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Western Balkans Investment Framework
Infrastructure Project Facility
Technical Assistance 4 (IPF 4)

WB15-REG-ENE-03

Pre-feasibility Study for Albania to Kosovo Gas Pipeline

Pre-feasibility Study Report

Final

December 2018

COWI | IPF

*) This designation is without prejudice to positions on status, and is in line with UNSCR 1244/1999 and the ICJ Opinion on the Kosovo declaration of independence.

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The technical assistance operation is financed under the Western Balkans Investment Framework (WBIF) which is a joint initiative of the EU, International Financial institutions, bilateral donors and the governments of the Western Balkans which supports socio-economic development and EU accession across the Western Balkans through the provision of finance and technical assistance for strategic investments, particularly in infrastructure, energy efficiency and private sector development.

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List of Abbreviations

ALB	Albania
bcm	Billion Cubic Meter
BVS	Block Valve Station
CTMS	Custody Transfer and Metering Station
DCF	Discounted Cash Flow
EB/C	Economic Benefit/Cost Ratio
EBRD	European Bank for Reconstruction and Development
EC	European Commission
EIA	Environmental Impact Assessment
EIB	European Investment Bank
EIRR	Economic Internal Rate of Return
ESIA	Environmental and Social Impact Assessment
ENPV	Economic Net Present Value
FIRR	Financial Internal Rate of Return
GDP	Gross Domestic Product
GMP	Gas Master Plan
IAP	Ionian-Adriatic Pipeline
IESE	Initial Environmental and Social Evaluation
IFI	International Financial Institutions
KOS	Kosovo
LFO	Light Fuel Oil
LNG	Liquefied Natural Gas
LPG	Liquefied Petroleum Gas
mcm	Million Cubic Meter
PCI	Projects of Common Interest
PECI	Projects of Energy Community Interest
PRMS	Pressure Regulation and Metering Station
PTS	Pig Trap Station
PV	Present Value
SEA	Strategic Environmental Assessment
TAP	Trans-Adriatic Pipeline
ToR	Terms of Reference
TSO	Transmission System Operator
VoLL	Value of Lost Load
WB	Word Bank
WBIF	West Balkans Investment Framework

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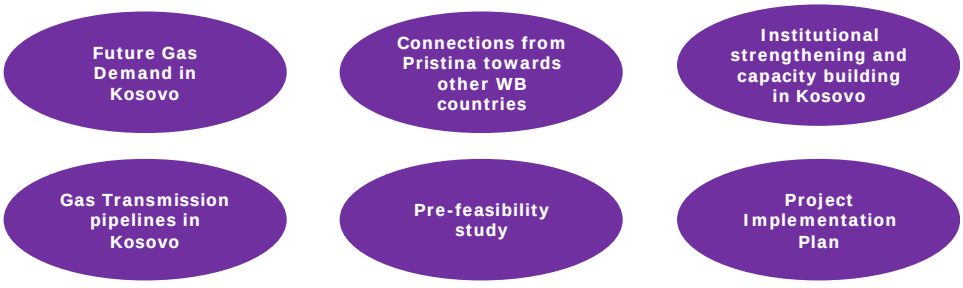
1 Executive Summary

COWI-IPF Consortium has been commissioned by EC DG NEAR to elaborate the Pre-feasibility study of the Albania - Kosovo Gas Pipeline (ALKOGAP), the gas transmission pipeline which aims to establish a new supply route for the natural gas transported from the Caspian Region via the Trans-Adriatic Pipeline in a north-east direction through Albania towards Kosovo.

The region is characterized by a lack or underdevelopment of infrastructure in the gas field. Natural gas industry or gas market is inexistent in Kosovo (some LPG is used) and a very limited gas network is in place in Albania. Albania has a very small gas production and there is no domestic gas supply in Kosovo. There is very limited infrastructure for gas transport in Kosovo (e.g. the short section from Pristina towards the former Yugoslav Republic of Macedonia; previous network for gas from coal gasification).

Following the development of TAP and IAP and the gasification of Albania, this project consists of preparation of a pre-feasibility study for a potential gas interconnector between Albania and Kosovo. The study covered the following topics:



Market background

Expected consumption of natural gas for both the Albania part and Kosovo will grow to up to 2,121 mil. m3 of natural gas in 2040 out of which 625 mil. m3 is for a potential CCGT in Kosovo and 242 mil. m3 is for DH CHP systems in major consumption centres in Kosovo.

Technical issues

Since Albania currently has no major gas transmission network, the present study assumed that ALKOGAP would be implemented after the future construction of IAP and the gas transmission system up to Fushe-Kruje.

The sustainability of the development of the transmission pipeline section in Albania was carried out in the GMP phase of the project while the transmission pipeline section in Kosovo is developed in the present report.

Due to constraints in the capacity of the IAP, i.e. capacity for Kosovo is not foreseen in the design parameters for IAP, it was agreed with the PMU of the ALKOGAP sub-project to develop the present PFS based on following scenario:

- **A 24" gas pipeline from Milot, Albania to Prishtina, Kosovo with a capacity of 1 bcm per year.**

This correspond to the Albanian Gas Master Plan, approved by the Government of Albania by DCM no. 87, dated 14.02.2018.

The total investment cost for the 24" transmission pipeline and facilities amounts up to 150 mil. EUR in Albania and 61 mil. EUR in Kosovo.

With a threshold of 1 bcm in the capacity of ALKOGAP then a potential 500 MW CCGT in Kosovo will impact the gas supply to the residential, service and industrial sectors as well as to potential DH CHP systems in major consumption centres, i.e. less available gas quantities to these consumers.

To allow for gas consumption in Kosovo in 2040 according to the market assessment, i.e. 2.1 bcm with a potential CCGT or 1.5 bcm without a potential CCGT, a 32" gas pipeline should be developed from Milot, Albania to Prishtina, Kosovo. The CAPEX for a 32" gas interconnector would reach 321.7 mil. EUR (225.6 mil. EUR for the Albania section and 96.1 mil. EUR for the section in Kosovo). This scenario would also require that the design conditions for IAP should be modified, i.e. the capacity of IAP should be increased from 5 bcm to 7 bcm.

Financial and economic issues

Financial and economic analyses were carried out for the 24" gas interconnector in order to evaluate the project sustainability. The financial analysis evaluated two development variants:

- Variant A: Transmission assets ownership, investment duties, operating activities as well as maintenance and the other operating activities would be divided between the national TSOs in Albania (Albgaz) and in Kosovo (to be established), according to the physical location of the assets. To this extend, the analysis was divided in two sections, one for the gas pipeline section located in Albania and the other in Kosovo.

- Variant B: ALKOGAP will be constructed and managed by an SPV and, therefore, the analysis considered the two sections as a whole.

The financial analysis revealed that, for both variants, external support is needed (i.e grant) in order to keep transmission charges at acceptable level and, hence, to facilitate the gas penetration to Kosovo market. The amount of grant needed was roughly estimated at the range of 10 to 30% of the investment costs; the lower value apply if ALKOGAP is implemented by an SPV. On the contrary, if the 500

MW power plant is included, no external financing will be needed, since the financial performance indicators meet the acceptability criteria.

As regard as the economic analysis is concerned, the assessment considered the project only as a whole. With an estimated 35% economic rate of return, a positive economic net present value of 3.2 bil. euro and a benefit/cost ratio equal to 12.2, the construction of the new gas pipeline is expected to increase social welfare. In the case that the 500 MW power plant is included, the economic performance indicators were above the set thresholds, although they were calculated at a lower level.

Environmental and social screening assessment for the project have been conducted.

- The likely adverse environmental impacts of the development phases are evaluated of low significance. They affect only a limited local area linked to Right-of-Way.

- The positive impacts are evaluated of medium to high significance. They are of socioeconomic nature and affect the local, regional and national level.

Environmental issues

Albania

The implementation of the next stages of project development in Albania should reduce at minimum the potential impacts to natural and social environment. The refining of the pipeline route should identify the most opportune route options that avoid/minimize the potential impacts. This refinement should be based on the recommendations of the SEA on Albanian Gas Master Plan. Special attention should be paid to the avoidance/minimization of the induced geological risks (landslides, debris flows, erosion, etc.) across the mountainous sharp terrain.

Kosovo

A different set of recommendations can be offered with regard to the implementation of the next stages of project development in Kosovo. First the impacts on human settlements should be mitigated through close consultation with local representatives and close review of latest territorial planning to determine that the pipeline will be specified over areas with the least negative impact on human settlements and their future developments.

Similarly, the final location of the pipeline should be specified over areas that will impact as little as possible the commercial and industrial zones such as the business park near Korrotice Village, the industrial zone near Prishtina, and any strategically economic areas alongside the major highway Kukes - Prishtina. Consultations with local government representatives, and business representatives may facilitate the identification of the best possible location for the future pipeline.

Meanwhile, the negative impacts on major highways can be avoided by implementing special construction methods such as auger boring, pipe-jacking, micro-tunnelling, horizontal directional drilling, etc. Some of these methods should

be also contemplated for crossing forested areas or environmentally sensitive areas. Alternatively, the pipeline location should be refined further through consultations with local representatives and environmental organizations to avoid some crossings of infrastructure or sensitive areas.

Next steps

Present study report is elaborated on a pre-feasibility level as well as the environmental and social assessment which is elaborated at an initial evaluation level.

To gain full knowledge about the feasibility and sustainability of the gas transmission pipeline from Albania to Kosovo it is recommended to develop a Gas Master Plan for Kosovo. A GMP for Kosovo should provide detailed knowledge about the potential gas market in Kosovo, through assessment of distribution systems feasibility for consumption centres in Kosovo, as well as potential gas interconnectors to neighbouring countries and the impact on the regional gas infrastructure, i.e. the design criteria for IAP.

After development of the GMP for Kosovo a full detailed feasibility study should be carried out including a full Environmental and Social Impact Assessment in accordance with both the Albanian legislation as well as the legislation in Kosovo.

2 Introduction

Recent developments and the initiated construction of the Trans-Anatolian Natural Gas Pipeline (TANAP) and its extension the Trans-Adriatic Pipeline (TAP) as a corridor for gas supply from the Caspian Sea to Europe create the necessary preconditions for the introduction of natural gas in the currently non-existent natural gas markets of Kosovo and Albania. In addition to TAP, the Ionian-Adriatic Pipeline (IAP) aims at establishing a new supply route for natural gas from the Middle East and the Caspian Region northwards, along the Adriatic coast.

Currently, there are no gas pipelines connecting Albania to Kosovo, nor to other major regional markets. Based on recent studies it is presumed that the entire future gas consumption in Albania will be supplied from TAP and Ionian-Adriatic Pipeline (IAP). The IAP Project intends to connect the existing gas transmission system of Croatia via Montenegro and Albania to the TAP system, which is expected to be operational by 2020.

The technical, economic, environmental and social analysis of the Albanian GMP have provided for a gas corridor toward Kosovo starting from Milot and ending at the Albanian – Kosovo border point near Kukes.

The Albania-Kosovo Gas Pipeline (ALKOGAP) aims to interconnect the existing and planned gas transmission system of Albania (including the TAP and IAP Project) with the future projected gas transmission system of the Republic of Kosovo, and the interconnectors of transmission, which are a part of the eastern branch of the Energy Community Gas Ring (ECGR). The Project aims to establish a new supply route for natural gas from the Middle East and the Caspian Region, through transportation from the Trans-Adriatic Pipeline, in the north-east through Albania towards Kosovo as a first step and possibly in the future to continue to other countries (Western Balkans countries).

2.1 Scope of work

The Pre-feasibility Study will indicate the general routes in the two countries based on desk study and site visits to potential critical points, provide practical system configurations, and show the expected investment costs based on experience and cost estimates of similar projects. While the Gas Demand Assessment in Albania was addressed in the Gas Master Plan and can be used, the Consultant will assess the gas demand in Kosovo, covering future potential gas consumption (e.g. households, services, industry, agriculture, transport, co-generation for district heating and power generation). The Pre-feasibility Study will also address the main relevant social and environmental aspects and impacts along the route, cost estimates, and cost-benefit analysis. This information will include identification of sensitive environmental and social receptors (including land use and protected areas) along the route(s) that could impact the feasibility of the route(s). It should be noted that this information will form the foundation of future assessment of route alternatives as required as review of alternatives in the ESIA.

The Project include:

(1) Gas demand and supply assessment in Kosovo;

(2) Analysis of the necessary institutional strengthening and capacity building in Kosovo;

(3) Route Investigations;

(4) Hydraulic studies and system optimization;

(5) Cost estimate;

(6) Cost-benefit analysis; and

(7) Project Implementation Plan.

The Project is a subproject within the overall WBIF-IPF4 project.

This report is using the approved Terms of Reference as agreed by the Government of Albania, the Government of Kosovo and EBRD (Jan 25th 2018) and the methodology (comments on the ToR) agreed by EBRD (Feb 7th 2018) as a basis

The overall objectives of the Project are the following:

- Increase the energy security in Albania and Kosovo;
- Introduce an environmentally more acceptable energy source in Albania and Kosovo;
- Provide access to the Albanian storage capacities;
- Provide a diversified gas supply to the region;
- Provide a significant transit capacity and income to Albania and Kosovo;
- Reduce CO2 emissions in the region and facilitate economic development;
- Develop and increase competition;
- Facilitating the gasification of significant parts of eastern Albania and Kosovo;
- Creation of the preconditions for supporting the regional concept of the South European Gas Ring.
- Reduce environmental degradation, pollution, and health problems by fuel switching.

Following the successful implementation of the Project, and the definition of the Project Implementation Plan, the Project deliverables will be used as a basis for the Government of Albania, the Government of Kosovo and the International Financial Institutions (EBRD, EIB, WB etc.) and other investors (PSP) to make infrastructure investment decisions.

3 Market Background and Analysis in Kosovo

3.1 Population data

Economic development in all former socialist countries, including Kosovo, has been proven to be very difficult for forecasting the energy demand in general and natural gas in particular. This becomes particularly difficult for forecasting natural gas demand in a country such as Kosovo, which has very little or no history of using this particular energy source. These difficulties stem from a significant difference between key energy and economic indicators, the lack of a suitable and effective infrastructure of data collection and an inability to select a proper method for modelling the trends of energy supply and energy source consumption, especially in transition periods.

The methodology used for forecasting natural gas demand is based on the bottom-up approach at the regional and national levels and this will create possibilities to have a better forecast such as the one used in different countries of the world for all energy sectors in general and natural gas in particular. The Main assumptions that are used for this natural gas demand scenario are:

- The energy demand forecast are made based on a set of key documents, such as the Kosovo Energy Strategy, 3rd Draft EE Action Plan, Kosovo Renewable Sources' Implementation Plan, Energy Balances 2011-2016, Electro-Energy Demand Forecasts by KOSTT, and different studies currently being undertaken by MED, supported by international assistance for development of new generation capacities in thermal and renewable energy sources;

- Historic data related to primary and secondary energy sources for the period 2010-2016. This group included all energy sources: oil and its derivatives, coal/lignite, firewood, solar and hydro energy;

- Historic data related to transformation of primary and secondary energy sources. This group involved all actual and future demand forecasts for all categories of TPPs, HPPs and District Heating facilities;

- Historic data related to secondary energy source consumption. This group covered consumption of all energy commodities, used in population/households, industry, public and private services and other sectors.

Number of population and number of households is the main driving factor for forecasting natural gas energy demand for household sector and based on the Census 2011 the main data of all Kosovo's municipalities and seven regions are presented in Table 3-1 below.

Table 3-1: Population for each municipality and each region of Kosovo in 2011

District	Pop.	Surface (km^2)	Pop. density (pop./km^2)	Municipality	Pop.	Surface (km^2)	Pop. density (pop./km^2)
Prishtinë	477,312	2,470	193.24	**Prishtinë**	**198,897**	**572**	**347.72**
				Besianë	88,499	663	133.48
				Drenas	58,531	290	201.83
				Lipjan	57,605	422	136.50
				Fushë Kosovë	34,827	83	419.60
				Obiliq/Kastriot	21,549	105	205.23
				Gracanicë	10,675	131	81.49
				Novobërdë	6,729	204	32.99
Prizren	331,620	1,739	190.70	**Prizren**	**177,781**	**626**	**284.00**
				Suharekë	59,722	306	195.17
				Malishevë	54,613	361	151.28
				Dragash	33,997	435	78.15
				Mamushë	5,507	11	500.64
Ferizaj	185,806	1,030	180.39	**Ferizaj**	**108,690**	**345**	**315.04**
				Kaçanik	33,454	221	151.38
				Shtime	27,324	134	203.91
				Hani i Elezit	9,389	83	113.12
				Shtërpcë	6,949	247	28.13
Pejë	174,235	1,365	127.64	**Pejë**	**96,450**	**603**	**159.95**
				Istog	39,289	454	86.54
				Klinë	38,496	308	124.99
Gjakova	194,672	1,129	172.43	**Gjakova**	**94,557**	**587**	**161.09**
				Rahovec	55,053	276	199.47
				Deçan	38,984	180	216.58
				Junik	6,078	86	70.67
Mitrovicë	272,247	2,077	131.08	**Mitrovicë**	**71,909**	**350**	**205.45**
				Vushtrri	69,870	344	203.11
				Skënderaj	50,858	378	134.54
				Mitrovica Veriore	29,460	11	2,678.18
				Leposaviq	18,600	539	34.51
				Zveçan	16,650	122	136.48
				Zubin Potoku	14,900	333	44.74
Gjilan	180,783	1,206		**Gjilan**	**90,015**	**385**	**233.81**
				Viti	46,959	278	168.92
				Kamenicë/ Dardanë	35,600	423	84.16
				Ranillug	3,866	78	49.56
				Kllokot	2,556	24	106.50
				Partesh	1,787	18	99.28
KOSOVO	**1,816,675**	**11,016**	**995**		**1,816,675**	**11,016**	**8,778**

Source: KAS-Kosovo Agency of Statistics

Three very important parameters for calculating natural has demand for households are the base year (2017) population, number of household and their breakdown in urban and rural areas. Table 3-2 below presents this breakdown for all municipalities of Kosovo based on the KAS data for 2017.

Table 3-2: Population and number of households (breakdown in urban and rural areas) for each municipality of Kosovo in 2017

Nr	Municipality		Urban	Rural	Total	Rural includi	Urban	Total
1	Prishtinë	Pristina	161751	37146	198897	5436	24884	30320
2	Besianë	Podujevë	23453	65046	88499	12137	4112	16249
3	Drenas	Gllogoc	6143	52388	58531	7898	1051	8949
4	Lipjan	Lipjan	6870	50735	57605	8784	1087	9871
5	Fushë Kosovë	Fushë Kosovo	18515	16312	34827	2819	3250	6069
6	Obiliq/Kastriot	Obiliq	6864	14685	21549	2168	1642	3810
7	Gracanicë	Graçanicë	0	10675	10675	2758	0	2758
8	Novobërdë	Novobërdë	0	6729	6729	1235	0	1235
9	Prizren	Prizren	94517	83264	177781	12569	15759	28328
10	Suharekë	Suharekë	10422	49300	59722	7535	3989	11524
11	Malishevë	Malishevë	3395	51218	54613	8926	618	9544
12	Dragash	Dragash	1098	32899	33997	5251	194	5445
13	Mamushë	Mamushë	0	5507	5507	1423	0	1423
14	Ferizaj	Ferizaj	42628	65982	108610	9851	9657	19508
15	Kaçanik	Kaçanik	10393	23016	33409	3668	3662	7330
16	Shtime	Shtime	7255	20069	27324	4175	1260	5435
17	Hani i Elezit	Hani i Elezit	0	9403	9403	2430	0	2430
18	Shtërpcë	Shtërpcë	1265	5684	6949	2113	239	2352
19	Pejë	Pejë	48962	47488	96450	8038	8325	16363
20	Istog	Istog	5115	34174	39289	7308	950	8258
21	Klinë	Klin	5908	32588	38496	5185	1418	6603
22	Gjakova	Gjakovë	40827	53729	94556	8562	10966	19528
23	Rahovec	Rahovec	15892	40316	56208	6547	2577	9124
24	Deçan	Deçan	3803	36216	40019	7136	719	7855
25	Junik	Junik	0	6084	6084	1023	0	1023
26	Mitrovicë	Mitrovicë	46132	25777	71909	4602	10348	14950
27	Vushtrri	Vushtrri	27272	42598	69870	10119	4903	15022
28	Skënderaj	Skenderaj	6612	44246	50858	6950	1927	8877
29	Mitrovica Veriore	Mitrovica e Veri	18899.564	10,560	29,460	2729	4964	7693
30	Leposaviq	Leposaviq	2460	11,055	13,515	2832	570	3402
31	Zveçan	Zveqan	1339	6,019	7,358	1210	445	1655
32	Zubin Potoku	Zubin Potok	1189.9993	5,347	6,537	1367	350	1717
33	Gjilan	Gjilan	54239	35939	90178	9536	7948	17484
34	Viti	Viti	4924	42063	46987	7917	908	8825
35	Kamenicë/Dardanë	Kamenicë	7331	28754	36085	4989	1370	6359
36	Ranillug	Ranillug	0	3866	3866	999	0	999
37	Kllokot	Kllokot	0	2556	2556	660	0	660
38	Partesh	Partesh	0	1787	1787	462	0	462
	Kosovo		685475	1111220	1796695	199347	130092	329439

Source: KAS-Kosovo Agency of Statistics

Demographic data of population and the number of urban families in Kosovo for the period 2011-2017 20-30-40-50 are presented in Table 3-3 and Figure 3-1. These data are going to be used for the natural gas energy demand forecast for the household sector. Population trends are based on KAS and WB forecasts.

Table 3-3: Population forecast for Kosovo in 2017

Scenario	2011	2017	2020	2025	2030	2035	2040	2045	2050
KAS Low	1,816,675	1,783,531	1,761,400	1,693,191	1,603,544	1,488,439	1,361,640	1,220,909	1,066,711
KAS Medium	1,816,675	1,783,531	1,803,705	1,823,396	1,821,470	1,801,428	1,768,009	1,723,294	1,665,623
KAS High	1,816,675	1,783,531	1,860,381	1,996,466	2,116,862	2,229,059	2,329,426	2,427,242	2,520,099

Source: KAS and the WB

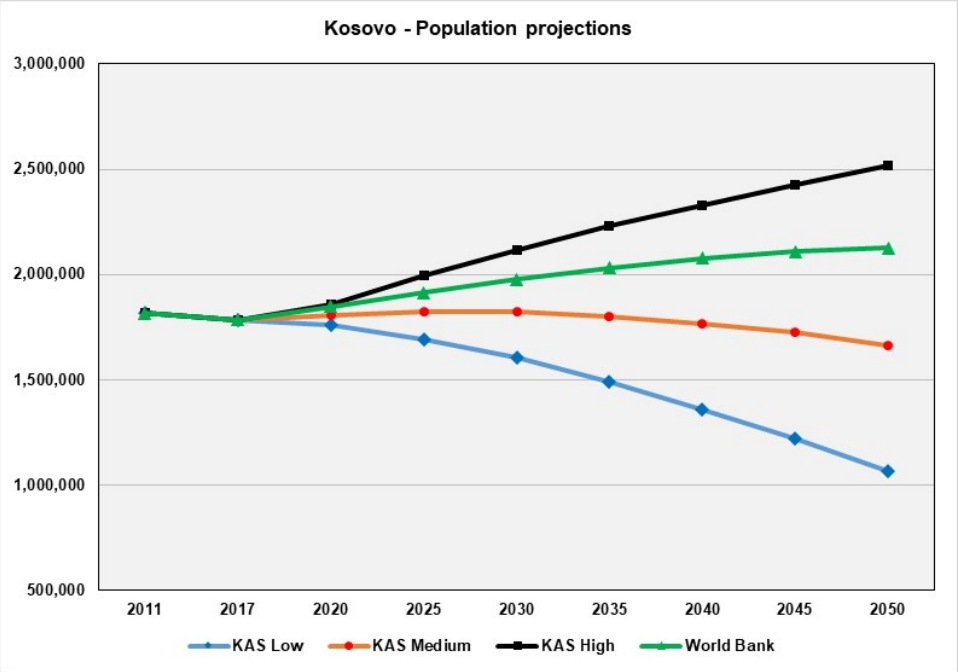


Figure 3-1: Kosovo population projections

Time series of number of persons per household in developed and developing European countries show that the number of persons per household decreases as the standard of living increases. However, what is surprising is that this decrease in developing countries happens very quickly, and some of these countries are already very close to a level of two persons per household, like most developed European countries. The decrease occurs due to migration, aging of population and lifestyle, all factors which contribute to the constant increase in the share of one-member and two-member households. In Kosovo, the number of persons per household would decrease from 5.51 in 2013 to 3.26 in 2040.

With the decrease of the number of persons per household and with the same number of inhabitants, the number of housing units is growing. This movement is reflected in the growth of the number of housing units in major cities, because the population there increases intensively, and the number of persons per household decreases faster than in smaller cities and especially in rural settlements.

The number of population have been forecast for each municipality and for each region based on the trends for the period 2011-2017 and the results are presented in Table 3-4. In the same time, the number of households have been forecasted for each municipality and for each region are based on the trends of the period 2011-2017 and the results are presented in Table 3-5.

