - Development of concentrated solar power systems
3. **Renewable fuel production**
    - Development of renewable fuel production systems
    - Promotion of renewable fuel for transport and heating
4. **Renewable for heating and cooling**

- Development of geothermal heating and cooling systems
- Optimization and upgrading of solar heating and cooling systems
- Innovative integration of renewable energy supply and energy efficiency in multi-story residential and multipurpose buildings

5. **CO_2 capture and storage technologies for zero emission power generation**
    - Opportunities and alternatives of CO_2 capture an storage systems in Kosovo
    - Integration of CO_2 capture systems to the new TPP
6. **Clean coal technologies**
    - Introducing of technology for a substantial improve of efficiency of TPP
    - Advancing of pollution control technologies
7. **Smart energy networks**
    - Integration of variable distributed resources in electricity distribution networks
    - Enhancing electricity networks through use of distributed intelligent monitoring and control systems
    - Support to the coordination of stakeholders activities in the field of Smart Grids
8. **Energy efficiency and energy storage**
    - Analysis of consumer attitudes and behavior
    - Research, development and promotion of net zero-energy houses
    - Development of energy efficient technologies in industry
    - Promotion of efficient transportation technology, transport demand management and restructuring of urban transport system
    - Development and promotion of thermal energy storage systems

5.1 Energy research priorities on the basis of the country's readiness

Based on existing infrastructure, human resources, recent performance and the current trends, the top fields in the Kosovo energy research sector include:

1. Optimization and upgrading of existing power capacities
2. Promotion of co-generation and centralized heating systems in urban areas
3. Development of geothermal and solar heating and cooling systems
4. Developing of alternative sources (water, wind, solar and geothermal) for electricity production
5. Improvement of energy efficiency and transformation of energy market

5. 2 Energy research priorities on the basis of future potential

In order to cope with advanced research priorities, Kosovo needs a systematic and target-oriented strengthening of their institutional and legal framework for R&D on energy. Further, specific programs on upgrading of human capacity buildings are indispensible. Among advanced research priorities to be tackled in the future may be emphasized:

1. CO_2 capture and storage technologies for zero emission power generation
2. Clean coal technologies
3. Smart energy networks
4. Establishing of an integrated energy and climate policy
5. Establishing of a sustainable and regionally integrated energy supply system

Annex I: Classification of the Energy research fields

The most appropriate classification scheme to which fits the energy research fields, tackled within the current report, is found to be the classification provided in the UK Energy Research Centre (Table 5)[32].

Table 5: Classification of energy research fields

Area	Sector	Topic
ENERGY EFFICIENCY	Industry	
	Residential and Commercial	
	Transport	
	Other	
FOSSIL FUELS: OIL, GAS AND COAL	Oil and Gas	Enhanced oil and gas production
		Refining, transport and storage of oil and gas
		Non-conventional oil and gas production
		Oil and gas combustion
		Oil and gas conversion
		Other oil and gas
	Coal	Coal production, preparation and transport
		Coal combustion
		Coal conversion (excluding IGCC)
		Other Coal
	CO_2 capture and storage	CO_2 capture/separation
		CO_2 transport
		CO_2 storage
RENEWABLE ENERGY SOURCES	Solar Energy	Solar heating and cooling (including daylighting)
		Photovoltaic
		Solar thermal power and high-temp. applications
	Wind Energy	
	Ocean Energy	
	Bio-Energy	Production of transport biofuels (incl. Production from wastes)
		Production of other

[32] http://ukerc.rl.ac.uk/cgi-bin/erccats.pl#ECAT

		biomass-derived fuels (incl. Production from wastes)
		Applications for heat and electricity
		Other bio-energy
	Geothermal Energy	
	Hydropower	Large hydropower (capacity of 10 MW and above)
		Small hydropower (less than 10 MW)
	Other Renewables	
NUCLEAR FISSION AND FUSION	Nuclear Fission	Light-water reactors (LWRs)
		Other converter reactors
		Fuel cycle
		Nuclear supporting technologies
		Nuclear breeder
		Other nuclear fission
	Nuclear Fusion	
HYDROGEN AND FUEL CELLS	Hydrogen	Hydrogen production
		Hydrogen storage
		Hydrogen transport and distribution
		Other infrastructure and systems R&D
		Hydrogen end uses (incl. combustion; excl. fuel cells)
	Fuel Cells	Stationary applications
		Mobile applications
		Other applications
OTHER POWER and STORAGE TECHNOLOGIES	Electric power conversion	
	Electricity transmission and distribution	
	Energy storage	
OTHER CROSS-CUTTING TECHNOLOGIES or RESEARCH	Energy system analysis	
	Environmental, social and economic impacts	

wbc-inco.net
Co-ordination of Research Policies with the Western Balkan Countries

NATIONAL BACKGROUND REPORT ON ENERGY FOR KOSOVO*

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Prishtina, March 2012

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* This designation is without prejudice to positions on status, and is in line with UNSC 1244 and the ICJ Opinion on the Kosovo declaration of independence.

List of abbrevations

AUK	American University in Kosovo
DH	District Heating
EEA	Energy Efficiency Agency
EI	Energy Intensity
ERO	Energy Regulatory Office
ESD	Energy Service Directive
EU	European Union
FEE	Faculty of Electrical Engineering
FME	Faculty of Mechanical Engineering
FMM	Faculty of Mining and Metallurgy
FP7	The EC Seventh Framework Programme
HERD	Norwegian Programme for Higher Education Research and Development
HPP	Hydropower Plant
IMF	International Monetary Fund
KEEP	Kosovo Energy Efficiency Plan
KEK	Kosovo Energy Corporation
KOSTT	Kosovo Transmission System and Market Operator
MED	Ministry of Economic Development
MEM	Ministry of Energy and Mining
MEST	Ministry of Education, Science and Technology
NRC	National Research Council
NRP	National Research Programme
RES	Renewable Energy Sources
Tempus	EU Trans-European Mobility Programme for University Studies
TPP	Thermal Power Plant
UNDP	United Nations Development Programme

Table of Contents

Executive Summary

The main objective of the current report is to provide an overview of research activities in the field of energy in Kosovo* and identification of national research priorities in order to facilitate the interaction between the WBC INCO-NET, and EU member states in the European Research Area (ERA).

In the first sections, the report provides a brief description of entire energy policy. The focus is given to the electricity supply service, which despite large lignite reserves, is still poor performing. Due to inadequate maintenance of existing power capacities, higher losses and dramatic increase of demand, electricity outages are very frequent. The financial assistance from government to the KEK for electricity import was a common practice in the past couple of years.

In order to change this situation, government was active in drafting and promulgation of legal documents and upgrading of institutional capacities required to cope with this problems. The report shows that a solid legal and institutional framework in the field of energy is already in place. The report, further describes the government activities to upgrade the existing power capacities and the associated discussions.

As far as research in the field of energy is concerned, the report underlines the insufficient and inadequate institutional treatment of this issue. It shows that the budgetary appropriation for research and development in general was far below the strategic objectives set in relevant documents. The major research activities, performed so far were basically driven by the needs for emergency interventions and for the further development of the energy sector.

The report shows that for upgrading of existing research capacities and stronger integration of research and development in the ERA, a long term planning and consistency of institutional engagement is indispensable.

Furthermore, the country specific SWAT analysis shows that apart of certain potentials such as solid legal framework, the institutions must dial with numerous weaknesses and challenges in order to establish a sustainable system for research and development in the energy sector.

Based on the analysis of the current needs in the energy sector, existing research potential and assessment of perspective developments, last section of the current report, provides the immediate and future priorities in the field of energy.

* This designation is without prejudice to positions on status, and is in line with UNSC 1244 and the ICJ Opinion on the Kosovo declaration of independence.

