



**Renewable & Appropriate Energy Laboratory
Energy & Resources Group
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Sustainable Energy Options for Kosovo

An analysis of resource availability and cost

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Executive Summary

Today Kosovo faces critical energy and development choices that will impact the energy supply available to meet basic needs, and provide for economic growth. These choices will also impact the health of the population, determine the job creation potential of the energy sector, and impact the wider regional role that Kosovo may play in the European Community and European Union.

A variety of opportunities exist to provide support for sustainable energy development in Kosovo. The European Union, the World Bank (including the International Development Association), and the efforts of individual donor nations working individually or ideally in partnership are a few among all. The energy sector in Kosovo will require significant investment, both financial, and also in terms of capacity support, irrespective of what energy plan is pursued. A critical component of any sustainable development strategy for Kosovo is the continued transparent dialog between donors and the national government, particularly because international resources will be needed under any pro-growth, pro-environment agenda in Kosovo and the region.

The Renewable and Appropriate Energy Laboratory at the University of California, Berkeley (<http://rael.berkeley.edu>) has conducted an assessment of the economic, social, and environmental costs and benefits of a set of energy scenarios for Kosovo.

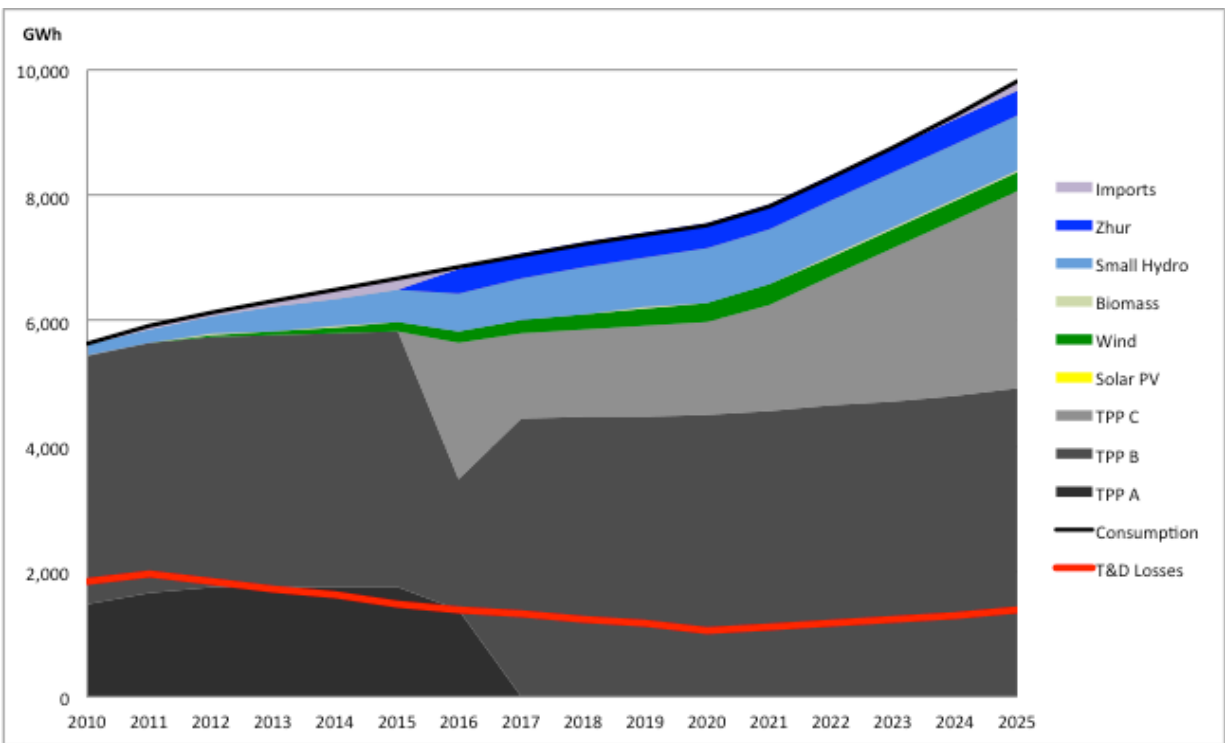
This assessment is an analytic treatment of the energy options that exist today and that can be created through investigation of new energy efficiency, renewable energy, and the wise use of fossil fuel resources. Key components of such a forward-looking energy plan for Kosovo, and arguably for the Balkans more widely, are: job creation and the support of indigenous industry; reduced exposure to energy supply and price risks through regional coordination and integration; and an energy mix that reduces human and environmental health risks and facilitates economic integration with the European Union.

Base Case Scenario

This Scenario is based on the Ministry of Energy and Mining (MEM) indicative targets of renewable energy resources and a proposed new thermal power plant to be integrated into the Kosovo power grid by 2017.

The resource mix involved in this energy development scenario include:

- 141 MW Wind by 2020
- 140 MW new small Hydro by 2020 (Total of 182MW including existing capacity)
- 300 MW HPP Zhur by 2016
- 800 kW Solar PV by 2020
- 16.5MW Biomass/Biogas by 2020
- 600 MW New Thermal Power Plant (Kosovo C) by 2017
- Decommissioning of TPP Kosovo A by 2017
- Rehabilitation of TPP Kosovo B to 600 MW by 2017
- Reduction of total T&D losses to 14% by 2020



Executive Summary Table 1:
Simulated Net Electricity Generation for 'Base Scenario' 2010-2025

As shown on the graph, in this scenario Kosovo will still get the bulk of its demand from conventional fossil fuel generation and by 2025 only 12% of the electricity generation is through renewable resources.

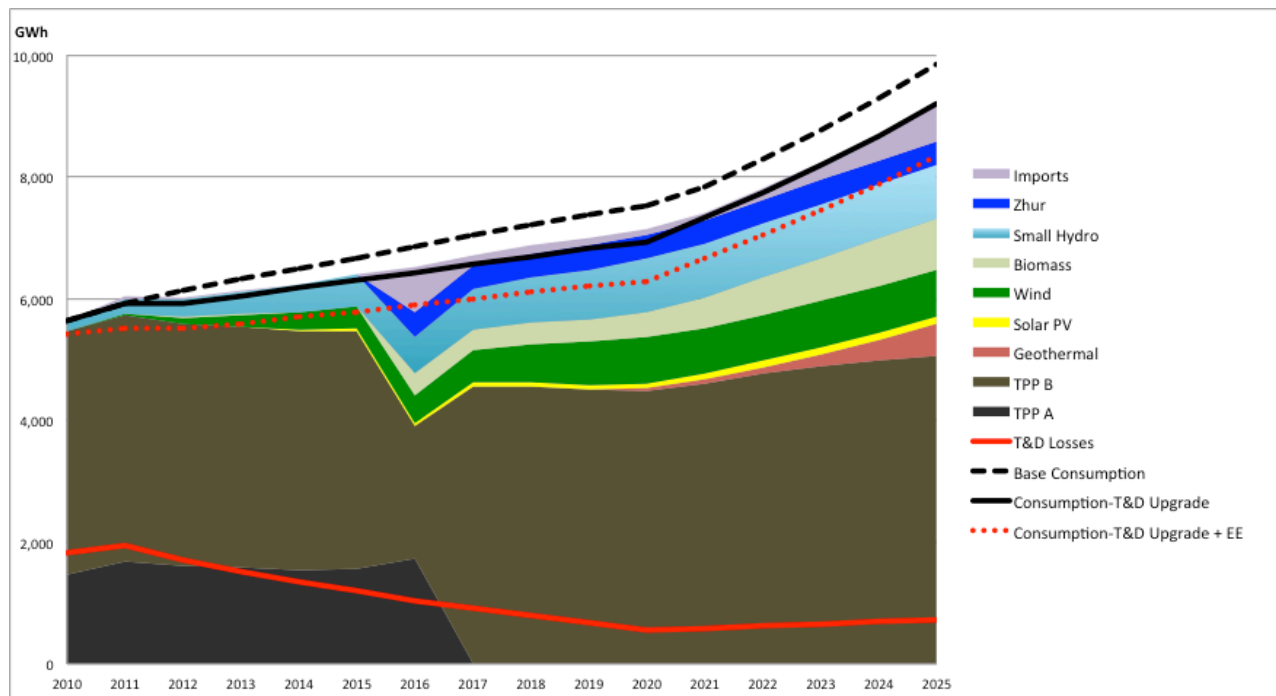
Low-Carbon & EE Scenario

In this Scenario Kosovo's forecasted electrical demand is met through a combination of renewable resources, T&D grid upgrades, energy efficiency measures and regional cooperation with neighboring countries on electricity import. This is shown as an increase in capacity for biogas, wind and solar from the base scenario together with a conservative estimation of new Geothermal capacity coming online between 2020 and 2025.

This scenario also shows the highest job creation numbers amongst all scenarios studied.

A summary of the assumptions in this scenario is presented below:

- 300 MW Wind by 2025
- 140 MW new small Hydro by 2020 (Total of 182MW including existing capacity)
- 300 MW HPP Zhur by 2016
- 75 MW Solar PV by 2020
- 165 MW Biomass/Biogas by 2020
- 100 MW Geothermal Power Plant (2020-2015)
- Decommissioning of TPP Kosovo A by 2017
- Rehabilitation of TPP Kosovo B to 600 MW by 2017
- Reduction of total T&D losses to 8% by 2025



*Executive Summary Table 2:
Simulated Net Electricity Generation for 'Low-Carbon & EE Scenario' 2010-2025*

In the Low-Carbon graph shown above the black dash line represents the Base consumption, the solid line shows the load forecast in the presence of more aggressive T&D upgrades and the red

dash line illustrates the load forecast if energy efficiency measures were to be adopted countywide. We have adopted a conservative load reduction due to the energy efficiency measures implemented. In this scenario by 2020 about 30% of the load is met through renewable resources. This value is foreseen to reach 34% by 2025.

A small component of geothermal energy is included in this scenario because: (1) the regional potential, while not explored in detail to date, suggests a large resource, of 800 MW or larger; and (2) significant U. S.¹ and multinational donor interest² and investment in geothermal energy has already taken place, and forecasts are for this attention to expand over time. Geothermal plays a small role in the energy mix examined in the Low-Carbon and EE scenario, but reflects a useful opportunity to build a diverse international portfolio of baseload renewable energy generation.

Job creation is an especially pressing issue in Kosovo as the country is facing double-digit unemployment rates and a fast growing youth rate entering the workforce. With a 46 percent unemployment rate (75% among young workforce), Kosovo has the weakest employment track record in Europe. Therefore we also examined the job opportunities each of these scenarios would present. Three scenarios were examined:

- Business As Usual (BAU): In this scenario the load till 2020 is supplied through the existing electricity resources (TPP A & B, Existing HPP), the new Kosovo C and Imports.
- Base Scenario: This is the same 'Base Scenario' identified above
- Low-Carbon Scenario: This is the same 'Low-carbon Scenario' identified above

Our analysis shows that the renewable energy sector generates more jobs per unit of energy delivered than the fossil fuel-based sector. There is a respective 20% and 88% increase in the number of total jobs created from the 'Base' and 'Low-Carbon' Scenarios compared to the BAU case. The Low-Carbon Scenario creates over 60% more jobs than the Base Case Scenario. It's worth noting that this estimation doesn't yet include job opportunities from energy efficiency measures and this is while energy efficiency has the highest number of job opportunities per unit of energy generation. This means in a scenario where energy efficiency measures were implemented the employment would by far out-beat a coal based energy sector.

We have also examined the total cost of electricity production in each scenario. The next table summarizes the cost for both capacity and annual production in each of the 'Base' & 'Low-Carbon' Scenarios.

As shown in *Executive Summary Table 3*, even in the absence of externalities the LCOE for the 'Base Case Scenario' (including the coal power plant) is above the cost for the 'Low-Carbon Scenario'. If externalities get included, the cost of energy generation from the 'Base Case Scenario' could become 3 times more expensive.

¹ <http://www.faststartfinance.org/programme/ex-im-bank-geothermal-energy-generation>

² <http://think-energy.org/wordpress/?p=584>;

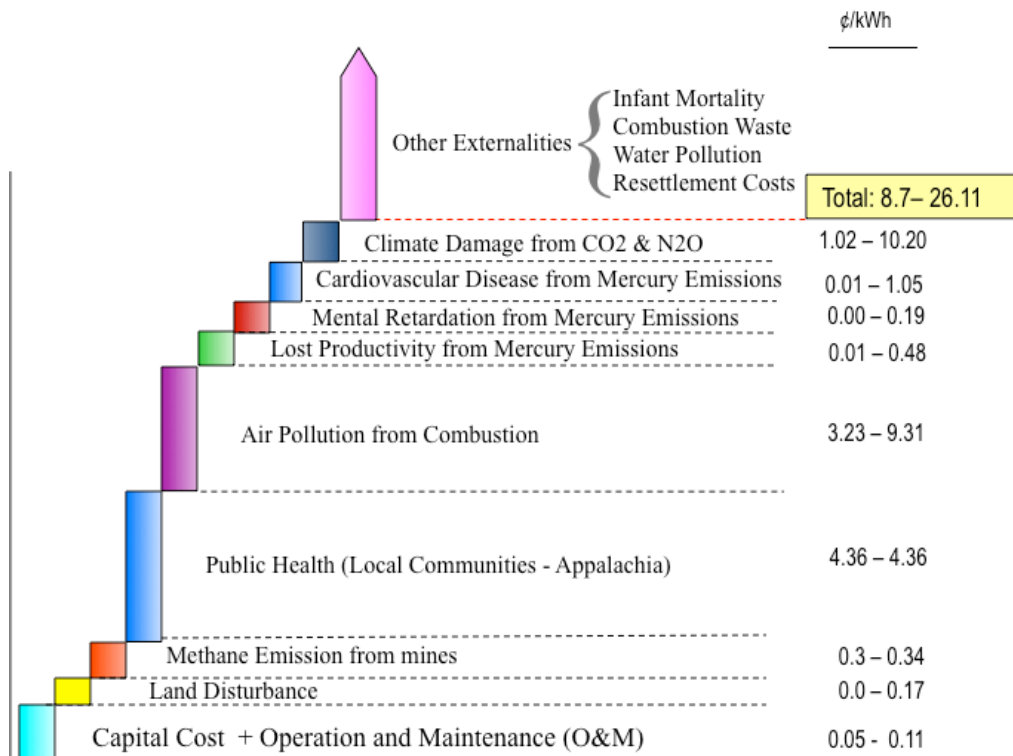
<http://web.worldbank.org/external/projects/main?pagePK=64283627&piPK=73230&theSitePK=40941&menuPK=228424&Projectid=P075046>

CASE	DESCRIPTION	Peak MW	Total GWH	\$/W_peak	\$/MWh	\$ million (Installed Capacity)	\$ million (LCOE)	\$ million (LCOE w Low Externalities)	\$ million (LCOE w Base Externalities)	\$ million (LCOE w High Externalities)
Base Scenario	TPP Kosovo A3-A5		11458							
	TPP Kosovo B1-B2		67818							
	TPP Kosovo C1-C2	600	20034	2.60	95	1560	1899	3642	5325	7108
	Wind	141	3087	1.95	97	275	299	299	299	299
	Small Hydro	182	10137	1.50	86	273	876	876	876	876
	HPP Zhur (cf=15%)	305	3966	1.44	125	439	495	495	495	495
	Residential PV	1	15	4.65	230	4	3	3	3	3
	Biomass	17	124	2.40	113	40	14	14	14	14
	Imports	295	840		142		119	156	191	229
	Total:			117480			2590	3706	5486	7204
Low-Carbon & EE Scenario	TPP Kosovo A3-A5		11185							
	TPP Kosovo B1-B2		68385							
	Wind	300	7787	1.95	97	585	755	755	755	755
	Small Hydro	182	10137	1.50	86	273	876	876	876	876
	HPP Zhur (cf=15%)	305	3966	1.44	125	439	495	495	495	495
	Residential PV	75	1033	4.65	230	349	238	238	238	238
	Biomass	165	5317	2.40	113	396	598	598	598	598
	Geothermal	100	1244	1.00	102	100	127	127	127	127
	Imports	295	3029		142		430	562	689	824
	Total:			112083			2142	3519	3650	3778

Executive Summary Table 3:

Total cost of generation for 'Base' & 'Low-Carbon' Scenarios with and without externalities

The true ecological and health costs of coal are far greater than its current market price.. Accounting for the many external costs over the life cycle for coal-derived electricity conservatively doubles to triples the price of coal per kWh of electricity generated. Executive Summary Table 4 shows some of the coal externalities accounted for in US.



Executive Summary Table 4:

External Cost of Coal in US (2008 US Cents/KWh)

In conclusion we find that:

- A low-carbon path exists for Kosovo that integrates aggressive energy efficiency deployment, T&D grid upgrades, use of both large and small-scale hydropower, solar, biomass and extensive use of wind energy while reducing human and ecological impact of energy generation. This path whilst delivering 34% of the energy demand through renewable resources also provides over 60% more jobs than a business as usual path and it does so at an estimated cost savings of 5-50% relative to a base-case scenario that includes a new coal power plant.

We recommend this development path because: (1) it meets Kosovo's energy needs; (2) provides a critical opening to bring private sector investment into the country's energy sector in a way that large-scale multinational-dominated projects will not provide; (3) paves the way for Kosovo to exceed the European Union's 20-20-20 standard, which will be important to move Kosovo to an economically and environmentally advantaged position as the EU evolves; (4) has the largest health and local benefits to a country that today suffers some of the worst local environmental pollution and degradation from its legacy of high-polluting thermal energy, and (5) by transforming Kosovo into a clean energy leader, opens the door for added exploration of renewable energy options and partnerships with neighboring nations that could, in time, transform the nation into an *exporter* of clean energy to EU neighbors looking to lead the world in this regard.

- The business as usual path, dominated by an expanded use of low-quality coal, is not the least-cost energy option for Kosovo given the social cost of thermal generation. A coal dominant energy path burdens future generations with an energy mix that is neither environmentally sustainable nor is it a path that maximizes job creation.