Table 3-4: Population forecast for each of Kosovo's municipalities and regions

Year	2011	2017	2020	2025	2030	2035	2040	2045	2050
Population			4.31%	7.31%	6.03%	5.30%	4.50%	4.20%	3.83%
Prishtinë	477,312	468604	498571	545742	590226	633939	675733	718190	760578
Prizren	331,620	325570	342994	371765	398126	423419	446909	470332	493209
Ferizaj	185,806	182416	191608	207063	221087	234435	246705	258864	270649
Pejë	174,235	171056	174858	183896	191086	197190	201947	206219	209826
Gjakova	194,672	191120	197362	209681	220102	229450	237384	244878	251704
Mitrovicë	272,247	267280	267645	275734	280667	283722	284637	284725	283793
Gjilan	180,783	177485	187342	202585	215568	226905	236111	244033	250340
Total	1,816,675	1783531	1860381	1996466	2116862	2229059	2329426	2427242	2520099
Total Population	2011	2017	2020	2025	2030	2035	2040	2045	2050
Prishtinë	**198,897**	195268	207756	227412	245948	264164	281579	299271	316935
Besianë	88,499	86884	92441	101187	109434	117539	125288	133160	141020
Drenas	58,531	57463	61138	66922	72377	77738	82863	88069	93267
Lipjan	57,605	56554	60171	65864	71232	76508	81552	86676	91791
Fushë Kosovë	34,827	34192	36378	39820	43066	46255	49305	52403	55495
Obiliq/Kastriot	21,549	21156	22509	24638	26647	28620	30507	32424	34338
Gracanicë	10,675	10480	11150	12205	13200	14178	15113	16062	17010
Novobërdë	6,729	6606	7029	7694	8321	8937	9526	10125	10722
Prizren	**177,781**	174538	183879	199303	213435	226994	239587	252144	264408
Suharekë	59,722	58632	61770	66952	71699	76254	80485	84703	88823
Malishevë	54,613	53617	56486	61224	65566	69731	73599	77457	81224
Dragash	33,997	33377	35163	38113	40815	43408	45816	48217	50563
Mamushë	5,507	5407	5696	6174	6611	7031	7422	7811	8190
Ferizaj	**108,690**	106707	112084	121125	129328	137136	144314	151427	158320
Kaçanik	33,454	32844	34499	37281	39806	42210	44419	46608	48730
Shtime	27,324	26825	28177	30450	32512	34475	36280	38068	39801
Hani i Elezit	9,389	9218	9682	10463	11172	11846	12466	13081	13676
Shtërpcë	6,949	6822	7166	7744	8268	8768	9227	9681	10122
Pejë	**96,450**	94690	96795	101798	105778	109157	111790	114155	116152
Istog	39,289	38572	39430	41467	43089	44465	45538	46501	47314
Klinë	38,496	37794	38634	40631	42219	43568	44619	45563	46359
Gjakova	**94,557**	92832	95864	101847	106909	111450	115303	118943	122259
Rahovec	55,053	54049	55814	59297	62245	64888	67132	69251	71182
Deçan	38,984	38273	39523	41990	44077	45949	47537	49038	50405
Junik	6,078	5967	6162	6547	6872	7164	7412	7646	7859
Mitrovicë	**71,909**	70597	70693	72830	74133	74940	75182	75205	74959
Vushtrri	69,870	68595	68689	70765	72031	72815	73050	73073	72833
Skënderaj	50,858	49930	49998	51509	52431	53002	53173	53189	53015
Mitrovica Veriore	29,460	28923	28962	29837	30371	30702	30801	30810	30709
Leposaviq	18,600	18261	18286	18838	19175	19384	19446	19453	19389
Zveçan	16,650	16346	16369	16863	17165	17352	17408	17413	17356
Zubin Potoku	14,900	14628	14648	15091	15361	15528	15578	15583	15532
Gjilan	**90,015**	88373	93281	100871	107335	112980	117564	121508	124649
Viti	46,959	46102	48663	52622	55994	58939	61331	63388	65027
Kamenicë/Dardanë	35,600	34951	36892	39893	42450	44682	46495	48055	49297
Ranillug	3,866	3795	4006	4332	4610	4852	5049	5219	5353
Kllokot	2,556	2509	2649	2864	3048	3208	3338	3450	3539
Partesh	1,787	1754	1852	2003	2131	2243	2334	2412	2475

Table 3-5: Household forecast for each of Kosovo's municipalities and regions

year	2011	2017	2020	2025	2030	2035	2040	2045	2050
Households	5.51	5.51	5.41	5.21	4.92	4.56	4.15	3.71	3.26
Prishtinë	79,261	77815	84447	96134	110208	127840	149895	178431	215417
Prizren	56,264	55238	59358	66910	75954	87242	101290	119390	142725
Ferizaj	37,055	36379	38976	43805	49578	56777	65724	77238	92060
Pejë	31,224	30654	31962	34959	38505	42914	48344	55291	64134
Gjakova	37,530	36845	38810	42881	47713	53719	61134	70632	82764
Mitrovicë	53,316	52343	53463	57282	61805	67476	74463	83425	94793
Gjilan	34,789	34154	36772	41355	46645	53026	60696	70260	82166
Total	329,439	323429	343788	383326	430410	488994	561545	654667	774060
Total House	2011	2017	2020	2025	2030	2035	2040	2045	2050
Prishtinë	**30,320**	29767	32304	36775	42158	48903	57340	68256	82404
Besianë	16,249	15953	17312	19708	22593	26208	30729	36579	44162
Drenas	8,949	8786	9535	10854	12443	14434	16924	20146	24322
Lipjan	9,871	9691	10517	11972	13725	15921	18668	22221	26828
Fushë Kosovë	6,069	5958	6466	7361	8439	9789	11477	13662	16494
Obiliq/Kastriot	3,810	3740	4059	4621	5298	6145	7205	8577	10355
Gracanicë	2,758	2708	2938	3345	3835	4448	5216	6209	7496
Novobërdë	1,235	1212	1316	1498	1717	1992	2336	2780	3357
Prizren	**28,328**	27811	29886	33688	38241	43925	50998	60111	71860
Suharekë	11,524	11314	12158	13705	15557	17869	20746	24454	29233
Malishevë	9,544	9370	10069	11350	12884	14799	17182	20252	24210
Dragash	5,445	5346	5744	6475	7350	8443	9802	11554	13812
Mamushë	1,423	1397	1501	1692	1921	2206	2562	3020	3610
Ferizaj	**19,508**	19152	20520	23062	26101	29891	34601	40663	48466
Kaçanik	7,330	7196	7710	8665	9807	11231	13001	15279	18211
Shtime	5,435	5336	5717	6425	7272	8328	9640	11329	13503
Hani i Elezit	2,430	2386	2556	2873	3251	3723	4310	5065	6037
Shtërpcë	2,352	2309	2474	2780	3147	3604	4172	4903	5843
Pejë	**16,363**	16064	16750	18320	20179	22489	25335	28975	33610
Istog	8,258	8107	8453	9246	10184	11350	12786	14623	16962
Klinë	6,603	6483	6759	7393	8143	9075	10223	11693	13563
Gjakova	**19,528**	19172	20194	22312	24827	27952	31810	36752	43065
Rahovec	9,124	8958	9435	10425	11600	13060	14862	17171	20121
Deçan	7,855	7712	8123	8975	9986	11243	12795	14783	17323
Junik	1,023	1004	1058	1169	1301	1464	1666	1925	2256
Mitrovicë	**14,950**	14677	14991	16062	17330	18921	20880	23393	26580
Vushtrri	15,022	14748	15063	16139	17414	19012	20980	23505	26708
Skënderaj	8,877	8715	8901	9537	10290	11235	12398	13890	15783
Mitrovica Veriore	7,693	7553	7714	8265	8918	9736	10744	12037	13678
Leposaviq	3,402	3340	3411	3655	3944	4306	4751	5323	6049
Zveçan	1,655	1625	1660	1778	1919	2095	2311	2590	2942
Zubin Potoku	1,717	1686	1722	1845	1990	2173	2398	2687	3053
Gjilan	**17,484**	17165	18481	20784	23443	26650	30504	35311	41295
Viti	8,825	8664	9328	10491	11833	13451	15397	17823	20843
Kamenicë/ Dardanë	6,359	6243	6722	7559	8526	9693	11094	12843	15019
Ranillug	999	981	1056	1188	1339	1523	1743	2018	2359
Kllokot	660	648	698	785	885	1006	1151	1333	1559
Partesh	462	454	488	549	619	704	806	933	1091

3.2 Economy

Macro-economic data, such as Gross National production by all economic sectors of Kosovo: industry, private services and agriculture and other sectors are the basis for forecasting the natural gas energy demand. Annual GDP growth of Kosovo in the period 2012 - 2022 was determined by the IMF (International Monetary Fund – World Economic Outlook Database, April 2015) and presented in Table 3-6. GDP forecast for the period 2021-2050 are based on IMF and Kosovo Energy Strategy.

Table 3-6: GDP forecast for Kosovo' (IMF)

Country	Units	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Kosovo	Percent change	2.8	3.4	1.2	4.1	3.4	3.5	3.5	3.6	3.7	3.8	4.0

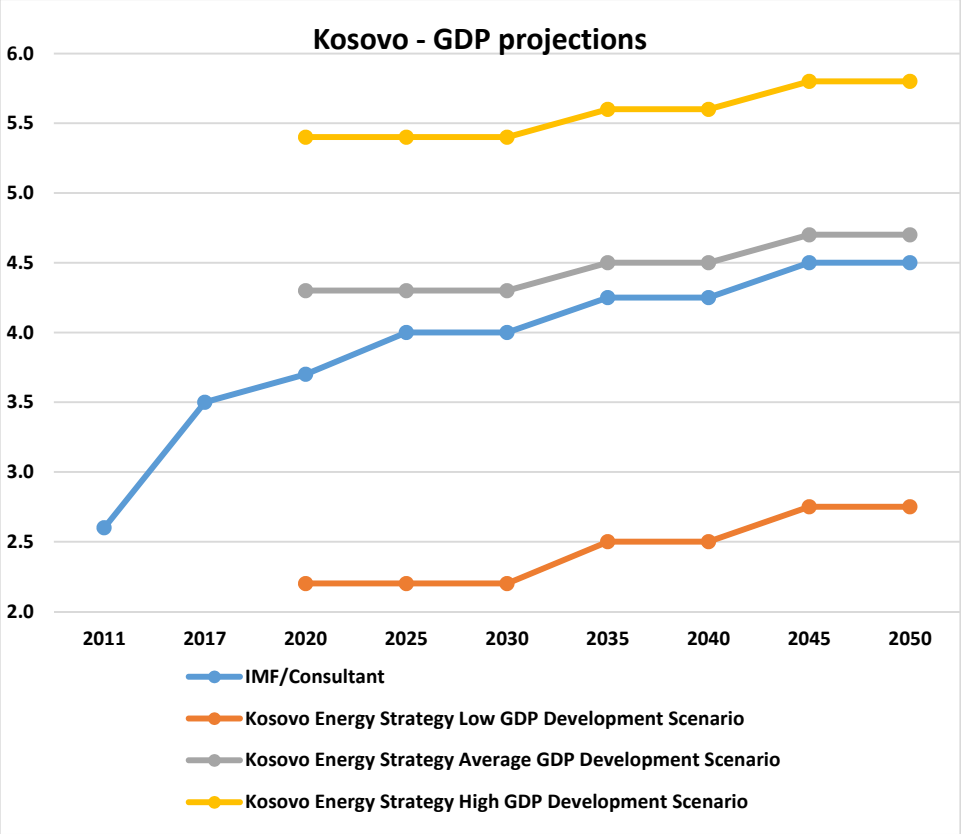


Figure 3-2: GDP forecast for Kosovo' (IMF and Kosovo Energy Strategy)

GDP forecast is the main indicator that is used for forecasting natural gas energy demand for the industrial sector and more details are presented in the respective chapter.

3.2.1 Lignite

Natural resources are abundant in Kosovo. Kosovo possesses around 12.5 billion tons of lignite in geological reserves, which makes it the country with the second largest lignite reserves in Europe and fifth largest in the world. Lignite is the most important energy resource of Kosovo, supplying 97% of total generation of electricity (TPP Kosovo A and TPP Kosovo B). As shown in Figure 3-3, the most important lignite reserves in Kosovo are located in:

- Kosovo Basin;
- Dukagjini Basin; and
- Drenica Basin.

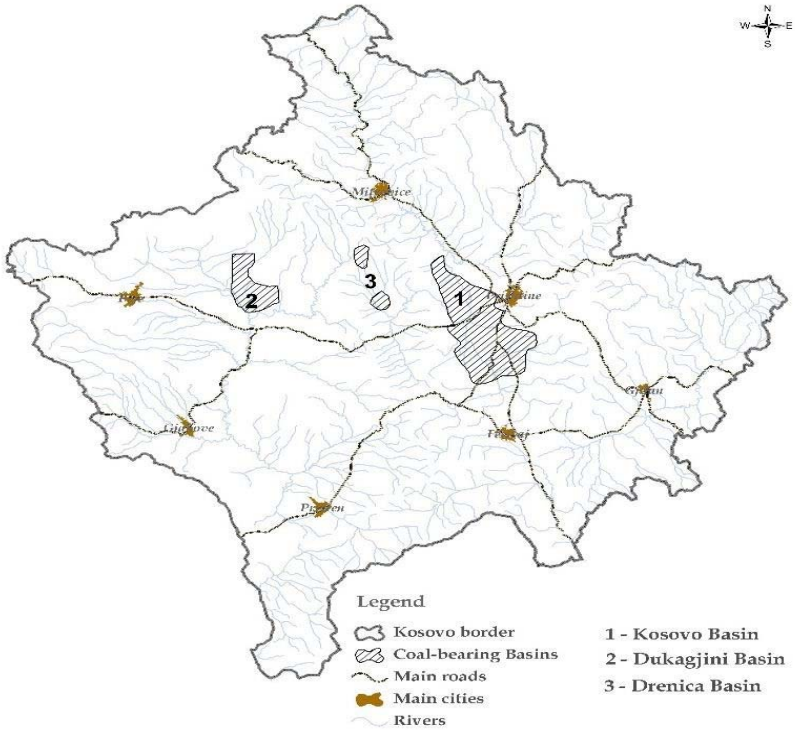


Figure 3-3: Lignite resources in Kosovo (Kosovo Energy Strategy)

Coal supply from the existing mines supplying the existing power plants will be exhausted by 2024, according to the mining plan and capacity. To safeguard future supply of both existing and new generation capacities, a new mine must be opened by 2024 with a capacity of over 430 million tons which would allow for the supply of existing power plants in the next 30 years. The opening of the new mine will ensure safe and sufficient supply for existing as well as new generation capacities. The Government made a priority decision for opening the mine of South Sibovc Field with a capacity of 430 million tons of coal. This project was approved by both the Keshilli Kombetar per Investime (KKI) (National Investment Council) and the Government of Kosovo.

From the entire quantity of coal generated in the mines, 97.5% of the total amount is used to supply Kosovo's power plants, whereas the remaining 2.5% is dedicated to the market for consumption needs in the industry, households, agriculture, and services.

3.2.2 Power generation and transmission

Electricity generation is mainly provided by the Kosovo Energy Corporation (KEK), mainly through the operation of its two thermal power plants 'Kosova A' and 'Kosova B', and in smaller amounts from medium and small hydropower plants (Ujman, Lumbardh, Radac, Dikanc and Burim). The installed capacity of the two thermal power plants is 1,478 MW, but due to their age, their current operational capacity is around 1,171 MW. On the other hand, installed hydropower capacity amounts to 45.84 MW. In 2017, gross generation of electricity from all existing power plants was 5,978 GWh, with only 560 GWh coming from net imports. Table 3-7 provides specific details regarding the installed electricity generation plants in

Kosovo, including the historical average electricity generation and year of commissioning.

Table 3-7: Installed Capacities and Electricity Generation Data for Kosovo

Power Plant Name	Ownership	Net Operational Capacity (MW)	Average Multi-Year Generation Figures (GWh/year)	Unit Commissioning (upgrading) Dates
Kosova A	KEK	551	2,463.243	1970 – 1975
Kosova B	KEK	620	2,771.707	1983 – 1984
Ujman	KEK	32	112	1983
Lumbardh	Private	8	28	2006
Radac	Private	0.94	3.29	2010
Dikanc	Private	0.84	2.94	2010
Burim	Private	0.8	2.8	2011
Wind	Private	1.34	2.6	2010
Total	Private	1,213.58	5,383.98	---

The transmission system in Kosovo is managed by the Kosovo Transmission System and Market Operator. As shown in Figure 3-4, the Kosovo transmission system is interconnected with all neighbouring systems at the 400 kV level with the exception of Albania, where up until recently the connection was at the 220 kV level. Starting in early 2016, a new 400 kV interconnection with Albania was commissioned and is waiting to start commercial operation.

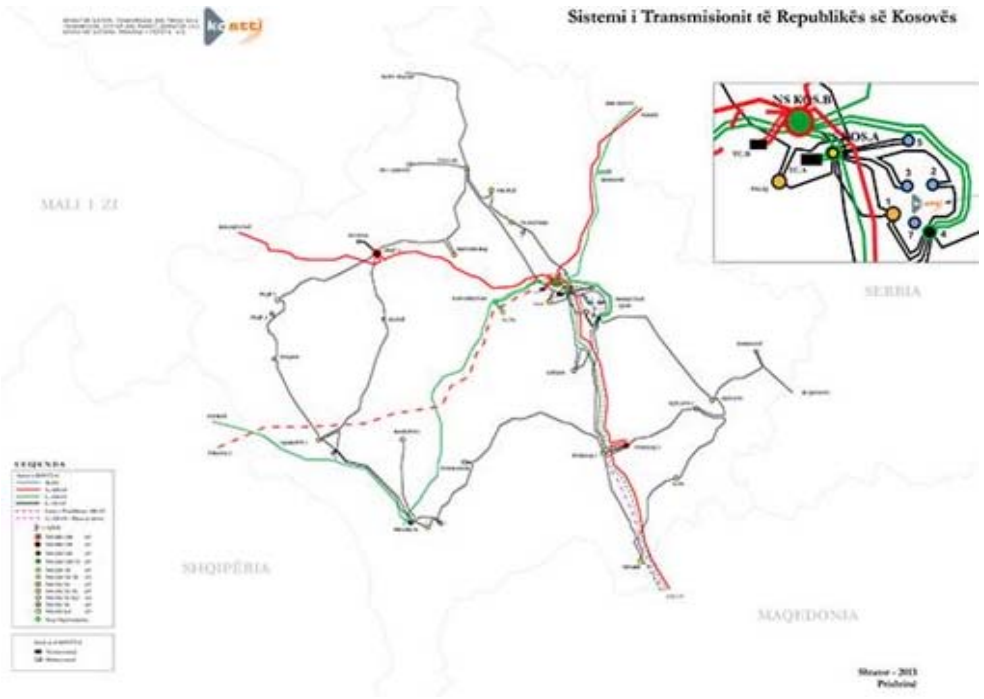


Figure 3-4: Kosovo Transmission System (KOSTT)

Development of the high voltage 400 kV interconnection line between Albania and Kosovo increases the transmission capacity between both countries and in the region in general, while increasing safety and reliability of electricity systems of

Kosovo and Albania. It also has the potential to facilitate optimizing the operation of both systems.

3.3 Energy Supply and Consumption

Primary energy supply in Kosovo has dropped from a historic peak of 2.98 Mtoe in 1989 to 2.11 Mtoe in 1999. Since then, primary energy supply has increased almost constantly with a lower growth rate, reaching 2.442 Mtoe by 2016. Figure 3-5 and Figure 3-6 present the primary energy supply of Kosovo for the whole period 2013-2016 based on the Energy Balance prepared by KAS (Kosovo Statistics Agency).

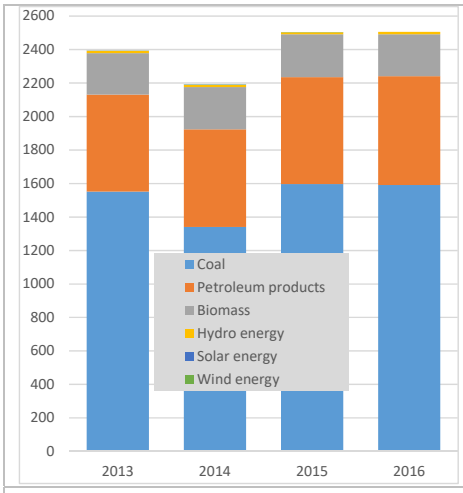


Figure 3-5: Primary energy supply for Kosovo for years 2013 - 2016 (ktoe)

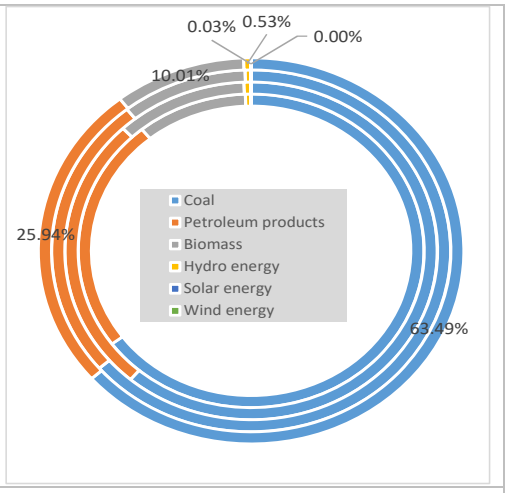


Figure 3-6: Primary energy supply of Kosovo for years 2013 (inner circle) and 2016 (outside circle) (%)

All figures of primary energy supply are based on the Yearly Energy Balance of Kosovo and it is important to mention that uncertainty for such figures is very small, which from the other side shows that Kosovo's Energy Balance has proper figures from the supply side. Following the disruption caused by the 1998–1999 war, Kosovo has stabilized electricity supply industry and it is very important to point out that Kosovo Governmental has taken many programmes to mitigate this problem. Figure 3-7 and Figure 3-8 present the final energy consumption for Kosovo for the whole period 2013-2016 based on the Energy Balance prepared by KAS.

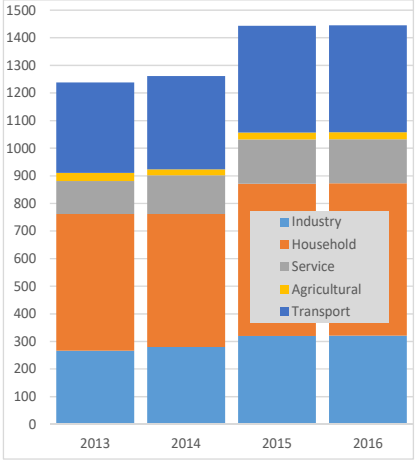


Figure 3-7: Final Energy Consumption for all Sectors for Kosovo for years 2013-16 (ktoe)

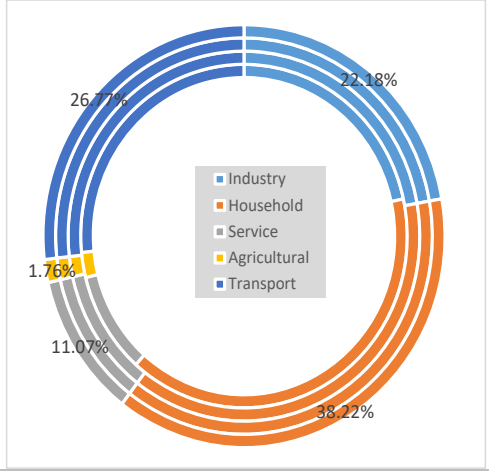


Figure 3-8: Final Energy Consumption for all Sectors for Kosovo for years 2013 (inner circle) and 2016 (outside circle)

All figures of final energy consumption for each sector are based on the Yearly Energy Balance of Kosovo and it is important to mention that natural gas will penetrate in the industry, service, household sectors and DH and power generation systems. The following chapters will present the main findings based on the calculation of natural gas demand, either top-down or bottom-up, and including the EE targets for each sector based on the second Kosovo Energy Efficiency Action Plan (KEEAP) for all economic sectors.

3.4 Natural Gas Demand in Kosovo

Kosovo is not currently using natural gas. The World Bank/KfW South East Europe Gasification Study (October 2007 and revised in November 2008) has considered the economics of bringing gas into Kosovo. It concluded that it may be viable to supply industrial and commercial load and build gas distribution networks particularly in Prishtina and Mitrovica (the two main cities analysed by the above-mentioned study). Government policy based on the Energy Strategy (2017-2026) is to promote and support Kosovo's connection with regional gas supply project through TAP via Albania. Project for Southeast Europe, as well as to support construction, by private investment, of the local network for gas utilisation mainly by the household, services, industrial sectors, and the District Heating systems. A detailed analysis of natural gas demand has been prepared under this pre-feasibility study.

Although a gas transmission pipeline has existed within Kosovo, the system has not been used since 1986. It is totally out of operation and all parts of it have been destroyed. The system previously supplied town gas, produced in Kastriot/Obilic, to Pristina, Mitrovica and Skopje in FYROM. It should also be noted that the transmission system was not properly decommissioned in 1986 and the normal measures of purging and nitrogen filling were not applied. Consequently, widespread corrosion of the pipeline has occurred. Although initially designed for an operational pressure of 25 bar and yearly capacity of 0.2 bcm, the present owners of the pipeline, Kosovo power company KEK, report that the system has been completely damaged in several areas due to third party construction work on and around the pipeline. Legally, the easement along the route should be available

for the construction of a new pipeline, representing one of the possibilities to be used as right-of-the-way for transmission natural gas development network in the east of the country (Kosovo - Hani i Elezit). However, an assessment of the potential gas interconnector between Kosovo and FYROM is not included within the scope of this study.

This chapter presents a detailed estimate of the increase in natural gas final consumption in Kosovo by the year 2040. The basis for the forecasts of final energy consumption for thermal purposes in households and services sectors are the forecasted number of inhabitants, households public (municipal and central) building stock, commercial and private building stock as well as industrial share of GDP. The indicator used in measuring the economic development is the gross domestic product.

Security of supply, promotion of investments in the sector, preserving of environment and further development of the energy market are the main strategic goals of the updated Kosovo Energy Strategy prepared by MED. An important aspect of increasing the security of supply is also related to the diversification of energy sources. Based on the actual energy balance, where coal is contributing 59% and oil products with 29.5%, the introduction of natural gas in the Kosovo energy system has significant potential. The Kosovo energy strategy considers that it may be viable to initially supply the industrial and commercial energy demand and secondly to build gas distribution networks, particularly in the main cities, in the following order:

- Industries;
- District heating and cogeneration plants;
- Commercial and public buildings (within the service sector); then
- Finally, for the residential sector.