Introduction

Energy sector along with mining and agricultural sector have been traditionally basic pillars of Kosovo economy. All these sectors are currently far from performing adequately. Consequently large rate of unemployment and poverty continues to be regularly reported.

Kosovo has significant potentials for electricity production. The lignite reserves of Kosovo with ca. 12.5 billion tones of which 10.9 billion are exploitable are considered to belong to largest lignite reserves in Europe[1],[2]. Nevertheless, Kosovo is facing serious problems in meeting electricity demands for entire last decade even though since 1999 some improvements have been noted. Despite a yearly increase of ca. 6 %, the electricity production does not yet meet the consumer's demands. The poor electricity supply has been considered as one of major obstacles preventing economical growth of the country over the past decade. The lack of the electricity contributes to bypassing the foreign investments towards other countries of region and makes the local companies to operate under very difficult circumstances und very often on the limit of economical feasibility. The electricity sector was in the past years the major drain on the public budget due to persistent subsidies and the need for electricity imports.

Negative impact of the unreliable and deficient electricity supply, is reflected not only to the normal development of the economy but also to other sectors like public health, education system and daily activities of the people. Because of all this reasons, the electricity supply is considered the poorest performing service publically provided. A recent UNDP publication[3] shows that only 14 % or respondents are satisfied with electric power supply.

1. Purpose of the national background report and methodology/summary of the consultation process

Current national report is prepared within the framework of WBC-INCO.net with the primary objective to highlight the existing situation, weaknesses and potentials for participation and contribution of Kosovo in regional R&D projects and activities in the field of energy. The report intends also to describe the overall state of the energy sector including the related socio-economic aspects in order to provide the background of the current developments in the R&D in the field of energy.

[1] MEM, Energy Strategy 2009-18
[2] R. P. Stoll et. al (Hrsg): Der Braunkohlentagebau, Springer, 2009
[3] UNDP: Public Pulse Pull, Fast Facts III, March 2012

Furthermore, the report aims to identify the R&D priorities in the field of energy which would support the establishing of a sustainable energy sector and hence contribute to boost the overall economical development.

The specific data, statements and conclusions in the report are based on the extensive analysis of available studies, reports, existing legal framework and strategic documents. The report reflects also the opinion of key stakeholders among public institutions, energy companies, donators and non-governmental organizations.

2. The Energy S&T System in Kosovo

Setting the research as one of priorities, the government has contributed to a limited progress related to establishing of well design and functional scientific research system. The National Research Council established in 2007, drafted the National Research Programme (NRP) which has been approved by the Parliament in 2010. Research in the field of Energy has been identified as one of top priorities in the NRP. However, there are still many barriers which prevent the implementation of identified priorities in NRP. Although the Government, initially allocated 1 million € for financing the projects within the 6 identifies priority areas, due to public budget shifts, only 0.4 million were invested in research projects. On the other hand, participation in the 7th European Research Framework Program (FP7) has slightly increased in terms of submissions, but was very limited in successful and funded projects. There have been implemented some small research projects financed by public budget or donators but they aim to support primarily the development of energy sector. In general, the scientific research is to a wide extend still based on voluntary and individual basis, with little or no technology transfer to the economy.

2.1. The Kosovo and Energy policy framework

On 17th of February 2008, the Assembly of Kosovo declared Kosovo an independent and sovereign state. When it declared independence, Kosovo pledged to implement the Comprehensive Proposal for the Kosovo Status Settlement, drafted by U.N. envoy Martti Ahtisaari. The provisions of the plan have been incorporated into Kosovo's new Constitution, which went into effect on 15 of June 2008. Meanwhile a considerable number of laws and strategic documents have been approved by the Parliament. The entire institutional and in particular legal framework of Kosovo is being upgraded in the line with EU's Acquis. In the past four years Kosovo has been recognized by 89 countries, joined the International Monetary Fund (IMF) and the World Bank and is aspiring to become a full member of the European Union (EU).

2.1.1 The overall energy policy framework

Institutional and Legal framework

The basic institutions responsible for governing of energy sector in Kosovo are Ministry of Economic Development (ex Ministry of Energy and Mining-MEM) and Energy Regulatory Office (ERO). Other important responsibilities in the field of energy lie with Ministry of Environment and Spatial Planning, Ministry of Health, Ministry of Trade and Industry, Ministry of Agriculture, Forestry and Rural Development, Ministry of Infrastructure and Kosovo Environmental Protection Agency. The Numerous legal documents drafted and implemented by these institutions tend to regulate the energy sector and to provide the basis for planning of strategic activities in the Energy field. The most relevant laws, administrative instructions, regulations and strategic documents formalized up to know are:

Laws

- Law 03/L-184on Energy
- Law 03/L-201 on Electricity
- Law 03/L-185 on Energy Regulator
- Law 03/L-165 on Mines and Minerals
- Law 04/L-016 on Energy Efficiency
- Law 03/L-133 on Natural Gas
- Law 03/L-116 on Central Heating
- Law 2004/5 on Trade of Petroleum and Petroleum Products
- Law 04/15 on Construction
- Law 03/L-025 on Environmental Protection
- Law 2003/14 on Spatial Planning
- Law 03/L-230 on Environmental Strategic Assessment
- Law 03/L-214 on Environmental Impact Assessment

Administrative Instructions

- Administrative Instruction No. 01/2012 on Energy Audits
- Administrative Instruction Nr. 07/2012 on the Rules for Energy Balance
- Administrative Instruction Nr. 01/2010 on Security of Supply in the Natural Gas Sector

- Administrative Instruction Nr. 04/2009 on Opening of the Electricity Market for all Non-household Costumers
- Administrative Instruction Nr. XX/2008 on Labeling of Electric Household Appliances
- Administrative Instruction No. 02/2011 on Rules and Procedures for the Collection of Mining Royalties

Regulations

- Regulation No. 01/2012 on Establishment and Functioning of the Commission for Certification of Energy Auditors and Managers
- Regulation No. 08/2011 on Internal Organization of the Kosovo Agency for Energy Efficiency
- Technical Regulation No. 03/2009 on Thermal Energy Saving and Thermal Protection in Buildings
- Regulation No. 04/2011 on the Mining Sector Community Treatment
- Regulation No. 02/2011 on the Content of the Geological Investigations Program and Elaboration of the Geological Survey Results

Strategy and Program documents

- Energy Strategy of the Republic of Kosovo 2009-2018
- Kosovo Energy Efficiency Action Plan 2010-2018
- Kosovo Heating Strategy 2011-2018

Apart of governmental institutions the other entities having strong influence on the energy sector are large energy companies. The dominating companies in this sector are: Kosovo Energy Corporation (KEK), Kosovo Transmission System and Market Operator (KOSTT) and District Heating Companies (in Prishtina, Gjakova and Mitrovica). Currently all relevant energy companies have a public status governed by central or local institutions. However, the government is committed to complete formal procedures for privatization of Public Supply and Distribution System Operator. The privatization is planned also for TPP Kosova B, based on a specific public private partnership for its revitalization and construction of the TPP "Kosova e Re".

Current situation on Energy Supply

The primary role of the entire energy sector infrastructure of Kosovo is the security of sufficient and uninterrupted end-use energy supply. The basic primary energy

source used in Kosovo in order to satisfy energy needs of different economic sectors is lignite. Other primary energy sources are imported oil products (mainly for transport), imported heavy fuel oil (for heating purposes), electricity import, firewood and a small amount on hydroenergy. The Kosovo primary energy mix is presented in Fig. 1.