And hence recommend that:

- The priority is placed on Energy Efficiency and Electricity grid improvement and International financial assistance is allocated towards these issue prior deciding on new thermal generation
- Aggressive energy efficiency programs together with a well designed and effective FIT for renewables is implemented. These enabling policies will enhance private investment independent of international financial assistance.
- Explore the country's potential on Geothermal and implement opportunities to make the hydropower capacity a resource year-round, and to develop wind or other renewable energy sources that can address peak energy demands, potentially utilizing wind and hydropower in concert.

1. Kosovo's Electricity Sector

1.1 Current Electricity Balance in Kosovo

1.1.1 Power Generation

Approximately 98% of power generated within Kosovo is from two lignite coal-fired thermal power plants (TPP), 'Kosovo A & B'. These plants are owned and operated by Korporata Energjetike e Kosoves (KEK): Kosovo's vertically integrated power utility is responsible for the mining of coal, generation, distribution and supply. TPP Kosovo A consists of five units (A1-A5), with a total installed capacity of 800 MW, although units A1 and A2 are no longer operational and considered unfit for further commissioning [11]. TPP Kosovo B consists of two larger units (B1 and B2) with an installed capacity of 678 MW. Data on the installed and available capacities, age and remaining hours [1,11] of TPP Kosovo A & B is presented in *Table 1* below.

Name	Installed Capacity	Available Capacity		First Year	Retirement	Remaining Lifetime
	(MW)	min (MW)	max (MW)	Yr	Yr	Hours
Kosova A1	65			1962	2007	
Kosova A2	125			1965	2002	
Kosova A3	200	100	130	1970	2017	61,320
Kosova A4	200	100	130	1971	2017	61,320
Kosova A5	210	100	135	1975	2017	61,320
Kosova B1	339	189	260	1983	2030	175,200
Kosova B2	339	189	280	1984	2030	175,200

Table 1: Capacities of Existing TPP within Kosovo (2010)

The availability of TPP Kosovo A & B is low due to frequent system failures, disconnections and repairs. This has been particularly burdensome for the manufacturing and construction sectors, where in 2009, firms reported an average of 43 outages per month [12]. These outages resulted in losses equivalent to 17% of the firms' annual sales, compared to less than 4% for similar transition economies. The low availability of TPP A & B is also due, in part, to damages incurred during the war. Damages in low-pressure rotors of units B1 and B2, for example, have reduced the maximum available capacities to 240 MW and 280 MW, respectively.

Figure 1 below shows the gross and net generation per month in 2010 from TPP Kosovo A & B [4]. Here, the net generation is equivalent to the gross generation less the auxiliary power consumption needed to support the operation of the power plant (generating auxiliaries).

- Total annual gross generation from TPP Kosovo A & B (2010) = 5041 GWh
- Total annual net generation from TPP Kosovo A & B (2010) = 5010 GWh

The relative net generation from TPP Kosovo A & B in 2010 was 1740 GWh (35%) and 3271 GWh (65%), respectively.

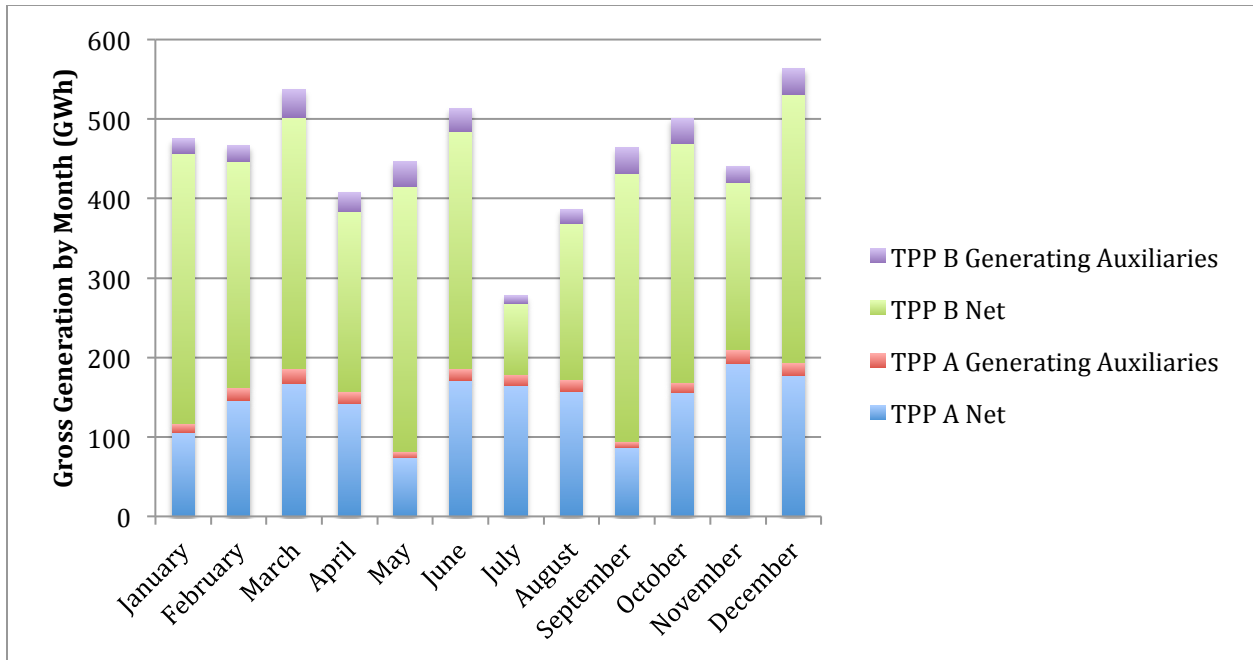


Figure 1: Gross Generation by Month from TPP A & B (2010)

Hydro power plants (HPP) accounted for the remaining ~2.2% of the net power generation within Kosovo in 2010. Data on the installed capacities of existing HPP within Kosovo was obtained from [3]. This data is reproduced in *Table 2* below.

Generating Unit	Capacity (MW)	
	Installed	Net
Ujmani/Gazivoda	35	32
Lumbardhi/Kozhnjer	9	8
Radavc	0	0
Burimi/Istog	0	0
Dikance	1	1
Total	46	42

Table 2: Installed Capacities of Existing HPP within Kosovo (2010)

HPP Ujmani/Gazivoda (HPP Ujmani) is managed by the public enterprise, Iber-Lipenci. This plant, which feeds directly to the transmission network, had a net generation of 114 GWh in 2010 [4] (corresponding to a capacity factor of ~41%). The remaining small HPP (all owned by private investors [3]) connect to various locations in Kosovo’s distribution network. In aggregate, these small HPP had a net generation of 42 GWh (capacity factor ~48%).

1.1.2 Transit, Imports and Exports

KOSTT j.s.c (KOSTT) manages and operates the electricity transmission system of Kosovo and is responsible for the bulk transmission of electric power on the high voltage electric networks. KOSTT was established in 2006 as a result of the restructuring of the energy sector under the

Energy Community Treaty for South-eastern Europe [3]. Data on the transmission lines operated by KOSTT is presented in *Table 3* below [13].

Voltage (kV)	Number of lines	Total Length Installed (km)
400	6	182
220	13	232
110	45	728
TOTAL		1,142

Table 3: Existing KOSTT Transmission Lines

In addition to transmission within Kosovo, the KOSTT system interconnects with neighboring Montenegro (400 kV line), Macedonia (400 kV line), Albania (220kV line) and Serbia (400 kV, 220 kV and 110 kV lines) allowing transit, imports and exports of electricity. Figure 2 shows the transmission network in Kosovo.

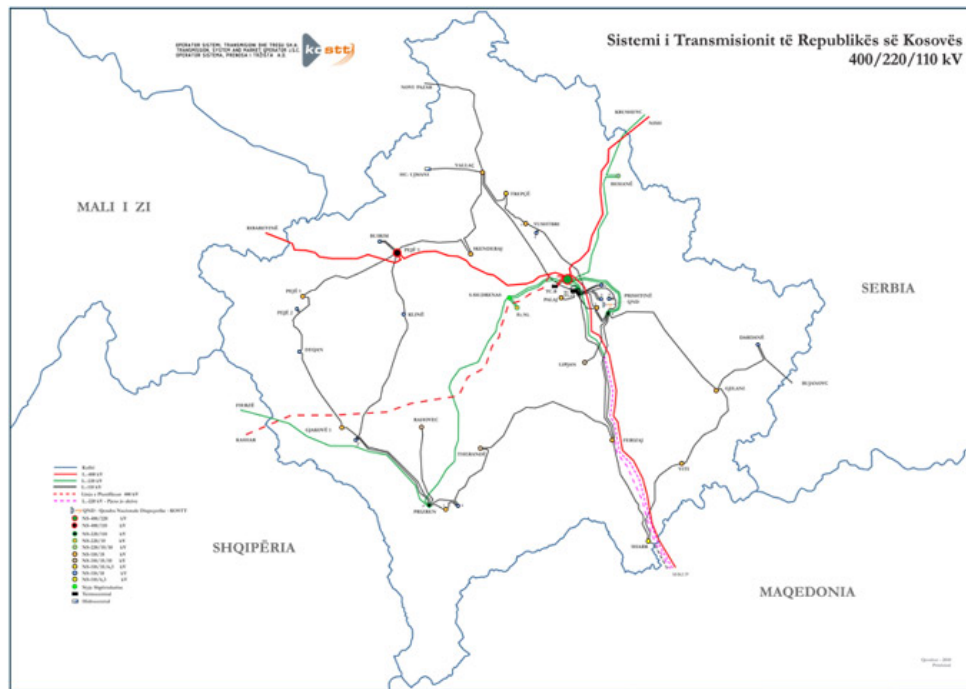


Figure 2: Map of transmission network in Kosovo [KOSTT]

The maximum capacity of energy exchange between Kosovo and its neighbors (calculated as the sum of the natural transmission capacity of each line) is ~1740 MW [11]. However, the net capacity for energy exchange is likely lower than this maximum, due to physical constraints in the lines, substations and generation capacities of neighboring countries.

A new 400 kV transmission line to Albania is expected to be commissioned by the end of 2012, boosting transfer capacity in each direction by roughly 500 MW. A new 400 kV connection to Macedonia is also planned that will boost transfer capacity in each direction an additional 500 MW. The new 400kV lines, to Albania and Macedonia will greatly increase Kosovo’s capacity for importing energy.

Table 4 below shows the total flows of energy in and out of the KOSTT transmission system in 2010 from interconnections with neighboring countries [4]. The difference between the ‘Interconnections IN’ and ‘Interconnections OUT’ each month is net import of electricity into the KOSTT electricity grid. These imports are crucial for balancing demand in the country with supply from its TPP and HPP as described in the previous section. Table 4 shows that net imports of electricity from interconnections with neighboring countries in 2010 totaled 470 GWh. The transit³ of electricity (travelling through the KOSTT network) to neighboring countries thus totaled 3113 GWh.

	Interconnections IN (GWh)	Interconnections OUT (GWh)	Net Imports (GWh)
January	399	242	157
February	306	205	101
March	348	314	34
April	298	239	59
May	214	231	-17
June	158	271	-113
July	376	264	112
August	350	318	32
September	263	316	-53
October	271	254	17
November	297	214	83
December	304	245	59
TOTAL	3,583	3,113	470

Table 4: Total Flow of Electricity through Interconnections with Neighboring Countries (2010)

1.1.3 Transmission System Flows

Figure 3 below shows the total energy (GWh) flow through KOSTT transmission system in 2010 via net generation from TPP Kosovo A & B (90%), net generation from HPP Ujmani (2%) and Net Imports (8%) from neighboring countries as detailed in the previous sections. In aggregate, these sources supplied a total of 5594 GWh to the transmission system.

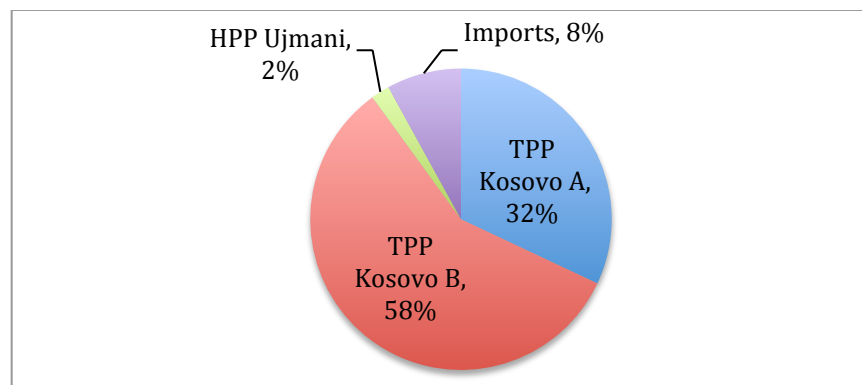


Figure 3: Total Energy Supplied to KOSTT Transmission System in 2010 (GWh)

³ Transit is defined by ENTSOE as an energy flow that occurs in a country, which is neither the source nor the sink. The energy flow arrives in the grid over one border and leaves country over one or more borders [14].

Transmission system losses in 2010 totaled 131 GWh (2.3% of the net energy input). This includes the losses caused by transit. Transmission system losses have declined over recent three years as shown in *Table 5* below. These improvements are due to numerous investments over the past decade.

Year	Losses (GWh)	%
2008	215	4.3%
2009	174	3.3%
2010	131	2.3%

Table 5: Transmission System Losses (2008 - 2010) [3]

Three large industrial customers, Ferronikeli, Trepça and Sharrcemi consume electricity directly from the KOSTT transmission network. In 2010, the total consumed by these direct customers was 701 GWh [4]. Thus, the remaining 4762 GWh was supplied to the distribution system.

1.1.4 Distribution System Flows

Kosovo's electric distribution system is owned and operated by Korporata Energjetike e Kosoves (KEK). The net electricity supplied to the distribution system in 2010 totaled 4804 GWh, with 42 GWh being supplied directly by small hydro power plants (HPP) and 4762 GWh being supplied by the transmission system [3]. The destination of this energy flow through the distribution network is shown in *Figure 4* below.

Figure 4 shows that of the total 4804 GWh supplied to the distribution system in 2010, 782 GWh accounted for distribution losses, 238 GWh was internal KEK use, 185 GWh was supplied to the northern municipality of Mitrovice⁴ and ultimately 3599 GWh (~75%) was available for sale to customers. However, only a total of 2673 GWh was actually billed to these customers [4].

The 926 GWh difference is classified as 'commercial' or 'un-accounted-for' energy losses and occur due to misuse of electricity [3]. This electricity was delivered to customers (or taken from the power system) without being paid-for or metered. The primary factors that cause this large volume of commercial losses are deficiencies in billing procedures and non-collection of unpaid bills [11].

Technical losses in the distribution system are high (782 GWh) accounting for 16% of the total energy input. These losses occur due to inefficiencies in the network elements, lack of investment, inadequate maintenance and a large proportion of obsolete equipment [3].

⁴ This territory has been subjected to conflicts since the end of the war on 1999 and hence is currently beyond the reach of the billing system

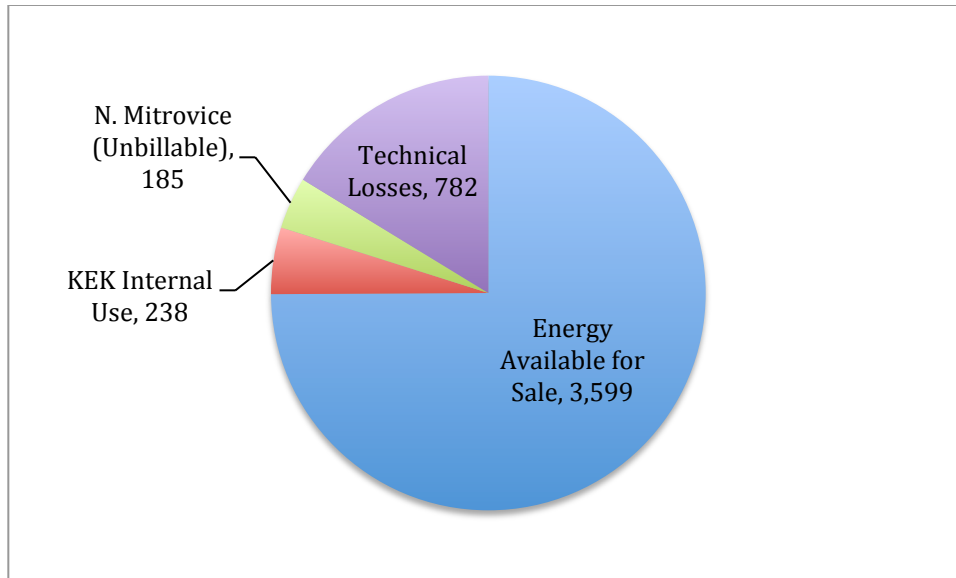


Figure 4: Energy Available (Sale & Other Flows) through Distribution Network in 2010 (GWh)

1.1.5 Electricity Balance

The net energy flows in and out of the Kosovo electricity system are summarized in *Figures 5 and 6*, respectively. Summing the total in either figure gives an estimate of the total consumption of electricity in the Kosovo grid in 2010 of 5636 GWh⁵.

Total losses in the system are 1839 GWh, which account for ~33% of consumption (2.3% from transmission system losses, 14% from technical losses in the distribution system, 16% from commercial ‘un-accounted-for’ losses).

The ratio of transit of electricity (estimated to be 3113 GWh in Section 1.1.2) to total consumption is ~55%. This ratio is very high and leads to transmission system losses as well as network congestion. Although an ITC (inter transmission-system-operator compensation) mechanism has been established to compensate transmission system operators for this transit, Kosovo has not been included due to issues with Serbia [3]. As a result, losses caused by transit are instead recovered through fees to regulated customers.

It should be noted that this electricity balance was done based on data from the supply-side, and thus reflects the actual energy delivered to customers. However, often the true demand for electricity in Kosovo is higher than the energy available. As a result, Kosovo is subject to daily periods of planned outages during hours when the energy demand cannot be met by supply due to insufficient generation, transmission capacity or financial means for energy imports (4).