3.4.1 Natural Gas Demand in the Household Sector

Energy consumption and forecasted demand for the urban and rural household sector has been carefully analyzed and calculated because of its highest contribution in the total energy consumed, as well as because of the very high wood and electricity consumption in this sub-sector. The natural gas demand is forecasted to cover part of space heating, water heating and cooking in all urban and rural areas of Kosovo. Natural gas demand has been calculated based on bottom-up engineering methodology following the eight steps below:

Step 1: Population Forecast is carried out based on the High Growth Rate Scenario. Population forecast was carried out by the consultant and the respective figures for each municipality and each region are presented above in Table 4.

Step 2: Households Forecast is carried out based on Kosovo Population and trend development of persons/households (EU/MED/KAS Survey). Number of households is used as the driving factor for calculation of natural gas demand at municipality and regional level. And the respective figures for each municipality and each region are presented above in Table 3-5.

Step 3: Urban & Rural Population Forecast is carried out (based on KAS data) for actual shares (2017) between urban-rural areas for each municipality. Future trend is based on the internal migration from rural areas towards large urban areas (based on the trend of 2011-2017). Annexes 1 and 2 are presenting the forecast of Urban & Rural Population for the whole period 2017-2040**.**

Step 4: Urban & Rural Households Forecast is carried out for actual shares (2017) between urban-rural areas for each municipality. Future trend is based on important trend of the driving factor persons/households and the internal migration from rural areas towards large urban areas (based on the trend of 2011-2017). Annexes 3 and 4 are presenting the forecast of Urban & Rural Households for the whole period 2017-2040**.**

Step 5: Defined fuel share for each energy service (Space heating, Water heating and Cooking) based on Europeaid/136562/dh/ser/xk "*Support on Implementing the 3rd Energy Package with a focus on EE & RES*". Annexes 5-8 present fuel shares for meeting Space Heating, Water Heating and Cooking for Urban & Rural Households**.** Meanwhile, the fuel shares for meeting the Water heating are respectively 92% through electricity, 6.5% through fuel wood and 1.5% through LPG**.**

Step 6: Defined Energy Intensity for each energy service: 1) Space heating, 2) Water heating and 3) Cooking based on the Europeaid/136562/dh/ser/xk "*Support on Implementing the 3rd Energy Package with a focus on EE & RES*". Table 3-8 and Table 3-9 presents Energy Intensity for each energy service: 1) Space heating, 2) Water heating and 3) Cooking calculated by the consultant taking into consideration EE targets of KEEAP.

Table 3-8: Energy Intensity for urban areas (kWh/households or kWh/person) for each energy service (for urban areas) 1) Space heating, 2) Water heating and 3) Cooking calculated by the consultant under the above-mentioned project

Energy Service	Space Heatin	Water Heating		Cooking
Energy itensity	kWh/household	kWh/person	kWh/household	Energy intens
Prishtinë	27891	341	1555	1832
Podujevë	28424	314	1430	1712
Gllogoc	25905	289	1103	2312
Lipjan	24239	429	2094	1643
Fushë Kosovë	25171	395	1926	2164
Obiliq	21481	364	1772	1521
Graçanicë	0	0	0	0
Novobërdë	26016	314	1430	1728
Prizren	24096	261	1242	1723
Suharekë	26081	213	1071	1793
Malishevë	25943	267	1208	1643
Dragash	24239	267	1208	2823
Mamushë	0	0	0	0
Ferizaj	26511	339	1653	1740
Kaçanik	31635	330	1673	1825
Shtime	27907	390	2082	2001
Hani i Elezit	26511	314	1430	1574
Shtërpcë	28500	497	1739	2441
Pejë	27360	254	1070	1535
Istog	27664	262	1130	1528
Klinë	26114	229	1044	2790
Gjakovë	23995	374	1637	1774
Rahovec	22140	368	1759	2106
Deçan	26688	273	1226	2409
Junik	28102	337	1417	2531
Mitrovicë	23432	260	1270	1801
Vushtrri	26822	321	1594	2416
Skenderaj	24347	282	1292	1758
Mitrovicë Veriore	23639	571	2000	1947
Leposaviq	26511	462	1544	1849
Zveçan	24996	477	1352	1995
Zubin Potok	24390	477	1352	2506
Gjilan	27215	282	1336	1556
Viti	36129	263	1390	1882
Kamenicë	27407	263	1390	1669
Ranillug	0	0	0	0
Kllokot	0	0	0	0
Partesh	0	0	0	0

Table 3-9: Energy Intensity for rural areas (kWh/households or kWh/person) for each energy service (for rural areas) 1) Space heating, 2) Water heating and 3) Cooking calculated by the consultant under the above-mentioned project

Energy Service	Space Heatin	Water Heating		Cooking
Energy itensity	kWh/household	kWh/person	kWh/household	Energy intens
Prishtine	27508	326	1705	1633
Podujevë	30137	195	1059	1785
Gllogoc	24166	227	1163	1699
Lipjan	25486	362	1998	2009
Fushë Kosovë	22936	167	755	1560
Obiliq	22310	194	876	1698
Graçanicë	25834	266	1124	1950
Novobërdë	26016	176	850	1728
Prizren	28460	304	1539	2204
Suharekë	30391	304	1539	1613
Malishevë	26752	304	1539	1632
Dragash	26196	303	1461	2048
Mamushë	30930	356	2071	2847
Ferizaj	28843	330	1774	2025
Kaçanik	32169	291	1581	1987
Shtime	29127	359	2020	2306
Hani i Elezit	31118	366	1915	2220
Shtërpcë	30075	362	1764	2184
Pejë	27923	362	1764	2631
Istog	27239	239	1176	2763
Klinë	27157	205	1058	2522
Gjakovë	29870	366	1871	2682
Rahovec	24925	242	1350	2085
Deçan	28348	237	1194	2445
Junik	28102	337	1417	2531
Mitrovicë	23456	234	1208	1811
Vushtrri	28062	277	1482	1584
Skenderaj	24507	252	1412	1808
Mitrovicë Veriore	21563	252	1412	1825
Leposaviq	28156	396	1276	2109
Zveçan	24874	482	1934	1937
Zubin Potok	23595	247	888	1941
Gjilan	27422	313	1599	1531
Viti	31465	334	1710	2332
Kamenicë	25954	371	1898	1694
Ranillug	25451	312	1221	1930
Kllokot	27218	480	1999	2117
Partesh	22976	358	1323	1995

Step 7: Carry out the Final Natural Gas Energy Demand Forecast for Urban and Rural Households based on the formula:

e = a x shares of activity level where NG will penetrate x share of fuels x i

Penetration rate of natural gas for household urban and rural areas are presented in Table 3-10.

Table 3-10: Penetration rate of natural gas for household urban and rural areas

Penetration rate of Natural Gas	2017	2020	2025	2030	2035	2040
for Household Urban areas	75%	77.5%	80%	82.5%	85%	87.5%
for Household Rural areas	50%	52%	54%	56%	58%	60%

Based on the above mentioned formula has been calculated the natural gas demand for three energy services: 1) Space heating, 2) Water heating and 3) Cooking for urban and rural households.

Step 8: Carry out the Final Natural Gas Energy Demand Forecast for Total Households based on the sum of Urban and Rural respective NG Energy Demand for each municipality and region

Figure 3-9 presents the summary of household potential natural gas demand for each region for each of the presented years 2017-2040. Figure 3-10 present the summary of household potential natural gas demand for Kosovo for each of the presented year 2017-2040.

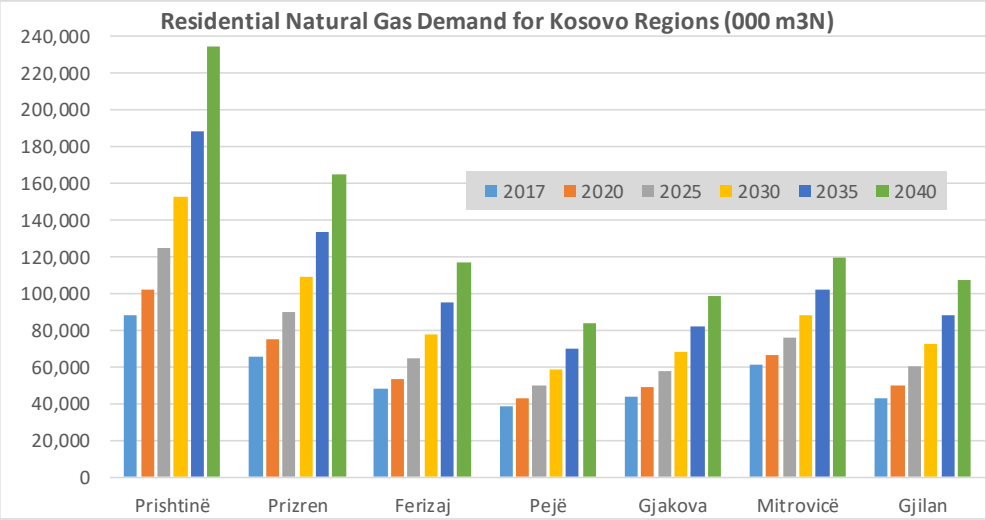


Figure 3-9: Summary of household potential natural gas demand for each region for each of the presented years 2017-2040.

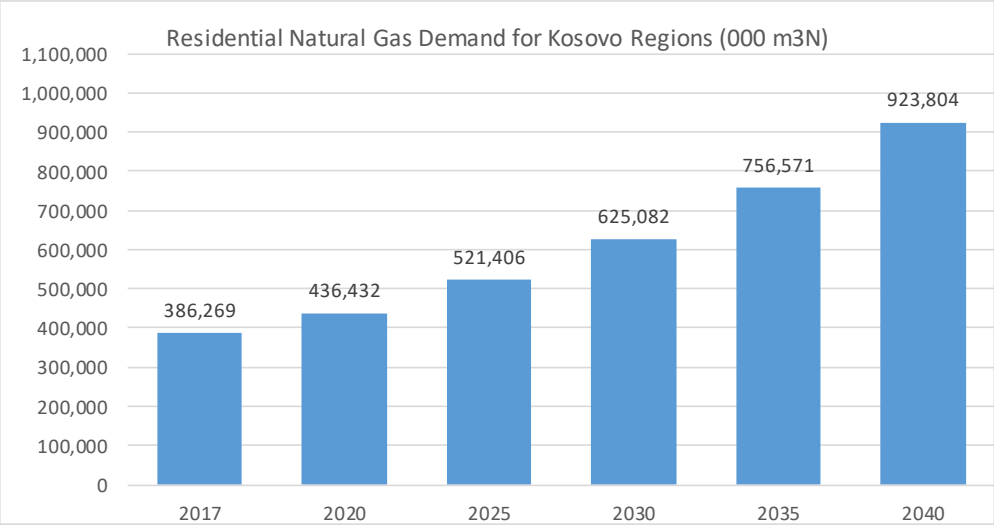


Figure 3-10: Summary of household potential natural gas demand for each region for each of the presented years 2017-2040.

Table 3-11 presents the summary of potential natural gas consumption expressed in Nm3 for the residential sector in Kosovo. This table also presents the potential capacities for the year 2040 which are a very important factor for the technical design of the natural gas transmission pipeline.

Table 3-11: Summary of potential natural gas consumption expressed in m3N for the residential sector of Kosovo

Potential natural gas consumption (000 m3) / capacities (m3/h) for the Residential Sector in Kosovo												
District	Potential natural gas consumption (000 m3) in 2040				80% of Potential natural gas consumption (000 m3) in 2040				Potential capacities in 2040 in m3/h			
	Space Heating	Water Heating	Cooking	Residential	Space Heating	Water Heating	Cooking	Residential	Space Heating	Water Heating	Cooking	Residential
Pejë	70,780	3,104	9,261	**83,145**	56,624	2,483	7,409	**66,516**	23,752	283	846	**24,881**
Gjakova	82,956	4,654	11,146	**98,757**	66,365	3,723	8,917	**79,006**	25,633	425	1,018	**27,076**
Mitrovicë	100,889	6,656	12,037	**119,582**	80,711	5,325	9,630	**95,666**	26,342	608	1,099	**28,049**
Prishtinë	198,425	10,889	24,846	**234,160**	158,740	8,711	19,877	**187,328**	54,927	994	2,269	**58,191**
Gjilan	91,270	7,034	8,369	**106,674**	73,016	5,627	6,695	**85,339**	25,782	642	764	**27,189**
Ferizaj	101,223	5,504	10,300	**117,026**	80,978	4,403	8,240	**93,621**	28,294	503	941	**29,738**
Prizren	140,275	8,353	15,832	**164,460**	112,220	6,682	12,666	**131,568**	52,026	763	1,446	**54,235**
Total	785,818	46,195	91,791	923,804	628,654	36,956	73,433	739,043	236,757	4,219	8,383	249,358

Main conclusion of this section shows clearly that natural gas demand is 739,043 Nm3 and the biggest potential demand belongs to space heating energy service.

3.4.2 Natural Gas Demand in the Service Sector

Public and commercial buildings in the service sector includes schools, hospitals, administrative buildings, universities, restaurants, shops and all other commercial buildings. To increase the quality of the services and to improve the working conditions and comfort of the public administration, the study analyzed the ratio heated over total heated and unheated areas based on the energy survey carried out. GDP growth from the private service sector will be associated with increased energy demand due to high demands for comfort and the need for qualitative improvement of services. Energy consumption and forecasted demand for the public and commercial buildings in the service sector has been carefully analyzed and calculated because of its third contribution in the total energy consumed for Kosovo. Natural gas demand is forecasted to cover part of space heating, water heating and cooking in all Kosovo urban areas and its year of penetration for each

municipality and each region is related with the development of natural gas transmission system and gas distribution system for that particular region.

Energy consumption and forecasted demand for the public and private buildings has been carefully analysed and calculated because of its highest contribution in the total energy consumed, as well as because of the very high electricity, wood, diesel and consumption in this sub-sector. The natural gas demand is forecasted to cover part of space heating, water heating and cooking in all urban and rural areas of Kosovo. Natural gas demand has been calculated based on bottom-up engineering methodology following the eight steps below:

Step 1: Forecast Number and Areas of Service Buildings is carried out based on the WB/MED Study "Energy Efficiency Building Stock for Kosovo". Forecast of number of service buildings was carried out by the Consultant and presented below in Table 3-12 for the whole period 2013-2040. Forecast of total areas of service buildings was carried out by the consultant and presented below in Table 3-13 for the whole period 2013-2040.

Table 3-12: Forecasted of number of service buildings for the whole period 2013-2040

Number of all buildings	2013	2017	2020	2025	2030	2035	2040
Commercial Buildings	56583	59815	60549	61192	61858	62507	63135
Central Public Buildings	369	392	404	424	446	468	492
Buildings serving to pul	137	145	150	157	165	174	183
Public Buildings (Comm	255	271	279	293	308	324	340
Hospitals and Health Ce	384	408	420	441	464	488	512
Universities and School	1090	1157	1192	1253	1317	1384	1454
Total	**58818**	**62,187**	**62,993**	**63,761**	**64,558**	**65,344**	**66,117**

Table 3-13: Forecasted of total area of service buildings for the whole period 2013-2040

Total Area of all buildings	2013	2017	2020	2025	2030	2035	2040
Commercial Buildings	7627352	8727654	9102473	9668438	10272217	10909349	11581080
Central Public Buildings	817123	913249	978096	1091167	1217308	1351336	1500119
Buildings serving to pul	64555	72150	77273	86632	97126	108890	122079
Public Buildings (Comm	212866	237908	254801	285664	320265	359057	402547
Hospitals and Health Ce	736660	823321	881783	988589	1108332	1242578	1393086
Universities and School	1407047	1572572	1684236	1888240	2116953	2373369	2660844
Total	**10865603**	**12,346,853**	**12,978,662**	**14,008,729**	**15,132,200**	**16,344,579**	**17,659,757**

Step 2: Forecast Number and Areas of Public Buildings for each region is carried out based on the actual shares (MED data base for Public Buildings and WB/MED Study "Energy Efficiency Building Stock for Kosovo" for Commercial/Private Buildings and future trend is based on the actual trend of 2013-2017). Forecast of number of public buildings was carried out by the Consultant and presented below in Table 3-14 for the whole period 2013-2040**.** Total areas of public buildings forecast was carried out by the Consultant and presented below in Table 3-15 for the whole period 2013-2040**.**

Table 3-14: Forecasted number of public buildings for the whole period 2013-2040

Number of all public buildi	2013	2017	2020	2025	2030	2035	2040
Peja Region	202	214	221	232	244	256	269
Gjakova Region	232	247	254	267	281	295	310
Mitrovica Region	296	315	324	341	358	376	395
Prishtina Region	623	661	681	716	753	791	831
Gjilani Region	228	242	249	262	275	289	304
Ferizaj Region	233	248	255	268	282	296	311
Prizreni Region	420	446	460	483	508	534	561
Total Public Buildings	**2235**	**2372**	**2444**	**2569**	**2700**	**2837**	**2982**

Table 3-15: Forecasted total area of public buildings for the whole period 2013-2040

Total Area of all public buil	2013	2017	2020	2025	2030	2035	2040
Peja Region	292312	326700	349898	391792	438704	490630	548713
Gjakova Region	336699	376309	403029	451285	505320	565132	632035
Mitrovica Region	429349	479857	513931	575464	644369	720639	805951
Prishtina Region	902893	1009109	1080763	1210165	1355066	1515457	1694863
Gjilani Region	329763	368556	394726	441988	494910	553489	619014
Ferizaj Region	338206	377993	404833	453304	507581	567661	634863
Prizreni Region	609029	680,675	729,008	816,294	914,034	1,022,223	1,143,238
Total Public Buildings	**3238251**	**3619199**	**3876189**	**4340291**	**4859983**	**5435230**	**6078676**

Step 3: Forecast Number and Areas of Private and Commercial Buildings for each region is carried out based on the actual shares of total service building stock according to the WB/MED Study "Energy Efficiency Building Stock for Kosovo" for Commercial/Private Buildings and future trend is based on the actual trend of 2013-2017). Forecast of number of private and commercial buildings was carried out by the Consultant and presented below in Table 3-16 for the whole period 2013-2040**.** Forecast of total area of private and commercial buildings was carried out by the Consultant and presented below in Table 3-17 for the whole period 2013-2040**.**

Table 3-16: Forecasted number of private and commercial buildings for the whole period 2013-2040

Number of all private/com	2013	2017	2020	2025	2030	2035	2040
Peja Region	5108	5399	5466	5524	5584	5642	5699
Gjakova Region	5883	6219	6296	6363	6432	6499	6564
Mitrovica Region	7502	7931	8028	8113	8202	8288	8371
Prishtina Region	15777	16678	16882	17062	17247	17428	17603
Gjilani Region	5762	6091	6166	6231	6299	6365	6429
Ferizaj Region	5910	6247	6324	6391	6461	6528	6594
Prizreni Region	10642	11,250	11,388	11,509	11,634	11,756	11,874
Total private/commercial I	**56583**	**59815**	**60549**	**61192**	**61858**	**62507**	**63135**

Table 3-17: Forecasted total area of private and commercial buildings for the whole period 2013-2040

Total Area of all private/co	2013	2017	2020	2025	2030	2035	2040
Peja Region	688510	787833	821667	872756	927258	984771	1045407
Gjakova Region	793059	907464	946436	1005283	1068061	1134307	1204151
Mitrovica Region	1011285	1157170	1206866	1281905	1361958	1446433	1535496
Prishtina Region	2126667	2433454	2537962	2695764	2864111	3041757	3229050
Gjilani Region	776721	888769	926938	984572	1046057	1110939	1179343
Ferizaj Region	796608	911525	950671	1009781	1072840	1139383	1209539
Prizreni Region	1434503	1,641,440	1,711,934	1,818,377	1,931,932	2,051,759	2,178,094
Total private/commercial I	**7627352**	**8727654**	**9102473**	**9668438**	**10272217**	**10909349**	**11581080**

Step 4: Define fuel share for each energy service (Space Heating, Water Heating and Cooking) for Public Buildings for each region based on the Europeaid/136562 "Support on Implementing the 3rd Energy Package". Fuel share for each energy service (Space Heating) for Public Buildings is presented below in Table 3-18. Fuel share for each energy service (Water Heating and Cooking) for Public Buildings are presented below in Table 3-19.

Table 3-18: Fuel share for each energy services (Space Heating) for Public Buildings

En. Service	SPACE HEATING (Public Buildings)									
Fuel	District Heating	Fuel wood	Pellets	Briquettes	Electricity	LPG	Diesel	Coal	Mix (coal and wood)	TOTAL
Peja Region	0.00%	34.00%	0.00%	0.00%	46.00%	5.00%	15.00%	0.00%	0.00%	100.00%
Gjakova Reg	0.00%	32.00%	0.00%	0.00%	48.60%	3.00%	16.40%	0.00%	0.00%	100.00%
Mitrovica Re	1.60%	28.00%	2.00%	0.00%	48.00%	4.40%	16.00%	0.00%	0.00%	100.00%
Prishtina Re	4.00%	26.00%	3.00%	0.00%	51.00%	1.00%	11.00%	1.26%	2.74%	100.00%
Gjilani Regio	0.00%	35.00%	0.00%	0.00%	45.00%	5.00%	15.00%	0.00%	0.00%	100.00%
Ferizaj Regi	0.00%	33.00%	0.00%	0.00%	61.00%	6.00%	0.00%	0.00%	0.00%	100.00%
Prizreni Reg	0.00%	31.00%	0.00%	0.00%	60.00%	9.00%	0.00%	0.00%	0.00%	100.00%

Table 3-19: Fuel share for each energy services (Water Heating and Cooking) for Public Buildings

Service	WATER HEATING (Public Buildings)							Cooking (Public Buildings)				
Fuels	Fuel wood stoves	Electric stoves	Electric boiler	Solar Water	Central Heating	LPG	Total	Wood	Electricity	LPG	Coal	Total
Peja Region	1.40%	0.70%	97.30%	0.10%	0.50%	0.10%	100%	23.28%	61.89%	14.90%	0.00%	100%
Gjakova Reg	8.00%	0.00%	90.00%	1.00%	0.00%	1.00%	100%	49.85%	39.44%	10.73%		100%
Mitrovica Re	7.50%	0.00%	92.30%	0.20%	0.00%	0.00%	100%	36.00%	54.00%	10.00%		100%
Prishtina Re	6.00%	0.00%	93.00%	1.00%	0.00%	0.00%	100%	19.00%	56.00%	25.00%	0.00%	100%
Gjilani Regio	4.00%	0.00%	85.35%	0.65%	10.00%	0.00%	100%	26.00%	69.00%	14.00%	0.00%	109%
Ferizaj Regi	12.00%	0.00%	87.00%	1.00%	0.00%	0.00%	100%	22.93%	40.36%	32.12%	4.59%	100%
Prizreni Reg	14.50%	0.00%	85.00%	0.50%	0.00%	0.00%	100%	25.00%	42.00%	33.00%	0.00%	100%

Step 5: Define fuel share for each energy service (Space Heating, Water Heating and Cooking) for Public, Private and Commercial Buildings for each region based on the Europeaid/136562 "Support on Implementing the 3rd Energy Package". Fuel share for each energy service (Space Heating) for Private and Commercial Buildings is presented below in Table 3-20. Fuel share for each energy service (Water Heating and Cooking) for Private and Commercial Buildings is presented below in Table 3-21.

Table 3-20: Fuel share for each energy service (Space Heating) for Private and Commercial Buildings

En. Service	SPACE HEATING (Private Buildings)									
Fuel	District Heating System	Fuel wood	Pellets	Briquettes	Electricity	LPG	Diesel	Coal	Mix (coal and wood)	Total
Peja Region	0.00%	31.00%	3.00%	0.00%	46.00%	5.00%	15.00%	0.00%	0.00%	100.00%
Gjakova Reg	0.00%	29.00%	3.00%	0.00%	48.60%	3.00%	16.40%	0.00%	0.00%	100.00%
Mitrovica Re	1.40%	25.00%	5.20%	0.00%	48.00%	4.40%	16.00%	0.00%	0.00%	100.00%
Prishtina Re	3.00%	23.00%	7.00%	0.00%	51.00%	1.00%	11.00%	1.26%	2.74%	100.00%
Gjilani Regio	0.00%	32.00%	20.00%	0.00%	45.00%	5.00%	15.00%	0.00%	0.00%	117.00%
Ferizaj Regi	0.00%	30.00%	3.00%	0.00%	61.00%	6.00%	0.00%	0.00%	0.00%	100.00%
Prizreni Reg	0.00%	28.00%	3.00%	0.00%	60.00%	9.00%	0.00%	0.00%	0.00%	100.00%

Table 3-21: Fuel share for each energy service (Water Heating and Cooking) for Private and Commercial Buildings

	Water Heating (Private Buildings)							Cooking (Private Buildings)				
Fuels	Fuel wood stoves	Electric stoves	Electric boiler	Solar Water Collectors	Central Heating System	LPG	Total	Wood	Electricity	LPG	Coal	Total
Peja Region	4.40%	0.70%	94.30%	0.10%	0.50%	0.10%	100%	28.28%	61.89%	9.90%	0.00%	100%
Gjakova Reg	11.00%	0.00%	87.00%	1.00%	0.00%	1.00%	100%	54.85%	39.44%	5.73%	0.00%	100%
Mitrovica Re	10.50%	0.00%	89.30%	0.20%	0.00%	0.00%	100%	41.00%	54.00%	5.00%	0.00%	100%
Prishtina Re	9.00%	0.00%	90.00%	1.00%	0.00%	0.00%	100%	24.00%	56.00%	20.00%	0.00%	100%
Gjilani Regio	7.00%	0.00%	82.35%	0.65%	10.00%	0.00%	100%	31.00%	60.00%	9.00%	0.00%	100%
Ferizaj Regi	15.00%	0.00%	84.00%	1.00%	0.00%	0.00%	100%	27.93%	40.36%	27.12%	4.59%	100%
Prizreni Reg	17.50%	0.00%	82.00%	0.50%	0.00%	0.00%	100%	30.00%	42.00%	28.00%	0.00%	100%

Step 6: Define Energy Intensity for each energy service: 1) Space heating, 2) Water heating and 3) Cooking for Public, Private and Commercial Buildings for each region based on the Europe aid/136562. Table 3-22 and Table 3-23 present Energy Intensity for each energy service for Public Buildings and Private and Commercial Buildings for the following services: 1) Space heating, 2) Water heating and 3) Cooking calculated by the Consultant taking into consideration EE targets of KEEAP.