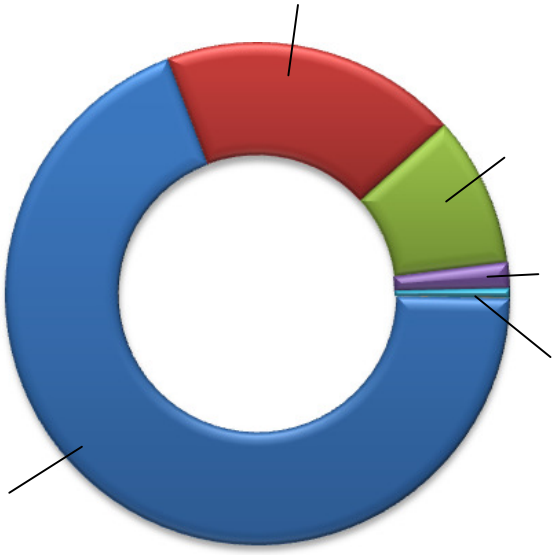


Fig. 1 Primary energy mix for Kosovo in 2010[4]

While the import of LPG and oil products are being managed without big troubles, the situation with electricity and heat supply is problematic.

The electricity generation sector is dominated by KEK which owns and operates with the two lignite fired power plants "Kosova A & B". The thermal power plant (TPP) Kosova A consists of five units with a total installed capacity of 800 MW and TPP Kosova B of two units with an installed capacity of 678 MW. Table 1 summarizes data on existing thermal power generation capacities in Kosovo.

The total installed capacity of 1478 MW of both TPP's would be sufficient to meet even the pick electricity demands amounting of ca. 1300 MW in the winter periods. But, due to the degradation and underinvestment in the lignite mines and TPP sector in Kosovo during 1990-1999, lack of maintenance, lack of necessary periodical rehabilitations and aged TPP's, the technical availability is far below installed capacities and this situation has not been substantially improved despite several major overhauls actions performed in the last 10 years. A reliable operation

[4] MEM: Republic of Kosovo's Energy Balance for the Year 2010

and production which would be sufficient to cover basics electricity demands is not possible with outdated and poor maintained TPP capacities.

Table 1: Existing thermal power generation capacities in Kosovo[5]

Power plant unit	Power plant unit capacity (MW)		Year of Commission
	Installed	Net available	
TPP Kosova A			
Unit A1	65	0	1962
Unit A2	125	0	1964
Unit A3	200	115	1970
Unit A4	200	115	1971
Unit A5	210	125	1975
TPP Kosova B			
Unit B1	339	250	1983
Unit B2	339	270	1984

The transmission system is managed by KOSTT. Kosovo is a Contracting Party to the regional Energy Community and is linked to the regional system via interconnections with Serbia, Macedonia, Montenegro, and Albania (Fig. 2).

The electricity transmission system is interconnected with all neighboring systems at the 400 kV level, except of the interconnection with Albania which currently is at 220 kV level. However, the construction of a new 400 kV interconnection with Albania is ongoing and according to the plans the line should be ready in 2013. By the new line Kosovo current capacities for electricity exchange will be substantially upgraded. On the other hand the line will contribute towards optimization of the cooperation between Kosovo's thermal power based system and Albania's hydropower based one. The 400 kV line will also evidently enhance electricity exchanges in the region. Apart of upgrading their transmission capacities, KOSTT is actively working in reducing the transmission losses which actually are in the range of 2-2.5 %[6].

[5] MED: Energy Strategy of the Republic of Kosovo

[6] ERO: Statement of Security of Supply for Kosovo, 2011

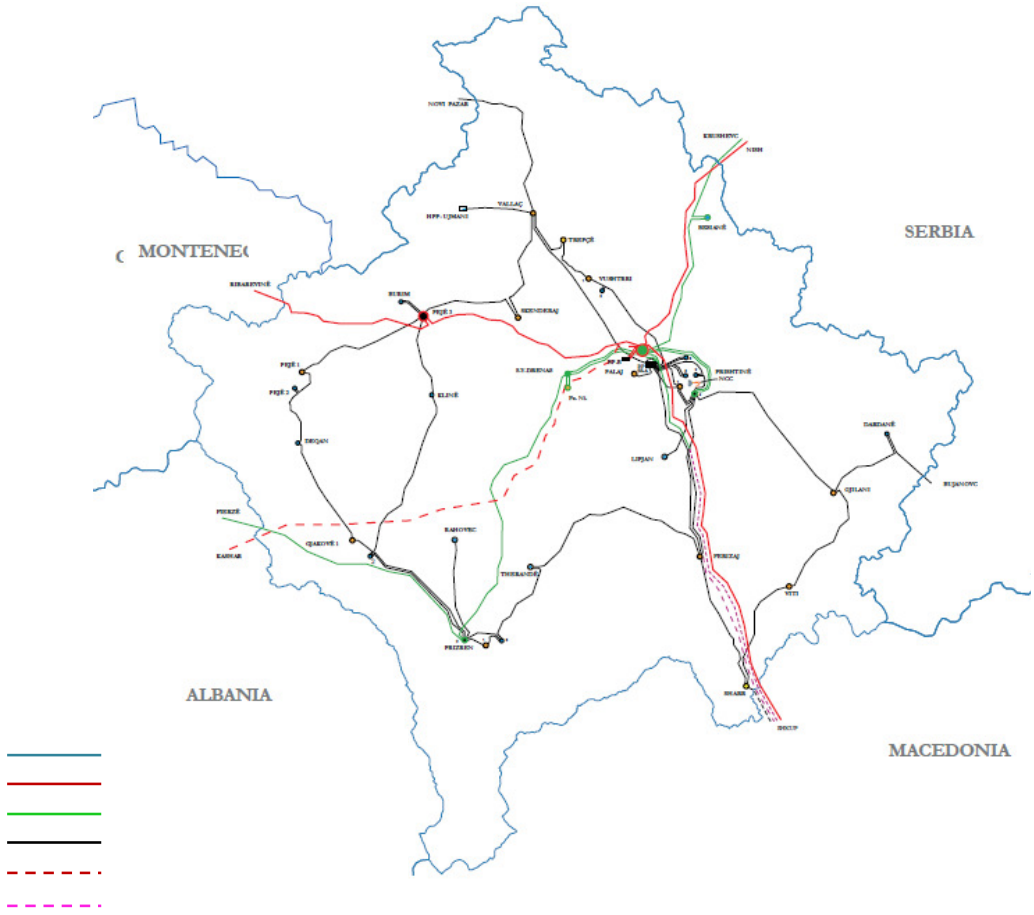


Fig. 2 Kosovo Transmission System 400/220/110 kV[7]

One of major problems in Kosovo's electricity system in the past decade is high level of losses in the distribution system, currently managed by KEK. The distribution losses consist of technical and commercial (non technical) loses. Even though a slight reduction of such losses is recorded recently, they still represent ca. 38 % of total supplied electricity. Particularly concerning issue for the distribution system of the KEK remains the high part of commercial losses which represent over 21 % of total distribution loses. Such losses have also a technical background (metering problems) but primarily are generated due to electricity theft and non-payment of electricity bills[8].

Kosovo has no other fossil fuel sources (oil, gas) than lignite and hence no TPP based on such sources. However Kosovo has certain potential on **renewable energy sources (RES)**. Currently, there exists very limited generation capacities

[7] KOSST: Annual Report 2009
[8] UNDP: Energy for Development, 2007

based on RES which consists of the hydro power plant (HPP) Ujmani/Gazivoda (=32 MW a. c.), Lumbardhi (=8 MW a. c.) and some small HPP (= 2 MW a. c.) with a total of 42 MW available generation capacity[9]. There have been build also three small wind power units of very limited capacity (ca. 1.3 MW) which are currently out of operation due to some divergences with the Energy Regulatory Office related to the feed-in tariffs. Other generation capacities on wind, solar and geothermal with exception of few cased in household and small enterprise level are not yet developed.