⁵ ENTSOE defines ‘electricity balance’ as the consumption of electricity computed from the supply side. It is calculated as the sum of Net Production plus Net Imports. Due to the fact that consumption is computed from the supply side, the electricity balance includes distribution and transmission system losses [14].

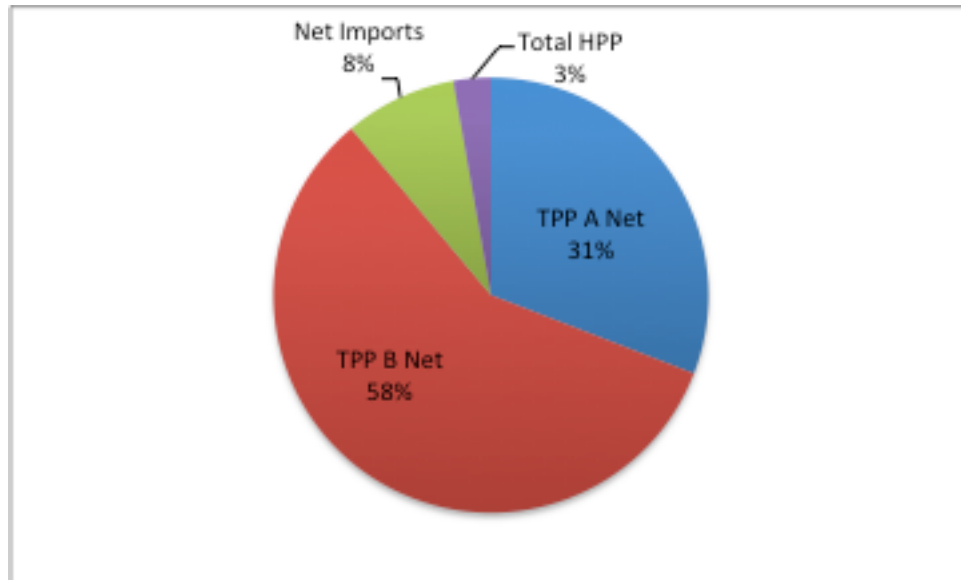


Figure 5: Net Energy Inputs to Kosovo Electricity System 2010 (%)

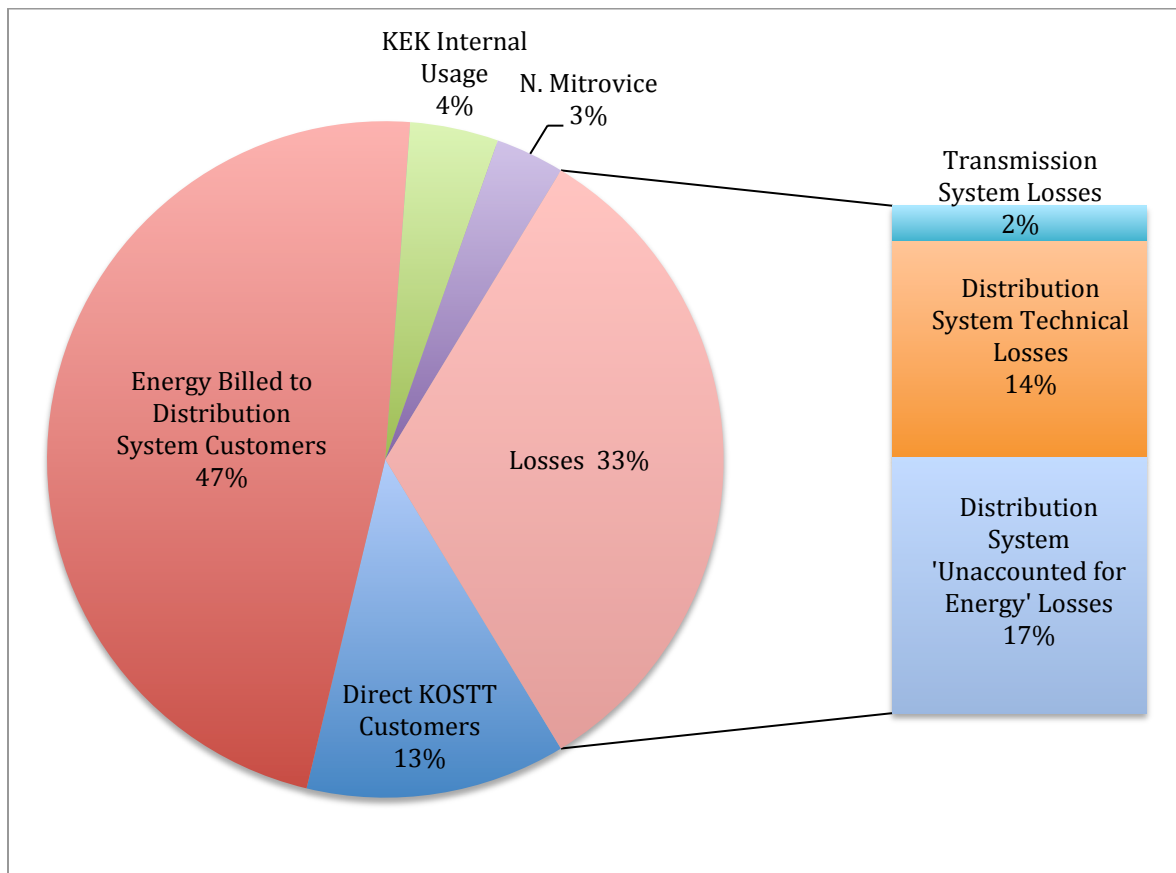


Figure 6: Net Energy Outputs from Kosovo Electricity System 2010 (%)

1.2 Forecast of Demand and Generation, 2010-2020

1.2.1 Demand Forecast

The long-term energy balance for Kosovo is modeled by KOSTT. This balance includes forecast scenarios for the growth in electricity demand based on growth in GDP and correlations with electricity use, implementation of efficiency programs, more efficient billing and other economic factors [15,11]. Three forecast scenarios, which estimate the total consumption and peak load for 2011-2020 are presented in the general adequacy plan [11]: a ‘base scenario’ corresponding to annual GDP growth of 3.2%, a ‘low growth’ scenario corresponding to annual GDP growth of 1.7%, and a ‘high growth’ scenario corresponding to annual GDP growth of 4.7%. *Table 6* below shows KOSTT’s estimates for the Gross Demand (GWh) and Peak Load (MW) corresponding to these three scenarios [3]. The estimates for Gross Demand and Peak load in 2010 shown here are based on data from [4] and [3], respectively.

Total Consumption (GWh)	2010*	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Average Growth
Base Scenario	5636	5916	6144	6323	6499	6674	6853	7035	7210	7381	7530	3.04%
High-Growth Scenario	5636	6010	6280	6550	6832	7112	7404	7655	7916	8177	8430	4.10%
Low-Growth Scenario	5636	5760	5904	6046	6167	6290	6416	6544	6655	6762	6890	2.21%

Peak Load (MW)	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Average Growth
Base Scenario	1126	1175	1190	1220	1250	1283	1310	1340	1365	1390	1410	2.53%
High-Growth Scenario	1126	1183	1215	1250	1290	1330	1375	1415	1460	1510	1550	3.41%
Low-Growth Scenario	1126	1145	1155	1175	1195	1215	1240	1260	1280	1300	1320	1.91%

Table 6: Demand Forecast Scenarios (2011-2020)

The values in *Table 6* reflect the ‘gross latent consumption’ that includes the demand for electricity, which was previously shed due to forced outages [15]. The Base Scenario, High-Growth Scenario and Low-Growth Scenario are derived from a complex mathematical model which inter-relates corrective factors to the correlation of electricity demand to GDP [11]. Key factors include:

- Implementation of Law No.04/L –016 on Energy Efficiency
- Reduction of commercial losses as a result of more efficient billing and metering procedures
- Forecast of technical losses in the transmission and distribution networks
- Survey of expected growth from industrial and service sectors

The Statement of Security Supply for Kosovo [3] separates the Base Scenario for Gross Consumption into six categories: residential, industrial, services, distribution system losses, transmission system losses and commercial losses. This breakdown is replicated in *Table 7* below. Similar data was not available for the High-Growth and Low-Growth scenarios.

Analysis of the KOSTT Base Scenario in *Table 7* yields the following observations:

- Technical losses in the distribution are forecast to decrease from 14% to 11% of total consumption from 2011-2020
- Commercial losses in the distribution system are forecast to decrease dramatically from

17% to 1% of total consumption from 2011-2020

- Transmission system losses are forecast to remain at ~2% of the total consumption during the period 2011-2020
- The Total Losses (sum of technical, commercial and transmission) are forecast to decrease from 33% in 2011 to 14% in 2020.

The KOSTT Base Growth Scenario was used as the basis for the “Base Scenario” analysis in this report. The forecast was extended through 2025 assuming the same relative growth in demand and stabilized technical, transmission and commercial losses at 2020 percentage levels.

Base Scenario															
Total Consumption (GWh)	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Residential consumers	2051	2248	2513	2704	2893	3095	3258	3413	3560	3701	3953	4222	4509	4816	5144
Commercial consumers	568	627	675	711	762	816	860	904	946	995	1059	1127	1200	1277	1359
Industrial consumers	1266	1332	1348	1405	1445	1487	1524	1575	1631	1674	1727	1781	1838	1896	1956
Distribution Technical losses	828	860	885	910	868	891	915	865	886	828	862	912	965	1022	1082
Commercial losses	1006	860	696	585	467	343	281	216	148	75	78	83	88	93	98
Transmission losses	118	123	126	130	133	137	141	144	148	151	157	166	176	186	197
TOTAL	5916	6144	6323	6499	6674	6853	7035	7210	7381	7530	7836	8291	8775	9290	9836
Distribution Technical losses (% of total consumption)	14%	14%	14%	14%	13%	13%	13%	12%	12%	11%	11%	11%	11%	11%	11%
Commercial losses (% of total consumption)	17%	14%	11%	9%	7%	5%	4%	3%	2%	1%	1%	1%	1%	1%	1%
Transmission losses (% of total consumption)	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Total Losses (GWh)	1952	1843	1707	1625	1468	1371	1337	1226	1181	1054	1097	1161	1229	1301	1377
(as % of Total Consumption)	33%	30%	27%	25%	22%	20%	19%	17%	16%	14%	14%	14%	14%	14%	14%

Table 7: Demand Forecast & System Losses in the ‘Base Scenario’ for 2011-2025

The same demand growth methodology is used for the low carbon scenario with the difference in more aggressive efficiency measures on distribution grid improvements. In the Low Carbon scenario the distribution technical losses are assumed to decrease to 5% by 2020 and remain the same through 2025. Transmission and commercial losses are assumed to be at the same percentage levels as the base case scenario. This places the Kosovo grid closer to the normal 5-9% total T&D losses observed internationally.

Low Carbon Scenario															
Total Consumption (GWh)	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Residential consumers	2051	2248	2513	2704	2893	3095	3258	3413	3560	3701	3953	4222	4509	4816	5144
Commercial consumers	568	627	675	711	762	816	860	904	946	995	1059	1127	1200	1277	1359
Industrial consumers	1266	1332	1348	1405	1445	1487	1524	1575	1631	1674	1727	1781	1838	1896	1956
Distribution Technical losses	828	770	726	680	630	578	525	469	409	346	366	388	410	434	460
Commercial losses	1006	830	665	556	441	321	262	201	136	69.2	73	78	82	87	92
Transmission losses	118	119	121	124	126	129	131	134	136	138	146	155	164	174	184
TOTAL	5916	5925	6048	6179	6296	6426	6560	6695	6819	6924	7325	7751	8203	8684	9195
Distribution Technical losses (% of total consumption)	14%	13%	12%	11%	10%	9%	8%	7%	6%	5%	5%	5%	5%	5%	5%
Commercial losses (% of total consumption)	17%	14%	11%	9%	7%	5%	4%	3%	2%	1%	1%	1%	1%	1%	1%
Transmission losses (% of total consumption)	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Total Losses (GWh)	1952	1718	1512	1359	1196	1028	918	803	682	554	586	620	656	695	736
(as % of Total Consumption)	33%	29%	25%	22%	19%	16%	14%	12%	10%	8%	8%	8%	8%	8%	8%

Table 8: Demand Forecast & System Losses in the 'Low Carbon Scenario' for 2011-2025

1.2.2 Generation Forecast

In July 2009, the Government of Kosovo articulated a five-pronged strategy to meet rising energy needs. This strategy is comprised of: (a) private sector investment in a new lignite-fired power generation project, (b) privatization of the electricity distribution and supply business, (c) private sector participation in rehabilitation and environmental upgrade of the Kosovo B Power Station (Increased capacity of about 600 MW), (d) decommissioning of the Kosovo A Power Station by 2017, and (e) development of renewable resources (including small hydropower plants, wind, solar, biomass).

With TPP Kosovo A reaching the end of its useful life by 2017, the government has proposed the development of a new thermal power plant (New Kosova Power Plant) to begin operation in 2016. The design for this plant is comprised of two units (C1 and C2) with a total installed capacity of 600 (2x300) MW. The first of these units is expected to become operational in late 2016, and the second unit six months to a year later [3,11].

In addition to the proposed New Kosova Power Plant, upgrades are planned to improve the capacity of TPP Kosovo B. It is anticipated that these units will be rehabilitated in 2016 – 2017, including investments required to meet the emission standards required by the European Union Directive for Large Combustion Power Plants [3,16]. During the rehabilitation period, only one of the two units is available and Kosovo B's net available capacity is assumed to be average 300 MW. After rehabilitation, its net available capacity is assumed to be 618 MW. However, Flue Gas Desulphurization (FGD) is expected to reduce further the capacity of each unit by roughly 10 MW with a net available capacity of 598 MW.

The Ministry of Energy and Mining (MEM) has determined indicative targets of renewable energy resources to be integrated into the Kosovo power grid through the Governmental Program for Clean and Efficient Energy. The program has presented a base scenario which includes expanded hydro resources, wind, biomass and solar photovoltaics [3,11,15]. This scenario is

presented below as it pertains to Kosovo’s energy strategy. Our investigation of the potential for each of these resources is examined further in Section 2 of this report.

MEM ‘base scenario’ for renewable energy resources to be developed by 2020:

- The MEM base scenario foresees the development of a known accumulating hydro power plant project, HPP “Zhur”, with an installed capacity of 305 MW. This project is expected to be operational by 2016. It is estimated that HPP Zhur could produce ~398 GWh per annum [11].
- Development of an additional 20 ‘small’ HPP is expected to contribute 140.3 MW by 2020 [3,11].
- Three private wind developers have submitted project applications to KOSTT with a combined total capacity of 157 MW [11.1]. MEM estimates that from these projects, 141 MW of wind energy capacity will be installed on the Kosovo grid by 2020 [3].
- The development of biomass and urban waste fuelled power plants is envisaged to start in 2012, with progressive capacity development reaching 16.5MW by 2020 [11].
- Estimates of the potential for installed solar photovoltaic (solar) capacity are low – primarily due to a perception of too-high capital costs [11]. The MEM base scenario envisages only 0.8 MW of solar capacity on the Kosovo grid by 2020 [3].

The MEM base scenario for new generation capacity is summarized in *Table 9* below.

	Unit	Installed Capacity (MW)	In Operation
New TPP	C1	300.0	Q1 2016
	C2	300.0	Q1 2017
New Renewable Energy Capacity	HPP Zhur	305.0	Q1 2016
	Small HPP	140.3	Q1 2010 - Q4 2020
	Wind	141.0	Q1 2010 - Q4 2020
	Biomass	16.5	Q1 2012 - Q4 2020
	Solar	0.8	Q1 2017 - Q4 2020

Table 9: MEM Base Scenario for New Generation Capacity (2010 – 2020)

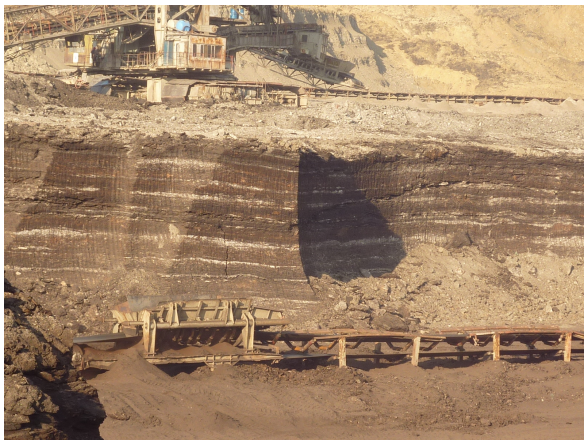
2. Electricity Resources: Availability, Cost and Environmental Quality

2.1 Fossil Fuels

2.1.1 Coal

Coal is the primary source for electricity generation in Kosovo. Over 90% of the demand is supplied through the two thermal power plants Kosovo A & B. Domestic lignite reserves are estimated to amount to 12.5 billion tones, of which 10.9 billion tones are exploitable. Kosovo's coal reserves consist of Lignite (also known as brown coal). Lignite has the lowest carbon content and the highest amount of moisture. It's geologically younger than other forms of coal, and mostly used in power generation. Brown coal is the dirtiest coal type as the process converting it into usable energy is very intensive.

Though abundant, the quality of the lignite is fairly poor and its use in electricity generation releases an average of 5.8 million tons of CO₂ into the atmosphere annually. With the planned construction of a new power plant, it is possible that Kosovo could be responsible for annual CO₂ emissions as high as 22.5 million tons [16].



Left: Coal in the Kosovo mine



Right: Kosovo coal mine



Above: Kosovo A

Below: Kosovo B



2.1.2 Oil & Natural Gas

Kosovo has no domestic crude oil resources. In 2010 Kosovo imported 566,000 ton of oil products. The one small oil processing plant has a capacity of around 100,000 tons per year, which uses gasoline and some lighter distillates as raw material and produces diesel, residual fuel oil and LPG. In 2010 this plant provided less than 4% of the total oil product import [11,1]. Kosovo is not linked to an operational natural gas supply network. A connection to natural gas supply would be an important option to diversify fuel supply in the country and to increase security of supply, but there are currently no projects planned. Gas supply and consumption in Kosovo is therefore limited to bottled LPG (liquefied petroleum gas) [11.1].