Table 3-22: Energy Intensity for each energy services for Public Buildings
for 1) Space heating, 2) Water heating and 3) Cooking

Public Buildi	Space Heating	Water Heating	Cooking
Fuels	kWh/m2	kWh/m2	kWh/m2
Peja Region	213.86	37.57	14.45
Gjakova Reg	210.97	36.13	15.03
Mitrovica Re	225.42	28.90	15.90
Prishtina Re	208.08	34.68	16.47
Gjilani Regio	222.53	31.21	15.03
Ferizaj Regi	205.19	31.79	17.05
Prizreni Reg	202.30	26.01	13.29

Table 3-23: Energy Intensity for each energy services for Private and Commercial Buildings
for 1) Space heating, 2) Water heating and 3) Cooking

Private Build	Space Heating	Water Heating	Cooking
Fuels	kWh/m2	kWh/m2	kWh/m2
Peja Region	236.80	41.60	26.01
Gjakova Reg	233.60	40.00	26.59
Mitrovica Re	249.60	32.00	27.46
Prishtina Re	230.40	38.40	28.03
Gjilani Regio	246.40	34.56	26.59
Ferizaj Regi	227.20	35.20	28.61
Prizreni Reg	224.00	28.80	27.74

Step 7: Carry out the Final Natural Gas Energy Demand Forecast for Public and Private Buildings for each region based on the formula:

e = a x shares of activity level (where NG will penetrate) × share of fuels x i

Penetration rate of natural gas for public and private service buildings areas are presented in Table 3-24.

Table 3-24: Table 22: Penetration rate of natural gas for public and private service buildings areas

Penetration rate of Natural Gas:	2017	2020	2025	2030	2035	2040
for public buildings service areas	50%	55%	60%	65%	67.5%	70%
for private and commercial buildings service areas	50%	55%	60%	65%	67.5%	70%

Based on the above mentioned formula it has been calculated the natural gas demand for three energy services: 1) Space heating, 2) Water heating and 3) Cooking for public and private service buildings areas for the whole period 2017-2040.

Step 8: Carry out the Final Natural Gas Energy Demand Forecast for Public, Private and Commercial Buildings for each region is based on the sum of the respective NG Energy Demand for each region. Figure 3-11 presents the summary of public and private service sector potential natural gas demand for each region and for each year 2017-2040. Figure 3-12 presents the summary of public and private service sector potential natural gas demand for Kosovo for each year 2017-2040.

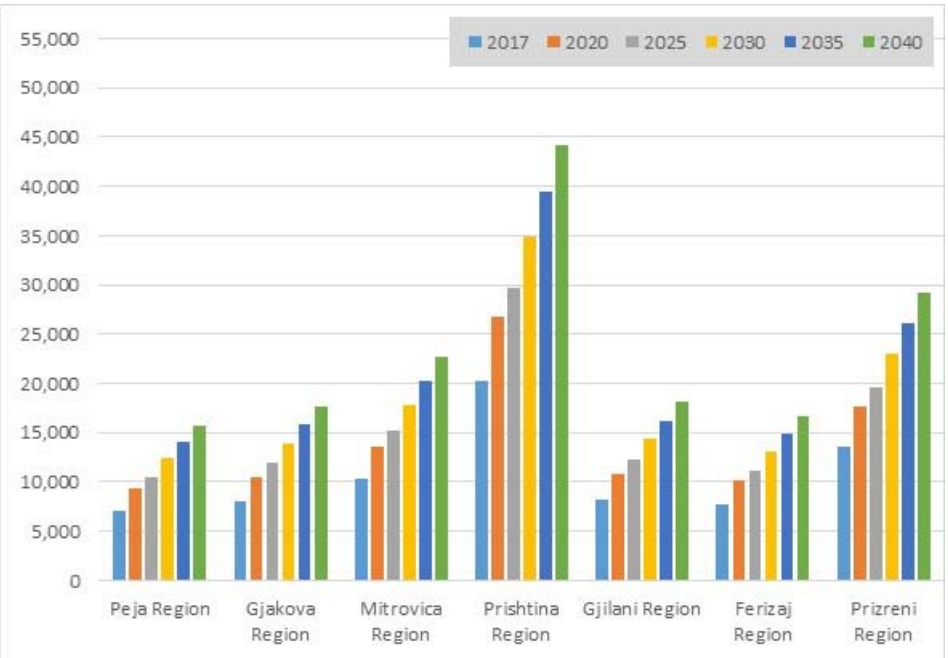


Figure 3-11: Summary of public and private service sector potential natural gas demand for each region for each year 2017-2040

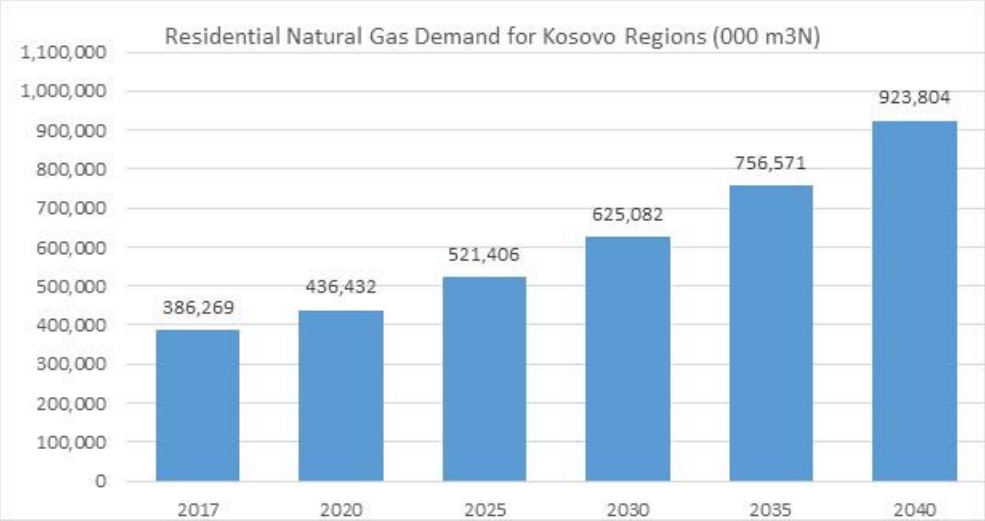


Figure 3-12: Summary of public and private service sector potential natural gas demand for each year 2017-2040

Table 3-25 and Table 3-26 present the summary of potential natural gas consumption expressed in Nm3 for the public and commercial private service sectors of Kosovo. These tables also are presenting the potential capacities for the year 2040, which are a very important factor for the technical design of the natural gas transmission pipeline.

Table 3-25: Table 23: Summary of potential natural gas consumption expressed in m3N for the public service sector of Kosovo

Potential natural gas consumption (000 m3) / capacities (m3/h) for the Service Sector (Public buildings) in Kosovo												
District	Potential natural gas consumption (000 m3) in 2040				80% of Potential natural gas consumption (000 m3) in 2040				Potential capacities in 2040 in m3/h			
	Space Heating	Water Heating	Cooking	Public Buildings	Space Heating	Water Heating	Cooking	Public Buildings	Space Heating	Water Heating	Cooking	Public Buildings
Pejë	5,674	902	641	**7,216**	4,539	722	513	**5,773**	2,522	200	142	**2,865**
Gjakova	6,384	1,050	713	**8,148**	5,107	840	570	**6,518**	2,837	233	158	**3,229**
Mitrovicë	8,382	1,064	1,000	**10,446**	6,706	851	800	**8,357**	3,725	236	222	**4,184**
Prishtinë	15,312	2628	2280	**20,221**	12,250	2,102	1,824	**16,177**	6,805	584	507	**7,896**
Gjilan	6,682	933	818	**8,432**	5,346	746	654	**6,746**	2,970	207	182	**3,359**
Ferizaj	5,817	954	875	**7,646**	4,654	763	700	**6,117**	2,585	212	194	**2,992**
Prizren	10,429	1444	1222	**13,094**	8,343	1,155	978	**10,475**	4,635	321	272	**5,228**
Total	**58,680**	**8,975**	**7,547**	**75,202**	**46,944**	**7,180**	**6,038**	**60,162**	26,080	1,994	1,678	**29,752**

Table 3-26: Table 24: Summary of potential natural gas consumption expressed in m3N for the commercial & private service sector of Kosovo

Potential natural gas consumption (000 m3) / capacities (m3/h) for the Service Sector (Commercial/Private buildings) in Kosovo												
District	Potential natural gas consumption (000 m3) in 2040				80% of Potential natural gas consumption (000 m3) in 2040				Potential capacities in 2040 in m3/h			
	Space Heating	Water Heating	Cooking	Private Buildings	Space Heating	Water Heating	Cooking	Private Buildings	Space Heating	Water Heating	Cooking	Private Buildings
Pejë	11,570	1,958	2,168	**15,696**	9,256	1,566	1,734	**12,557**	5,142	435	482	**6,059**
Gjakova	13,015	2277	2369	**17,661**	10,412	1,822	1,895	**14,129**	5,784	506	526	**6,817**
Mitrovicë	17,065	2,308	3,244	**22,617**	13,652	1,846	2,595	**18,094**	7,584	513	721	**8,818**
Prishtinë	31,103	5,703	7,295	**44,102**	24,882	4,562	5,836	**35,282**	13,824	1,267	1,621	**16,712**
Gjilan	13,627	2,020	2,480	**18,127**	10,902	1,616	1,984	**14,502**	6,056	449	551	**7,056**
Ferizaj	11,828	2067	2760	**16,655**	9,462	1,654	2,208	**13,324**	5,257	459	613	**6,330**
Prizren	21,215	3,126	4,793	**29,133**	16,972	2,501	3,834	**23,306**	7,868	285	438	**8,592**
Total	**119,422**	**19,459**	**25,109**	**163,990**	**95,538**	**15,567**	**20,087**	**131,192**	51,516	3,915	4,952	**60,384**

Main conclusion of this section shows clearly that natural gas demand is 191,354 Nm3 and the biggest potential demand belongs to space heating energy service.

3.4.3 Natural Gas Demand in the Industry Sector

During recent years, stabilization developments and tendencies for growth in the industrial sector have been mainly based on the existing technology and few new industrial production lines, with some positive developments especially related to improvements of EE. From the energy consumption viewpoint, the industry continues to have high energy intensity per unit of production, both in quantity and value, respectively 0.149 toe/ton of production and 0.522 toe/thousands of Euros.

The main factors for calculating natural gas energy demand have been the GDP contribution as well as on the energy intensity of each energy commodity. Those factors are based on the same indicators used in the Strategy of Energy for the Industrial Sector. It is envisaged that the largest contribution in the GDP from the industry sector will continue to come from the food, beverages, tobacco, metallurgy and construction materials sub-sectors. Whereas, regarding consumption of energy sources, the main contributors are metallurgy, construction materials and food sub-sectors. Figure 3-13 presents the energy demand consumption by all industrial subsectors based on the yearly energy balance for this sector.

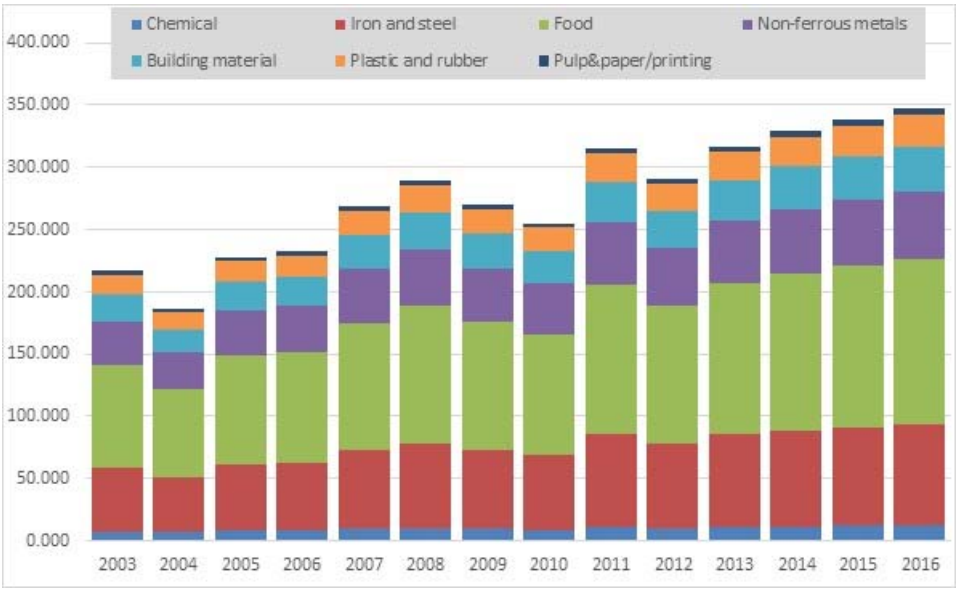


Figure 3-13: Energy consumption (expressed in ktoe) by all industrial subsectors based on the yearly energy balance for this sector.

In order to calculate the natural gas demand for different industrial sectors for different regions of Kosovo, the Consultant based his breakdown calculation on the number of industrial enterprises derived from the yearly publications of the Ministry of Trade and Industry. So, the stock of industrial enterprises has been broken down approximately according to number of respective industrial sub sectors according to each region. Natural gas demand is forecasted to cover a part of three important energy services: 1) low temperature process heating; 2) space heating, water heating and 3) cooking in all urban areas of Kosovo and its year of penetration for each municipality and each region is related with the development of a natural gas transmission and distribution system for that particular region.

In order to calculate the natural gas demand for different industrial sectors for different regions of Kosovo, consultant based breakdown calculation on the number of industrial enterprises on the yearly publication of Ministry of Trade and Industry. So, the stock of industrial enterprises has been broken down approximately according to number of respective industrial sub sectors according to each region. Natural gas demand is forecasted to cover part of three important energy services: 1) low temperature process heating; 2) high temperature process heating; and 3) motive power.

Energy consumption and forecasted demand for all industrial sub-sectors has been carefully analysed and calculated since they are consuming very high amounts of electricity, heavy fuel oil, diesel and wood. Natural gas demand has been calculated based on top down methodology following the eight steps described below:

Step 1: Breakdown total industrial energy consumption on 7 sub-industrial sectors. Breakdown for above mentioned sub-industrial sectors is based on the actual trend of 2010-2016 that is based on the Industrial Enterprises Energy Survey which in turn is based on Europeaid/136562/dh/ser/xk "*Support on Implementing the 3rd Energy*

Package with a focus on EE & RES". The respective calculations carried out from the consultant are presented in Table 3-27.

Table 3-27: Breakdown of total industrial energy consumption on 7 sub-industrial sectors (ktoe)

Sub-industrial sector	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Chemical industry	9.049	11.205	10.319	11.242	11.675	12.009	12.304
Iron and steel industry	59.899	74.175	68.310	74.422	77.287	79.498	81.449
Food industry	97.113	120.259	110.749	120.659	125.303	128.888	132.051
Non-ferrous metals industry	40.400	50.029	46.073	50.195	52.127	53.619	54.935
Building material industry	26.254	32.511	29.940	32.619	33.875	34.844	35.699
Plastic and rubber industry	26.254	32.511	29.940	32.619	33.875	34.844	35.699
Pulp and paper/printing industry	3.568	4.419	4.070	4.434	4.604	4.736	4.852
TOTAL industry	254.890	315.640	290.681	316.689	328.879	338.289	346.591

Step 2: Breakdown energy consumption for each of the 7 sub-industrial on the respective energy services: 1) low temperature process heating (LTPH); 2) low temperature process heating (HTPH); and 3) motive power (MP). Breakdown for above mentioned energy services is based on the actual trend of 2010-2016 that is based on the Industrial Enterprises Energy Survey which in turn is based on Europeaid/136562/dh/ser/xk "*Support on Implementing the 3rd Energy Package with a focus on EE & RES*". The respective calculation carried out from the consultant are presented in Table 3-28.

Table 3-28: Breakdown energy consumption for each of the 7 sub-industrial
for the following services: 1) low temperature process heating (LTPH); 2) low temperature process heating (HTPH); and 3) motive power (MP)

Sub-industrial sector	Energy service	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Chemical industry	Total	9.049	11.205	10.319	11.242	11.675	12.009	12.304
	LTPH	2.659	3.292	3.032	3.303	3.430	3.529	3.615
	HTPH	3.564	4.413	4.064	4.428	4.598	4.730	4.846
	MP	2.826	3.500	3.223	3.511	3.647	3.751	3.843
	Total	59.899	74.175	68.310	74.422	77.287	79.498	81.449
	LTPH	26.955	33.379	30.740	33.490	34.779	35.774	36.65

Iron and steel industry	HTPH	14.975	18.544	17.078	18.606	19.322	19.875	20.36
	MP	17.970	22.253	20.493	22.327	23.186	23.849	24.43
Food industry	Total	97.113	120.259	110.749	120.659	125.303	128.888	132.051
	LTPH	24.278	30.064	27.687	30.165	31.326	32.222	33.01
	HTPH	48.556	60.129	55.375	60.329	62.652	64.444	66.03
	MP	24.278	30.064	27.687	30.165	31.326	32.222	33.01
Non-ferrous metals industry	Total	40.400	50.029	46.073	50.195	52.127	53.619	54.935
	LTPH	18.180	22.513	20.733	22.588	23.458	24.129	24.72
	HTPH	10.100	12.507	11.518	12.549	13.032	13.405	13.73
	MP	12.120	15.009	13.822	15.059	15.638	16.086	16.48
Building material industry	Total	26.254	32.511	29.940	32.619	33.875	34.844	35.699
	LTPH	14.440	17.881	16.467	17.940	18.631	19.164	19.63
	HTPH	3.938	4.877	4.491	4.893	5.081	5.227	5.35
	MP	7.876	9.753	8.982	9.786	10.162	10.453	10.71
Plastic and rubber industry	Total	26.254	32.511	29.940	32.619	33.875	34.844	35.699
	LTPH	14.440	17.881	16.467	17.940	18.631	19.164	19.63
	HTPH	3.938	4.877	4.491	4.893	5.081	5.227	5.35
	MP	7.876	9.753	8.982	9.786	10.162	10.453	10.71
Pulp and paper/printing industry	Total	3.568	4.419	4.070	4.434	4.604	4.736	4.852
	LTPH	1.606	1.988	1.831	1.995	2.072	2.131	2.18
	HTPH	0.892	1.105	1.017	1.108	1.151	1.184	1.21
	MP	1.070	1.326	1.221	1.330	1.381	1.421	1.46
TOTAL industry	Total	254.890	315.640	290.681	316.689	328.879	338.289	346.591
	LTPH	96.490	119.487	110.039	119.884	124.500	128.061	131.204
	HTPH	86.677	107.334	98.848	107.692	111.838	115.037	117.860
	MP	71.723	88.817	81.794	89.112	92.543	95.190	97.527

Step 3: Collect data for the industrial enterprises according to each region and for each sub-industrial sector based on the publication of MTI for SME Development Sector. Number of industrial enterprises according to each region and for each sub-

industrial sector based on the publication of MTI for SME Development Sector are presented in Annexes 9-13. Breakdown is presented for 23 industrial activities and all of them are aggregated on the seven industrial sub-sectors to have the conformity with energy balance for industry sector. Table 3-29 presents number of aggregated industrial enterprises on the seven industrial sub-sectors to have the conformity with energy balance for industry sector**.**

Table 3-29: Number of aggregated industrial enterprises on the seven industrial sub-sectors to have the conformity with energy balance for industry sector

Sub industrial sectors	Chemical	Iron and steel	Food	Non-ferrous metals	Building material	Plastic and rubber	Pulp&paper/printing	TOTAL
Gllogoc	4	17	12	0	5	33	20	91
Fush Kosove	7	26	25	1	6	19	22	106
Lipjan	7	26	27	0	2	33	18	113
Obiliq	0	13	12	0	1	11	6	43
Podujeve	3	33	37	0	10	23	39	145
Prishtine	32	173	222	10	64	73	341	915
Prishtine Reg	53	288	335	11	88	192	446	1413

Sub industrial sectors	Chemical	Iron and steel	Food	Non-ferrous metals	Building material	Plastic and rubber	Pulp&paper/printing	TOTAL
Dragash	0	17	65	0	4	9	22	117
Rahovec	6	35	57	2	3	29	34	166
Prizren	17	76	207	5	29	105	166	605
Suhareke	2	28	37	1	12	52	40	172
Malisheve	1	12	14	0	4	15	19	65
Prizren Regio	26	168	380	8	52	210	281	1125

Sub industrial sectors	Chemical	Iron and steel	Food	Non-ferrous metals	Building material	Plastic and rubber	Pulp&paper/printing	TOTAL
Gjilan	4	79	63	2	18	72	98	336
Kacanik	4	17	18	0	8	23	16	86
Kamenice	3	10	16	0	4	11	25	69
Novo Berdo	0	1	0	0	0	1	0	2
Shtime	1	11	12	2	4	12	14	56
Sterpce	1	2	9	0	2	3	2	19
Ferizaj	22	109	88	0	102	106	131	558
Viti	2	39	30	1	8	28	55	163
Gjilan and Fe	37	268	236	5	146	256	341	1289
Gjilan Regio	13	146	127	3	38	135	194	656
Ferizaj Regio	24	122	109	2	108	121	147	633

Sub industrial sectors	Chemical	Iron and steel	Food	Non-ferrous metals	Building material	Plastic and rubber	Pulp&paper/printing	TOTAL
Gjakova	5	69	91	0	16	39	124	344
Istog	1	23	23	0	4	15	17	83
Klina	0	11	16	0	1	30	13	71
Peja	14	59	94	1	43	50	92	353
Peja and Gja	20	180	234	1	65	145	278	923
	0	0	0	0	0	0	0	0
Peja Region	15	93	133	1	48	95	122	507
Gjakova Regi	5	87	101	0	17	50	156	416

Sub industrial sectors	Chemical	Iron and steel	Food	Non-ferrous metals	Building material	Plastic and rubber	Pulp&paper/printing	TOTAL
Mitrovica	2	29	52	0	10	22	51	166
Leposaviq	1	2	2	0	0	3	2	10
Skenderaj	0	7	14	0	2	19	12	54
Vushtrri	4	34	41	1	11	9	30	130
Zubi Patok	0	0	0	0	0	0	0	0
Zvecan	0	1	1	0	0	1	0	3
Mitrovica Re	7	73	110	1	23	54	95	363

Step 4: Forecast the number industrial enterprises according to each region and for each sub-industrial sector. Analysis carried out and presented at Table 3-29 give the possibility to finally define the summary number of industrial enterprises for each industrial subsector and for each region and the results are presented in Table 3-30.

Table 3-30: Number of aggregated on the seven industrial sub-sectors to have the conformity with energy balance for industry sector

	Chemical	Iron and steel	Food	Non-ferrous metals	Building material	Plastic and rubber	Pulp&paper/ printing	TOTAL
Peja Region	15	93	133	1	48	95	122	507
Gjakova Region	5	87	101	0	17	50	156	416
Mitrovica Region	7	73	110	1	23	54	95	363
Prishtine Region	53	288	335	11	88	192	446	1413
Gjilan Region	13	146	127	3	38	135	194	656
Ferizaj Region	24	122	109	2	108	121	147	633
Prizren Region	26	168	380	8	52	210	281	1125
TOTAL	143	977	1295	26	374	857	1441	5113

Step 5: Forecast energy demand for industrial subsectors (without introduction of the natural gas) for the year 2017-2040 is based on the energy balance (base year 2017); energy strategy for the period 2017-2026) and extrapolation for the period 2027-2040 (Table 3-31).

Table 3-31: Forecast energy demand for industrial subsectors (without introduction of the natural gas) for the years 2017-2040 (ktoe)

ktoe		2017	2020	2025	2030	2035	2040
Chemical industry		12.906	14.885	18.666	22.585	26.361	29.678
Baseline Scenario	High Temperature energy	3.792	4.374	5.485	6.636	7.746	8.720
ktoe	Low Temperature energy	5.083	5.862	7.351	8.895	10.382	11.688
	Mechanical/motive energy	4.031	4.649	5.830	7.054	8.234	9.269
Iron and steel industry		85.432	98.535	123.566	149.507	174.505	196.458
Baseline Scenario	High Temperature energy	38.44	44.34	55.60	67.28	78.53	88.41
ktoe	Low Temperature energy	21.36	24.63	30.89	37.38	43.63	49.11
	Mechanical/motive energy	25.63	29.56	37.07	44.85	52.35	58.94
Food industry		138.509	159.752	200.334	242.391	282.919	318.511
Baseline Scenario	High Temperature energy	34.63	39.94	50.08	60.60	70.73	79.63
ktoe	Low Temperature energy	69.25	79.88	100.17	121.20	141.46	159.26
	Mechanical/motive energy	34.63	39.94	50.08	60.60	70.73	79.63
Non-ferrous metals industry		57.621	66.459	83.342	100.838	117.698	132.505
Baseline Scenario	High Temperature energy	25.930	29.906	37.504	45.377	52.964	59.627
ktoe	Low Temperature energy	14.405	16.615	20.835	25.209	29.425	33.126
	Mechanical/motive energy	17.286	19.938	25.002	30.251	35.309	39.751
Building material industry		37.445	43.188	54.159	65.529	76.485	86.107
Baseline Scenario	High Temperature energy	20.59	23.75	29.79	36.04	42.07	47.36
ktoe	Low Temperature energy	5.62	6.48	8.12	9.83	11.47	12.92
	Mechanical/motive energy	11.23	12.96	16.25	19.66	22.95	25.83
Plastic and rubber industry		26.538	30.608	38.384	46.442	54.207	61.027
Baseline Scenario	High Temperature energy	11.94	13.77	17.27	20.90	24.39	27.46
ktoe	Low Temperature energy	6.63	7.65	9.60	11.61	13.55	15.26
	Mechanical/motive energy	7.96	9.18	11.52	13.93	16.26	18.31
Pulp and paper/printing industry		5.089	5.870	7.361	8.906	10.395	11.703
Baseline Scenario	High Temperature energy	2.29	2.64	3.31	4.01	4.68	5.27
ktoe	Low Temperature energy	1.27	1.47	1.84	2.23	2.60	2.93
	Mechanical/motive energy	1.53	1.76	2.21	2.67	3.12	3.51
TOTAL industry		363.540	419.296	525.812	636.198	742.572	835.988
Baseline Scenario	High Temperature energy	137.620	158.727	199.049	240.836	281.105	316.468
ktoe	Low Temperature energy	123.624	142.584	178.805	216.343	252.516	284.283
	Mechanical/motive energy	102.296	117.985	147.957	179.018	208.951	235.237
BL Natural Gas TOTAL industry		124.889	149.285	198.163	253.018	310.793	367.308

Step 6: Define NG Penetration Ratio for each industrial subsector and energy service: (i) High Temperature energy; ii) Low Temperature energy and iii) Mechanical/motive energy for 8 sub-industrial sectors. Calculation of natural gas demand is carried out based on the entire data mentioned on all steps above and on the NG penetration ratio. Penetration rates of natural gas for each industrial subsector and energy service are presented in Table 3-32.