In relation to the development of renewable energy, MED implemented a number of pilot projects for sanitary hot water by using of solar energy in public buildings. In addition, solar energy was promoted through a number of demonstrating projects (installation of solar panels in the Kosovo Clinical University Centre and Students Centre in Prishtina). In this context, solar energy can become a source of hot water supply, regardless of the high cost of the equipment and the scarcely developed market.

Agricultural biomass has high energetic potential, however, the agricultural sector in Kosovo is insufficiently prepared to develop this commercial potential[10].

Important conclusions in relation with addressing problems and challenges of energy sector in Kosovo can be derived based on the analysis of sector-based breakdown of energy consumption.

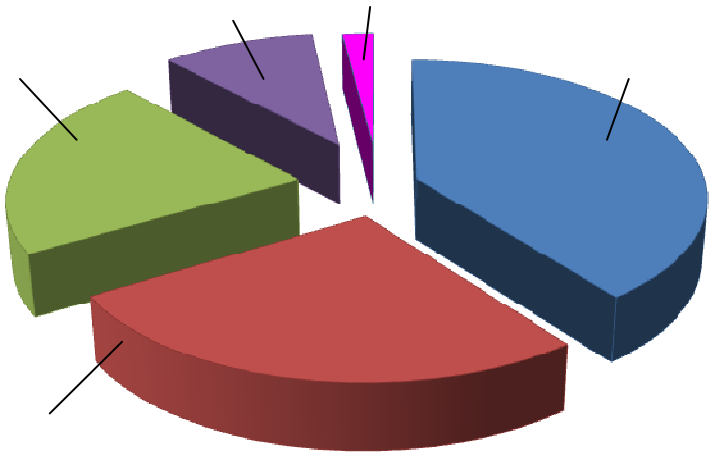


Fig. 3 Breakdown of energy consumption by sectors in 2010[11]

[9] ERO: Statement of Security of Supply for Kosovo, 2011
[10] MED: Heating Strategy of Kosovo 2011-2018
[11] MEM: Republic of Kosovo's Energy Balance for the Year 2010

As presented in Fig. 3 the largest energy consuming sector is household sector. On the other hand, electricity takes place with ca. 30 % in the total energy consumed by households. Therefore a substantial improvement in electricity supply system is only possible, if electricity consumption by households is reduced. This can be achieved primarily by reducing of commercial losses, since addressing the non-metered electricity, theft and non-payment of bills will considerably reduce the consumption. Another issue to be addressed is the extensive use of electricity for space heating. Analysis shows that over 50 % of electricity consumption in households is used for heating purposes[12],[13]. Fig. 2 also shows that households and services sector accounts for 50 % of the total energy consumption in Kosovo with largest part, ca. 66 %, being used for heating purposes[14].

The high level of energy consumption indicates the high potential for rationalization of energy consumption in residential and public buildings. In this respect, the government was quite active in addressing **energy efficiency** primarily in the buildings of public sector as recommended in the EU Energy Service Directive (ESD)[15]. The aim of such activities was establishing of a legal basics in the line with EC directives, upgrading of human capacities and establishing of the institutional framework able to address all relevant aspect of energy efficiency. The revised version of the Law on Energy and the promulgation of the Law on Energy Efficiency in 2011, including some bylaws recently formalized, have substantially improved the legal basis for energy efficiency. Following the Energy Strategy goals and based on the requirements of the Energy Community, Government of Kosovo prepared the Kosovo Energy Efficiency Plan 2010-2018 (KEEP) as an implementation platform for energy efficiency improvement measures. Pursuant to ESD and taking into consideration the three EU targets to be achieved by 2020, namely to improve energy efficiency by 20%, to reduce greenhouse gases by 20% and to have 20% of the total energy consumption covered by Renewable Energy Sources (RES), Kosovo set in KEEP an indicative target of 9% reduction of energy consumption until 2018, thus accomplishing an improvement of energy efficiency in the range of 1% per year. Meanwhile a methodology for monitoring, verification and evaluation of energy savings based on EU harmonized methods has been established.

Regarding human capacities, different programs on building of energy auditors have been implemented resulting in 59 certified energy auditors. Two programs, on building energy auditing have been completed and the implementation of energy

[12] ERO: Statement of Security of Supply for Kosovo, July 2011
[13] WB: Development and Evaluation of Power Supply Options for Kosovo, December 2011
[14] MEM: Energy Consumption in Kosovo, 2010
[15] EC: Directive 2006/32

efficiency measures recommended by energy auditors is running. A further improvement of institutional framework is going to take place next week's by establishing of Energy Efficiency Agency (EEA). One of basic activities of the EEA is planned to be providing of support to local authorities in relation with preparation of energy efficiency local plans and reporting.

The background of extensive use of electricity for heating in single family houses is assumed to be primarily in abusing of electricity. However, many of households in multi-story buildings do not have other alternatives, since many of such buildings neither have an own heating system nor have access to a district heating system. Furthermore, the electricity is extensively used for heating even by households living in multi-story buildings which are connected to a district heating since the district heating systems, actually are facing also serious problems and therefore the heat supply is much under demands.

District heating (DH) exists in four cities (Prishtina, Gjakova, Mitrovica and Zvecan) and meets only 5 % of the total head demand of Kosovo. The operational capacity of DH in Prishtina is 134 MW, in Gjakova 20 MW, in Mitrovica 16.9 MW and in Zvecan 1.6 MW[16]. The DH systems are operated by public companies under the responsibility of corresponding municipality authorities. All DH plants are equipped with boilers which operate mainly by using of imported heavy fuel oil (mazut) and provide space heating only. Since the DH systems provide no hot water, they are operational only in winter periods. The existing DH are quite obsolete, not well maintained and characterized with high generation and distribution losses. The generation losses are estimated between 20 and 30 % while the distribution losses in the primary network between 15 and 20 %. Billing of costumers is still based on heated area with exception of few cases which are charged with costs accounted based on metered heat. This form of billing does not motivate consumers to change their behavior in order to rationalize their energy usage for heating purposes. Furthermore, the poor quality and not stable heat supply impacts negatively the bill payment which is reported to be ca. 57 %[17].

Development perspectives

As described above, the current power generation capacities are limited, some of them very outdated (TPP Kosova A), not well maintained and therefore not reliable in the operation. On the other hand, as might be expected the total electricity consumption has been continuously increased during the past decade resulting in

[16] ERO: Annual Report 2007
[17] ERO: Annual Report 2010

an average yearly increase of 8.6 %[18]. Consequently the electricity imports (ca. 10 % of the total electricity consumption) often under very unfavorable conditions were inevitable all the time.

Due to the critical situation in the energy sector, Kosovo currently is in front of difficult strategic choices which will influence the future development of this sector for at least next 40 years. Different scenarios for development of the energy sector proposed by government, international institutions, civil society and independent experts, differs with the regard to which of factors like large lignite reserves, environmental and social impact, existing potential on renewable energy sources and eventually electricity export should be given the priority. Discussions are also driven from different viewpoints regarding the financing of new generation capacities, capacity of new generation units, maintenance of existing power capacities and managing of existing and new lignite mines. Several studies have been performed in order to assess the potential of Kosovo on energy resources and to find the best option to overcome the energy crisis[19,20,21,22]. The World Bank study[23] tends to synthesize all studies and evaluations made in the past in order to provide the lower costly option for a sustainable energy sector while keeping all actual provisions on environmental protection. According to that study, the best option for Kosovo would be to upgrade the current generation capacities based on lignite by construction of new TPP with a total capacity of 600 MW supported by a HPP of ca. 300 MW and power generation capacities based on renewable energy sources with a firm capacity of ca. 170 MW. The scenario recommended by the WB study is in the line with government projections for consolidation of the energy sector namely building of a lignite based TPP named "Kosova e Re" with two units x 300 MW, developing of a new lignite mine near the new TPP and refurbishment of Kosovo B power plant which is going to be included within the privatization package offered to the investors. The operation of "Kosova e Re" should start by the end of 2017 and meanwhile the activities related to building of a new HPP with a capacity of 305 MW should be continued. In spite of strong opposition of civil society[23] which claims that the government plans will monopolize the electricity market, the government is committed to keep their plans. The civil society is in favor of promoting the power plant unit based on RES. According to government plans, the tendering procedures for the new TPP should be finalized in coming months and

[18] ERO: Statement of Security of Supply for Kosovo, July 2011
[19] NEK: Wind Resource Assessment-Kosovo, December 2010
[20] KIPRED&FIQ&GAP Institute: Energy Projects in Kosovo, September 2011
[21] WB: Development and Evaluation of Power Supply Options for Kosovo, December 2011
[22] University of California: Sustainable Energy Options for Kosovo, January 2012
[23] KIPRED, FIQ and GAP Institute: Energy Projects in Kosovo, September 2011

before the end of 2012 the responsible consortium for developing of new lignite TPP should be formally selected.