2.2 Hydroelectricity

In this study two different hydro resources will be analyzed: An aggregate of distributed small hydro resources (river run) and a larger proposed utility scale hydro power plant.

2.2.1 Small Run-of-the-River Hydro

One feasibility study on the water resources for small hydro power plants [7] shows a potential of 63 MW aggregated hydro capacity with a total annual production of 300 GWh. *Table 10* shows the proposed HPPs and their respective capacities. The ERO Office in Kosovo foresees an even larger development of small hydropower plants reaching a capacity of 140.3 MW by 2020 [3].

River	HPP	Capacity (MW)	Production (GWh)
	Kuqishtë	4	19
Peja	Drelaj	6	30
	Shtupeq	8	37
Decani	Bellaje	5	26
	Decani	8	41
Llocani	Llocani	3	14
	Mal	3	19
Erenik	Erenik	2	10
	Jasiq	2	10
Plave	Dragash	2	12
	Orcush	6	29
Prizreni	Recan	2	8
Lepenc	Brezovica	2	12
	Lepenci	4	19
Bajska	Bajska	0	2
Bistrica	Batare	1	6
Kacandoll	Majanc	1	3
Drini+Decani	Mirusha	5	28
All New Small HPPs		63	323

Table 10: The proposed Small HPP

2.2.2 Large dam-based hydropower

The proposed hydropower plant Zhuri will be located in the southwest of the municipalities of Prizren and Dragash, with an estimated capacity of 305 MW and an average annual production of ~ 400 GWh [3]. The data for the two Zhur plants are presented in *Table 11*.

Resouce	Capacity	Production
Zhur 1	2 x 131	342
Zhur 2	43	55
Total	305	398

Table 11: Capacity and Estimated Production for Proposed Zhur HPP

This 305 MW power plant (estimated capacity factor ~15%). has been proposed as a peaking plant to help compensate for the variability in Kosovo's demand. A common practice in developed countries is to designate gas fired plants as peaking power plants due to their ability of quick adjustments in production. However in the absence of a gas reserves or a gas pipe line in Kosovo, and the inability of the existing coal power plants to quickly and reliably adjust production, the Zhur plant can be operated as a peaking plant. Moreover the profile of this hydro resource is similar to the demand profile (coincidental peaks) and this brings a big advantage to the HPP. *Figure 8* shows the location of the proposed small HPPs as well as the Zhur power plant.



Figure 8: Spatial Distribution of Proposed HPP

2.3 Wind

Studies on the wind energy potential of Kosovo vary widely. One study [8] is based on meteorological data collected at 10 potential project sites throughout the country. 7 out of the 10 sites were found to have wind speeds too slow for commercial viability. Of the remaining 3 locations, the highest wind speed was measured at BBUD, in Budakova. The modeled wind resource at this location is shown in the *Figure 9*. The estimated annual average wind speed at 38 meters is estimated to be 6.9 m/s.

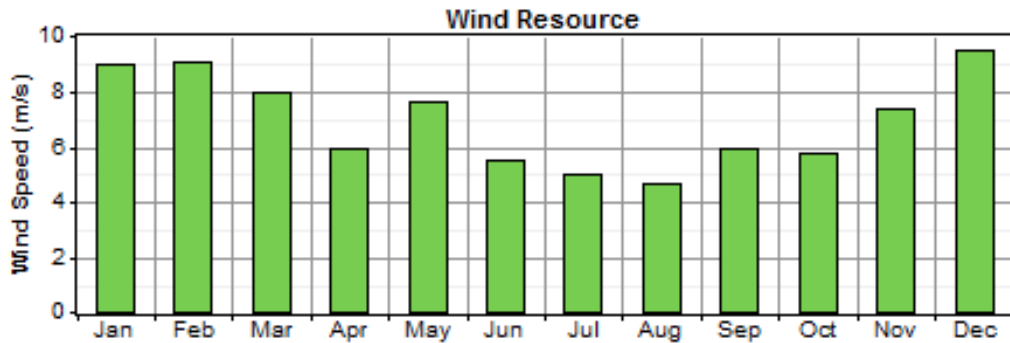


Figure 9: Annual wind speed in Budakova

Another study [8] uses computer modeled data to calculate the wind speed in the municipalities of Lipjan and Dukagjin however since the values were not real measured valued we based our model on the more reliable measured data for Bukadova. Figure 10 shows the two potential sites for wind farms.

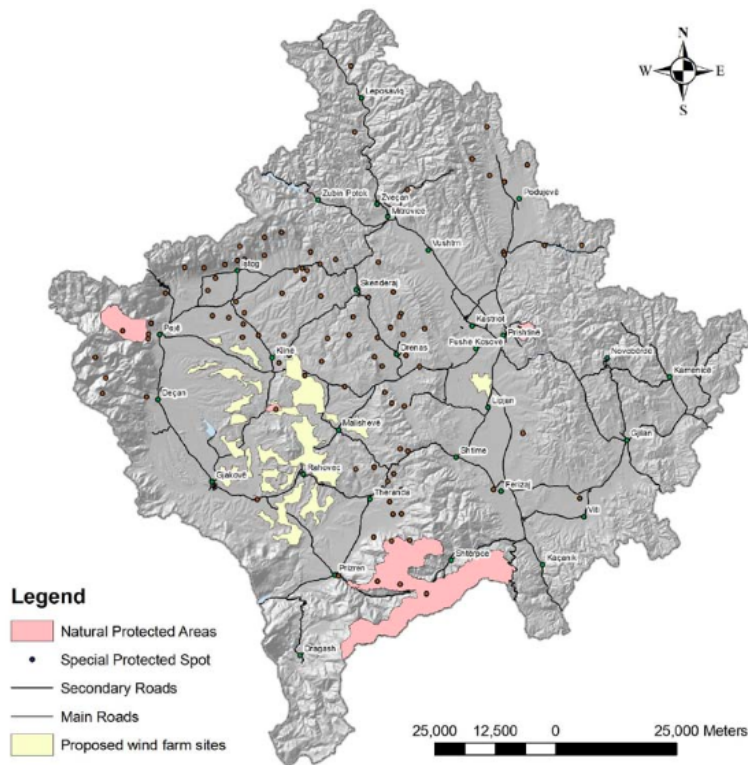


Figure 10: Available sites for potential wind farms

2.4 Solar

The annual radiation on a solar collector panel directed towards south and with an optimum inclination of 35 degree (calculated optimum inclination) varies between 1550 kWh/m²/year and 1650 kWh/m²/year in Kosovo [10]. This range can be seen on the solar map for the South East Europe in *Figure 11*. The variation between the various municipalities is less than 10%. For design purpose it can be considered that the solar radiation is the same all over Kosovo and equal to 1600 kWh/m²/year for an ideally located solar collector.

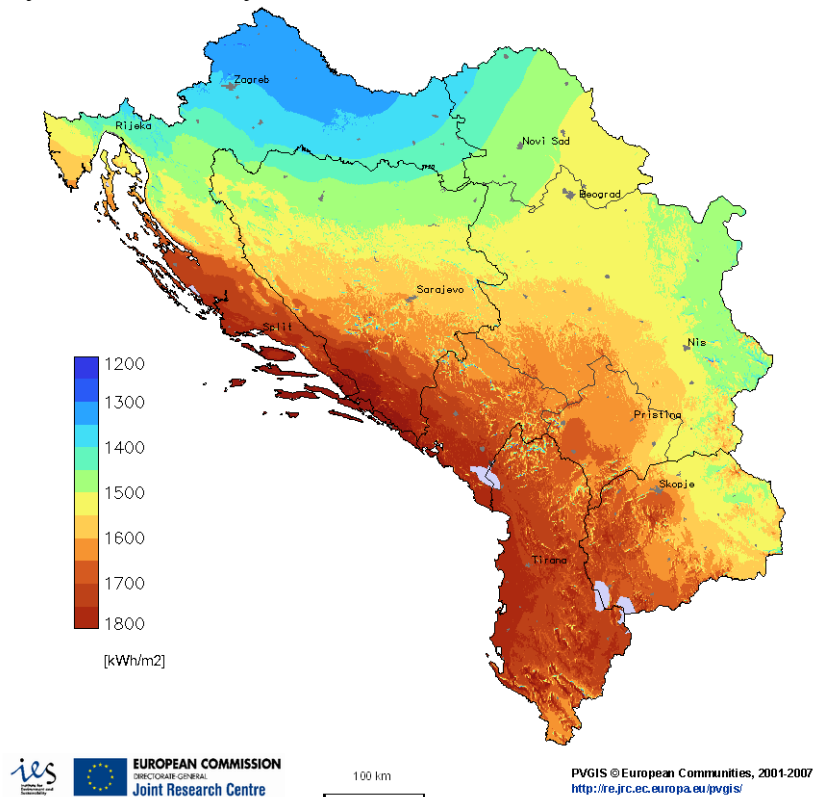


Figure 11: Solar radiation in Balkan region, optimum inclination and direction

2.5 Biomass

The theoretical energy potential from biomass resources is shown in Table 12. [9]

Type of resource	Resource	GWh/y
Biomass, wood	0.9 mill m ³	2,812
Biomass, livestock	352.000 cattle, 152.000 sheep/goats	1,363
Biomass, agriculture	0.30 mill ton straw	1,200
Solid waste	0.44 mill ton	1,229
Total		6,604

Table 12: Theoretical renewable energy resources in Kosovo, GWh/year

Assumptions made for the theoretical energy potential are:

- Max annual sustainable wood cut, 30 % moisture, oak and beech
- All livestock waste utilized and maximum theoretical biogas production
- All straw utilized, 15% moisture
- All solid waste utilized

The study estimated the total theoretical annual energy from biomass resources within Kosovo to be ~6600 GWh/yr.

2.6 Geothermal

There are no detailed studies available on the geothermal potential within Kosovo, however the neighboring countries (Macedonia and Serbia) have a history of using geothermal as an energy resource. In Macedonia the potential for geothermal energy production is estimated at 210,000 MWh per year and currently there are more than 14 geothermal sites used for heating load. In Serbia there are more than 60 geothermal systems with temperatures lower than 150 C. The estimated energy reserves of geothermal resources in Serbia (and Kosovo) are around 800 MW [20]. *Figure 12* shows the heat flow map and distribution of major convective geothermal systems in Serbia and Kosovo.

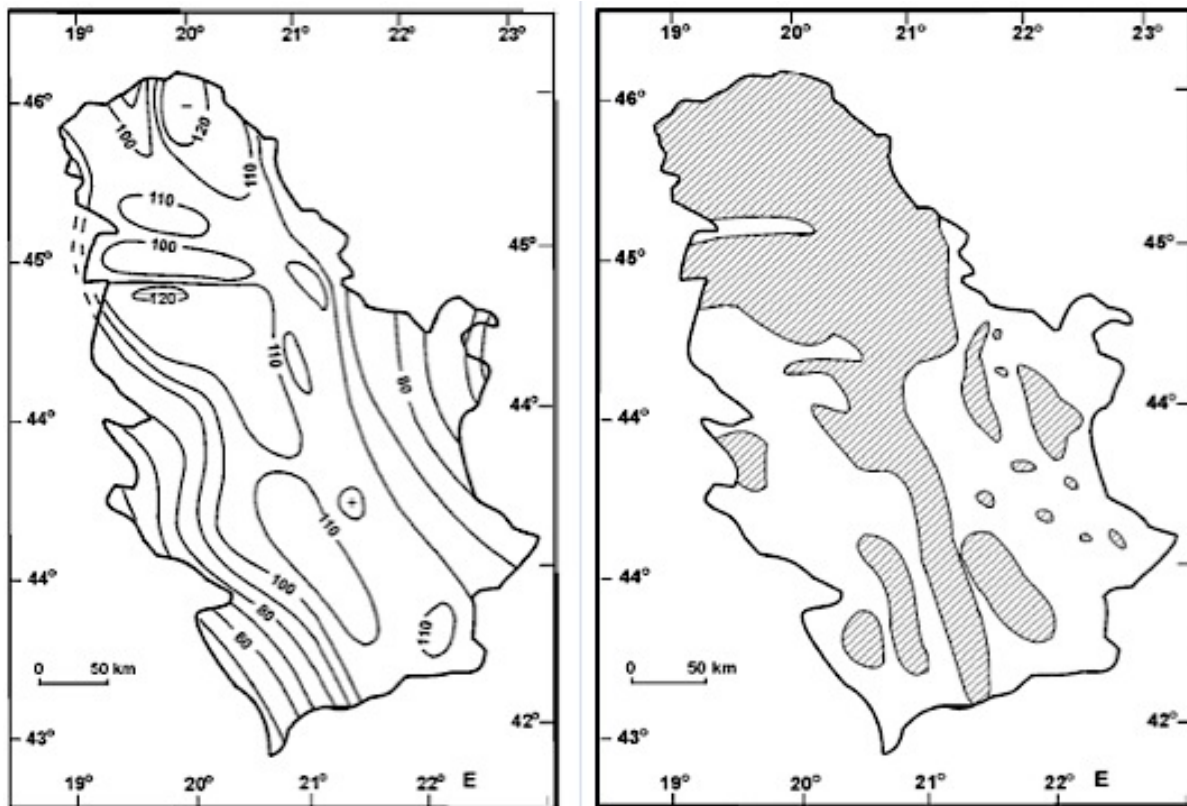


Figure 12: Heat flow map & distribution of major convective geothermal systems in Serbia and Kosovo

2.7 Energy Efficiency

The World Bank has listed Kosovo as a non energy-efficient country, and very little progress has been made to improve energy efficiency to date. European Union (EU) integration requires 20 percent energy efficiency improvements by 2020.

Various studies show that Kosovo has considerable potential to improve energy efficiency.

In 2010 United Nations Development Program (UNDP) carried out an energy assessment on the municipality of Dragash that showed a potential of 26 GWh saving per year from Energy Efficiency measures such as (CFL lighting, Thermal Insulation) [22]. *Table 13* shows the energy consumption and CO₂ emission prior and post study.

	Energy Consumption (GWh/y)	CO ₂ Emission (Ton/y)
Before EE measures	124	41,377
After EE measures	98	37,014
EE Gains	26	4,363
(%)	21%	11%

Table 13: energy consumption and CO₂ emission before & after EE measures

It's worthy to note that the total energy saving in Dragash was over 20% of consumption. This shows a large energy saving potential if the EE measures were to be adopted throughout the country.

2.7.1 Grid Efficiency

As discussed in Section 1.1, the transmission and distribution grid inefficiencies in Kosovo contribute to a large energy loss in the country. In 2010 total losses in the system constituted around ~33% of consumption. From the total of 33%, 2.3% were transmission losses, 14% were technical losses in the distribution system and 16% commercial 'un-accounted-for' losses. (This figure does not include the unbilled energy supplied to the municipality of Mitrovice)

This means the Kosovo citizens who actually pay their bills are in fact bearing the extra cost for this 33% energy loss. This is not only a large inefficiency in the system but also raises equity and consumer right issues.

2.7.2 Demand-Side Management

KEK has started installing digital meters throughout its jurisdiction. So far from over 400,000 KEK customers 30,000 have received smart meters. This program aims to reduce electricity theft throughout Kosovo. There are no further DSM applications planned.

3. Power Supply Simulation Analysis

Kosovo's electric power generation system was modeled using HOMER – a hybrid system optimization software package developed by the U.S. National Renewable Energy Laboratory. HOMER simulates a power system's physical behavior (60 minute time step) and life-cycle cost.

The simulations of Kosovo's electric power system presented in the sections below reflect data gathered and synthesized from a number of sources. Key assumptions are stated in each section.

3.1 Simulation of Kosovo's Current Electric Power System (2010)

3.1.1 Key Assumptions

Data on the diurnal cycle of electricity consumption was modeled based on data obtained from [5]. A representative daily consumption profile is shown in *Figure 13*. This data was used along with monthly consumption data from [4] to create a model of the total electrical consumption.

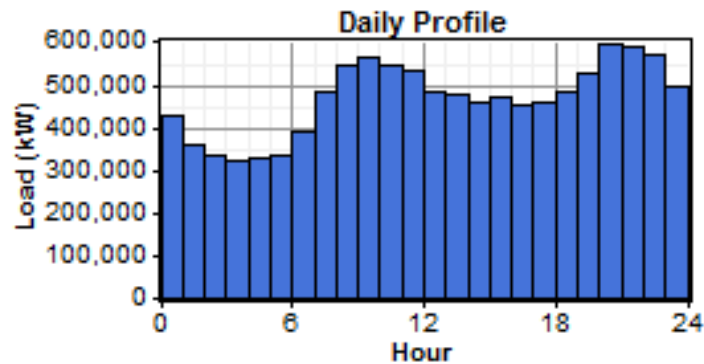


Figure 13: Modeled Daily Consumption Profile (2010)

The efficiencies of TPP Kosova A and B were modeled based on data obtained from Pg. 219 of [2]. The modeled efficiency curves are shown in *Figure 14* below. Note the higher efficiency of the newer Kosovo B plants. The resulting full-load fuel consumption of the TPP Kosovo A & B was estimated as 1.629 kg/kWh and 1.491 kg/kWh, respectively.