Table 3-32: Penetration rate of natural gas for public and private service buildings areas

Penetration rate of Natural for securing:	2017	2020	2025	2030	2035	2040
High Temperature processing heat energy	50.42%	51.67%	53.75%	55.83%	57.92%	60%

Low Temperature processing heat energy	40.42%	41.67%	43.75%	45.83%	47.92%	50%
Mechanical/motive power energy	5.42%	6.67%	8.75%	10.83%	12.92%	15%

Step 7: Carry out the Final Natural Gas Energy Demand Forecast for energy category: (i) High Temperature energy; ii) Low Temperature energy and iii) Mechanical/motive energy) for 7 sub-industrial sectors based on the formula:

e = shares of activity level (where NG will penetrate) × energy demand for subsector and for the subcategory

Based on the above mentioned formula has been calculated the natural gas demand for each industrial subsector for three energy services: 1) Space heating, 2) Water heating and 3) Cooking for public and private service buildings areas for the whole period 2017-2040. Natural gas energy demand has been calculated for two respective cases: i) without taking into consideration energy saving measures in the industrial sector; and ii) with taking into consideration energy saving measures in the industrial sector; according to second KEEAP. Respective results are presented in Table 3-33.

Table 3-33: Natural gas energy demand for two respective cases: i) without taking into consideration energy saving measures in the industrial sector; and ii) with taking into consideration energy saving measures in the industrial sector

000m3N		2017	2020	2025	2030	2035	2040
BL Natural Gas Chemical industry		4865.6	5828.2	7761.0	9937.4	12237.5	14496.0
BL Natyral Gas Scen	High Temperature energy	2223.0	2627.6	3427.9	4308.3	5216.3	6083.8
000m3N	Low Temperature energy	2388.7	2840.3	3739.9	4740.5	5784.6	6795.4
	Mechanical/motive energy	253.9	360.4	593.2	888.6	1236.6	1616.8
EE Natural Gas Chemical industry		4815.0	5746.6	7586.3	9619.4	11717.4	13713.2
EE Natyral Gas Scen	High Temperature energy	2199.9	2590.8	3350.8	4170.5	4994.6	5755.3
000m3N	Low Temperature energy	2363.8	2800.5	3655.7	4588.8	5538.7	6428.5
	Mechanical/motive energy	251.2	355.4	579.8	860.2	1184.1	1529.5
BL Natural Gas Iron and steel industry		34189.4	40865.2	54239.7	69248.2	85054.1	100513.2
BL Natyral Gas Scen	High Temperature energy	22537.7	26638.8	34752.9	43678.5	52884.0	61678.5
000m3N	Low Temperature energy	10037.4	11934.9	15715.1	19919.7	24307.2	28554.9
	Mechanical/motive energy	1614.3	2291.5	3771.6	5650.0	7862.9	10279.8
EE Natural Gas Iron and steel industry		33833.8	40293.1	53019.3	67032.3	81439.3	95085.5
EE Natyral Gas Scen	High Temperature energy	22303.3	26265.8	33971.0	42280.8	50636.4	58347.9
000m3N	Low Temperature energy	9933.1	11767.8	15361.5	19282.3	23274.1	27012.9
	Mechanical/motive energy	1597.5	2259.4	3686.8	5469.2	7528.7	9724.6
BL Natural Gas Food industry		55027.7	65789.2	87354.9	111565.6	137073.4	162033.3
BL Natyral Gas Scen	High Temperature energy	20299.8	23993.7	31302.2	39341.6	47633.0	55554.3
000m3N	Low Temperature energy	32546.9	38699.5	50957.0	64590.6	78817.2	92590.5
	Mechanical/motive energy	2181.0	3096.0	5095.7	7633.4	10623.2	13888.6
EE Natural Gas Food industry		54455.4	64868.2	85389.4	107995.5	131247.7	153283.5
EE Natyral Gas Scen	High Temperature energy	20088.7	23657.8	30597.9	38082.6	45608.6	52554.3
000m3N	Low Temperature energy	32208.4	38157.8	49810.5	62523.7	75467.4	87590.6
	Mechanical/motive energy	2158.3	3052.6	4981.1	7389.2	10171.7	13138.6
BL Natural Gas Non-ferrous metals industry		23059.8	27562.4	36583.1	46705.9	57366.5	67793.2
BL Natyral Gas Scen	High Temperature energy	15201.0	17967.1	23439.8	29459.9	35668.7	41600.4
000m3N	Low Temperature energy	6770.0	8049.8	10599.4	13435.3	16394.5	19259.4
	Mechanical/motive energy	1088.8	1545.6	2543.9	3810.7	5303.3	6933.4
EE Natural Gas Non-ferrous metals industry		22819.9	27176.5	35760.0	45211.3	54928.4	64132.4
EE Natyral Gas Scen	High Temperature energy	15042.9	17715.5	22912.4	28517.2	34152.8	39354.0
000m3N	Low Temperature energy	6699.6	7937.1	10360.9	13005.4	15697.7	18219.4
	Mechanical/motive energy	1077.5	1523.9	2486.6	3688.8	5077.9	6559.0
BL Natural Gas Building material industry		15420.6	18413.4	24402.9	31113.4	38168.5	45056.1
BL Natyral Gas Scen	High Temperature energy	12073.4	14270.3	18617.1	23398.5	28329.9	33041.1
000m3N	Low Temperature energy	2639.6	3138.6	4132.8	5238.5	6392.3	7509.3
	Mechanical/motive energy	707.5	1004.4	1653.1	2476.4	3446.3	4505.6
EE Natural Gas Building material industry		15260.2	18155.6	23853.9	30117.7	36546.3	42623.0
EE Natyral Gas Scen	High Temperature energy	11947.8	14070.6	18198.2	22649.8	27125.9	31256.9
000m3N	Low Temperature energy	2612.2	3094.7	4039.8	5070.8	6120.6	7103.8
	Mechanical/motive energy	700.2	990.3	1615.9	2397.1	3299.8	4262.3
BL Natural Gas Plastic and rubber industry		10620.5	12694.2	16848.8	21511.0	26420.9	31223.0
BL Natyral Gas Scen	High Temperature energy	7001.0	8275.0	10795.5	13568.1	16427.7	19159.6
000m3N	Low Temperature energy	3118.0	3707.4	4881.7	6187.8	7550.7	8870.2
	Mechanical/motive energy	501.5	711.8	1171.6	1755.1	2442.5	3193.3
EE Natural Gas Plastic and rubber industry		10510.0	12516.5	16469.7	20822.6	25298.0	29537.0
EE Natyral Gas Scen	High Temperature energy	6928.2	8159.1	10552.6	13133.9	15729.5	18125.0
000m3N	Low Temperature energy	3085.6	3655.5	4771.9	5989.8	7229.8	8391.2
	Mechanical/motive energy	496.2	701.9	1145.2	1698.9	2338.7	3020.8
BL Natural Gas Pulp and paper/printing industry		2036.7	2434.4	3231.1	4125.2	5066.8	5987.7
BL Natyral Gas Scen	High Temperature energy	1342.6	1586.9	2070.3	2602.0	3150.4	3674.3
000m3N	Low Temperature energy	597.9	711.0	936.2	1186.6	1448.0	1701.0
	Mechanical/motive energy	96.2	136.5	224.7	336.6	468.4	612.4
EE Natural Gas Pulp and paper/printing industry		2015.5	2400.3	3158.4	3993.2	4851.4	5664.3
EE Natyral Gas Scen	High Temperature energy	1328.6	1564.7	2023.7	2518.7	3016.5	3475.8
000m3N	Low Temperature energy	591.7	701.0	915.1	1148.7	1386.5	1609.2
	Mechanical/motive energy	95.2	134.6	219.6	325.8	448.5	579.3
BL Natural Gas TOTAL industry		145220	173587	230422	294207	361388	427102
BL Natyral Gas Scen	High Temperature energy	80679	95359	124406	156357	189310	220792
000m3N	Low Temperature energy	58099	69082	90962	115299	140694	165281
	Mechanical/motive energy	6443	9146	15054	22551	31383	41030
EE Natural Gas TOTAL industry		143710	171157	225237	284792	346029	404039
EE Natyral Gas Scen	High Temperature energy	79840	94024	121607	151354	181264	208869
000m3N	Low Temperature energy	57494	68114	88915	111609	134715	156356
	Mechanical/motive energy	6376	9018	14715	21829	30049	38814

Step 8: Carry out the Final Natural Gas Energy Demand Forecast for each region based on the sum of Urban and Rural respective NG Energy Demand for each municipality and region.

Natural gas energy demand has been broken down for each region and for each sub-industrial sector taking also into consideration EE targets in the industry sector according to second KEEAP. Respective results are presented in Table 3-34.

Table 3-34: Natural gas energy demand has been broken down for each region and for each sub-industrial sector taking also into consideration EE targets in the industry sector according to second KEEAP

	2017	2020	2025	2030	2035	2040
Peja Region						
Chemical	505.07	602.79	795.77	1009.03	1229.10	1438.45
Iron and steel	3220.62	3835.47	5046.87	6380.76	7752.15	9051.12
Food	5592.72	6662.14	8769.73	11091.43	13479.50	15742.63
Non-ferrous metals	877.69	1045.25	1375.38	1738.90	2112.63	2466.63
Building material	1958.53	2330.13	3061.46	3865.38	4690.43	5470.33
Plastic and rubber	1165.05	1387.48	1825.70	2308.23	2804.33	3274.23
Pulp&paper/printing	170.64	203.22	267.40	338.08	410.74	479.56
TOTAL	**13490.32**	**16066.47**	**21142.31**	**26731.80**	**32478.88**	**37922.96**
Gjakova Region						
Chemical	168.36	200.93	265.26	336.34	409.70	479.48
Iron and steel	3012.84	3588.02	4721.27	5969.10	7252.01	8467.18
Food	4247.10	5059.22	6659.72	8422.82	10236.31	11954.93
Non-ferrous metals	0.00	0.00	0.00	0.00	0.00	0.00
Building material	693.65	825.25	1084.27	1368.99	1661.20	1937.41
Plastic and rubber	613.19	730.25	960.89	1214.86	1475.96	1723.28
Pulp&paper/printing	218.20	259.85	341.92	432.29	525.21	613.21
TOTAL	**8953.32**	**10663.53**	**14033.33**	**17744.39**	**21560.39**	**25175.49**
Mitrovica Region						
Chemical	235.70	281.30	371.36	470.88	573.58	671.27
Iron and steel	2528.01	3010.64	3961.52	5008.55	6085.02	7104.65
Food	4625.56	5510.04	7253.16	9173.36	11148.46	13020.22
Non-ferrous metals	877.69	1045.25	1375.38	1738.90	2112.63	2466.63
Building material	938.46	1116.52	1466.95	1852.16	2247.50	2621.20
Plastic and rubber	662.24	788.67	1037.76	1312.05	1594.04	1861.14
Pulp&paper/printing	132.88	158.24	208.22	263.26	319.84	373.43
TOTAL	**10000.54**	**11910.67**	**15674.36**	**19819.16**	**24081.07**	**28118.54**
Prishtina Region						
Chemical	1784.59	2129.87	2811.72	3565.22	4342.83	5082.51
Iron and steel	9973.54	11877.60	15629.02	19759.77	24006.66	28029.29
Food	14086.92	16780.57	22089.16	27937.06	33952.12	39652.49
Non-ferrous metals	9654.59	11497.76	15129.22	19127.87	23238.95	27132.94
Building material	3590.64	4271.90	5612.68	7086.53	8599.13	10028.95
Plastic and rubber	2354.63	2804.16	3689.83	4665.05	5667.69	6617.39
Pulp&paper/printing	623.82	742.91	977.55	1235.92	1501.55	1753.15
TOTAL	**42068.72**	**50104.77**	**65939.19**	**83377.43**	**101308.93**	**118296.72**
Gjilani Region						
Chemical	437.73	522.42	689.67	874.49	1065.22	1246.65
Iron and steel	5056.03	6021.28	7923.05	10017.11	12170.04	14209.29
Food	5340.41	6361.59	8374.10	10591.06	12871.40	15032.44
Non-ferrous metals	2633.07	3135.75	4126.15	5216.69	6337.90	7399.89
Building material	1550.50	1844.68	2423.66	3060.09	3713.26	4330.68
Plastic and rubber	1655.60	1971.68	2594.41	3280.11	3985.10	4652.85
Pulp&paper/printing	271.35	323.15	425.21	537.60	653.14	762.58
TOTAL	**16944.69**	**20180.55**	**26556.25**	**33577.16**	**40796.06**	**47634.39**
Ferizaj Region						
Chemical	808.12	964.47	1273.23	1614.44	1966.56	2301.51
Iron and steel	4224.90	5031.48	6620.63	8370.46	10169.49	11873.52
Food	4583.50	5459.95	7187.22	9089.97	11047.11	12901.86
Non-ferrous metals	1755.38	2090.50	2750.77	3477.80	4225.26	4933.26
Building material	4406.69	5242.78	6888.29	8697.10	10553.48	12308.25
Plastic and rubber	1483.91	1767.21	2325.36	2939.95	3571.83	4170.33
Pulp&paper/printing	205.61	244.86	322.20	407.35	494.91	577.83
TOTAL	**17468.11**	**20801.25**	**27367.69**	**34597.08**	**42028.63**	**49066.57**
Prizreni Region						
Chemical	875.46	1044.84	1379.33	1748.98	2130.44	2493.31
Iron and steel	5817.90	6928.60	9116.93	11526.53	14003.89	16350.42
Food	15979.19	19034.68	25056.36	31689.80	38512.85	44978.95
Non-ferrous metals	7021.52	8362.01	11003.07	13911.18	16901.06	19733.05
Building material	2121.74	2524.30	3316.58	4187.49	5081.30	5926.20
Plastic and rubber	2575.38	3067.05	4035.75	5102.40	6199.04	7237.77
Pulp&paper/printing	393.03	468.07	615.90	778.68	946.04	1104.57
TOTAL	**34784.22**	**41429.55**	**54523.93**	**68945.07**	**83774.62**	**97824.25**
	2017	2020	2025	2030	2035	2040
Peja Region	**13490**	**16066**	**21142**	**26732**	**32479**	**37923**
Gjakova Region	**8953**	**10664**	**14033**	**17744**	**21560**	**25175**
Mitrovica Region	**10001**	**11911**	**15674**	**19819**	**24081**	**28119**
Prishtina Region	**42069**	**50105**	**65939**	**83377**	**101309**	**118297**
Gjilani Region	**16945**	**20181**	**26556**	**33577**	**40796**	**47634**
Ferizaj Region	**17468**	**20801**	**27368**	**34597**	**42029**	**49067**
Prizreni Region	**34784**	**41430**	**54524**	**68945**	**83775**	**97824**
TOTAL	**143710**	**171157**	**225237**	**284792**	**346029**	**404039**

Figure 3-14 present the summary of industry sector potential natural gas demand for each region for each the presented year 2017-2040. Figure 3-15 present the summary of industry sector potential natural gas demand for Kosovo for each the presented years 2017-2040.

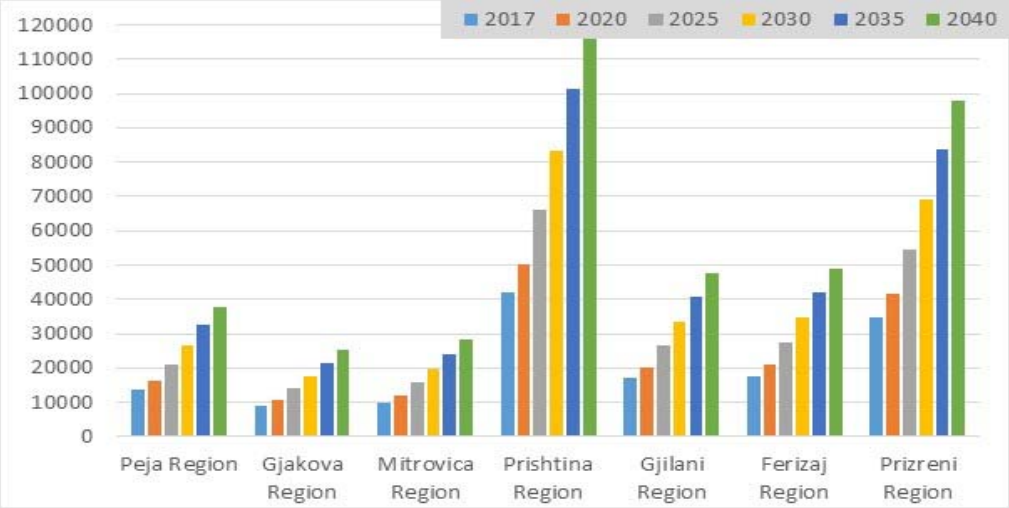


Figure 3-14: Summary of industry sector potential natural gas demand for each region for each the presented years 2017-2040 (m^3N)

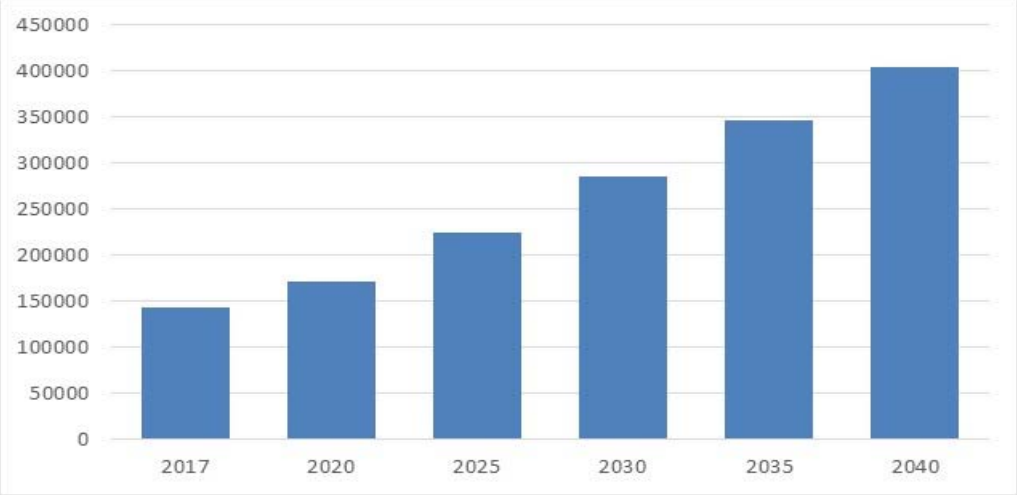


Figure 3-15: Summary of industry sector potential natural gas demand for each region for each the presented year 2017-2040 (m^3N)

Table 3-35 presents the summary of potential natural gas consumption expressed in Nm^3 for the industry sector of Kosovo. These tables also presents the potential capacities for the year 2040 which is a very important factor for the technical design of the natural gas transmission and distribution pipelines.

Table 3-35: Summary of potential natural gas consumption expressed in Nm3 for the industry sector of Kosovo

Potential natural gas consumption (000 m3) / capacities (m3/h)for the Industrial Sector in Kosovo						
District		2040	80% of Potential natural gas consumption (000 m3) in 2040		Potential capacities in 2040 in m3/h	
Pejë		37,923		30,338		5,541
Gjakova		25,175		20,140		3,679
Mitrovicë		28,119		22,495		4,109
Prishtinë		118,297		94,638		17,285
Gjilan		47,634		38,107		6,960
Ferizaj		49,067		39,254		7,170
Prizren		97,824		78,259		14,294
KOSOVO		404,039		323,231		59,038

Main conclusion of this section shows clearly that natural gas demand is 404,039 Nm^3 and the biggest potential demand belong to food industry subsector.

3.4.4 Natural Gas Demand in the District Heating and Cogeneration Sector

District Heating (DH) Companies exist in Prishtina, Gjakova, and Mitrovica. Their total heat generation is approximately 250 GWh_{th}/year, or about 4-5% of the Kosovo heating demand[1]. The district heating facilities supply the most densely inhabited parts of the cities and public facilities such as hospitals, schools and administrative buildings as well as industrial enterprises. The Prishtina DH system accounts for over 90% of the total DH capacity in Kosovo. It is operated by Termokos JSC, a local public utility. The present operating capacity of 2 x 75 MW is supplied via heat from Kosovo B TPP (and by Mazut fired boilers as back-up system). The other existing DH systems of Kosovo are relatively small (almost 15-20 MW each) and the heat production plants are located within the urbanized sector of Gjakova and Mitrovica, wherefore they are very critical from the environmental viewpoint and a conversion to biomass and natural gas will be accepted by the population.

The construction of collective housing buildings in all cities of Kosovo, particularly in the largest ones, has taken off in unprecedented high levels since the end of the war in 1999. Accordingly, the treatment of thermal energy used for space heating through district heating systems is one of the main objectives of the strategy of Kosovar energy sector.

The use of electricity for heating spaces is a high burden to the power system, particularly in a situation where large amounts of electricity are used in an unauthorized manner, on the one hand, and the generation capacities of electricity are limited on the other. Use of other types of energy such as firewood, oil and its products, etc., is inconvenient for collective residential buildings and buildings in the service sector. In 2012 MED financed a project for a preliminary study in district heating in Peja, Prizren, Gjilan, and Ferizaj. The Consultant have carried out the forecast for the energy demand for natural gas to supply district heating systems of Prishtina (enlarging the existing one), Prizren, Gjilan, Peja, Mitrovica (enlarging the existing one), Ferizaj, Gjakova (enlarging the existing one) based on the following assumption presented in Table 3-36 and Table 3-37.

[1] MEM study supported by the Kosovo Energy Strategy 2016-2026

Table 3-36: Energy demand for natural gas to supply district heating systems of Prishtina (enlarging the existing one), Prizren, Gjilan, Peja, Mitrovica (enlarging the existing one), Ferizaj, Gjakova (enlarging the existing one)

No	City	"new" DH area		kWh per household	Household No connected to DH	Gas engines		Plant configuration					Annual energy conversion		
						J920	J624	CHP			Boiler				
		Annual heat ' ' MWh	Annual HTW ' ' MWh			pcs	pcs	Heat MW	Elec MW	Fuel MW	Heat MW	Fuel MW	Heat MWh	Electricity MWh	Natural gas m3
1	Prishtina	400,000	34,000	23,977	16,683	3	1	30.3	35.6	72.2	245	272	471,277	153,864	65,702,256
2	Prizren	250,000	21,250	26,261	9,520	2	1	21.7	25.2	51.3	155	172	294,548	107,872	42,225,948
3	Gjilan	160,000	13,600	27,267	5,868	1	1	13.1	14.8	30.4	100	111	188,511	63,649	26,423,858
4	Peja	155,000	13,175	26,767	5,791	1	1	13.1	14.8	30.4	95	106	182,620	63,504	25,855,996
5	Mitrovica	175,000	14,875	24,818	7,051	1	2	17.6	19.2	39.9	110	122	206,467	80,799	29,976,766
6	Ferizaj	160,000	13,600	28,772	5,561	1	1	13.1	14.8	30.4	100	111	188,511	63,649	26,423,858
7	Gjakova	155,000	13,175	25,910	5,982	1	1	13.1	14.8	30.4	100	111	182,620	63,504	25,786,297
	TOTAL	**1,455,000**	**123,675**		**56,456**			**122**	**139**	**285**	**905**	**1,006**	**1,714,552**	**596,843**	**242,394,979**

Table 3-37: Energy demand for natural gas and the respective capacities for supply district heating systems of Prishtina, Prizren, Gjilan, Peja, Mitrovica (enlarging the existing one), Ferizaj, Gjakova

CHP systems in DH					
Cities/DH&CHP	Potential natural gas volume (000 m3) in 2040			Potential capacities in 2040 in m3/h	
Peja		25,856			11,457
Gjakova		25,786			11,410
Mitrovica		29,977			13,114
Prishtina		65,702			29,229
Gjilan		26,424			11,733
Ferizaj		26,424			11,733
Prizren		42,226			18,562

Consultant has calculated the yearly heat and electricity generation curve from the respective cogeneration and DH plants for all above mentioned cities and the results are presented in Annex 14.

Main conclusion of this section shows clearly that energy demand for natural gas to supply district heating systems of Prishtina (enlarging the existing one), Prizren, Gjilan, Peja, Mitrovica (enlarging the existing one), Ferizaj, Gjakova (enlarging the existing one) is 242 Mil. Nm^3.