The arguments that Kosovo primarily should develop lignite based power generation capacities to cover basic energy demands, and quasi parallel start with development of capacities based on RES, seems to be widely accepted from the major part of key players. Even though currently underdeveloped, in Kosovo exists sufficient potential on RES to support basic energy needs and also to reach the announced targets on reduction of green house gasses and in parallel increase the share of RES in the overall energy production. Up to now, the authorities were mostly active in studying the hydro potential for electricity production. A feasibility study for construction of a HPP with capacity of ca. 305 MW in location Zhur (near Prizren) is finalized and the authorities are currently planning to commence procedures for construction of that HPP. There exists also a feasibility study which shows that Kosovo has the potential for construction of additional 77 small HPP with a total capacity of 128 MW.

With exception of some basic studies, there are no detail and reliable data and wind map of Kosovo potential for utilization of wind energy. Preliminary top-down assessment conducted by Mercados[24] shows that Kosovo has a wind generation potential of more than 1000 MW installed capacity with a capacity factor of 25%. However, another study carried out by consultants NEK Technologies (Zürich)[25] concluded that Kosovo has moderate wind resources with very few areas characterized by wind speeds exceeding 6 m/s, a minimum needed for commercial utilization of wind energy. The composition of wind map based on detailed field measurements and derivation of corresponding data is one of the objectives of MED for developing of power capacities based on wind energy.

In relation to RES, the public perception is that Kosovo has a considerable potential on solar energy. Nevertheless, currently there exist no solar map and the available data based on measurements are very scarce. Mercados estimated a potential equivalent to about 77 MW installed capacity with a capacity factor of 22-25%.

In order to reduce the demand for electricity in the winter pick periods, institutions were active in upgrading the heat generation capacities particularly in Prishtina which owns the largest district heating system. A feasibility study to support the district heating in Prishtina with co-generation of energy in TPP Kosova B is finalized. According to the study the co-generation will provide up to 120 MW

[24] Mercados Energy Markets International, Kosovo - Regulatory Framework for RES – Procedures and Methodology for RES Electricity Pricing Task 1 Report, May 2009.
[25] NEK UMWELTECHNIG AG: Wind Resource Assessment -Kosovo, December 2010

thermal energy and thus will substantially improve the capacity and heating quality of existing district heating. The project is financed by EC with 13.8 million, by KfW with 11 million € and by Prishtina Municipality with 2 million €. The selection of the company for supervision of works is in the final phase and the tendering procedures for selection of implementing company are expected to commence fairly soon. The finalization of the project is expected within 2 years.

2.1.2 The elements of Energy research policy making

The background of the research policy in Kosovo is provided by the Law Nr.2004/42 on Scientific Research Activity, Strategy for Development of Higher Education in Kosovo 2005-2015 and The National Research Programme of the Republic of Kosovo (NRP). According to the Law on Scientific Research Activity, public institutions (Academy of Science and Arts, Scientific institutions and Universities) and private organizations are entitled to carry research works and obtaining funds to do this. The article 7 of the Law, states that up to 0.7 % of public budget shall be allocated for research activities. Further, the Law promotes upgrading of scientific human capacities by training of new R&D personnel in order to reduce the lacking of young scientific researchers.

Advancing of capacities of research and scientific work has been identified as one of strategic objectives also in the Strategy for Development of Higher Education in Kosovo 2005-2015. Identifying the low budget as primary reason for an unsatisfactory level of scientific research activities, the Strategy foresee for the increase of budget for scientific research and transfer of knowledge up to 3.5 % of GDP in the line with Bologna Process objectives. However, the allocated budget practically is usually under 0.1% of GDP and thus far below to the EU average.

The key institution for establishing and implementation of the overall research policy in Kosovo is Ministry of Education, Science and Technology (MEST) respectively its department for Science and Technology. Pursuant to the Law on Scientific Research Activity, based on recommendation of MEST respectively government of Kosovo, Kosovo Assembly established in 2007 the National Research Council (NRC). In the line with its primary obligations, NRC drafted a National Research Programme (NRP)[26] which has been approved by Kosovo Assembly in 2010. The two outmost important outcomes of the NRP are indentifying of 6 research priorities and developing of the corresponding implementation plan. The priorities were selected based on the most suitable approach for Kosovo circumstances. The Environment, **Energy** and Natural Resources have been

[26] Republic of Kosovo: The National Research Programme, 2010

identified as first priority. The implementation plan describes research activities, time-schedule and the budget estimation for each activity. NRP provides also a kind of mid-term budget planning in order to implement the stipulated research activities. It is recommended an average yearly budget increase of ca. 1 million Euros, starting from 2010 so as to reach a stabilized level of budget appropriations after 2015 in the range of 4.5-6.5 million Euros. Following recommended budgetary projects by NRP, MEST allocated 1 million Euros for research activities in 2011, but due to budget shifts (reallocations) only 0.4 million were practically available for research projects. This is equivalent to 0.03 % of GDP and hence far from aspirated budget on the Law on Scientific Research Activity and in the NRP.

2.2. Overview of Energy research activities

The only institution performing typical scientific research activities in Energy is University of Prishtina, respectively the Faculty of Mechanical Engineering and Faculty of Electrical Engineering. However, most of activities with exception of few cases are of small scale nature for which no institutional support is provided. Such research activities are driven basically by the need of young researchers for their further professional development. There exists no central database of projects, results and published work in the field of energy.

As stated above, trying to remedy this situation MEST supported in 2011 with 0.5 million Euros the research activities in various fields among which also a project on Analysis of Renewable Energy Sources with 25.000 Euros.

There have been noted an increased interest from institutions to participate on large scale projects such as FP7, but so far the application were not successful.

2.2.1 Energy research projects

In spite of small number of scientific research projects, there have been undertaken numerous studies, investigations and other research activities mainly driven by economical needs. Accomplishing institutions of such activities were basically MED, INKOS, Riinvest Institute, American University of Kosovo and Donators. The basic data on some of implemented or continuing R&D projects in the field of Energy are provided in Table 2.