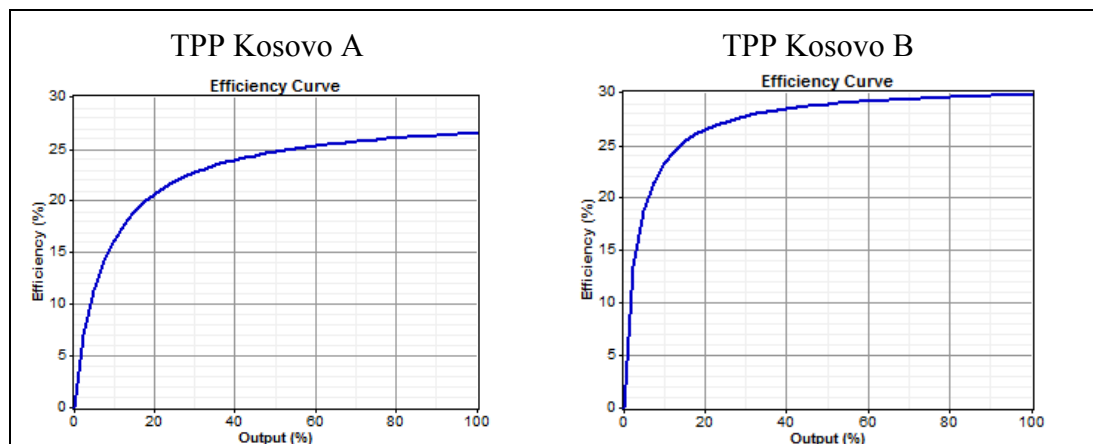


Figure 14: Modeled Efficiency Curves of Existing Kosovo TPP (2010)

Data from [2] was also utilized to model the lignite fuel used in TPP Kosovo A & B. The modeled lignite fuel properties are summarized in *Table 14*.

Lignite Fuel Properties	Kosovo A	Kosovo B
Lower Heating Value (MJ/kg)	7.75	7.86
Density (kg/m ³)	753	753
Carbon Content	24.1%	24.0%
Sulfur Content	0.82%	0.77%

Table 14: Summary of Modeled Lignite Fuel Properties (2010)

Emissions factors for ‘NO_x’ and ‘Particulate Matter’ were modeled based on data from [2]. Emissions factors for ‘CO’ were modeled based on formulae presented in [6]. Emissions factors for ‘Unburned Hydrocarbons’ and ‘Fuel Sulfur’ were modeled to reflect estimates presented in pp. 7-10 of [1]. The resulting emissions factors are presented in *Table 15* below. For this analysis, it was assumed that the emissions factors for Net Imports of electricity from neighboring countries match those of Kosovo B.

Emissions Factor	TPP Kosovo A	TPP Kosovo B	Net Imports
Carbon Monoxide (g/kg of fuel)	0.13	0.13	0.13
Unburned Hydrocarbons (g/kg of fuel)	200	200	200.00
Particulate Matter (g/kg of fuel)	6.62	0.87	0.87
Proportion of Fuel Sulfur Converted to Particulate Matter	67%	67%	0.67
Nitrogen Oxides (g/kg of fuel)	1.16	2.53	2.53

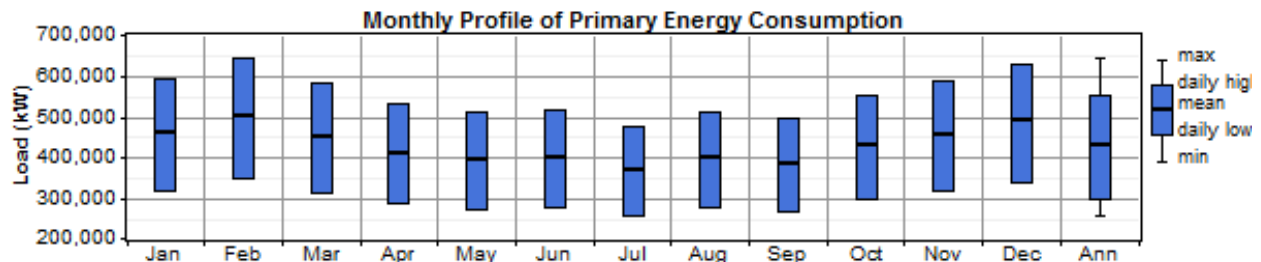
Table 15: Summary of Modeled TPP Emissions Factors (2010)

3.1.2 Simulation Results

The total consumption data presented in Section 1.1 (*Figure 6*) was separated into two loads in HOMER:

- ‘Total System Losses’ which incorporates the transmission system losses, technical and commercial losses in the distribution system
- ‘Primary Energy Consumption’ which incorporates the energy billed to customers, KEK direct usage, energy supplied to N. Mitrovice and direct KEK customers

The resulting monthly profiles for these two loads are summarized in *Figure 15* and *Table 16*.



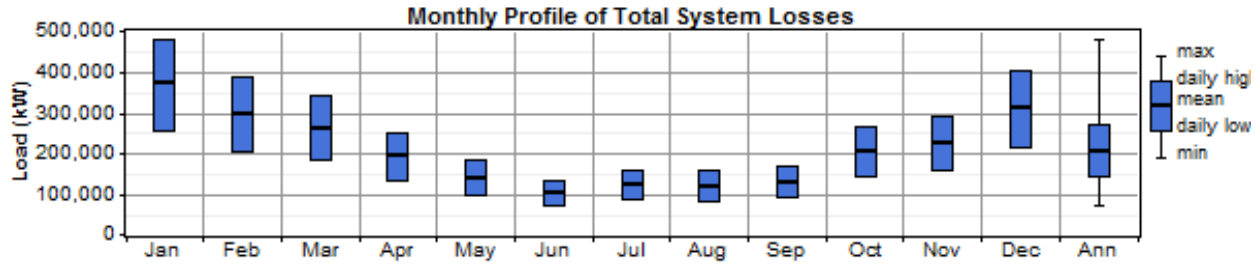


Figure 15: Modeled Monthly Primary Consumption and Loss Profiles (2010)

	Days	Total Primary Consumption		Total Losses	
		Total (MWh)	Average (kWh/day)	Total (MWh)	Average (kWh/day)
January	31	347,394	11,206,258	279,085	9,002,742
February	28	340,004	12,143,000	203,192	7,256,857
March	31	339,196	10,941,806	198,318	6,397,355
April	30	299,740	9,991,333	141,865	4,728,833
May	31	297,207	9,587,323	106,780	3,444,516
June	30	291,543	9,718,100	75,983	2,532,767
July	31	277,773	8,960,419	93,567	3,018,290
August	31	299,718	9,668,323	91,054	2,937,226
September	30	281,001	9,366,700	94,531	3,151,033
October	31	322,624	10,407,226	155,923	5,029,774
November	30	332,770	11,092,333	165,126	5,504,200
December	31	367,100	11,841,935	234,912	7,577,806
Total		3,796,070		1,840,336	

Table 16: Modeled Monthly Primary Consumption and Loss Profiles (2010)

The existing hydro power plants (HPP) in Table 2 were modeled to match monthly production estimates given in [4]. Simulation results show a mean output of ~ 18 MW with an overall capacity factor of 42% as seen in both Figure 16 and Table 17. The total production from existing HPP is estimated at 156 GWh/yr (2010).

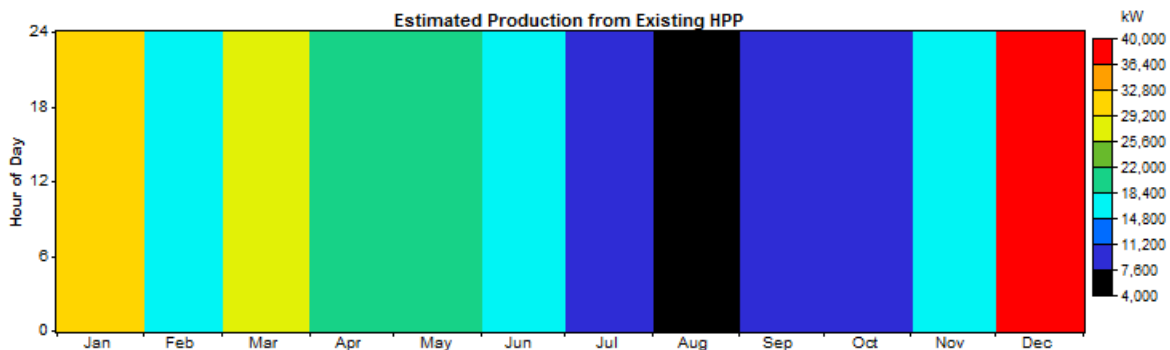


Figure 16: Modeled Monthly Generation from Existing HPP (2010)

Modeled Production of Existing HPP	
Nominal capacity	42 MW
Mean output	18 MW
Capacity factor	42 %
Total production	156 GWh/yr

Table 17: Modeled Monthly Generation from Existing HPP (2010)

Kosovo’s electricity generation system was modeled given the key assumptions presented in Section 3.1.1 as well as the net generation capacities specified in *Tables 1, 2 and 4*. Simulation results for the total net generation and fuel use of each generator is shown in *Table 18* below. HOMER optimizes the dispatch of each generator according to its efficiency, thus the relative percentage of power generated by each of TPP Kosovo A3 – A5 may not match actual figures. However, the total annual energy generated by TPP A matches data given in [11]. The same holds true for results presented for TPP Kosovo B.

Production	Net Generation (GWh/yr)	% of Total Generation	Fuel Consumption (million tons)
HPP	156	3%	
KSA3	750	13%	1.39
KSA4	603	11%	1.11
KSA5	386	7%	0.71
KSB1	1,991	35%	3.36
KSB2	1,280	23%	2.16
Imports	470	8%	
Total	5,637	100%	8.74

Table 18: Summary of Modeled Net Generation and Fuel Use (2010)

The simulated greenhouse gas emissions from Kosovo’s current generation system are presented in *Table 19*. In addition, the assumed Global Warming Potential (GWP) of each pollutant is shown for reference. The GWP is a relative scale which compares each gas to an equivalent mass of CO₂. Multiplying each pollutant by its GWP and summing them together gives an estimate of the total emissions in CO₂e (carbon dioxide equivalent) from combustion. Assumed emissions from the 470 GWh of Net Imports (2010) are included in this estimate. In total, the annual emissions of CO₂e are estimated to be 51 million tonnes; with 45 million tonnes (88%) from TPP Kosovo A & B and 6 million tonnes (12%) from Net Imports.

Pollutant	GWP	Total Emissions (tons)	CO2 Equivalent (tons)
Carbon dioxide	1	6,773,657	6,773,657
Carbon monoxide	3	1,202	3,605
Unburned hydrocarbons	11	1,922,446	21,146,911
Particulate matter	680	25,092	17,062,799
Sulfur dioxide	0.075	19,622	1,472
Nitrogen oxides	310	20,333	6,303,202
TOTAL			51,291,645

Table 19: Summary of Modeled Emissions from TPP Kosovo A and B and Net Imports (2010)

3.2 Base Case Scenario - Demand and Generation Forecast (2011-2025)

In this section, a HOMER model was created to simulate the electric power system of Kosovo for the years 2011-2025. The annual consumption of electricity from 2011-2025 was modeled to match KOSTT estimates presented in Table 7. Key assumptions and results are presented below.

3.2.1 Key Assumptions

- TPP Kosovo A: In this simulation, it was assumed that TPP Kosovo A will be decommissioned by 2017. The efficiency and capacities of A3 – A5 were modeled as presented in Section 3.1.1.
- TPP Kosovo B: In this simulation, it was assumed that TPP Kosovo B would remain in service through 2025. In 2016 the two units in TPP Kosovo B are scheduled to undergo rehabilitation. During this period (2016-2017), only one of the two units is available and Kosovo B’s net available capacity is assumed to be average 300 MW. After rehabilitation, its net capacity is assumed to become 618 MW however, Flue Gas Desulphurization (FGD) is expected to reduce further the capacity of each unit by roughly 10 MW and net available capacity to 598 MW.
- TPP Kosovo C: It was assumed that TPP New Kosovo C1 and C2 would come online in 2016, and 2017 respectively with installed capacities as shown in Table 8. The efficiency for the new TPP is assumed at 38%. The assumptions on the emission factors of the new thermal power plant TPP C are presented in Table 20

Emission Factors - Kosovo C	
Carbon Monoxide (g/kg of fuel)	0.125
Unburned Hydrocarbons (g/kg of fuel)	0
Particulate Matter (g/kg of fuel)	0.03
Proportion of fuel sulfur converted to PM (%)	0
Nitrogen Oxides (g/kg of fuel)	0.49

Table 20: Summary of Modeled Emissions for the new TPP Kosovo C

- Solar Photovoltaics: The hourly solar resource in Kosovo was modeled in HOMER

based on NASA telemetry data for insolation and cloudiness indices. The estimated monthly solar resource map is shown in *Figure 17* below.

Power generation from this solar resource was modeled as a solar photovoltaic (PV) plant with 13% efficiency at STC. It was assumed that the AC derating factor (which includes DC-AC conversion efficiencies, and losses due to age, soiling, etc.) is ~87%. The solar power plant was modeled as a fixed-tilt system, tilted to 42° above horizontal (an optimal angle given by the site’s latitude).

The installed capacity of solar (PV) in this Base Scenario reaches a total of 800kW by 2020, based on estimates by MEM presented in Section 1.2.2. of this report. It was assumed that this 800 kW capacity is brought online linearly over the period 2011-2020.

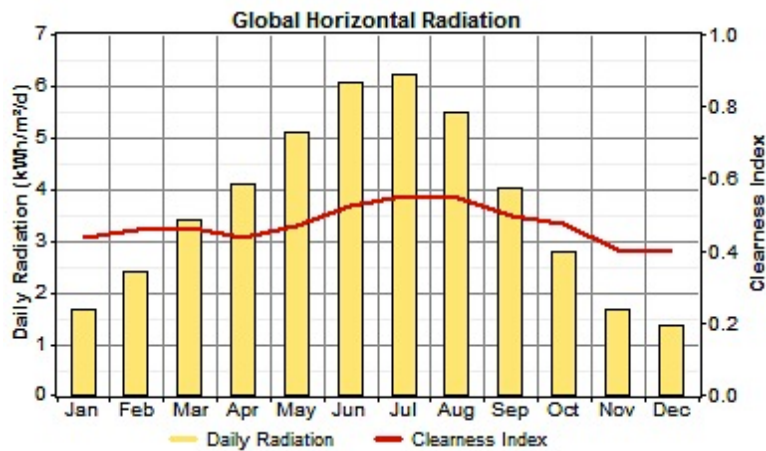


Figure 17: Modeled Solar Resource for Kosovo

- Small hydro power plants (HPP): The current installed capacity of small HPP in 2010 is ~ 42 MW. For this simulation, it was assumed that an additional capacity of 140 MW is installed by 2020 based on estimates by MEM presented in Section 1.2.2. The monthly variation in hydro resource was based on production estimates for 20 potential small HPP given in [7]. The simulated monthly average power generation (in MW) of the aggregate 182 MW capacity of small HPP is shown in *Figure 18* below. It was assumed that the capacity of installed small HPP is scaled from 42 MW to 182 MW linearly between 2010 and 2020.

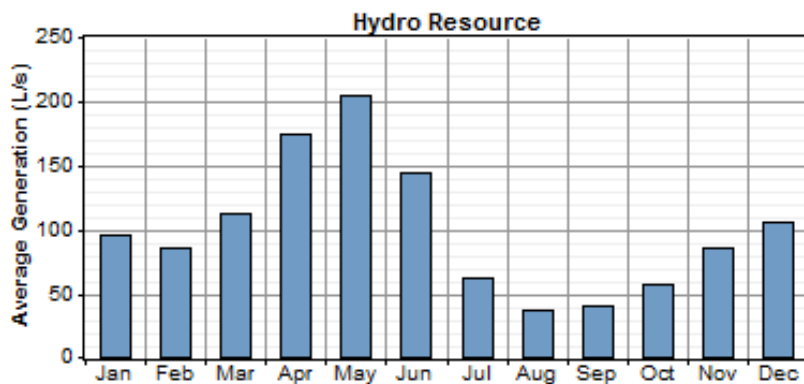


Figure 18: Modeled Average Power Generation by Month for 182.3MW of Small HPP

- HPP Zhur: It was assumed for this simulation that HPP Zhur is brought online in 2016. The Zhur HPP was modeled with an installed capacity of 305 MW and a capacity factor of 15% as shown in Section 2.2.2. of this report.
- Biomass: The MEM base scenario estimates the development of biomass and urban waste fuelled power plants to reach an installed capacity of 16.5 MW by 2020 [11]. The biomass resource was modeled in this scenario as a biogas generator with a capacity factor of ~ 58%. The emissions factors of the biogas generator were based on reference data provided by HOMER. These emissions factors are presented in *Table 21* below. In this simulation, it was assumed that this 16.5 MW capacity is brought online linearly over the period 2011-2020.

Emissions Factors	
Carbon Monoxide (g/kg of fuel)	6.5
Unburned Hydrocarbons (g/kg of fuel)	0.72
Particulate Matter (g/kg of fuel)	0.49
Proportion of fuel sulfur converted to PM (%)	2.2
Nitrogen Oxides (g/kg of fuel)	58

Table 21: Estimated Emissions Factors for Biogas Generator

- Wind: The MEM base scenario presented in Section 1.2.2. of this report shows an installed wind energy capacity of 141 MW by 2020. In this simulation, the wind resource was modeled as shown in *Figure 9*. The wind turbines were modeled as RE Power MM92 machines with installed capacity of 2MW. The modeled power curve for the MM92 turbine is shown in *Figure 19*. In [11] it was shown that the assumed capacity factor of this 141 MW of wind is ~25%. In this simulation, the annual average wind speed at 37m was scaled down from 6.94 m/s to 5.35 m/s in order to match this 25% capacity factor estimate.

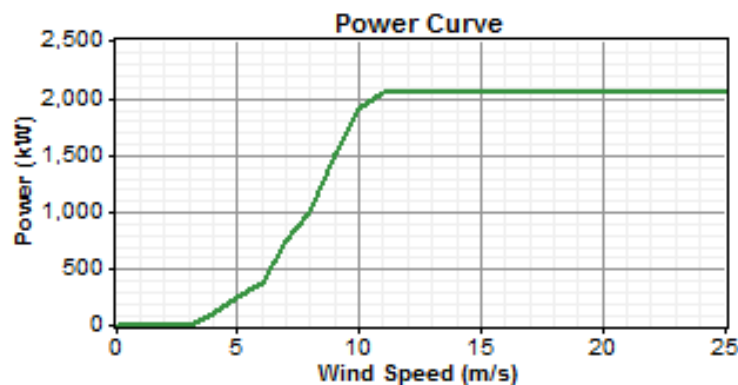


Figure 19: Modeled Power Curve for RE Power MM 92 Turbine

- Energy Efficiency: The efficiency measures in this scenario are derived from the MEM base scenario. It is hence assumed that the overall transmission, distribution and commercial losses are scheduled to reach 14% by 2020 and remain the through 2025.