3.4.5 Natural Gas Demand in the Power Generation Sector

Kosovo is addressing the aging of its power generation infrastructure through a new planned thermal power plant "Kosova e Re," which is one of its main energy sector projects and supports all pillars of the Energy Strategy of the Republic of Kosovo. This lignite-fired thermal power plant is envisaged to have two units of 250 MW per unit, and will be built with the Best Available Technology designed to ensure reliability of supply in the most environmentally friendly manner.

Kosova e Re is planned to conform to all requirements of the Industrial Emissions Directive, which stipulates the highest European environmental standards. The implementation of these standards means that this thermal power plant will generate electricity while emitting levels of air pollutants that are acceptable for new thermal power plants in Europe. Simultaneously, the development of this thermal power plant will enable the closure of Kosova A, which is one of the main sources of pollution in the Republic of Kosovo.

Estimation of the natural gas potential for power generation in the gas demand assessment was initially based on natural gas diversification objective of Kosovo Energy Strategy. Key drivers for actual gas contribution in the electricity mix will be:

- Availability and prices of natural gas, price relations between electricity and natural gas;
- Establishing electricity market coupling between Kosovo and Albania as complementary systems;
- Overall regional electricity market development and electricity trade in the region (including interconnections firstly with Albania (400 kv line already constructed and ready for its operation) with neighboring countries/electricity markets); and
- Meeting Kosovo Renewables and CO2 targets;

Natural gas power generation is complementary for systems with high percentage of coal TPPs. CCGT have relatively low fixed costs and can therefore be feasible even as non-baseload plants, generating power to balance intermittent output from renewables, providing peak-load electricity and also providing secondary services to electrical system as balancing. The Consultant have carried out the forecast for the energy demand for natural gas for supplying 500 MW CCGT Prishtina power plant and results are presented in Table 3-38.

Table 3-38: Energy demand for natural gas for supplying 500 MW-CCGT Prishtina power plant

Anchor loads		
	Potential natural gas consumption (000 m3) in 2040	Potential capacities in 2040 in m3/h
CCGT Prishtina, 500 MW	625,000	96,154

3.4.6 Natural Gas Demand in all Sectors

Summing the potential natural gas consumption in households, services, industry, DH & Cogeneration and power sector gives as the total potential natural gas consumption in every municipality of Kosovo by 2040 by regions. Since there are a large number of municipalities in Kosovo, below Table 3-39 show the potential natural gas consumption by regions of Kosovo by 2040.

Table 3-39: Total potential natural gas consumption in Kosovo by 2040 (m3)

Potential natural gas consumption (000 m3) / capacities (m3/h) for the Residential, Service and Industrial Sectors in Kosovo								
District	80% of Potential natural gas consumption (000 m3) in 2040				Potential capacities in 2040 in m3/h			
	Residential	Service	Industrial	Total	Households	Services	Industry	TOTAL
Peja	66,516	18,330	30,338	**115,184**	24,881	8,924	5,541	39,346
Gjakova	79,006	20,647	20,140	**119,793**	27,076	10,046	3,679	40,801
Mitrovica	95,666	26,450	22,495	**144,611**	28,049	13,002	4,109	45,160
Prishtina	187,328	51,458	94,638	**333,424**	58,191	24,608	17,285	100,084
Gjilan	85,339	21,247	38,107	**144,694**	27,189	10,415	6,960	44,565
Ferizaj	93,621	19,441	39,254	**152,315**	29,738	9,321	7,170	46,229
Prizren	131,568	33,782	78,259	**243,609**	54,235	13,819	14,294	82,348
KOSOVO	739,043	191,355	323,231	1,253,630	249,358	90,136	59,038	398,532

Anchor loads				
	Potential natural gas consumption (000 m3) in 2040		Potential capacities in 2040 in m3/h	
CCGT Prishtina, 500 MW		625,000		96,154

Interconnectors				
Interconnector	Potential natural gas volume (000 m3) in 2040		Potential capacities in 2040 in m3/h	
KOS - SRB		1,400,000		636,364
KOS - MKD		500,000		236,000
KOS - MNE		588,000		346,100

CHP systems in DH				
Interconnector	Potential natural gas volume (000 m3) in 2040		Potential capacities in 2040 in m3/h	
Peja		25,856		11,457
Gjakova		25,786		11,410
Mitrovica		29,977		13,114
Prishtina		65,702		29,229
Gjilan		26,424		11,733
Ferizaj		26,424		11,733
Prizren		42,226		18,562

Main conclusion of this chapters shows that potential of the natural gas demand is 1.2 bcm (considering only industry, service and residential sectors) up to approximately 2 bcm ((considering industry, service and residential sectors, DH & Cogeneration and 500 MW CCGT power plants)).

4 Pipeline Routing and Technical Assessment

4.1 Transmission pipeline routing

The Albanian section of pipeline route assessment exercise has been undertaken in order to verify the feasibility and constructability of the route determined during Gas Master Plan. General corridors were detailed further including facility location and technical optimization.

The Kosovo section of pipeline route assessment exercise has been undertaken in order to verify the feasibility and constructability of the route initially determined by desk studies within this project. General corridors were detailed including facility location and technical optimization.

The entire pipeline route sections and critical points have been inspected by means of a vantage point survey, visiting accessible road-, river- or rail-crossing locations and observing the route in each direction from the crossing point.

Official digital orthophoto maps, scale of 1: 5,000 have been used in conjunction with national topographic maps 1:25,000 and 1:10,000, to visit points of interest along the pipeline routes.

For most of the pipeline sections, the pipeline route assessment confirmed that the pre-selected routes are feasible to construct using well established pipeline construction practices. Some very difficult route segments in the high mountainous area of Albania might require specialized techniques of drilling or erosion protection. These practices are described in this report and special construction techniques have been specified, for example, the techniques which apply at major crossings.

The pipeline route passes over either hilly or flat and arable land, as well as some very steep mountainous sections. The pipeline route crosses several rivers, railway, national roads and smaller roads. The suitability of each crossing location for the proposed crossing technique has been assessed and confirmed.

4.1.1 Location and pipeline route description

The pipeline is optimized to enable future supply of the gas markets in northern Albania and Kosovo for different route development options. Below there is shown the route options identified during this study. Annex 15 include orthophotos and topographic maps in more detail for the selected ALKOGAP corridor.

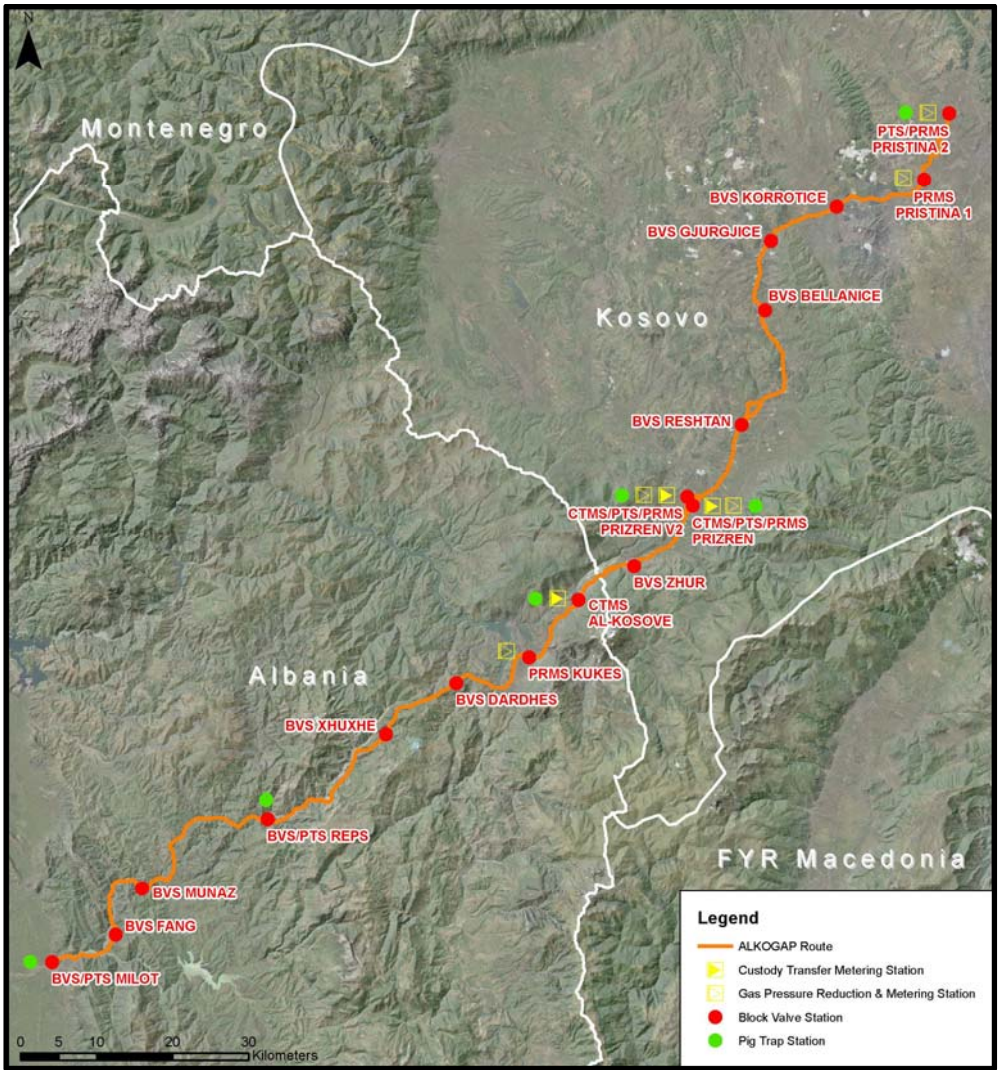


Figure 4-1: Pipeline corridor and pipeline facilities

The identified route have minor options (plus/minus 2 km) in the Kosovo section, near Prizren and near BVS Reshtan.

In Albania, the general pipeline route was already established during the Albanian GMP and only limited corrections and modifications of this general route were performed considering technical, geotechnical and environmental requirements.

In Kosovo, the general direction of the pipeline was established based on the locations of possible major gas consumption centres and the most convenient topography as well as other contributing factors such as available access roads, which would facilitate construction and future maintenance of the pipeline and other geological, geotechnical and environmental or social factors.

Below there is given a table of pipeline sections and their respective lengths.

Table 4-1: Pipeline sections and aboveground facilities

No	Component	Length
Albania		
1	BVS/PTS Milot – BVS Fang	10.8 km
2	BVS Fang – BVS Munaz	11.9 km
3	BVS Munaz – PTS Reps	25 km
4	PTS Reps – PTS Xhuxhe	23 km
5	PTS Xhuxhe – BVS Dardhez	12.5 km
6	BVS Dardhez – PRMS Kukes	13.8 km
7	PRMS Kukes – CTMS Al-Kosovo	11.3 km
Kosovo		
8	CTMS AL/Kosovo – BVS Zhur	9.8 km
9	BVS Zhur – CTMS/PTS/PRMS Prizren	14.1 km
10	CTMS/PTS/PRMS Prizren – BVS Reshtan	13.3 km
11	BVS Reshtan – BVS Bellanice	20.8 km
12	BVS Bellanice – BVS Gjurgjice	10.5 km
13	BVS Gjurgjice – BVS Korrotice	10.5 km
14	BVS Korrotice – BVS/PRMS Pristina 1	13.9 km
15	BVS/PRMS Prishtina 1 – PTS/PRMS Pristina 2	11 km

4.1.2 Detailed routing

In order to determine the most suitable corridors for the future pipeline, the technical team used official topographic maps 1: 25,000 and, depending on the availability, larger official topographic maps 1: 10,000. In addition, official geo-referenced aerial photography (orthophoto) were used. During the analysis, all available, local and national, spatial planning development documents were reviewed to avoid conflicts with any development plans. In the end, site investigations were carried out to assess and analyse closely all the geotechnical, environmental and social impacts. Below are given short descriptions of the pipeline sections.

Section 1: BVS/PTS Milot – BVS Fang

This section is nearly 10.8 km long and starts at BVS/PTS Milot, which is situated in a flat plain besides Mat River. From here the pipeline runs eastwards through

the this plain until it reaches Mat River Valley, where is stays for nearly 5.3 km as shown in the illustration below.

Figure 4-2: Gas pipeline route Milot – Fang and Protected Area of Berzane

The pipeline crosses the river four times, while running within Mat River valley and will be exposed to river erosion and floods, which should be mitigated through application of specific crossing methods to avoid these effects. After exiting the river valley, the corridor runs over a rough terrain with steep slopes before reaching BVS Fang.

The excavability of the terrain remains acceptable within the river valley limits, but it is much harder at the other areas and near BVS Fang.

The pipeline route runs near the southern edge of Berzane Protected Area (category IV of IUCN protection status), but doesn't impact it directly.

The pipeline corridor doesn't approach any human settlements within this section of the pipeline corridor.

Section 2: BVS Fang – BVS Munaz

The section is 11.9 km and runs on both sides of Fan river over relatively steep and rugged slopes. The corridor crosses Fan River six times in the process. The slopes on both sides of the valley are composed of flysch formations which are relatively easier to excavate. However, near Rubik hard limestone formations outcrop in the surface.

BVS Munaz is situated in a river terrace 50 m away from the Fan River banks.

Figure 4-3: Gas pipeline route options in the section BVS Fang – BVS Munaz

Section 3: BVS Munaz – PTS Reps

This section is 25 km long and is different from the previous ones, because does not run parallel to the river valley or the highway Milot-Kukes.

The corridor goes through a considerably rugged terrain often carved by erosion (see figure below). The corridor crosses a few times Fan River or its tributary, Little Fan River, and crosses also an artificial lake created by the construction of a hydropower power plant on Little Fan River.

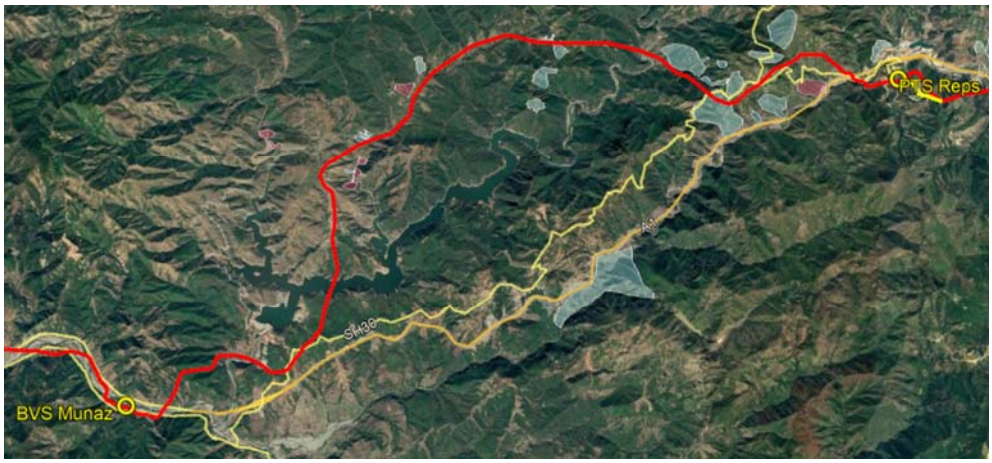


Figure 4-4: Route options in the section BVS Munaz – PTS Reps

Near Bukemire village the terrain is barren and wrinkled (see figure below). Near the village of Shperdheze and Simon the pipeline goes through a relatively flat terrain composed of softer geological formations, but this relatively easy segment is only 4 km long.

Figure 4-5: High erosion area near pipeline corridor in Bukemire Village

After Simon Village the terrain becomes rugged again and proceeds through another steep mountainous area, which rises continuously from 175 m above sea level to 500 m above sea level near the local road. After this high point the terrain heights decrease continuously down to 250 m above sea level at the crossing with the major highway Milot-Kukes.

Near Blinisht Village, a large landslide was identified. Below there is a photo from this landslide, where are evident all the classical signs of strain.

Figure 4-6: Recent landslide (March 22, 2018) near Blinisht Village

In the figure above it is evident the subsiding of the road, which used to be level, but now it is sloping downwards as a result of the landslide. The extent of this landslide is nearly half a kilometre from this point down to the toe of the slope. The

pipeline corridor was therefore modified to avoid this landslide as shown in the illustration below.

Figure 4-7: Landslide extent and pipeline route near Blinisht

Apart from this recent landslide, there are some smaller older landslides near Bukemire (marked with purple in the figure below), but they will not likely have an impact on the prospective pipeline

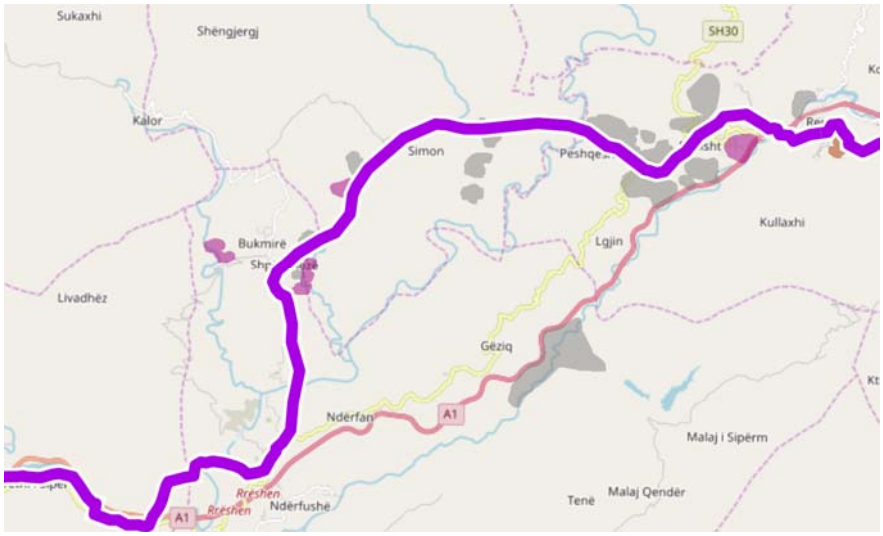


Figure 4-8: Location of identified landslides (in purple) and erosion areas (in grey)

The excavability varies in different portions of this section. Near Bukemire Village the excavability is relatively hard, because the terrain is composed of Breccia and

harder rock formations are exposed in the surface. Near Shperdheze Village the formations are soft because they are composed of river deposits from Little Fan River and the topsoil is thicker. After Simon Village the excavability index increases again, since ultrabasic and basic formations are encountered.

Before reaching Reps, the pipeline route runs close to a copper processing plant and to a copper mine (see figure below), which is formally abandoned (CMD No. 242 of May 18, 2000).

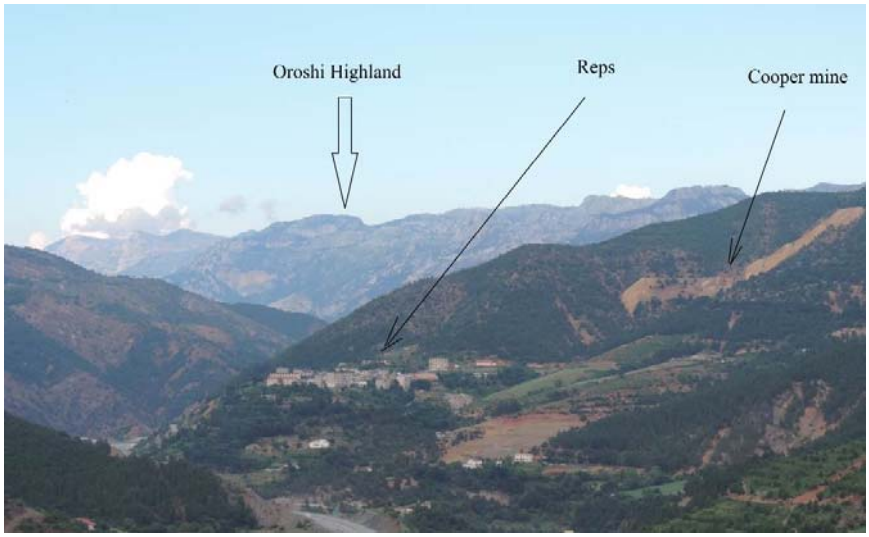


Figure 4-9: Wide view of the area near Reps

The route was modified at this location to avoid this shallow mine depicted with red in the illustration below (yellow line is the original path).

Figure 4-10: Route diversion around the cooper mine near Reps

PTS Reps (1,200 m^2 facility) is located on a mountainous terrace west of Reps Town at almost 350 m above sea level.

There is no significant impact on local human settlements by the prospective pipeline.

Section 4: PTS Reps – PTS Xhuxhe

This section is 23 km long and it is the most difficult section with regard to technical difficulties. The corridor runs generally in parallel to the major highway Durres-Kukes as demonstrated in the figure below.

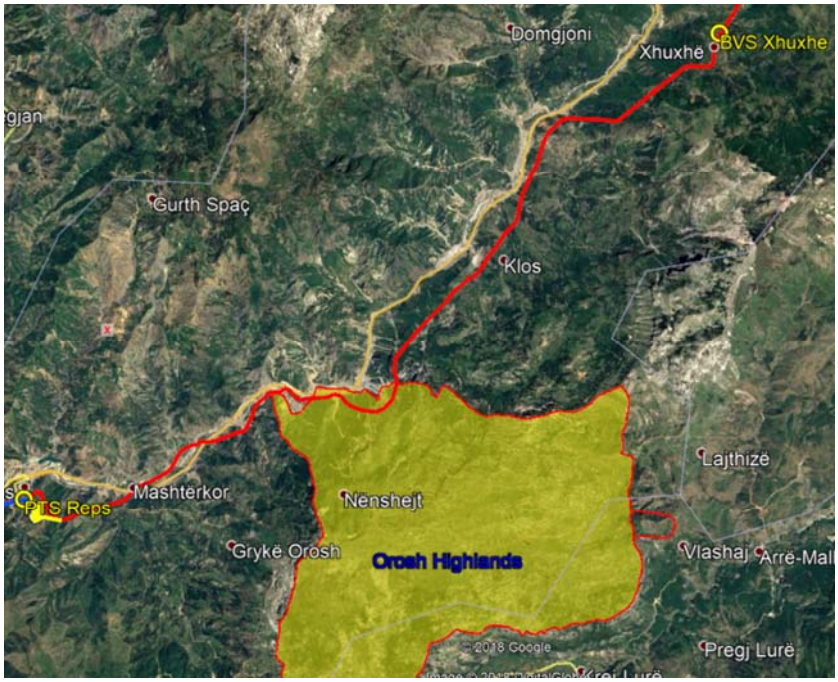


Figure 4-11: Gas route in the Section Reps – Xhuxhe and Protected Area of Orosh

The terrain is very rugged and characterized by steep slopes and rock formations that make it very sensible to landslides. Below there is a depiction (with red colour) of the extent of risky areas for landslides identified with the aid of GIS mapping.

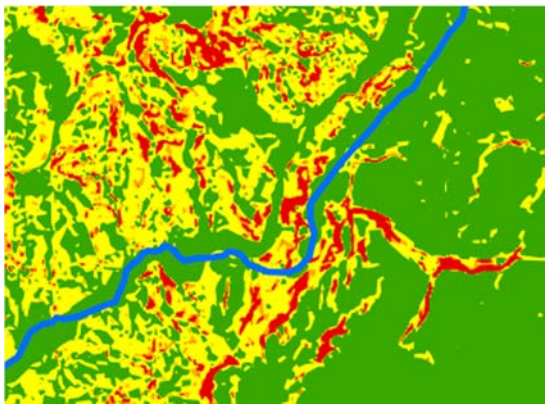


Figure 4-12: Landslide risk areas identified through GIS slope map

The corridor stays mostly on the southern side of the highway with the exception of the portion between Villages of Mashterkor and Shtrungaj, where it is on the northern side (crossing twice the highway and the Little Fan River in the process).

The terrain height increases from 400 to 850 m above sea level before reaching the mountainous terrace of Orosh Highlands.

At the terrace of Orosh Highlands the terrain is not as steep, but nonetheless with significant undulations that are common for a mountainous region. The pipeline goes through some mountainous villages that have some available access roads that may facilitate construction.

The prospective pipeline will impact the western part of Orosh Highlands, which is a Category VI protected area (CMD Nr.102, of January 15, 1996) according to IUCN protection status. Below there is a photo of the beginning of this protected area.

Figure 4-13: Landscape at the location near Orosh Highland (S to N view)

The excavability varies in different portions of this section. Near Bukemire Village the excavability is relatively hard because the terrain is composed of Breccia and harder rock formations are exposed in the surface. Near Shperdheze Village the formations are soft because they are composed of river deposits from Little Fan River and the topsoil is thicker. After Simon Village the excavability index increases again, since ultrabasic and basic formations are encountered.

Section 5: PTS Xhuxhe – BVS Dardhez

This section is 12.5 km and it is again a difficult section since it goes through a mountainous area beside the tunnel of the major highway (see figure below). The terrain heights initially increase continuously up to Thirre Village reaching a point of 1,330 m above sea level, then decrease continuously to around 900 m above sea level near Dardhez Village. Below there is shown a depiction of topography within this section to illustrate terrain heights.

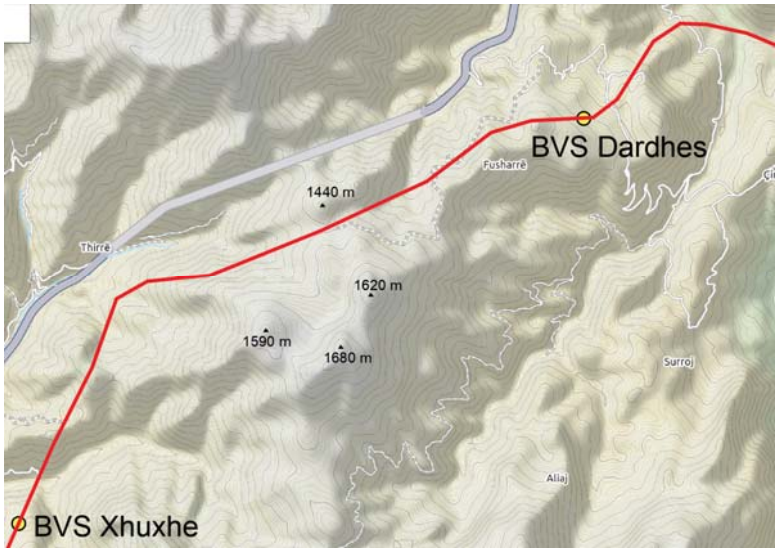


Figure 4-14: Pipeline route within the Section BVS Xhuxhe – BVS Dardhez

The geologic formation are hard ultrabasic and basic formations, which are hard to excavate. There are no major highways or major rivers, which are crossed within this portion of the corridor.