Table 2: Energy projects

Nr.	Project Name	Status/ imp. year	Donor	Implemen. institution	Project value (€)

1	Study of Kosovo Hydropotentials	2005	KPB	INKOS	3,900
2	Prefeasibility study for identifying hydropotentials for small scale hydropower plants	2006	DANIDA	Albanian Energy and Environmental Association for Sustainable Development	50,000
3	ESTAP III-3	2006	WB	-	500,000
4	ESTAP III-4	2006	WB	-	245,702.5
5	Assessment of geological reserves of lignite in Kosovo	2007	KPB	-	50,000
6	Kosovo Energy Sector - Heat Market Study	2007	WB	ELC-Electroconsult / ERM	-
7	Energy for Development-Kosovo	2007	UNDP	-	-
8	Assessment study on renewable energy sources in Kosovo	2008	EC	COWI	350,000
9	Promotion of utilization of solar energy in UCCK and Students Centre in Prishtina	2008	KPB	TERMO	350,000
10	Preparation of politics and strategies for regional geological investigations	2008	KPB	-	44,950
11	Compilation of strategy for promotion of mineral resources	2009	KPB	-	47,000
12	Promotion of utilization of	2009	KPB	GESER	150,000

	solar energy in UCCK				
13	Evaluation of hydro energy potential for mini HC	2010	KPB		140,000
14	Application of energy efficiency measures in public buildings	2010	EC	Kantor	1,300,000
15	Study on preparation of projecting data for utilization of solar energy in Kosovo	2010	KPB	B2B Consulting	60,000
16	Study on energy consumption distribution in the industry sector in Kosovo and possibilities for improvement of energy efficiency	2010	KPB	MPR/Grou p& Euro Service	57,995
17	Application of energy efficiency measures in public institutions in framework of implementation of national program on EE in the line with EC and ECT requirements	Ongoing	KPB&GIZ	Monten,Ter momontim i and ELEN	452,494
18	Study of public building stock for energy auditing	Ongoing	KPB	Eleganca	12,296
19	Assessment of wind potential	2010	American Universit y in Kosovo	NEK Umwelttec hnik AG	-
20	Study in implementation of energy efficiency measures in municipality level	Ongoing	EC	AlaNet	15,600,00 0
21	Study on consumption distribution in the	Ongoing	KPB	INTECH	50,000

	household sector and possibilities for improvement of energy efficiency				
22	IPA 2008 - Supervision for Implementation of Energy Efficiency Measures in Public Buildings	Ongoing	EC		179,555
23	IPA 2008 - Implementation of Energy Efficiency Measures in Public Buildings	Ongoing	EC		1,163,713
24	IPA 2010 - Energy Sector Reform	Planned	EC		2,000,000
25	Renewable Energy - Kosovo	Ongoing	Norway		851,735
26	Environmental Assessment for Thermal Power Plant-Kosovo B	Ongoing	USAID		432,900
27	Center for Energy and National Resources	Ongoing	USAID		254,224
28	LIGNITE POWER TECHNICAL ASSISTANCE PROJECT	Ongoing	WB		8,118,138

2.2.2 Key competencies in Energy research field

Kosovo underwent massive institutional changes after 1990 which directly affected research and innovation sector. Due to political situation, the intensive institutional cooperation among regional R&D intuitions broke up. Individual projects on different regional institutions came fast to the end and no new actions were started. The intensive cooperation with economy and solid technology transfer was seriously damaged. The almost one decade parallel institutional development of the education system was a handicap for maintaining and further developing of existing competencies in Kosovo. Further they became partially degenerated and even not more useful. The only possibility in developing of new competences was in relation to the individual research activities of young researches in different European Countries. This situation, however start to change after the war in 1999. Thus,

during the last decade a considerable number of young researchers, came back and are contributing in various ways on upgrading of R&D of Kosovo Institutions. Meanwhile, even more young students started their Master and PhD work in cooperation with Universities abroad and some of them continued to cooperate with Prishtina University. On the other hand, Prishtina University signed over 80 cooperation agreements with different Universities all over the World. Strengthening of R&D capacities is one of major outcomes of such agreements. As far as energy field is concerned an improvement has been noted regarding the cooperation with economy.

As result of complex developments in the higher education sector in past two decades, following key competences in Energy research field can be highlighted:

1. Power generation technology
    - Improvement of energy transformation efficiency
    - Combined power generation
    - Reduction of emissions
2. Renewable energy sources
    - Upgrading of HPP potentials
    - Establishing of detailed wind map and developing of wind power plants
    - Establishing of detailed solar map, developing of solar power plants, upgrading of capacities for solar water heating,
    - Research of potentials on geothermal energy and developing of geothermal systems
    - Developing of bio-energy based systems
3. Energy Efficiency
    - Improvement of energy efficiency in all sectors of economy
    - Strengthening of system for monitoring and evaluation of energy savings
    - Analysis of interrelation between socio-economic factors and energy efficiency
4. Energy Resources
    - Research of current potentials on lignite reserves

- Integration of socio-economic and environmental aspects in opening of new lignite mines and rehabilitation of depleted mine areas
- Utilization of environmental friendly lignite production technology

5. District heating
    - Improvement of efficiency of existing district heating
    - Introducing of smart heat metering system
    - Upgrading of district heating capacities (construction of new district heating systems in larger urban areas)

2.2.3 Energy research infrastructure

Energy research infrastructure in Kosovo comprises public and private institutions. Key public institutions responsible for financing of R&D in energy field are:

- Ministry of Education, Science and Technology
- Ministry of Economical Development

Key public institution for performing research in Energy is Prishtina University with corresponding Faculties:

- Faculty of Mechanical Engineering (FIM),
- Faculty of Electrical Engineering (FEE),
- Faculty of Mining and Metallurgy (FMM).

The three faculties, responsible for research and development in the field of energy, have more than 25 years tradition in education and research activities. The studies in Mechanical and Electrical Engineering started in 1967 as sections of former Faculty of Engineering but as separate academic units FIM and FEE were established in 1988. Both of these faculties provide three levels of study programs in the line with Bologna Agreement: Bachelor, Master and Doctoral Studies. They owns few laboratories and a quite limited number of equipments dedicated mainly for basic research activities

Non public institutions involved in research activities in the energy field are:

- Institute INKOS
- Institute Riinvest
- American University in Kosovo (AUK)

INKOS Institute was established in 1979 as part of KEK responsible for research and development activities. In the process of KEK unbundling, in 2006 INKOS has been evidenced as Joint Corporation. It owns 6 units with a solid number of laboratories and equipments as well as competent and experienced research potential. However, not fully clear legal status prevents INKOS management to make long term planning necessary for their future activities, for investment in advanced research equipment and for ensuring a normal knowledge transfer to young researchers. Clarifying of the legal status and the fully reorganization of the institute seems to be emergent in order to make INKOS working as an economically feasible and effective research institution.

Two other non public institutions (Riinvest and AUK) are basically higher education institutions. Regarding the energy field they conducted several studies and analysis, mainly based on evaluation of existing data and the newly task designed questionnaires.

2.3. Key drivers of Energy research

2.3.1 Main Energy sector trends in Kosovo

One of most relevant indicators in following energy trends of a country is energy intensity (EI). Kosovo is characterized with a relatively high EI index being the highest in the region after the EI of Bulgaria[27] . In order to predict the future development of energy sector in Kosovo, two basic scenarios are assumed for the Gross Domestic Production (GDP) growth rate in the period 2009-2018 (Table 3).