3.2.2 Simulation Results

The simulated net generation forecast for the ‘base scenario’ from 2010 – 2025 is summarized in *Figure 20*. In this simulation, the generators are dispatched such that renewable generation gets priority, and thus 100% of the energy generated from renewables goes toward meeting the Total Consumption. The lignite TPP are dispatched based on their efficiency. Thus, smaller capacity TPP are favored by HOMER for meeting lower loads, due to their higher relative efficiency. The TPP are only dispatched to meet the gap between the Total Consumption and the energy generated by renewables. Thus, this simulation produces no net exports and the Total Consumption is equal to the Total Net Generation.

In this scenario, by 2025 the total energy generated from renewables is 1225 GWh – which is equivalent to 12% of the Total Net Generation. Generation from hydro power plants accounts for 10% of the Total Net Generation, while Bio+Wind+Solar contribute 2%.

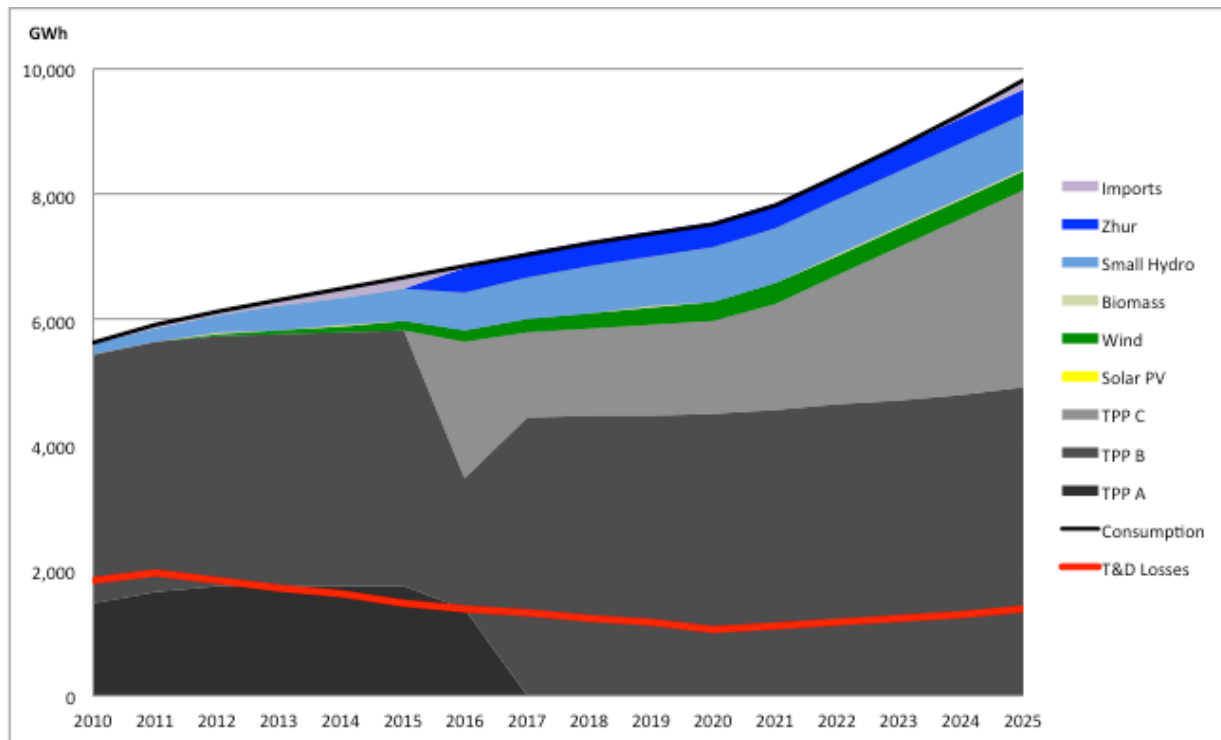


Figure 20: Simulated Net Electricity Generation for ‘Base Scenario’ 2010-2020

- 141 MW Wind by 2020
- 140 MW new small Hydro by 2020 (Total of 182MW including existing capacity)
- 300 MW HPP Zhur by 2016
- 800 kW Solar PV by 2020
- 16.5MW Biomass/Biogas by 2020
- 600 MW New Thermal Power Plant (Kosovo C) by 2017
- Decommissioning of TPP Kosovo A by 2017
- Rehabilitation of TPP Kosovo B to 600 MW by 2017
- Reduction of total T&D losses to 14% by 2020

3.3 Low Carbon & EE Scenario – Demand and Generation Forecast (2011-2025)

This section was created to present a scenario in which Kosovo's forecasted electrical demand is met through a combination of renewable resources, T&D loss prevention, energy efficiency measures and regional cooperation with neighboring countries on electricity import. This is shown as an increase in capacity for biogas, wind and solar from the base scenario together with a conservative estimation of new Geothermal capacity coming online between 2020 and 2025. The annual consumption of electricity from 2011-2025 was modeled as presented in *Table 8*. Key assumptions and results are presented below.

3.3.1 Key Assumptions

- TPP Kosovo A: In this simulation, it was assumed that TPP Kosovo A will be decommissioned by 2017. The efficiency and capacities of A3 – A5 were modeled as presented in Section 3.1.1.
- TPP Kosovo B: In this simulation, it was assumed that TPP Kosovo B will remain in service through 2025. In 2016 the two units in TPP Kosovo B are scheduled to under go efficiency improvements. During the rehabilitation period, only one of the two units is available and Kosovo B's net available capacity is assumed to be average 300 MW. After rehabilitation, its net capacity is assumed to be 618 MW. However, Flue Gas Desulphurization (FGD) is expected to reduce further the capacity of each unit by roughly 10 MW and net available capacity to 598 MW.
- Solar Photovoltaics: The total installed capacity of 800 kW in the Base Scenario is very low. A feasibility study done by Mercados estimates a medium term solar PV potential of about 77 MW of installed capacity, with a capacity factor of 22-25 percent – thus, the installed capacity of solar (PV) in this Low-Carbon Scenario is assumed to reaches a total of 75 MW by 2025. The capacity factor chosen for the analysis is 21% and at the lower end of the estimated range.
- Small HPP: The capacity of small hydro power plants (HPP) will remain as specified in the Base Scenario of Section 3.2
- HPP Zhur: It was assumed for this simulation that HPP Zhur is brought online in 2016. The Zhur HPP was modeled with an installed capacity of 305 MW and a capacity factor of 15% as shown in Section 2.2.2. of this report.
- Biomass: Section 2.5 of this report shows a theoretic potential for biomass of over 6000 GWh/yr. In this scenario we propose a factor of 10 increase in the 16.5 MW potential assumed in the Base Scenario. Thus, this scenario assumes an installed biomass resource of 165 MW by 2020. Again, we are assuming a biogas plant with a capacity factor of 58% (total annual energy production ~830 GWh/yr which is only 14% of the estimated resource potential).
- Wind: The MEM base scenario presented in Section 1.2.2. of this report shows an

installed wind energy capacity of 141 MW by 2020. This estimation was done based on three wind projects (aggregate capacity 157 MW), which had been submitted for government approval. **Currently there are over 200 MW wind projects waiting for approval in Kosovo.** In this scenario, we assume that the installed capacity by 2020 could easily be as high as 300 MW – by focusing development in the windy regions of *Figure 10* to areas near existing transmission. In addition, due to geographic dispersion of the wind farms, we're estimating an increase in the capacity factor from 25% to 30%.

- Geothermal: There are no site specific measurements available for Kosovo however the geothermal maps in the region show a high potential for Geothermal energy generation. Neighboring countries such as Serbia, Montenegro and Macedonia are already using. In this scenario we are assuming a 100 MW of Geothermal capacity to come online between 2020 and 2025. We find this estimation not far from reality due to an 800+ MW resource capacity identified in the region (Serbia+Kosovo) and significant US investments in geothermal energy worldwide.
- Energy Efficiency: **The Base Case Scenario assumes the total T&D losses to reach 14% by 2020. In the Low-Carbon scenario we believe transmission losses could be improved further hence in this scenario the total T&D losses will reduce to 8% by 2020. This percentage is closer to global standard limits on T&D losses (5-8%).**

3.3.2 Simulation Results

The simulated net generation forecast for the 'Low-Carbon Scenario' from 2010 – 2025 is summarized in *Figure 21*. As with the previous 'Base Scenario' simulation, here the Total Net Generation for each year matches the Total Consumption estimates in *Table 8*.

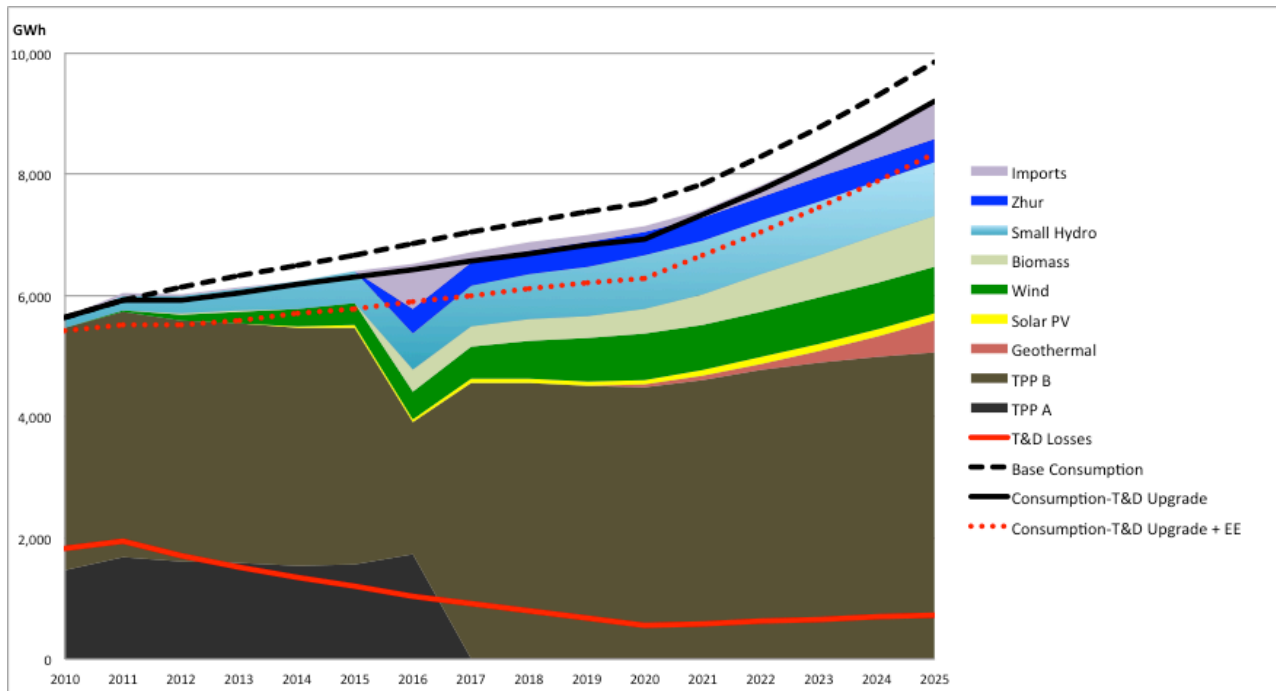


Figure 21: Simulated Net Electricity Generation for 'Low-Carbon Scenario' 2010-2020

- 300 MW Wind by 2025
- 140 MW new small Hydro by 2020 (Total of 182MW including existing capacity)
- 300 MW HPP Zhur by 2016
- 75 MW Solar PV by 2020
- 165 MW Biomass/Biogas by 2020
- 100 MW Geothermal Power Plant (2020-2015)
- Decommissioning of TPP Kosovo A by 2017
- Rehabilitation of TPP Kosovo B to 600 MW by 2017
- Reduction of total T&D losses to 8% by 2025

In the Low-Carbon graph shown above the black dash line represents the Base consumption, the solid line shows the load forecast in the presence of more aggressive T&D upgrades and the red dash line illustrates the load forecast if energy efficiency measures were to be adopted countywide. We have adopted a conservative load reduction due to the energy efficiency measures implemented. In this scenario by 2020 about 30% of the load is met through renewable recourses. This value is foreseen to reach 34% by 2025.

In this scenario, by 2020 the total energy generated from renewables is 3124 GWh – which is equivalent to 34% of the Total Net Generation. Generation from hydro power plants accounts for 10% of the Total Net Generation, while Bio+Wind+Solar+Geothermal now contribute 24%.

Furthermore, the real deficiency in Kosovo's energy production is an inability to meet peak-period energy demands, resulting in chronic blackouts at high-demand. This requires versatile peak-period supply sources- such small-scale hydro, wind, and solar projects- which can be ramped up and down quickly to meet immediate changes in demand. Figure 22 shows the monthly electricity supply in Kosovo for the 'Low-Carbon Scenario' in 2025. As seen on the

graph the ‘Low-carbon Scenarios’ is capable of meeting peak demand with enough capacity.

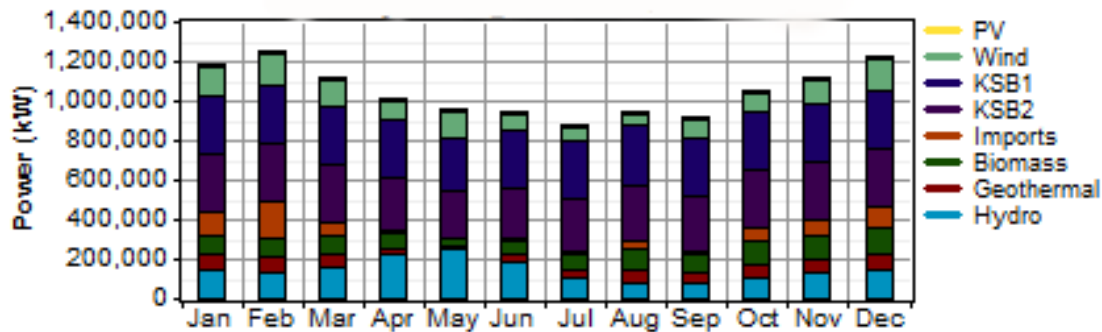


Figure 22: Monthly Electricity Supply Profile within Kosovo for ‘Low-Carbon Scenario’ 2025

3.4 Job Creation

Job creation is an especially pressing issue in Kosovo as the country is facing double-digit unemployment rates with a fast growing youth rate entering the workforce. With a 46 percent unemployment rate and a low employment rate (29 percent), Kosovo has the weakest employment track record in Europe. Unemployment among the population 15 - 25 years old reaches 76 percent, a figure that is more alarming considering that half of Kosovo’s total population is under 25.[25]

The clean energy industry has been targeted as a key area for investment for both environmental and economic reasons. Building up a domestically produced clean energy supply can provide greater energy independence and security, and has notable environmental benefits due to reduced CO₂ and other emissions. The clean energy industry can act as a driver for significant, positive economic growth through continual innovation and unlike a capitalized coal generation, clean energy create domestic jobs that are often dispersed throughout the country and additionally, many of these jobs are guaranteed to stay domestic as they involve local construction and installation. Moreover by investing in energy efficiency measures, money otherwise spent on energy costs can be redirected to stimulate the economy through job creation.

In a recent peer-reviewed study Wei, Patadia and Kammen ([23]: hereafter WPK) reviewed 15 studies on the job creation potential of renewable energy, energy efficiency, and low carbon sources such as carbon capture and sequestration (CCS) and nuclear power. The paper first clarifies job definitions and then introduces a common metric and normalization methodology to allow for meaningful comparison of studies. A meta-study of many papers is done to take ranges and averages of normalized job multipliers. Unlike most other renewable energy studies, an attempt is made to take into account job losses in the coal and natural gas industry as a first step to capturing wider economy effects.

In order to compare the various studies on an equal footing, WPK adopted two simple normalizations to calculate lifetime average employment per unit of energy. First, “one-time” employment factors such as construction and installation (“job-years per peak MW”) are

averaged over plant lifetime to obtain an average employment number (“jobs per peak MW”) that can be directly added to ongoing employment factors such as operations and maintenance. Next, to allow for comparison between technologies with different capacity factors, WPK calculate employment per unit of energy (“job-years per GWh”) or per unit of average-MW of power output (“job-years per average MW”).