BVS Dardhez is nearly 375 m^2 and it is located in an inclined area near some residential houses.

Section 6: BVS Dardhez – PRMS Kukes

This section is 13.8 km long. The height of the terrain falls continuously from around 900 at BVS Dardhe to nearly 350 m near the crossing of Black Drin River. After this point the corridor runs beside Kukes Airport where the terrain is very flat.

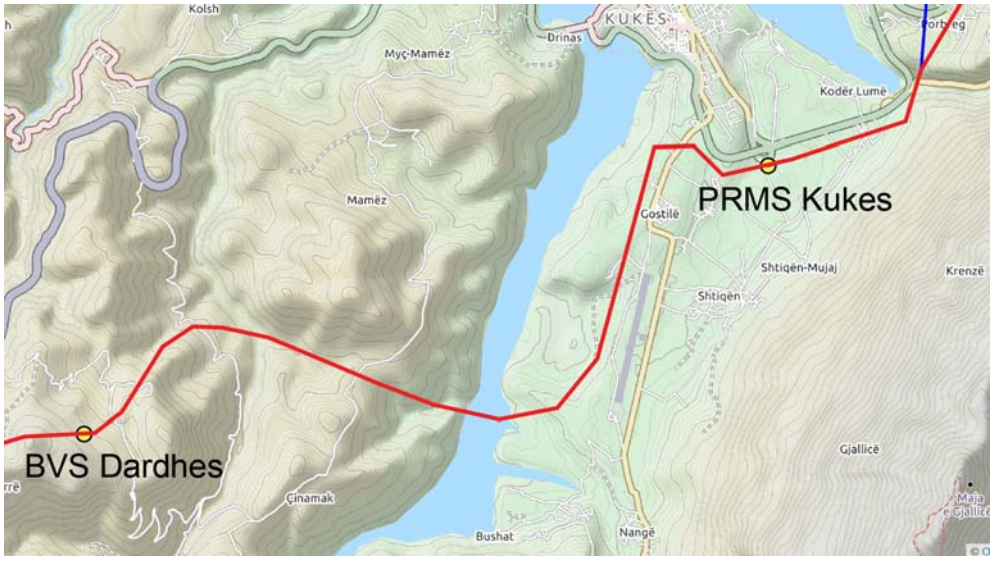


Figure 4-15: Gas route in the Section BVS Dardhez – PRMS Kukes

The excavability is hard on the mountainous portions of terrain and much more acceptable near the Black Drin valley and beside Kukes Airport.

PRMS Kukes is a 2,000 m^2 facility, and it is located next to the major highway Milot – Kukes in a flat area with good accessibility. This area is situated also on top of limestone formations that may be difficult to excavate.

Along this corridor section there is available space for pipeline construction and consequently the gas pipeline route avoids any state or private building.

Section 7: PRMS Kukes – CTMS Al-Kosovo

This section is 11.3 km and goes through an undulating terrain varying from 450 m to 550 m above sea level. The corridor crosses only a small stream near Fierza Lake and then stays all the time to the right side of the highway.

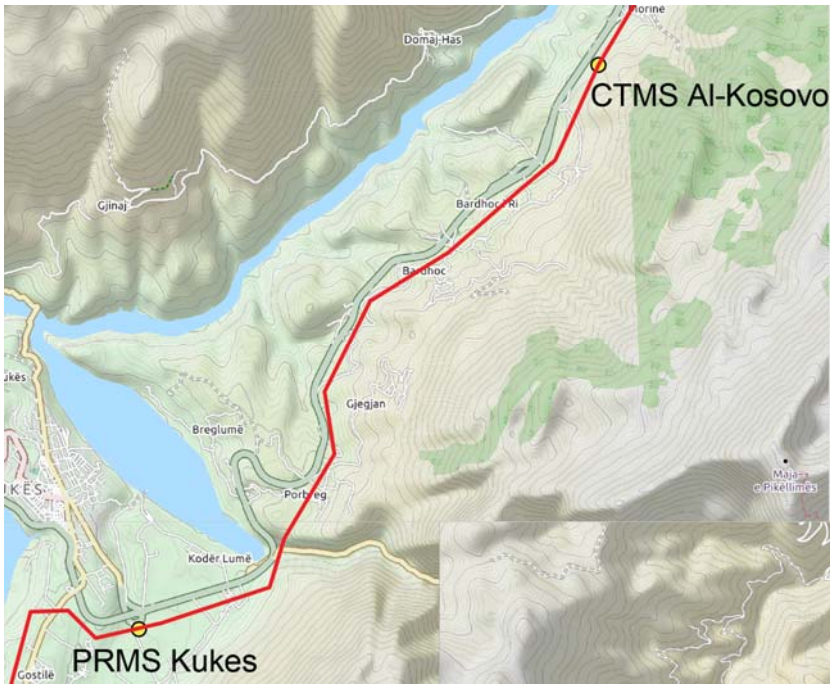


Figure 4-16: Pipeline route in the Section PRMS Kukes – CTMS Al-Kosovo

The excavability is acceptable because the formations are sufficiently weathered and the depth of topsoil and other soft layers is considerable.

CTMS Al-Kos (2,400 m^2) is located near Bardhoc Village in a slightly inclined area, 130 m to the right of the highway.

The corridor continues through a similar undulating terrain up to the border with Kosovo.

The pipeline route runs beside the sustainable zone of Korab-Koritnik, (Category IV area according to IUCN protection status) but does not impact it directly.

There are no foreseeable impacts on private, commercial or industrial facilities within this segment of the pipeline

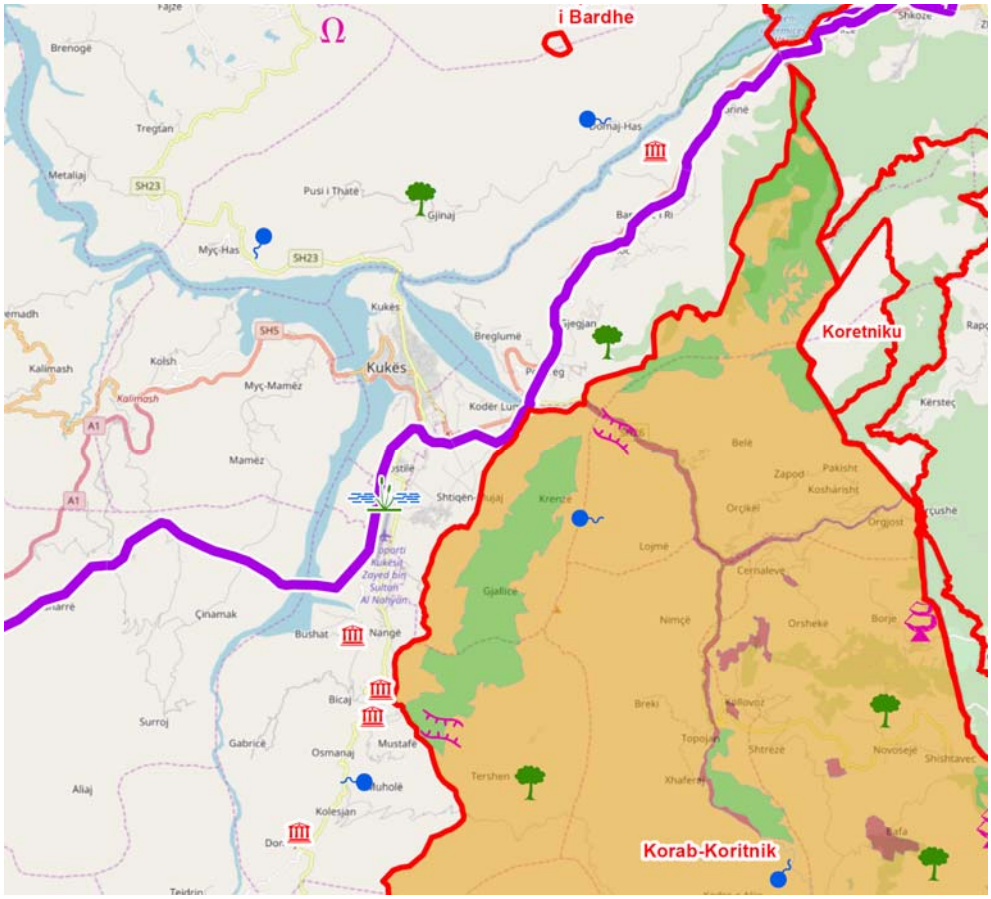


Figure 4-17: Korab-Koritnik protected area and the pipeline route

Along this corridor the considered gas pipeline route does not impact directly any private or commercial building.

Section 8: CTMS AL/Kosovo – BVS Zhur

This section is around 9.8 km and goes through the border by staying on the right side of the highway. The corridor crosses twice the highway Kukes – Pristina, before reaching BVS Zhur. The area is relatively dense with human settlements and the pipeline runs near some private properties.

Geologic formations for the most part are soft, but around Zhur Village hard limestone is encountered.

Figure 4-18: Route Alternatives in the Section CTMS Al-Kosovo – BVS Zhur

Near this section of the pipeline there is the protected area of Pashtrik Mountain and Lake Vermica (see below), but this area is not impacted directly by the prospective pipeline as it is evident in the figure below.

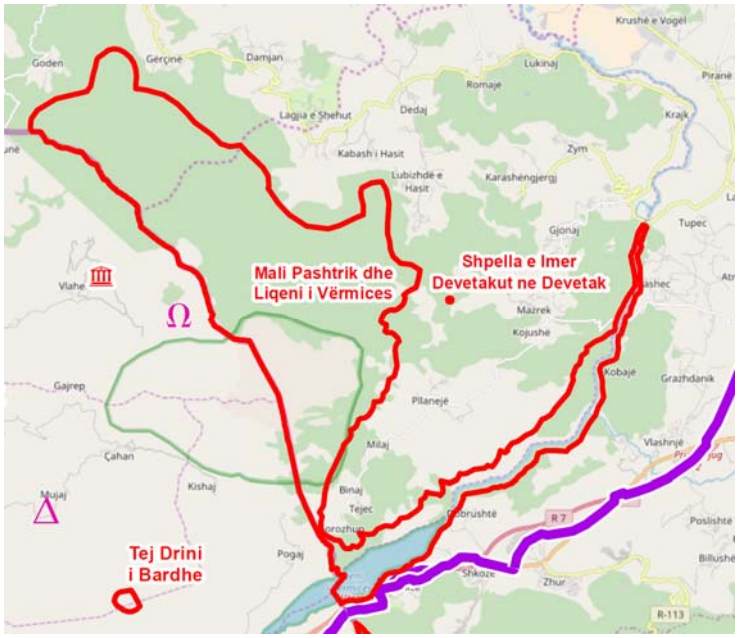


Figure 4-19: Extent of the protected areas of Pashtrik Mountain and Vermica Lake

BVS Zhur is foreseen to be nearly 375 m^2 and next to the local road leading to Zhur Village.

Section 9: BVS Zhur – CTMS/PTS/PRMS Prizren

The pipeline section Zhur to Prizren is about 12 to 14.1 km long depending on the alternative routes. Option 1 runs parallel to the highway Kukes – Prishtina, while Option 2 runs away from this highway and avoid the suburban area.

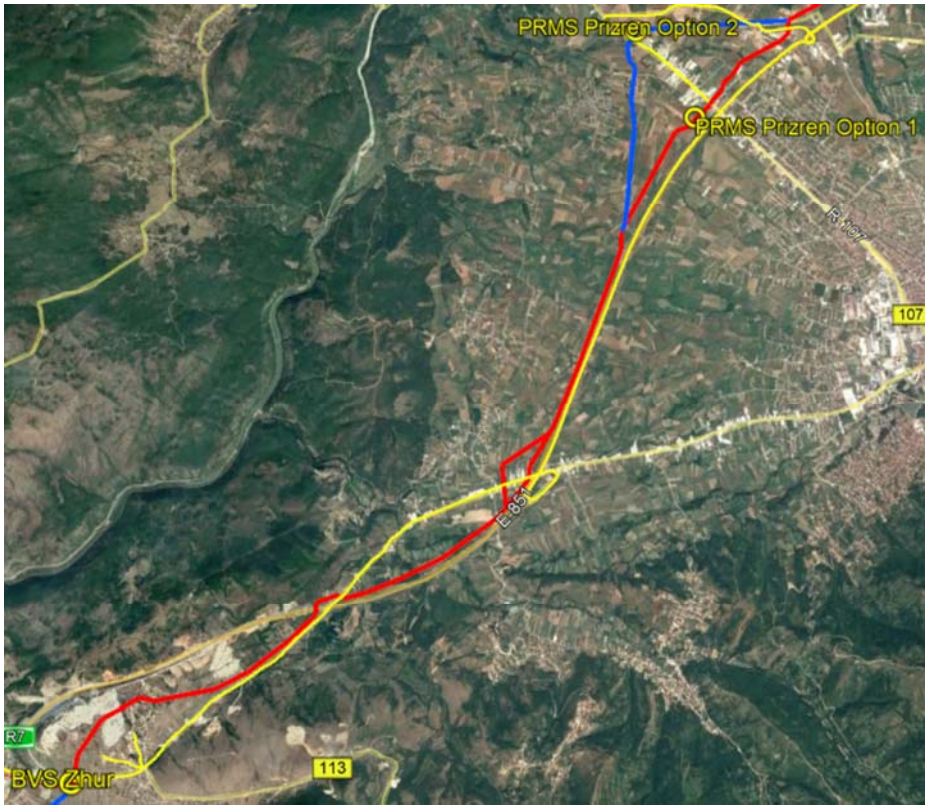


Figure 4-20: Route Alternatives in the Section BVS Zhur – CTMS/PTS/PRMS Prizren

The pipeline goes through soft geological formations composed of silt and sand, except for the area near Zhur Village where limestone is encountered. With the exception of this area near Zhur, which is elevated, the terrain is generally flat lands composed of sediments. The corridor crosses only once the major highway Kukes – Pristina.

Two locations are available for the CTMS/PTS/PRMS Prizren (2,400 m^2) based on the two alternative options as demonstrated in the figure above.

Section 10: CTMS/PTS/PRMS Prizren – BVS Reshtan

This section is 13.3 km and runs almost entirely next to the highway Kukes - Prishtina (without crossing it).

Figure 4-21: Section CTMS/PTS/PRMS Prizren – BVS Reshtan

The terrain is generally flat composed of silty and sandy sediments, which are easy to excavate. The area is generally agricultural and only some small forested areas are encountered.

At few areas near Prizren, Reshtan and places between them the pipeline runs near some private properties.

Section 11: BVS Reshtan – BVS Bellanice

This section is 21 km and up to the village of Peqan runs through flat agricultural lands. After Peqan the pipeline runs through Drenica Mountain, which is covered with dense forests. The corridor goes through forested areas for almost 3 km between the villages of Shllapuzhan and Bllace. The rest of the corridor runs on the eastern side of the highway from Bllace (where it crosses the highway) to BVS Bellanice, which is relatively flat agricultural terrain.

Figure 4-22: Section BVS Reshtan – BVS Bellanice

Near Shllapuzhan the corridor is specified away from the new highway considering that the slopes near the highway are very sensitive to landslides.

The pipeline crosses once the major highway Kukes – Prishtina and a few times other national and local roads.

The composition of geological formations is a mixture of gravels, sands and clay, which are relatively soft to excavate. Only between Shllapuzhan and Bllace are expected some harder flysch formations and some minor schists.

BVS Bellanice is 375 m^2 and located in an open area near an access road.

The prospective pipeline runs near some private properties near Reshtan and Peqan, Shllapuzhan, and Bellanice.

Section 12: BVS Bellanice – BVS Gjurgjice

This section is 10.5 km long and runs through some rolling hills west of Carraleva Mountain Range. The chosen corridor runs next to the highway without crossing it (see the map below).

The geologic formations are mostly soft sediments of silt, clay and gravel that are relatively easy to excavate.

Near Carralluke the corridor runs across a forested area, which extends for around 2 km.

The prospective pipeline is not expected to impact any human settlements or commercial properties.

BVS Gjurgjice (375 m^2) is located in an accessible area near the highway.

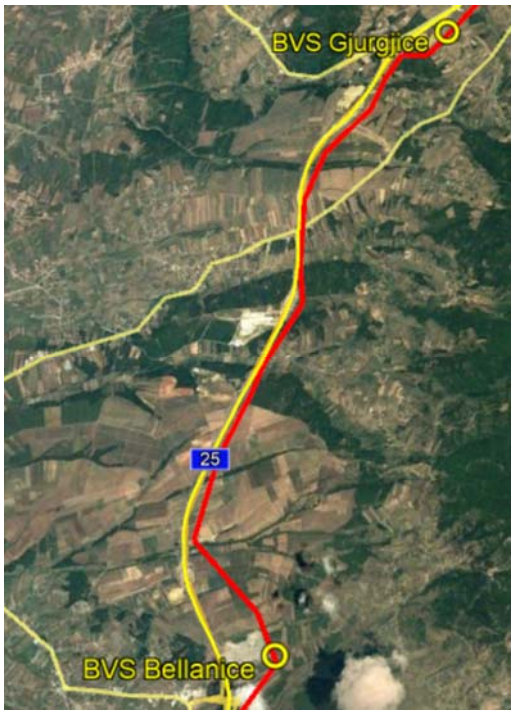


Figure 4-23: Section BVS Bellanice – BVS Gjurgjice

The prospective pipeline will not impact any private or commercial properties within this section.

Section 13: BVS Gjurgjice – BVS Korrotice

The length of this section is 10.5 km and similar to the previous sections with regard to its terrain features. The corridor crosses only once the major highway Kukes - Prishtina and runs near a few residential properties.

Figure 4-24: Section BVS Gjurgjice – BVS Korrotice

The geological formations are characterized by clayey and sandy deposits, which are expected to be easy to excavate.

There only two locations where the prospective pipeline runs near private properties in Llapushnik and Lower Zabel Village.

BVS Korrotice is 375 m^2 and located in a flat agricultural land.

Section 14: BVS Korrotice – BVS/PRMS Pristina 1

The length of the section is around 14 km. The terrain is generally flat composed in greater part of agricultural lands and soils which are easy to excavate. The prospective pipeline runs away from the major highway Kukes – Prishtina, but nevertheless it does cross numerous local roads of various importance especially near Sllatina Village.

Figure 4-25: Section BVS Korrotice – BVS/PRMS Pristina 1

From Korrotice to Sllatina Village the corridor goes across a forest for nearly 5 km, while near Upper The geologic formations in this particular portion of the corridor are composed of meta-sedimentary silicate rocks and schists, which are hard to excavate. However, the rest of the corridor runs through Kosovo Plain, where geological formations are composed of silt, sand and gravel deposits, which are easy to excavate.

From Korrotice to Sllatina Village the corridor goes across a forest for nearly 5 km, while near Upper Korrotice Village the prospective pipeline runs near a Business Park. Apart from this the prospective pipeline is specified in the vicinity of many private properties near Upper Korrotice and Sllatina Village.

Figure 4-26: Route pipeline BVS Korrotice close to the business park

It is worth mentioning the crossing of Drenica River, which is a significant river in Kosovo.

Section 15: BVS/PRMS Pristina 1 – PTS/PRMS Pristina 2

This section is around 11 km long and runs through Kosovo Plain, between residential facilities and industrial sites (see figure below).

The corridor passes between the landfill area for the Coal Ash produced by Kosovo Coal Fire Plant, which is under the management of Kosovo Energy Corporation (KEK) and National Interest Zones near Upper Grabovc and Kryshefc Villages.

The corridor crosses numerous local roads and Sitnica River, which is a major River in Kosovo.

Geological formations are composed of silt, sand and gravel deposits, which are fairly soft and easy to excavate.

Figure 4-27: Section PRMS Prishtina 1 – PRMS Prishtina 2; (National Interest Zone)

The prospective pipeline will run in the vicinity of some human settlements near Lismir and Kryshevc. Most importantly the prospective pipeline is specified 50 m away from the shrine of Sultan Murat, which is an historical monument.

Figure 4-28: Location of the Shrine of Sultan Murat

PTS/PRMS Pristina 2 is a 2,000 m^2 facility that is located in a flat agricultural field, south of Llazareve Village.

4.2 Technical Assessment

4.2.1 Gas quality

Natural gas composition shown in Table 5-2 corresponds to the gas composition of the Trans Adriatic Pipeline (TAP)2. The process calculations are based on this composition.

Table 4-2: Design Gas Composition

Component		Mole %
Methane	C1 (CH_4)	87.78
Ethane	C2 (C_2H_6)	2.72
Propane	C3 (C_3H_8)	1.54
Iso-Butane	C4 (C_4H_{10})	0.5
N-Butane	C4 (C_4H_{10})	0.51
Iso-Pentane	C5 (C_5H_{12})	0.24
N-Pentane	C5 (C_5H_{12})	0.24
Hexane	C6 (C_6H_{14})	0.03
Nitrogen	N2	4.43
Carbon Dioxide	CO2	2.01
Total		**100**

4.2.2 Standard conditions and operational availability

For the gas quality and throughput related calculations the following standard conditions were taken in account:

- Standard Pressure: 1.01325 bar
- Standard Temperature: 15°C

as customary for the international gas pipelines, although Albanian standard SSH EN ISO 13443 defines standard conditions (ps = 1 01,325 kPa = 1,01325 bar, Ts =273,15 K ≙ 0 °C)..

[2] IAP (Ionian Adriatic Pipeline), Hydraulic study and cost comparison (step 1) from “C205/ILFM-AD-0000/Rev. B” of 01.07.2008

4.2.3 Design pressure

General parameters of the ALKOGAP transmission pipeline:

- Pipeline Maximum Allowable Operating Pressures:
    - The calculations are based on a maximum supply pressure of 82 barg at a temperature of 10°C from the pressure reduction stations at TAP pipeline
- Material standard:
    - L485NB / L485MB ; (24”, 32”)
    - Pipe Wall Conductivity: 45 W/m/K
    - PE Coating Thickness: 3.5 mm
    - PE Coating Conductivity: 0.35 W/m/K

For the hydraulic calculations, the following heat transfer data of the buried pipeline have been considered:

- Soil cover above pipeline top: 0.8 m
- Soil Heat Conductivity: 1.0 W/m/K
- The soil temperature at laying depths: 10°C

The minimum delivery pressures are considered as follows:

- 16 bar at all PRMS at the pipeline system, to enable future development of HP and LP distribution system, (supply of potential PRMS at Peja, Gjakova, Ferizaj, Gjilan and Mitrovica are considered as well)
- 35 bar at PRMS Pristina 2, to enable supply of power plant in Pristina as a potential large gas consumer.

4.2.4 Wall thickness calculations

As per Albanian Gas Technical Rules G 463 clause 4.2.1.1.1, pipe wall thickness calculations have been performed per S SH EN 1594 clause 7.2 in accordance with SSH EN 10208-2.

S SH EN 1594 is applicable to gas supply systems - Pipelines for maximum operating pressure over 16 bar and defines functional requirements. SSH EN 10208-2 defines technical delivery conditions of steel pipes for pipelines for combustible fluids and defines applicable safety factors.

4.2.5 Technical requirements for transmission pipelines

The gas pipelines will be designed, constructed and used in accordance with the national and international norms, regulations and laws for that type of structures as described in Annex 16.

4.2.6 Hydraulic calculations

Initial hydraulic calculations were conducted and presented/discussed with the beneficiaries in a memo, please see Annex 17. The conclusion from the initial hydraulic assessment was to include following only 1 scenario in the PFS:

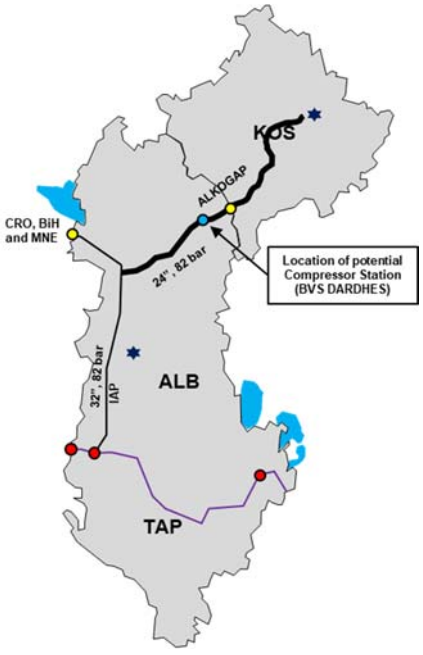
1. **A 24" gas interconnector between Albania and Kosovo with gas consumption in Kosovo limited to 1 bcm in 2040;**

Considering the options in which the forecasted 2.1 bcm/y gas supply to Kosovo could be achieved with compressor station(s), the consultant prepared preliminary hydraulic calculations.

The option of 2.1 bcm/y supply to Kosovo including a compressor station (CS) was tested, and the CAPEX for the CS, which in that case should be implemented on ALKOGAP, prepared. The result of the hydraulic test was:

- In order to transport 2.1 bcm/y (603 000 m3/h) through ALKOGAP, the inlet pressure for ALKOGAP at the entry point in Milot would have to be about 65 bar, which means that the IAP capacity should be increased (**either by increasing the IAP diameter or by installing a CS on IAP**);

- A compressor station at ALKOGAP would need to be placed at approx. km 80+000 (somewhat before Kukes) and should raise the pressure from 40 bar to 70 bar;



- Even with a CS a 24” pipeline does not allow transportation to neighbouring countries (SRB, fYRoM, MNE). For a 32" pipeline additional analysis are required to see if the CS allows for the supply of neighbouring countries; and

- For **a scenario that does not include IAP** (transport to CRO, MNE and BiH) it is possible to transport 2.1 bcm/y through ALKOGAP, with the construction of a CS at the same location as informed above and under similar technological conditions.