Table 3: GDP grow rate assumptions (in %) in the period 2009-2018

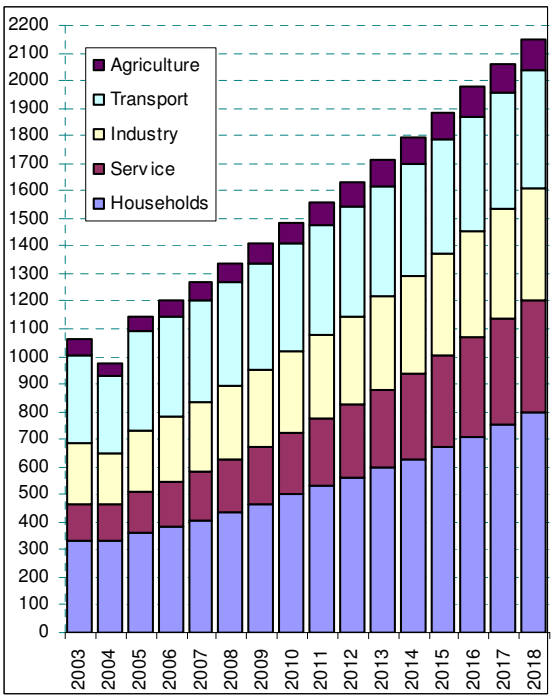
Scenario	2009-2010	2011-2014	2015-2018
Medium	3.20	3.10	3.00
High	6.20	5.29	5.00

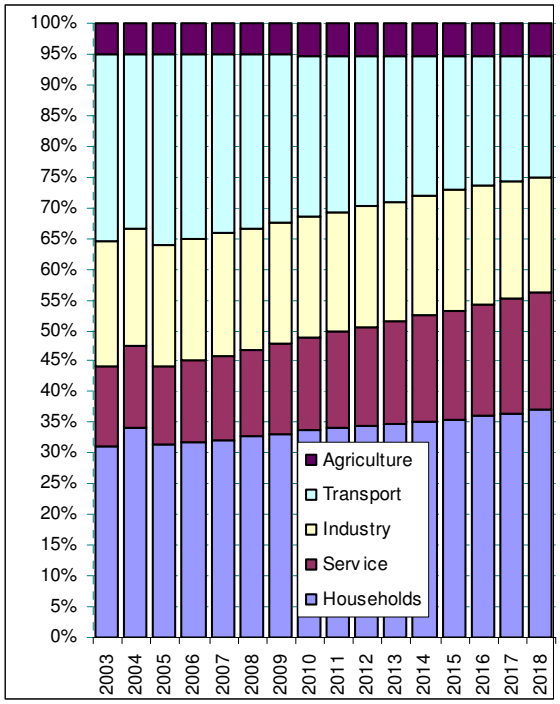
Primary energy demand: The primary energy demand forecast is based on "top-down" approach for all sectors of economy. As far as the main energy consuming sector is concerned, namely the household sector, main energy sources are electricity, firewood and oil byproducts. According to the demand forecast, the electricity consumption will increase in absolute terms, but it will undergo a relative decrease in consumption. This relative decrease will be compensated by increased consumption of LPG and firewood.

[27] MED: Energy Strategy of Kosovo 2009-2018

In the services sector, energy consumption will gradually increase, along with the increase of number of customers and improvement of services themselves. Structural changes are also envisaged, such as lower increase in coal consumption and increased role of oil products in energy consumption structure.

The primary energy demand increase is foreseen also in industry, transport and agricultural sector. Fig. 4 and 5 shows graphically the total energy demand from 2003 up to now and the energy demand forecast up to 2018.





Final energy demand: The two final energy forms influencing greatly future developments of the energy sector in Kosovo are **electricity** and **heat**. The medium demand scenario for electricity envisages a modest increase of demand in the household sector, whereas high increase of demand is projected for the services and industrial sectors. Electricity demand in 2018 is projected at 6,939 GWh/year (Table 4), associated this with a peak load of 1,543 MW in the power system. Gradual reduction of commercial losses down to 5% during the period 2009-2011 was assumed in this scenario. The high demand scenario envisages the demand of 7,431 GWh/year in 2018, with a peak load of 1,671 MW. Gradual reduction of

commercial losses down to 5% during the period 2009-2015 was assumed in this scenario.

Table 4: Electricity demand and peak load forecast for 2009 – 2018

	2009	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
GWh										
MDS	4994	5226	5418	5621	5834	6059	6295	6500	6715	6939
HDS	5299	5514	5713	5929	6164	6422	6662	6898	7153	7431
MW										
MDS	1130	1174	1212	1251	1297	1343	1403	1449	1506	1543
HDS	1210	1257	1302	1349	1389	1434	1515	1566	1618	1671

As far as the required generation capacities are concerned in order to meet the electricity demands, different analysis and scenarios are recently discussed. The study of the WB[28] on different power supply options fits more than all other options to the government plans. Based on this study Kosovo will need about 950 MW of new firm capacity by 2017. This need grows to about 1000 by 2019 and about 1500 MW by 2025. In order to fill the current gaps, WB recommends the construction of new TPP "Kosova e Re" by 2017 with a base load capacity of 600 MW, construction of HPP Zhur with an installed capacity of 305 MW and construction of generation capacities based on renewable sources with a firm capacity of roughly 170 MW. As stated in section 2.1.1, Government is committed to go ahead with necessary actions to build the TPP "Kosova e Re". Hence, these days the authorities of MED announced that the corresponding tendering pack is approved and the offers of interested companies are expected by the end of September 2012. The related works should start in 2013.

The fact that for a considerable number of households the electricity is used for heating purposes makes the prediction of the future needs for heating crucial for stabilization of the electricity sector. According to Heating Strategy of Kosovo[29] the annual net consumption of energy for space and sanitary water heating in the period 2012-2018 will increase in yearly average of ca. 3 % (Fig. 5 and 6).

Thus, if the heating energy sector does no undergo any changes, the net heating energy consumption is predicted to increase from ca. 5000 GWh/year in 2012 to ca

[28] WB: Development and Evaluation of Power Supply Options for Kosovo, December 2011
[29] MED: Heating Strategy of Kosovo 2011-2018

6000 GWh/year in 2018. At the same period of time the gross heating energy consumption is predicted to increase from 9500 GWh/year to 11500 GWh/year.

Pursuant to Heating Strategy, Kosovo will not be able to meet the indicative targets set in KEEP. Therefore, a part of measures foreseen in KEEP, additional actions are required. In case, that energy efficiency and technological improvement actions are implemented the net heating energy consumption is going to increase from 4750 GWh/year in 2012 to 5500 GWh/year in 2018. The gross heating energy consumption is going to increase from 9250 GWh/year in 2012 to 10500 GWh/year in 2018.

2.3.2 Main socio-economic challenges in Kosovo

The rapid institutional progress of Kosovo, have not been followed by adequate macro-economic changes necessary for the economical development. The steadily economic growth in a yearly average of ca. 5 %[30] was not sufficient to reduce the unemployment rate and poverty of the population. Low economic progress is reflected in the living standard of population. According to the WB reports, 34 % of Kosovo population lives below the poverty line whereas the unemployment rate lies at 45.4 %[31]. Although all groups in the working age population display poor employment outcomes, the youth unemployment rate of 74 percent is particularly anxious even though Kosovo has the youngest population in Europe. Consequently young people are concerned about their future in Kosovo, finding the migration as a promising solution.

Trying to tackle some of the main impediments to employment so as to oppose the negative development of socio-economic situation, the Government of Kosovo adopted and has begun implementation of the Employment Strategy in 2010. In labor policies, the Government launched a modernization of the Public Employment Services which could provide better integration between employment offices, vocational training centers, and social assistance offices; it also initiated a public work program to employ some of the unemployed, employing 845 workers; and it raised social assistance benefits and pensions to bring these benefits closer to the poverty line. In spite of presented governmental measures, current trends indicate that poverty and unemployment will continue to be to one of major challenging issues for the Government also in the near future.

[30] http://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG
[31] WB: World Bank-Kosovo Partnership, September 2011

3. Integration of Kosovo in the European Research Area in the field of Energy

The integration of the Western Balkan Countries in the European research area is considered of central importance for research policy, both for the region and for the European Union. As international cooperation partner, research entities of Kosovo have the possibility to apply for research projects under the Seventh research framework programme (FP7). In this relation, Kosovo has organized some information sessions and nominated contact points for FP7. The EU funded mobility programmes directed in higher education and research has contributed to increase the researcher's mobility. Researchers' mobility was significantly improved in 2011 also by implementation of NRP.