Table 22 shows the direct and indirect job multipliers for different electricity resources. [32]

Work-hrs per year	2000	Capacity Factor	Equipment lifetime (years)	Employment Components			Average Employment Over Life of Facility							
							Total jobs/MWp		Total jobs/MW		Total person-yrs/GWh			
				CIM (person-years/MWp)	O&M (jobs/MWp)	Fuel extraction & processing (person-yrs/GWh)	CIM	O&M and fuel processing	CIM	O&M and fuel processing	CIM	O&M and fuel processing	Total	Avg
Biomass 1	EPRI 2001	85%	40	4.29	1.53	0.00	0.11	1.53	0.13	1.80	0.01	0.21	0.22	0.21
Biomass 2	REPP2001	85%	40	8.50	0.24	0.13	0.21	1.21	0.25	1.42	0.03	0.16	0.19	
Geothermal 1	WGA 2005	90%	40	6.43	1.79	0.00	0.16	1.79	0.18	1.98	0.02	0.23	0.25	0.25
Geothermal 2	CALPIRG 2002	90%	40	17.50	1.70	0.00	0.44	1.70	0.49	1.89	0.06	0.22	0.27	
Geothermal 3	EPRI 2001	90%	40	4.00	1.67	0.00	0.10	1.67	0.11	1.86	0.01	0.21	0.22	
Small Hydro	EPRI 2001	55%	40	5.71	1.14	0.00	0.14	1.14	0.26	2.07	0.03	0.24	0.27	0.27
Large Hydro														0.29
Solar PV 1	EPIA 2006	20%	25	37.00	1.00	0.00	1.48	1.00	7.40	5.00	0.84	0.57	1.42	0.87
Solar PV 2	REPP 2006	20%	25	32.34	0.37	0.00	1.29	0.37	6.47	1.85	0.74	0.21	0.95	
Solar PV 3	EPRI 2001	20%	25	7.14	0.12	0.00	0.29	0.12	1.43	0.60	0.16	0.07	0.23	
Wind 1	EWEA 2008	35%	25	10.10	0.40	0.00	0.40	0.40	1.15	1.14	0.13	0.13	0.26	0.17
Wind 2	REPP 2006	35%	25	3.80	0.14	0.00	0.15	0.14	0.43	0.41	0.05	0.05	0.10	
Wind 3	McKinsey 2006	35%	25	10.96	0.18	0.00	0.44	0.18	1.25	0.50	0.14	0.06	0.20	
Wind 4	CALPIRG 2002	35%	25	7.40	0.20	0.00	0.30	0.20	0.85	0.57	0.10	0.07	0.16	
Wind 5	EPRI 2001	35%	25	2.57	0.29	0.00	0.10	0.29	0.29	0.83	0.03	0.09	0.13	
Coal	REPP, 2001	80%	40	8.50	0.18	0.06	0.21	0.59	0.27	0.74	0.03	0.08	0.11	0.11
Energy Efficiency 1	ACEEE 2008	100%	20										0.17	0.38
Energy Efficiency 2	J. Goldemberg 2009	100%	20										0.59	

Table 22: Job Multipliers for different energy resources (US)

The WPK modeling approach yields the following key conclusions:

- The renewable energy and low carbon sectors generate more jobs per unit of energy delivered than the fossil fuel-based sector;
- Among the new renewable energy technologies, solar photovoltaics (PV) create the most jobs per unit of electricity output;
- Energy efficiency and renewable energy taken together can contribute to much lower CO₂ emissions and significant job creation.

Thus we should look at solar, hydro and wind energy not only as viable energy sources from an environmental perspective, but as strong avenues for job creation within the country. In the absence of local data for job creation in Kosovo we used the above numbers derived from both US and EU resources. To compare, we have calculated the job creation numbers for 3 different scenarios.

- Business As Usual (BAU): In this scenario the load till 2020 is supplied through the existing electricity resources (TPP A & B, Existing HPP), the new Kosovo C and

Imports.

- Base Scenario: This is the same scenario identified in section 3.2
- Low-Carbon Scenario: This is the same scenario identified in section 3.3

Table 23 shows the results in total ‘job.yr’ created till 2025 for different energy scenarios.

	BAU	Base Case Scenario	Low-Carbon Scenario
Energy Technology	Job.yr till 2025	Job.yr till 2025	Job.yr till 2025
Biomass	0	25	1092
Small Hydro	671	2699	2699
Large Hydro (Zhur)	0	1150	1150
Solar PV	0	13	894
Wind	0	524	1322
Coal	13,143	11,372	9,112
Geothermal	0	0	308
EE	0	0	6031
Total (Job.yr till 2020)	13,814	15,784	22,607
Jobs vs BAU (%)	-	120	188

Table 23: Total Job.Yrs created for ‘BAU’, ‘Base’ & ‘Low-Carbon’ Scenarios till 2025

This means by changing from ‘BAU’ to ‘Base Scenario’ we create 20% more full time jobs and by choosing the ‘Low-Carbon Scenario’ over ‘Base Case’ we can add another 68% to the job opportunities created.

3.5 Levelized Cost of Electricity and Externalities

Cost of electricity is generally calculated on a “per Megawatt Hour” (MWh) or “Levelized” basis in order to enable comparison between sources of generation. There are two types of cost associated with the levelized cost of electricity- Explicit and External-.

The explicit cost of electricity generation includes capital costs, fixed and variable operation and maintenance costs (O&M) and the cost of fuel. This explicit cost is paid by the power plant owner to build the facility and generate electricity.

The external cost of electricity generation includes (but is not limited to) negative health impacts, air & water pollution, resettlement issues and economic consequences of environmental damage and climate change. This cost is often not paid by the facility owner but is borne by the general society.

The Energy Information Administration (EIA) publishes estimates of levelized costs for different power plants, looking at the expected cost of electricity per kilowatt hour from a power

plant constructed today (coming online in 2016), averaged over 30 years. *Table 24* shows the estimated levelized cost of new generation capacities. These values do not include externalities.

Plant Type	Capacity Factor (%)	U.S. Average Levelized Costs (2009 \$/megawatthour) for Plants Entering Service in 2016				
		Levelized Capital Cost	Fixed O&M	Variable O&M (including fuel)	Transmission Investment	Total System Levelized Cost
Conventional Coal	85	65.3	3.9	24.3	1.2	94.8
Advanced Coal	85	74.6	7.9	25.7	1.2	109.4
Advanced Coal with CCS	85	92.7	9.2	33.1	1.2	136.2
Natural Gas-fired						
Conventional Combined Cycle	87	17.5	1.9	45.8	1.2	66.1
Advanced Combined Cycle	87	17.9	1.9	42.1	1.2	63.1
Advanced CC with CCS	87	34.6	3.9	49.6	1.2	89.3
Conventional Combustion Turbine	30	45.8	3.7	71.5	3.5	124.5
Advanced Combustion Turbine	30	31.6	5.5	62.9	3.5	103.5
Advanced Nuclear	90	90.1	11.1	11.7	1.0	113.9
Wind	34	83.9	9.6	0.0	3.5	97.0
Wind – Offshore	34	209.3	28.1	0.0	5.9	243.2
Solar PV ¹	25	194.6	12.1	0.0	4.0	210.7
Solar Thermal	18	259.4	46.6	0.0	5.8	311.8
Geothermal	92	79.3	11.9	9.5	1.0	101.7
Biomass	83	55.3	13.7	42.3	1.3	112.5
Hydro	52	74.5	3.8	6.3	1.9	86.4

¹ Costs are expressed in terms of net AC power available to the grid for the installed capacity.

Source: Energy Information Administration, Annual Energy Outlook 2011, December 2010, DOE/EIA-0383(2010)

Table 24: Estimated levelized cost of new generation capacities

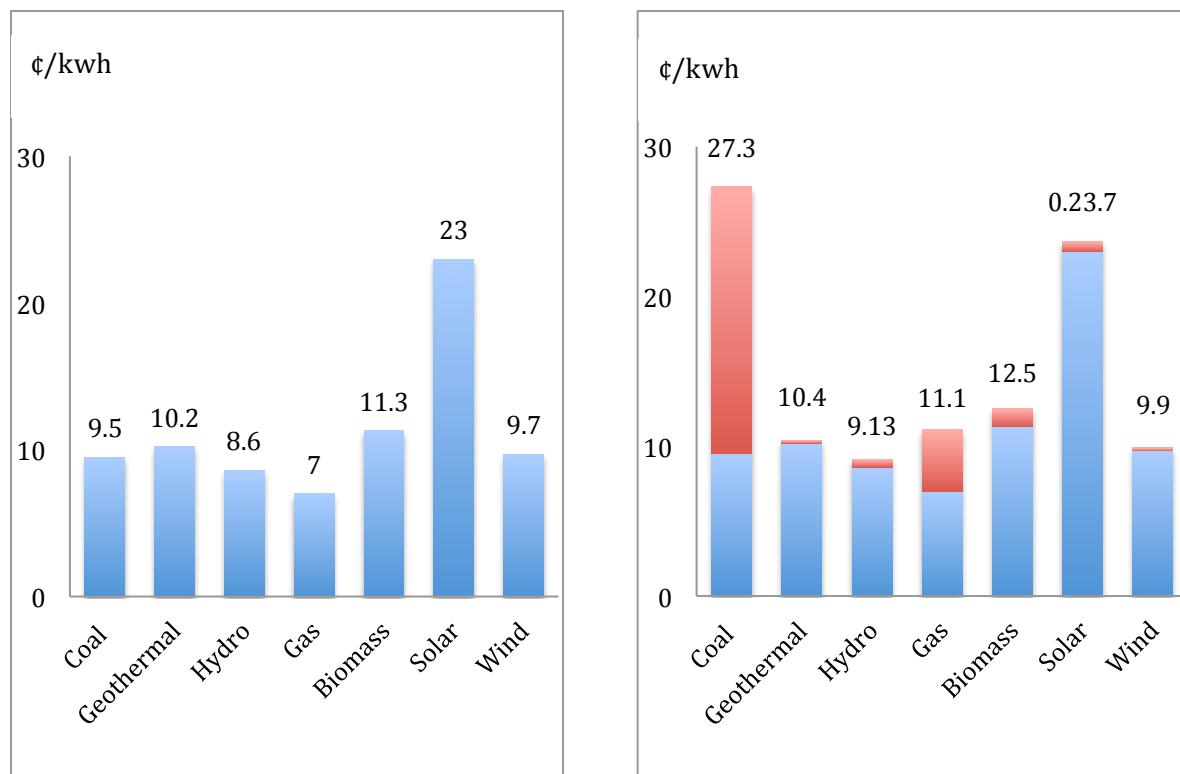


Figure 24: Social Cost of electricity generation (2010\$/MWh) [28]

There is common perception of coal as being the cheapest energy generation option however the notion doesn't hold true for new generation capacity. Coal's current market price is only half the story. The entire process from mining, through combustion to waste disposal, has a dire impact on the environment, human health and the social fabric of communities living near mines, plants and waste sites. It severely disrupts ecosystems and contaminates water supplies. It emits carbon dioxide and other greenhouse gases like nitrogen oxide and methane, as well as toxic chemicals like mercury and arsenic. Leaking waste ruins fish stocks and agriculture. It directly contributes to health problems like black lung disease.

A recent study on the externalities of coal in US finds that the best estimate for the total economically quantifiable costs, based on a conservative weighting of many of the study findings, adds about 17.8¢ /kWh to electricity generated from coal. The low estimate is 9¢ /kWh, while the true monetizable costs closer to the upper could be as high as 26.89¢ /kWh. And yet these figures do not represent the full societal and environmental burden of coal. In quantifying the damages, the study has omitted the impacts of toxic chemicals and heavy metals on ecological systems and diverse plants and animals; some ill-health endpoints (morbidity) aside from mortality related to air pollutants released through coal combustion that are still not captured; the direct risks and hazards posed by the combustion waste; the full contributions of nitrogen deposition to eutrophication of fresh water; the prolonged impacts of acid rain and acid mine drainage; many of the long-term impacts on the physical and mental health of those living in coal-field regions nearby sites; and the full assessment of impacts due to an increasingly unstable climate.

The true ecological and health costs of coal are thus far greater than the numbers suggest. Accounting for the many external costs over the life cycle for coal-derived electricity conservatively doubles to triples the price of coal per kWh of electricity generated. [31]. *Table 25* shows some of the coal externalities accounted for in US. Since there is some uncertainty in the monetization of the damages, low, base, and high estimates are presented. Low and high values indicate both uncertainty in parameters and different assumptions about the parameters that are used to calculate the estimates. Base estimates are not weighted averages, and are derived differently for each category.

Externality	2008 USD ¢/kWh		
	Low	Base	High
Land Disturbance	0.00	0.01	0.17
Methane Emission from mines	0.03	0.08	0.34
Public Health (Local Communities - Appalachia)	4.36	4.36	4.36
Air Pollution from Combustion	3.23	9.31	9.31
Lost Productivity from Mercury Emissions	0.01	0.10	0.48
Mental Retardation from Mercury Emissions	0.00	0.02	0.19
Cardiovascular Disease from Mercury Emissions	0.01	0.21	1.05
Climate Damage from CO2 & N2O	1.02	3.06	10.20
Climate Damage from black carbon emission	0.00	0.00	0.01
Total	8.66	17.15	26.11

Table 25: External Cost of Coal in US (2008 US Cents/KWh)

The data in *Table 25* are shown graphically in *Figure 25*.

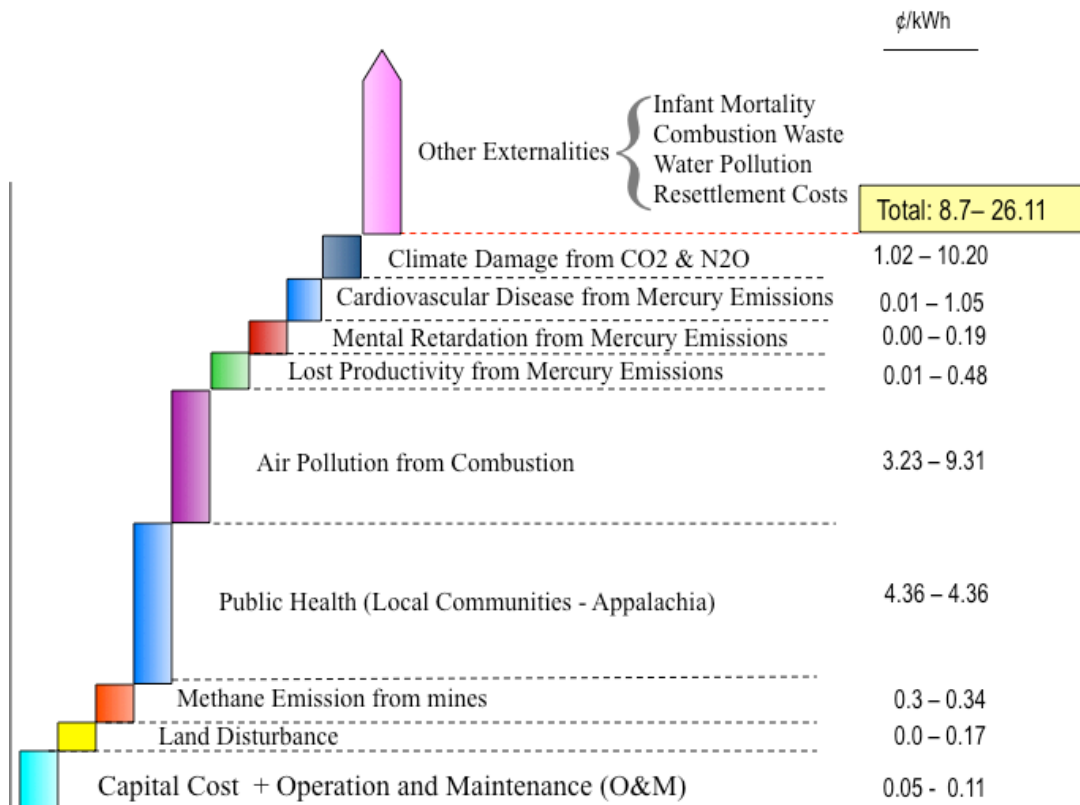


Figure 25: External Cost of Coal in US (2008 US Cents/KWh)

Table 26 shows the cost estimation for both of the scenarios studies in this paper. It includes the capital cost comparison as well as the LCOE analysis both with and without the externalities presented in Table 25. For both scenarios it was assumed that half of the imports are from fossil fuel sources and hence affected by the cost of carbon.

It can be seen that even in the absence of externalities the LCOE for the ‘Base Case Scenario’ (including the coal power plant) is above the cost for the ‘Low-Carbon Scenario’. If externalities get included, the cost of energy generation from the ‘Base Case Scenario’ could become 3 times more expensive.

CASE	DESCRIPTION	Peak MW	Total GWH	\$/W_peak ¹	\$/MWh ²	\$ million (Installed Capacity)	\$ million (LCOE)	\$ million (LCOE w Low Externalities)	\$ million (LCOE w Base Externalities)	\$ million (LCOE w High Externalities)
Base Scenario	TPP Kosovo A3-A5		11458							
	TPP Kosovo B1-B2		67818							
	TPP Kosovo C1-C2	600	20034	2.60	95	1560	1899	3642	5325	7108
	Wind	141	3087	1.95	97	275	299	299	299	299
	Small Hydro	182	10137	1.50	86	273	876	876	876	876
	HPP Zhur (cf=15%)	305	3966	1.44	125	439	495	495	495	495
	Residential PV	1	15	4.65	230	4	3	3	3	3
	Biomass	17	124	2.40	113	40	14	14	14	14
	Imports	295	840		142		119	156	191	229
	Total:			117480			2590	3706	5486	7204
Low-Carbon & EE Scenario	TPP Kosovo A3-A5		11185							
	TPP Kosovo B1-B2		68385							
	Wind	300	7787	1.95	97	585	755	755	755	755
	Small Hydro	182	10137	1.50	86	273	876	876	876	876
	HPP Zhur (cf=15%)	305	3966	1.44	125	439	495	495	495	495
	Residential PV	75	1033	4.65	230	349	238	238	238	238
	Biomass	165	5317	2.40	113	396	598	598	598	598
	Geothermal	100	1244	1.00	102	100	127	127	127	127
	Imports	295	3029		142		430	562	689	824
	Total:			112083			2142	3519	3650	3778

Table 26: Total cost of generation for ‘Base’ & ‘Low-Carbon’ Scenarios with and without externalities

Moreover, the new coal plant’s capacity will provide approximately half of the load in Kosovo. Replacing such a large percentage of the country’s base load capacity over a span of only a few years will cause a substantial increase in the cost of energy that will adversely affect the economic development of Kosovo and the impact on ratepayers.

An assessment of the cost externalities associated with a coal-dominated economy, was recently completed for the Republic of South Africa [24]. Although the analysis for South Africa covers only a few⁶ of the externalities associated with the power plant, it clearly shows that including just a few of the external costs in the true cost of coal-fired electricity generation would add

⁶ The externalities studied in the South African case include health impacts due to air pollution, the CO₂ emissions and its contribution to climate change, the cost of coal mining and transportation and finally the scarcity value (opportunity cost) of water. A lot of other important factors such as impact of heavy metals in causing cancer, health costs related to ash dumps, water quality degradation, among other factors, are left out of the study.

between 237% and 459% to the 2010 electricity tariff. [24] The energy generation mix in Kosovo is similar to that of South Africa in terms of the local coal mining to combustion value and impacts chain. This means a roughly 200% to 400% increase in the electricity cost in Kosovo should not be an overestimation.