In spite of recent progress on research and innovation, no substantial improvement of Kosovo integration to the ERA has been marked so far. At present, no serious R&D project or program in the area of energy is going on in cooperation with European partners. There have been noted some applications to the FP7 or HERD, but not successfully up to the moment of writing this report.

4. SWOT analysis of energy research capacity in Kosovo

4.1. Strengths

- Consolidated legal framework in science and higher education
- Legal framework on energy in place
- National Research Programme established
- Strategy on Energy and on Heating completed
- Energy Efficiency Action Plan approved
- Active participation of Institutions in ECT meetings and other energy related events
- Setting the R&D in the energy sector within top priorities by the government

4.2. Weaknesses

- Insufficient budget for Research and Development
- Lack of national strategy on scientific research
- Poor interaction between research and economical activities
- Low level of R&D project management skills

- No experience in writing proposals for EU-funded research programs
- Dominantly an education profile of higher education institutions
- No full utilization of existing environmental research equipments
- Poor maintenance of existing research infrastructure

4.3. Opportunities

- Setting the development and research in the energy sector within top priorities by the government
- Implementation of National Research Programme in particular the recommended budget allocations
- Implementation of energy sector relevant strategies
- Implementation of Energy Efficiency Action Plan
- Increasing the awareness in institutions in respect to the impact of R&D in energy sector on the overall development
- Strengthening the capacities for successful application in EU founded projects
- Participation on EU research programs
- Advocating for active support of R&D activities in energy sector by international organizations
- Utilize all opportunities for strengthening of the regional cooperation in energy research issues

4.4. Threats

- Budgetary shortage and reallocations due to shifting of priorities
- Poor knowledge and technology transfer to the industry
- Brain drain
- Poor institutional organization and cooperation in R&D activities
- Lack of socio-economic stability

5. Energy research priorities for Kosovo

The institutional contribution in establishing of well organized and effective research conjunctures so far was mainly related in formalization of necessary legal

framework. Certain promotion campaigns for different EU R&D programs were also provided. However, in financial and practical terms, the institutional support was very low. There exists no action plan on research activities required in order to substantially improve the overall R&D policy. The occasionally promoted programs often cannot be attributed to a country designed research strategy but rather to intentions for achieving of short term political advantages.

The poor integration of Kosovo in regional and international R&D programs is consequence of primarily inadequate and insufficient research work performed in the past from relevant institutions. Hence, the R&D priorities in the energy field preferably should support the fulfillment of the priorities specified in the energy strategy and should be in the line with research framework offered by EU ore EU countries, such as FP7, Tempus, HERD etc. Based on the Kosovo strategic objectives and research fields offered in EU programs, following priorities in the field of energy can be highlighted:

1. **Energy security**
    - Optimization of existing lignite mines and existing TPP
    - Socio-economic impact of new lignite TPP and lignite mines required to cover base load
    - Promotion and advancing of co-generation systems
    - Development of centralized heating systems on urban areas
    - Development of liquid fuel sector and establishing of gas supply network
2. **Renewable electricity generation**
    - Detailed investigation of potential for solar, wind, geothermal and hidro energy and compiling of corresponding detailed maps
    - Optimal utilization of hydro potential for electricity generation
    - Development of large scale wind power systems
    - Promotion of decentralized photovoltaic systems
    - Development of concentrated solar power systems
3. **Renewable fuel production**
    - Development of renewable fuel production systems
    - Promotion of renewable fuel for transport and heating
4. **Renewable for heating and cooling**

- Development of geothermal heating and cooling systems
- Optimization and upgrading of solar heating and cooling systems
- Innovative integration of renewable energy supply and energy efficiency in multi-story residential and multipurpose buildings

5. **CO_2 capture and storage technologies for zero emission power generation**
    - Opportunities and alternatives of CO_2 capture an storage systems in Kosovo
    - Integration of CO_2 capture systems to the new TPP
6. **Clean coal technologies**
    - Introducing of technology for a substantial improve of efficiency of TPP
    - Advancing of pollution control technologies
7. **Smart energy networks**
    - Integration of variable distributed resources in electricity distribution networks
    - Enhancing electricity networks through use of distributed intelligent monitoring and control systems
    - Support to the coordination of stakeholders activities in the field of Smart Grids
8. **Energy efficiency and energy storage**
    - Analysis of consumer attitudes and behavior
    - Research, development and promotion of net zero-energy houses
    - Development of energy efficient technologies in industry
    - Promotion of efficient transportation technology, transport demand management and restructuring of urban transport system
    - Development and promotion of thermal energy storage systems

5.1 Energy research priorities on the basis of the country's readiness

Based on existing infrastructure, human resources, recent performance and the current trends, the top fields in the Kosovo energy research sector include:

1. Optimization and upgrading of existing power capacities
2. Promotion of co-generation and centralized heating systems in urban areas
3. Development of geothermal and solar heating and cooling systems
4. Developing of alternative sources (water, wind, solar and geothermal) for electricity production
5. Improvement of energy efficiency and transformation of energy market

5. 2 Energy research priorities on the basis of future potential

In order to cope with advanced research priorities, Kosovo needs a systematic and target-oriented strengthening of their institutional and legal framework for R&D on energy. Further, specific programs on upgrading of human capacity buildings are indispensible. Among advanced research priorities to be tackled in the future may be emphasized:

1. CO_2 capture and storage technologies for zero emission power generation
2. Clean coal technologies
3. Smart energy networks
4. Establishing of an integrated energy and climate policy
5. Establishing of a sustainable and regionally integrated energy supply system

Annex I: Classification of the Energy research fields

The most appropriate classification scheme to which fits the energy research fields, tackled within the current report, is found to be the classification provided in the UK Energy Research Centre (Table 5)[32].

Table 5: Classification of energy research fields

Area	Sector	Topic
ENERGY EFFICIENCY	Industry	
	Residential and Commercial	
	Transport	
	Other	
FOSSIL FUELS: OIL, GAS AND COAL	Oil and Gas	Enhanced oil and gas production
		Refining, transport and storage of oil and gas
		Non-conventional oil and gas production
		Oil and gas combustion
		Oil and gas conversion
		Other oil and gas
	Coal	Coal production, preparation and transport
		Coal combustion
		Coal conversion (excluding IGCC)
		Other Coal
	CO_2 capture and storage	CO_2 capture/separation
		CO_2 transport
		CO_2 storage
RENEWABLE ENERGY SOURCES	Solar Energy	Solar heating and cooling (including daylighting)
		Photovoltaic
		Solar thermal power and high-temp. applications
	Wind Energy	
	Ocean Energy	
	Bio-Energy	Production of transport biofuels (incl. Production from wastes)
		Production of other

[32] http://ukerc.rl.ac.uk/cgi-bin/erccats.pl#ECAT

		biomass-derived fuels (incl. Production from wastes)
		Applications for heat and electricity
		Other bio-energy
	Geothermal Energy	
	Hydropower	Large hydropower (capacity of 10 MW and above)
		Small hydropower (less than 10 MW)
	Other Renewables	
NUCLEAR FISSION AND FUSION	Nuclear Fission	Light-water reactors (LWRs)
		Other converter reactors
		Fuel cycle
		Nuclear supporting technologies
		Nuclear breeder
		Other nuclear fission
	Nuclear Fusion	
HYDROGEN AND FUEL CELLS	Hydrogen	Hydrogen production
		Hydrogen storage
		Hydrogen transport and distribution
		Other infrastructure and systems R&D
		Hydrogen end uses (incl. combustion; excl. fuel cells)
	Fuel Cells	Stationary applications
		Mobile applications
		Other applications
OTHER POWER and STORAGE TECHNOLOGIES	Electric power conversion	
	Electricity transmission and distribution	
	Energy storage	
OTHER CROSS-CUTTING TECHNOLOGIES or RESEARCH	Energy system analysis	
	Environmental, social and economic impacts	