Health Costs:

Coal mining and combustion releases many more chemicals than those responsible for climate change. Coal also contains mercury, lead, cadmium, arsenic, manganese, beryllium, chromium, and other toxic, and carcinogenic substances. Coal crushing, processing, and washing releases tons of particulate matter and chemicals on an annual basis and contaminates water, harming community public health and ecological systems. [31] Particulate matter concentration in Pristina fluctuates between 40 and 130 $\mu\text{g}/\text{m}^3$ (i.e., almost always above the average concentration of 40 $\mu\text{g}/\text{m}^3$, which the EU defines as being consistent with human health).

Kosovo has the worst health outcomes in the Balkans. As shown in *Table 27* on every indicator—life expectancy, maternal death rates, infant and child mortality, immunization rates and tuberculosis incidence—Kosovo ranks far below neighboring countries, often by a factor of two. [18] According to 2007 UNDP data, Kosovo had the highest child and infant mortality rates and the lowest life expectancy (69 years) in South East Europe. Environmental problems such as air pollution, waste management and heavy metal pollution affect the population’s health: the Mitrovica municipality reports the highest blood lead levels in the world. [19]

Indicators	Kosovo	Serbia	Albania	Bosnia	Macedonia	EU
Life expectancy at birth, total (years)	69	74	76	n/a	n/a	79
Maternal deaths (per 100000 live births)	28.4*	12.68	16.75	n/a	13.34	6.01
Infant mortality (per 1,000 live births)	20.6*	7.11	7.8	n/a	n/a	4.56
Under 5 mortality (per 1,000)	69 (2002)	8.14	12.4	n/a	n/a	5.47
Immunization, measles (percent of children)	<80	92	98	83.5	98	92.8
Tuberculosis incidence per 100000	52 (2005)	26.6	13.9	60.5	25.7	15.5
UNDP Human Development Index (HDI)	0.734	0.821	0.807	0.802	0.808	n/a

Source: WHO health for all data 2006; UNDP Second Millennium Development Goals Report for Kosovo 2008; MOH: Perinatal situation in Kosovo 2000-2008.
 *Note: Infant deaths (proxied by perinatal deaths) and maternal deaths in Kosovo include only deaths in health facilities.

Table 27: Health Indicators for Kosovo and Neighboring Countries, 2007

Resettlement Costs:

The new mine will acquire approximately 13% of the territory of the Obiliq Municipality. The area planned for mining development, is largely composed of fertile land (i.e., agricultural), while the remaining parts are settlements, roads or forests.[26] According to the SESA, 2008 [27], local villages will need to be resettled with the total population of the affected area

estimated at around 1,500 families. The mine development-induced direct land acquisition is largely reflected in the four locations already slated for resettlement, including Hade (784 people remaining), Dardhishte (~ 987 people), Lajthishte (~ 921 people), and Sibovc (~ 1,114 people). In addition, 330 families in the town of Plemetin will need to be relocated because their houses are within the 1,000 m buffer zone from the new planned power plant.[27].

If resettlement is determined to be possible in the Kosovo Lignite Power Project, the project will require significant permanent relocation and rehabilitation of land, which are associated with high resettlement costs. Given the basic data needed for estimating resettlement costs, i.e., updated census, asset inventory, detailed socioeconomic survey, and project technical designs are all lacking, it is necessary to rely on average resettlement expenses for other World Bank projects.⁷ On average, World Bank-supported hydropower projects' completion reports indicate resettlement costs of an average of 11 percent of overall project costs. [29] Accordingly, resettlement costs for the Kosovo Lignite Power project are estimated to approximately equal \$33 million.⁸ [30]

4. Conclusions & Recommendations

This assessment is an analytic treatment of the energy options that exist today and that can be created through investigation of new energy efficiency, renewable energy, and the wise use of fossil fuel resources. Key components of such a forward-looking energy plan for Kosovo, and arguably for the Balkans more widely, are: job creation and the support of indigenous industry; reduced exposure to energy supply and price risks through regional coordination and integration; and an energy mix that reduces human and environmental health risks and facilitates economic integration with the European Union.

In conclusion we find that:

- A low-carbon path exists for Kosovo that integrates aggressive energy efficiency deployment, T&D grid upgrades, use of both large and small-scale hydropower, solar, biomass and extensive use of wind energy while reducing human and ecological impact of energy generation. This path whilst delivering 34% of the energy demand through renewable resources also provides over 60% more jobs than a business as usual path and it does so at an estimated cost savings of 5-50% relative to a base-case scenario that includes a new coal power plant.
- The business as usual path, dominated by an expanded use of low-quality coal, is not the least-cost energy option for Kosovo given the social cost of thermal generation. A coal

⁷ The World Bank's Involuntary Resettlement Sourcebook (2004) also recommends an estimate methodology based on three to five times per capita gross national income (GNI) for each person subject to relocation. Given the specific number of persons to be relocated was unknown and that the per capita GNI for Kosovo is so low (i.e., \$3,300 according to IFC's Doing Business 2012), this method was determined not to provide an accurate estimate.

⁸ Based on an analysis carried out by Vattenfall of the new mine to serve the new power station with 600MW capacity. It shows an investment of \$300 million in constant prices over the period 2007-2038. As cited in: Kosovo Lignite Power Initiative Proposed Lignite Power Development Project (LPDP): Economic Analysis (downloaded from the World Bank's project website, file dated May 11, 2011).

dominant energy path burdens future generations with an energy mix that is neither environmentally sustainable nor is it a path that maximizes job creation.

And hence recommend that:

- The priority is placed on Energy Efficiency and Electricity grid improvement and International financial assistance is allocated towards these issue prior deciding on new thermal generation
- Aggressive energy efficiency programs together with a well designed and effective FIT for renewables is implemented. These enabling policies will enhance private investment independent of international financial assistance.
- Explore the country's potential on Geothermal and implement opportunities to make the hydropower capacity a resource year-round, and to develop wind or other renewable energy sources that can address peak energy demands, potentially utilizing wind and hydropower in concert.

Appendix A:

World Bank Kosovo Lignite Power Project: Resettlement

Prepared by: Heike Mainhardt-Gibbs, December 2011

Resettlement has been identified as a major impact that the World Bank Kosovo Lignite Power Project will have on the local population. Resettlement will be necessary mainly due to the coal mine field development aspect of the project, but also from the new power plant and related facilities and infrastructure. There are 20 towns and villages in the Lignite Power Project area. According to the SESA (2008)⁹, most of the communities are located close enough to the existing mines and power plant sites to be substantially affected by the environmental pollution that they generate. The population of Obiliq municipality is around 32,300.¹⁰ The average population density is 304 persons per km² (higher than the Kosovo average of 193 per km²).¹¹

According to the Resettlement Policy Framework¹² (RPF) for the project, the project-affected areas can be divided into three primary categories: 1) areas directly required for the mining and power complex, including for any ancillary facilities; 2) areas required for the safety zones of the mine and any new roads, sub-stations and transmission lines; and 3) areas that are not required for the mining and power complex or for the formal safety zones but which suffer or will suffer significant social and environmental impacts: such as dust, noise, air pollution and contamination of ground and surface water, etc.

As such, the new mine operation will acquire approximately 13% of the territory of the Obiliq Municipality.¹³ According to the SESA, 2008, local villages will need to be resettled with the total population of the affected area estimated at around 1,500 families. The mine development-induced direct land acquisition is largely reflected in the four locations already slated for resettlement, including Hade (784 people remaining), Dardhishte (~ 987 people), Lajthishte (~ 921 people), and Sibovc (~ 1,114 people).¹⁴ In addition, 330 families in the town of Plemetin will need to be relocated because their houses are within the 1,000 m buffer zone from the new planned power plant.¹⁵

The majority of land is owned in close proximity of residents and renting of land is not a common practice in the project area.¹⁶ All residents in the project area own land around their

⁹ SESA, 2008. Strategic Environmental and Social Assessment. Government of Kosovo, Ministry of Energy and Mining. World Bank Lignite Power Technical Assistance Project (LPTAP), June 2008.

¹⁰ There are around 5,300 inhabitants in town and 27,000 in the rural areas. Ministry of Environment and Spatial Planning, 2006. "Spatial Analysis of Obiliq".

¹¹ Ibid.

¹² Ministry of Environment and Spatial Planning, 2009. Resettlement Policy Framework for Land Acquisition for the New Mining Field Zone. Republic of Kosovo, 2009.

¹³ SESA, 2008. Strategic Environmental and Social Assessment. Government of Kosovo, Ministry of Energy and Mining. World Bank Lignite Power Technical Assistance Project (LPTAP), June 2008.

¹⁴ These population estimates were cited in the SESA, 2008. The SESA noted that up dated census data was necessary. In addition, it appears that these estimates may only represent village residents and not rural populations.

¹⁵ SESA, 2008. Strategic Environmental and Social Assessment. Government of Kosovo, Ministry of Energy and Mining. World Bank Lignite Power Technical Assistance Project (LPTAP), June 2008.

¹⁶ SESA, 2008. Strategic Environmental and Social Assessment. Government of Kosovo, Ministry of Energy and Mining. World Bank Lignite Power Technical Assistance Project (LPTAP), June 2008.

houses or ‘yards’ on which 80-97% grow crops and cereals for household consumption.¹⁷ Income levels are low and most inhabitants are reliant on subsistence farmed for some, if not all, of their food supply. Additional income is generated through agricultural production, wood-cutting¹⁸ and small scale farming.¹⁹ The Project will acquire most of the fertile land in the surrounding area.²⁰

Appropriate resettlement and compensation for any lost land is especially important due to the reliance on agricultural production for both subsistence farming and as an additional source of income. Resettlement involved in the Kosovo Lignite Power Project is complicated²¹ and must abide by international standards, which in addition to land and house replacement, require affected families to be compensated for the loss of their livelihoods and/or subsistence. The SESA (2008) concluded that “the Project would provide limited paid employment for some residents, however, economic advantages are limited for most.”

Lack of Agricultural Land and Rehabilitation: Resettlement involved in the Lignite Power Project is further complicated by the fact that there is not enough replacement agricultural land to resettle people who rely on farming for their livelihoods.²² The RPF²³ asserts that this problem will be addressed through rehabilitated land:

There is an acute shortage of good agricultural land in the area around the proposed mining and power complex. The option of providing a plot of rehabilitated land is intended to encourage the Project Company to rehabilitate and make use of a large area of overburden dumps that is presently owned by KEK. To make this option more attractive, the Project Company will offer affected landowners a larger area of land than the plot that is affected and/or a package of additional benefits, which might include technical assistance and/or the use of shared equipment.

However, it has not been proven that the rehabilitated land will be suitable for food production. Once land has been fully rehabilitated, it will still take time and funding to monitor the soil and water quality to determine whether or not it is safe for food production.²⁴

Resettlement Costs: If resettlement is determined to be possible in the Kosovo Lignite Power Project, the project will require significant permanent relocation and rehabilitation of land, which are associated with high resettlement costs. Given the basic data needed for estimating resettlement costs, i.e., updated census, asset inventory, detailed socioeconomic survey, and project technical designs are all lacking, it is necessary to rely on average resettlement expenses

17 Ibid.

18 A quarter of all residents earn extra income cutting and selling wood for heating (SESA, 2008).

19 SESA, 2008. Strategic Environmental and Social Assessment. Government of Kosovo, Ministry of Energy and Mining. World Bank Lignite Power Technical Assistance Project (LPTAP), June 2008.

20 Ibid.

21 According to the SESA (2008), the legacy of the resettlement in 2003-2004 in the area, i.e. partial resettlement of Hade, has left both those remaining and those resettled extremely angry about the process. Residents are concerned that the Hade experience will be repeated. As of SESA (2008), 85 Hade-resettled families were still living in temporary accommodation in Obiliq town.

22 Ibid.

23 Ministry of Environment and Spatial Planning, 2009. Resettlement Policy Framework for Land Acquisition for the New Mining Field Zone.

24 Some data may be obtained from the Clean Up and Land Reclamation Project (CLRP) that was initiated in 2007.

for other World Bank projects.²⁵ On average, World Bank-supported hydropower projects' completion reports indicate resettlement costs of an average of 11 percent of overall project costs.²⁶ Accordingly, **resettlement costs for the Kosovo Lignite Power project are estimated to approximately equal \$33 million.**²⁷

25 The World Bank's Involuntary Resettlement Sourcebook (2004) also recommends an estimate methodology based on three to five times per capita gross national income (GNI) for each person subject to relocation. Given the specific number of persons to be relocated was unknown and that the per capita GNI for Kosovo is so low (i.e., \$3,300 according to IFC's Doing Business 2012), this method was determined not to provide an accurate estimate.

26 World Bank, 2004. Involuntary Resettlement Sourcebook - planning and implementation in development projects, 2004.

27 Based on an analysis carried out by Vattenfall of the new mine to serve the new power station with 600MW capacity. It shows an investment of \$300 million in constant prices over the period 2007-2038. As cited in: Kosovo Lignite Power Initiative Proposed Lignite Power Development Project (LPDP): Economic Analysis (downloaded from the World Bank's project website, file dated May 11, 2011).

Appendix B:

The Illogic of International Investments in Dirty Energy in Kosovo

The current situation:

Kosovo operates two coal-fired power plants (Kosovo A & B), one of which (A) is fifty years old and is the dirtiest power plant in Europe, and must be shut down as soon as possible. The power plants are 6 miles from the capital, Pristina, resulting in tremendous local air pollution, including toxic metal and particulates exposure for people and agriculture.

Kosovo has a vast resource of particularly dirty brown anthracite coal, yet high power prices.

Kosovo's power system has staggering energy losses of over 45%, due to technical inefficiency and theft.

The World Bank conducted an expert review of energy options, with three fossil fuel experts comprising the entire team, recommending a new coal plant, Kosovo C.

The former Chief Technical Specialist for Renewable Energy and Energy Efficiency at the World Bank conducted his own independent assessment, finding that a mixture of grid upgrades, efficiency, and investments in renewable energy would more than meet Kosovo's energy needs, while increasing private sector energy investment and producing up to 30% greater job creation than the coal energy path. The plan developed by this team, led by Professor Kammen, which calls for closing Kosovo A in 2017 is available online at: <http://rael.berkeley.edu/kosovoenergy>

[BORROWING MONEY TO BUILD AND UNNECESSARY NEW COAL PLANT WOULD INDEBT THE COUNTRY AND PUT UNNECESSARY STRESS ON BUDGETS AND RESOURCES FOR DEVELOPMENT.]

Kosovo seeks EU membership. Given the EU's clean energy policy platform, BUILDING a new a very dirty coal PLANT puts KOSOVO real disadvantage in pursuing EU membership.

DESPITE BEING UNNEEDED AND A THREAT TO ECONOMY, ENVIRONMENT AND POLITICAL FUTURE OF KOSOVO, both the U. S. government and the World Bank have endorsed a plan to build a new 600 MW coal PLANT

Investing in a clean energy path for Kosovo:

NEW COAL DOES NOT MEET KOSOVO'S ENERGY NEEDS. Kosovo NEEDS energy – BUT for added “peak power”, OR PERIODIC SPIKES IN DEMAND. BUT A coal plant can not respond to the daily demand changes this necessitates. A mixture of energy efficiency and new gas-fired capacity and/or renewable energy can flexibly and rapidly respond to this demand.

Kosovo DOES need TO greatly increased “baseload capacity” over the next decade. BUT KOSOVO DOES NOT NEED A NEW COAL PLANT TO MEET IT. The <http://rael.berkeley.edu/kosovoenergy> study found that sufficient wind, biomass, and hydropower resources exist in the region to more than fill the long-term baseload power needs.

ALTERNATIVE ENERGIES ARE POISED FOR SUCCESS. Kosovo has VERY GOOD GRID POLICIES (A “Feed-in-tariff” plan <http://dl.acm.org/citation.cfm?id=1807937>), BUT THEY HAVE not been implemented YET. The private sector HAS COME FORWARD WITH Over 220 MW of wind energy investments, but none HAVE been constructed due to ineffective management. MANY SUSPECT THE COAL INDUSTRY LOBBY IS HOLIDNG BACK IMPLEMENTATION. The World Bank plan fails to address this excellent resource and bureaucratic bottleneck, PREFERING TO BLINDLY PUSH FOR DIRTY ENERGY. UNLEASHING WIND ENERGY INVESTMENT WOULD BRING MORE ENERGY ON LINE FASTER AND CHEAPER THAN COAL, WHILE achieving major health benefits for Kosovo, promoting investment.

The World Bank’s LAST DIRTY ENERGY PROJECT, THE 4 GW Medupi coal-fired power plant IN SOUTH AFRICA, was CALLED ‘an exception in the trend of a decarbonized energy portfolio’ (CHECK ON A PRECISE QUOTE). IS KOSOVO ANOTHER EXCEPTION? NEW COAL MAKES NO SENSE FOR KOSOVO. WHEN WILL THE BANK KICK ITS NEEDLESS, DESTRUCTIVE DIRTY ENERGY HABIT?

SUPPORT KOSOVARS IN THEIR EFFORTS FOR A CLEAN, SUSTAINABLE FUTURE

CALL ON THE BANK TO WALK ITS TALK – AND INVEST IN THE FUTURE OF GREEN ENERGY, NOT THE PAST OF DIRTY, IMPOVERISHING MONSTERS.

SUPPORT International CALLS for power-sector transparency and an operational plan for system efficiency and reduced energy losses due to theft.

SUPPORT International and local engagement in Kosovo to make the Feed-in-tariff operational

SUPPORT Long-term partnership and investment in Kosovo to launch the clean energy options that exist in the region including construction of the Zhur hydropower plant, regional wind development with neighboring nations, and sustainable biomass.

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