Detailed hydraulic calculations are only developed for the 24” scenario.

The tables 5-3 and 5-4 below present the required quantities of gas for supply of consumers at the annual level.

Table 4-3: The required quantities of gas for supply of consumers in Albania

Albania	Anchor Consumers [mcm/year]	CHP [mcm/year]	Residential sector [mcm/year]	Service sector [mcm/year]	Industrial sector [mcm/year]	Total consump. [mcm/year]	Total capacity [m3/h]
PRMS KUKES	0.0	0.0	3.2	2.3	4.9	10.3	4,163
TOTAL	**0.0**	**0.0**	**3.2**	**2.3**	**4.9**	**10.3**	**4,163**

Table 4-4: The required quantities of gas for supply of consumers in Kosovo

Kosovo	Anchor Consumers [mcm/year]	CHP [mcm/year]	Residential sector [mcm/year]	Service sector [mcm/year]	Industrial sector [mcm/year]	Total consump. [mcm/year]	Total capacity [m3/h]
PEJA	0.0	25.9	40.2	11.1	18.3	**95.5**	**35,235**
GJAKOVA	0.0	25.8	47.7	12.5	12.2	**98.2**	**36,067**
MITROVICA	0.0	30.0	57.8	16.0	13.6	**117.4**	**40,406**
PRMS PRISHTINA	0.0	65.7	113.2	31.1	57.2	**267.2**	**89,712**
GJILAN	0.0	26.4	51.6	12.8	23.0	**113.9**	**38,665**
FERIZAJ	0.0	26.4	56.6	11.7	23.7	**118.5**	**39,671**
CTMS/PRM S PRIZREN	0.0	42.2	79.5	20.4	47.3	**189.4**	**68,327**
TOTAL	0.0	242.4	446.6	115.6	195.3	**1,000.0**	**348,082**

In case that potential 500 MW CCGT is implemented in Kosovo then the consumption for the CCGT plant is included as presented in below table.

Table 4-5: Consumption of the potential large consumers

Anchor loads	Consumption [mcm/year]	Total Capacity [m3/h]
CCGT Prishtina	**625.0**	**96,154**

Simulation Software

The process calculations have been conducted using the GASWorkS software 9.0 by Bradley B. Bean, PE.

GASWorkS™ provides Windows based steady-state network modelling tools. It is designed to assist the engineering professionals analyse and design distribution, gathering, transmission, and plant piping systems containing natural gas or other compressible fluids. Support is provided for systems made up of fittings, compressors, pipes, regulators, valves, and wells. A robust set of import and export routines allows data exchange with a variety of CAD, GIS, and Database applications.

4.2.7 Hydraulic results

The result of hydraulic calculation for the transmission pipeline is presented in Annex 18 and 19.

4.2.8 Technological and technical options

The nominal diameter of pipeline in the scenario is 24” (DN600) and the pipeline is dimensioned in accordance with the operating pressure of 82 bars.

ALKOGAP pipeline is in the entire length set as an underground installation with the exception of above ground facilities such as BVS, PRMS, CTMS and PTS. To ensure safe and reliable operation of the pipeline, BVS´s will be installed on the pipeline at appropriate distances.

For the internal cleaning of the pipeline PTS shall be installed.

To ensure industrial and other consumers gas supply at the appropriate locations along of the transmission pipeline and especially at the end of the transmission pipeline the PRMS will be installed.

Functions and recommendations regarding the pipeline facilities are presented in the following paragraphs.

Table 4-6: Specific Facilities on ALKOGAP in Albania

#	Facility name	Facility description	Location	PRMS Capacity (m^3/h)	Fence dimensions (m)
1	BVS/PTS MILOT	Two Pig Trap line. Block valve with exhaust line.	South-west part of village Pllane		30 x 70
2	BVS FANG	Block valve with exhaust line.	Sothern part of village Fang		20x30
3	BVS MUNAZ	Block valve with exhaust line.	4 km east from Munaz, vicinity of village Lugjet		20x30
4	BVS/PTS REPS	Two Pig Trap line. Block valve with exhaust line.	Vicinity of Reps, south part, near main road		30 x 70
5	BVS XNUXHE	Block valve with exhaust line.	Top of the hill of the village Xnuxhe		20x30
6	BVS DARDHES	Block valve with exhaust line.	Near Kroi and Dardhes headspring, north from village Fusharre		20x30
7	BVS/PRMS KUKES	Block valve with exhaust line. PRMS container type, with two metering lines-each 5-16	South from Kukes, vicinity of SH30 and road to Prizren interconnection	4,500	25x50
8	CTMS AL-KOSOVE	Custody Transfer Metering Station. Two Pig Trap line. Block valve with exhaust line.	North from Bardoh and Ri, vicinity of SH5 (SH30) road		60 x 80

Table 4-7: Specific Facilities on ALKOGAP in Kosovo

#	Facility name	Facility description	Location	PRMS Capacity (m^3/h)	Fence dimensions (m)
1	BVS ZHUR	Block valve with exhaust line.	West part of Zhur, bottom of hill, south from road		20x30
2	CTMS/PTS/PRMS PRIZREN	Custody Transfer Metering Station. Two Pig Trap line. PRMS solid object type with two metering lines (5-16 bar). Block valve with exhaust line.	Nort-west part of Prizren, east from village Hatmaxhe, near motorway	68,000	60 x 80
3	BVS RESHTAN	Block valve with exhaust line.	4 km South-east from Reshtan along the motorway, left side of motorway		20x30
4	BVS BELLANICE	Block valve with exhaust line.	North from village Bellanice, near the main road for Senik		20x30
5	BVS GJURGJICE	Block valve with exhaust line.	Right from motorway near village Gjurgjice		20x30
6	BVS KORROTICE	Block valve with exhaust line.	1.5 km South-east from village Korrotice along the motorway, left side of motorway		20x30
7	PRMS PRISTINA 1	PRMS solid object type with two metering lines (5-16 bar). Block valve with exhaust line.	East part of Prizren, vicinity of Kuzim village, north from main road	45,000	50x60
8	PTS/PRMS PRISTINA 2	PRMS solid object type with three metering lines (5, 16, 35 bar), Pig Trap line. Block valve with exhaust line.	North part of Prizren, near Llazareve village, right from the main road (M2)	45,000	60 x 70

Block Valve Station (BVS)

A BVS presents a facility on the gas pipeline that enables the closure of a pipe section of the pipeline. The reason for the closure of a pipe section can be reconstruction, repair or regular service. When a pipe of the gas pipeline is damaged and resulting in a gas leakage, the block system shall automatically close the damaged section of the gas pipeline. Gas leakage is detected due to increased pressure drop in the pipe (for example a pressure gradient of 3.5 bar/min).

Block valve device consists of a main in-line ball valve on the gas pipeline, a driver (actuator), control unit (Electronic Line Break Control – ELBC), SCADA system, power-supply, vent and related valves. Annex 20 shows typical mechanical scheme of a BVS.

Pig Trap Station (PTS)

PTS is the facility on the gas pipeline consisting of a block valve station and the pig trap. The purpose of the block valve device is the same as in the BVS, which is closing of the gas pipeline flow at a certain section. The pig trap enables the reception and sending of the cleaning intelligent pig to section of the gas pipeline to examine the condition of the gas pipeline. The basic components of the system are the main in-line block valve with control unit, pig trap with quick closures, SCADA system, vent, power supply and interconnecting piping. In normal operation gas flows through the block valve and the valves at the pig traps are closed. Annex 21 shows typical mechanical scheme of a PTS.

Gas Pressure Reduction and Metering Station (PRMS)

In accordance to recommended Scenario of Alkogap proposed is the construction of the PRMS Kukes in Albania, and in Kosovo PRMS Prizren, PRMS Pristina 1 and PRMS Pristina 2 at the ending point of the Alkogap gas pipeline where the pressure reduction from transmission system to the required working pressure of the distribution network will take place. The common level of reduced gas pressure intended for the industrial consumers is up to 16 bar, while the reduced pressure level intended for the population is up to 5 bar. PRMS can be set as a container type station with supply capacity up to 10,000 m3/h of gas. For bigger gas quantities a solid building shall be provided. The PRMS consists of a metering and reduction part and a boiler-room. In the metering and reduction part there are two or more lines with the regulating, safety and metering equipment that provides safe and uninterrupted operating of the station. In the boiler-room there are gas boilers with adequate thermal power. The connection of the PRMS and the connections to distribution network will be underground.

Annex 22, shows mechanical scheme of a PRMS Kukes and Annexes 23 and 24 show mechanical scheme of a PRMS for Pristina 1 and Pristina 2 at the end of transmission pipeline.

Construction of PRMS should be in compliance with G 491 (Gas Pressure Regulation Stations for Entry Pressures up to 100 bar - Design, Fabrication, Installation, Testing, Commissioning and Operation), G 492 (Gas Measuring Stations for Operating Pressure up to 100 bar - Design, Fabrication, Construction, Testing, Commissioning, Operation and Maintenance) and EN 12186: Gas supply systems – Gas pressure regulating stations for transmission and distribution - Functional requirements.

Custody Transfer Metering Station (CTMS)

At the each side of border, custody transfer metering station is set with the purpose of measuring quantity of gas that is entering and leaving each country. CTMS consists of the block valve station, pig station, meter runs, SCADA system, power

supply, and interconnecting piping. Annexes 25 and 26 show mechanical scheme of CTMS in Albania and CTMS in Kosovo.

4.2.9 Investment costs (including land take) and maintenance costs

CAPEX Estimate

Based on the proposed routes, their characteristics, technological and technical requirements and methods of construction, the investment costs were determined. The pipeline investment costs are presented in tabular form below.

Table 4-8: CAPEX estimate for ALKOGAP in EUR

		DN800	DN600
Section in ALB	Pipeline sections		
	BVS/PTS Milot - PTS Reps	84,554,308	55,530,958
	PTS Reps-PRMS Kukesh	118,622,189	79,370,399
	PRMS Kukesh - AL/KOS Border	15,471,129	9,694,929
	Facilities	8,855,000	5,414,200
	Sub-total	227,502,625	150,010,486
Section in KOS	Pipeline sections		
	AL/KOS Border - CTMS/PTS/PRMS Prizren	16,485,458	10,189,485
	CTMS/PTS/PRMS Prizren - PRMS Pristina 1	58,103,561	35,749,212
	PRMS Pristina 1 - PRMS Pristina 2	10,017,312	5,878,188
	Facilities	11,489,500	9,141,000
	Sub-total	96,095,832	60,957,886
Total		**323,598,457**	**210,968,372**

A more detailed breakdown of the CAPEX estimate for the DN600 (24”) pipeline is provided in ANNEX 28

The CAPEX for a potential compressor station is provided in below table.

Table 4-9: CAPEX estimate for a potential CS in EUR

COMPRESSOR STATION		
Investment costs		
Capacity	m3/h	600,000
Compression power (2X centrifugal)	kW	14,000
Shaft Power	MW	15.4
Investment costs compressor station	**Mio €**	**45.0**

5 Environmental and Social Screening Assessment

5.1 Purpose

The main purpose of this assessment is to highlight at the early stages of the project development any eventual significant environmental and social barriers that may impede the project implementation. In function of the findings of this document the future lender(s) will decide on the possibility of project's financing. IFIs, including EBRD[3] finance only the projects that are environmental friendly and therefore comply with their environmental and social standards.

In addition, based on this report EBRD will prepare, if necessary, an Initial Environmental and Social Examination in order *"to determine the appropriate category and scope of the appraisal… in order to gain a better understanding of the project and its potential adverse future environmental and social impacts[4]".*

In a more detailed way, this document aims also at the following:

- To highlight the main environmental and social features of the project area and the main potential impacts that may occur from the project's development phases;
- To highlight the significant potential environmental and social constraints that condition the defining of the gas corridor alternatives/options;
- To compare the eventual considered gas corridor alternatives/options in order to avoid, since this early stage of the project, the corridors that are not feasible from the environmental and social point of view;
- To draw attention to the indicative protection measures and their related cost during the next stages of the project. (Their detailed cost should be calculated during the detailed project design and full ESIA);
- To identify the environmentally sensitive areas and the main affected stakeholders that need to be consulted on the considered gas corridor alternatives / options, in order to make necessary corrections or improvements, wherever possible, since this early stage of the project development;
- To help the national environmental authorities and the future potential lender(s) to decide (screening decision) on the ESIA level to which the project should be submitted during the next development stages (detailed design and ESIA). This decision is taken based on the findings of this document and on the national, EU and potential lender(s) environmental and social standards.

[3] https://www.ebrd.com/environmental-and-social-policy.html
[4] Environmental and Social Procedures. EBRD, July 2015

- To solicit the approvals and opinions of other national and local authorities (local governments, institutions covering archaeological/cultural, water resources, agricultural land, forests, industry, etc., issues) from both Albania and Kosovo on the considered gas corridor options at this early stage of the project's development. Albanian authorities have already given their positive opinion on the general direction of the gas corridor during the preparation of the Albanian GMP. Thus, it is necessary to have the opinion of the Kosovo's institutions/authorities.

5.2 General approach

The general approach for preparing this chapter includes the following:

- Taking into consideration previous studies on ALKOGAP, as well as other reports already prepared as part of the ongoing PFS on ALKOGAP.

- Outlining the project's scenarios/alternatives/options, their specific elements and technical interventions, and the related potential significant environmental and social impacts, including the land use requirements;

- Defining the project's area;

- Outlining the baseline information with respect to the proposed gas corridor.

From Milot to the border Al/Kos to Pristina, the outlining of the baseline information has been carried out with respect to the proposed gas corridor, while in the sensitive areas it takes into account all the considered corridor options.

The information has been collected through a combination of literature research, thematic maps, site visits, and consultations with the project's technical experts.

During the site visits of May 2017 the project's team was consulted with locals in the most sensitive areas that might be crossed by the proposed gas corridor. Special attention was paid to the areas affected by old and recent (March 2018) landslides within the Albanian portion, where the project's team carried out two careful site visits, during which the geotechnical, technical and environmental experts project had some communication with local inhabitants as well.

The thematic maps (ortho-photos, geologic, hydro-geologic, projected areas, cultural heritage, and transport network maps) were provided by governmental sources from Albania[5] and Kosovo[6] geoportals. The data/information and the location and status of the protected areas crossed by the proposed gas corridor derived from the official web page of the Albanian and Kosovo institutions.

- Considering and selecting the environmental and social impacts that will be taken into consideration;

[5] https://geoportal.asig.gov.al/
[6] http://geoportal.rks-gov.net/search

- Evaluating the environmental and social impacts. This evaluation includes only the main residual impacts;
- Comparing the considered alignment for each option;
- Recommendations on the preferred gas route options.

For more detailed information please refer to the separate IESE report.

5.3 Methodology of impacts' evaluation

The evaluation of the considered gas corridor, as well as the comparison of the gas route options from the environmental and social point of view is based on the evaluation of the impacts' significance. The evaluation of impacts' significance also must be based on the criteria set out in points 1 and 2 of Annex III (3) of EIA Directive[7], as well as in points 1 and 2 of Annex I of Albanian CMD no. 686 of July 29.2015[8], with regard to the impact of the project on the factors specified in Article 3(1) of the EIA Directive and Annex I (3) of CMD 686/2015.

Once evaluated, the potential impacts should be submitted to a mitigation strategy.

The principle of the above significance evaluation is illustrated in the figure below.

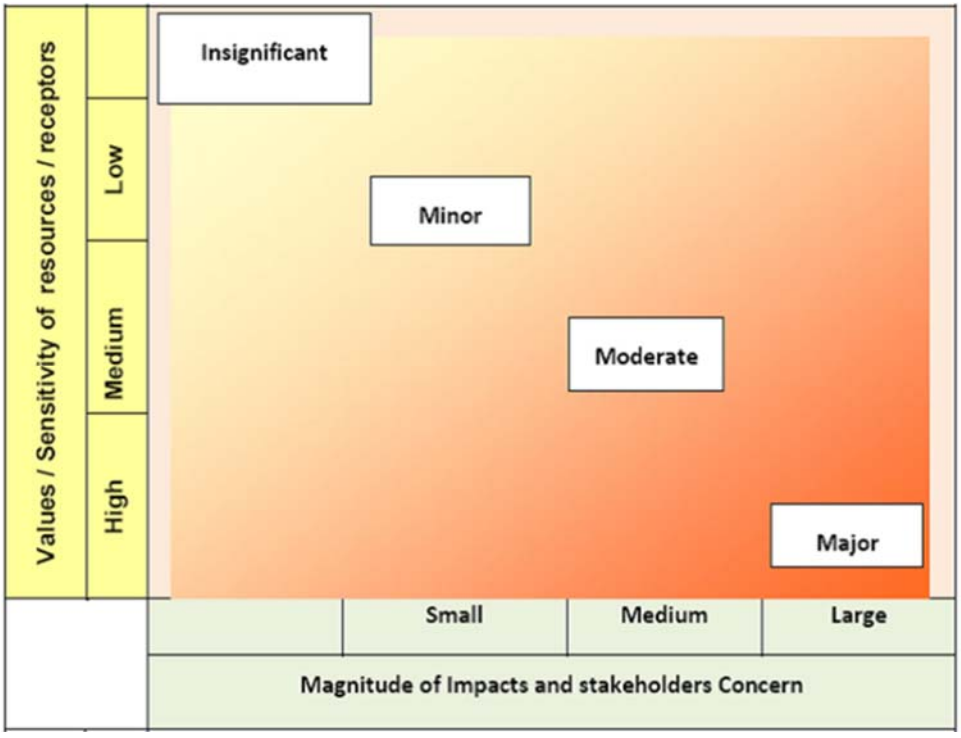


Figure 5-1 Principle of used evaluation of impact significance (source ERM)

The impacts' magnitude regards the geographical area and size of the population likely to be affected.

The stakeholders' concerns are linked overall with the purpose and objectives of the project and therefore regard the positive socioeconomic impacts at local, national and international level. But those concerns are also linked, in a smaller

[7] http://ec.europa.eu/environment/eia/eia-legalcontext.htm
[8] http://www.qbz.gov.al/botime/fletore_zyrtare/2015/PDF-2015/145-2015.pdf

level, to the potential negative effects on the local population directly affected by the gas pipeline and its associated facilities.

Based on the provisions of ToR and IR, and on the purpose and objectives of the project, it should be stressed that only the main residual impacts will be taken into account for assessing the considered gas corridor and eventually for comparing the gas route options wherever is necessary.

5.4. Main Findings

This chapter summarizes the main anticipated environmental and social impacts that may derive from the project development phases, as well as some suggestions regarding the next formal stage of the project's design and the related ESIA. For more detailed information please refer to the separate IESE report.

5.4.1. Albania

The main expected environmental and social impacts within the Albanian part are associated to the crossing of a mountainous area, which is characterized by the following[9]:

- Rugged Terrain often affected from geological risks such as landslides and erosion.

Almost 70% of the corridor is situated over areas of relatively steep slopes which lithological composition is often very sensitive to geological risks. Roughly 20% of the corridor (22 km) runs through areas where slopes are above 20°. Consequently the construction of the gas pipeline across this sharp terrain may lead to induced landslides, debris/mud flow, and erosion during and/or after construction works since all construction processes like clearing of vegetation, alignment of pipes, trenching, welding and backfilling are performed at an incline terrain, which is very sensitive to those geological risks. The induced geological risks will in turn affect the vegetation.

- Limited access roads

Earthworks for construction of any eventual permanent and/or temporary access roads will lead to vegetation clearing and induced landslides and erosion. The induced geological risks (mainly landslides, debris/mud flow, and erosion) may in turn affect the vegetation.

- Ground and surface waters

The pipeline crosses 33 times the rivers and streams in the area, leading to risky zones of erosion and floods that extend for nearly 20 km. That needs to be mitigated through proper countermeasures.

Heavy rainfalls paired with the rugged terrain, the lithology of the superficial formations, and earthworks may cause the penetration of the surface waters into

[9] Pre-feasibility Study for Albania to Kosovo Gas Pipeline (ALKOGAP). Technical Parameters and Environmental and Social Constraints Report. COWI-IPF Consortium, 2018

the contact surface between two successive geological formations. That creates a sliding surface which is the cause of landslide/mudflow phenomena (e.g. Blinisht landslide).

- Infrastructure crossing

It is expected the pipeline to cross 27 times the major highway Durres-Kukes and a few important national and local roads. However the roads' crossing is not a residual environmental and social impact, since it lasts only during construction stage.

Any eventual impact on mining infrastructure may be avoided by the refining of the pipeline route during the next stages of the project's development.

It is not expected the considered pipeline route to affect any human settlement, since the area is sparsely populated. Only 2 km of the prospective pipeline corridor are situated near human settlements. The impact on the livelihood of the inhabitants for the duration of the construction works is expected to be temporary, because of the effect on agricultural plants, but no major impacts such as expropriations of residential or commercial buildings are foreseen.

- Vegetation clearing

The high vegetation must be cleared for pipeline construction. The roots of the plants species within the pipeline route must not exceed 1 metre depth.

- Protected areas crossed by the gas pipeline

The considered gas pipeline route crosses for nearly 3 km the western edge of Orosh Highlands Protected Area (Category VI of IUCN protection status).

The above expected impacts can be characterised and mitigated as follows:

Table 5-1 Summary of the main potential impacts – Milot to Morine/ Vermice section

<table>
<tr><th>Source of impacts</th><th>Expected impacts</th><th>Expected residual impacts after mitigation measures</th></tr>
<tr><td>Crossing of rugged terrain, often affected from geological risks</td><td rowspan="3">-Creation of new induced landslides, mud flows, debris flow, etc.;

-Damage to land;

-Damage to vegetation;

-Damage to gas pipeline</td><td rowspan="3">Impacts can be characterised as of moderate significance (see chapter 4 – methodology). They can be reduced to minor significance if the necessary mitigation measures are undertaken.</td></tr>
<tr><td>Opening of any necessary temporary and/or permanent access roads</td></tr>
<tr><td>Ground and surface waters</td></tr>
</table>

Source of impacts	Expected impacts	Expected residual impacts after mitigation measures
Infrastructure crossing	-No settlement is affected; -Impacts on road infrastructure are temporary; -Impacts on mining infrastructure can be avoided	Impacts can be characterised as of small to moderate significance (see chapter 4 – methodology). They can be reduced to insignificant if the necessary mitigation measures are undertaken.
Vegetation clearing for pipeline route	Permanent impact from vegetation clearing	Impacts can be characterised as of minor to moderate significance (see chapter 4 – methodology). They can be reduced to minor significance if the necessary mitigation measures are undertaken.
Protected areas crossed by the gas pipeline	Orosh Highlands (category VI of IUCN protection status) is crossed by the gas route	Impacts can be characterised as of moderate significance (see chapter 4 – methodology). They can be reduced to minor significance if the necessary mitigation measures are undertaken.

Conclusion: Based on the table above it result that the construction of the ALKOGAP within the territory of Albania is feasible from the environmental and social point of view if the necessary mitigation measures are undertaken.

5.4.2. Kosovo

The main limitations encountered within the Kosovo part include the following:

- Impacts on human settlements
- Impacts on commercial and industrial areas
- Impacts on infrastructure
- Impact on the physical environment (air, water and soil).
- Impact on the biological environment (flora, fauna, ecosystems, landscape and protected areas)
- Impact on cultural sites

In contrast to Albania, the prospective pipeline corridor in Kosovo is not impacted by difficult terrain or technical aspects, but there are a few social, environmental, commercial, and cultural aspects to be considered. The corridor runs often near

human settlements, which will cause some limitation in the land use in the future by the people affected. For nearly 35 km the pipeline runs in the vicinity of human settlements creating some limitations for the future extension of these settlements. This will require close consultation with local representatives to identify local regulatory plans and plan the location of pipeline over areas that will have lesser negative impact on future development of these settlements.

Apart from human settlements, the prospective pipeline corridor runs for nearly 3 km close to commercial and industrial areas such as the business park near Korrotice Village and the industrial areas Prishtina. For similar reasons the presence of the pipeline may hinder the future expansion of these areas. Therefore, consultations with respective representatives are needed to delineate the best location for the future pipeline.

The prospective pipeline corridor in Kosovo runs in large parts along the major highway Kukes-Prishtina, which has a greater density of commercial and residential properties. This highway connects two of the biggest population settlements in Kosovo, such as Prishtina, and Prizren and many other smaller ones along the way. The areas on both sides of the highway are expected to see growth of human settlements, but most importantly new commercial and industrial properties. In fact, the areas beside the major highway Kukes-Prishtina will remain attractive for such developments and the presence of the pipeline corridor will limit these possible developments along the highway.

The impact on infrastructure is also very significant. The prospective pipeline corridor crosses 64 times the major highways and other roads of regional and local importance. This will cause some evident disruption of the traffic and of the economic life of the communities during pipeline construction.

Apart from the impact on the abovementioned entities, the proposed route pipeline will impact some environmentally sensitive areas. The prospective pipeline corridor runs for nearly 13 km over forested areas. This may cause segregation of biological and animal habitats and risk of depletion of animal populations. Other areas such as Bird Sanctuary near Henc and Gazimestan Natural Reserve are not expected to be directly impacted by the corridor.

Lastly, a cultural heritage site, such as the shrine of Sultan Murat will be impacted by the prospective corridor.

The above expected impacts can be characterised and mitigated as follows:

Table 5-2: Summary of the main potential impacts Vermice-Lazerev section

Source of impacts	Expected impacts	Expected residual impacts after mitigation measures
Impact on the biological environment (flora, fauna,	Lake Vermica and Mountain Pashtriku (category V of IUCN)	Avoiding any possible impact on the Natural Monument and Protected areas

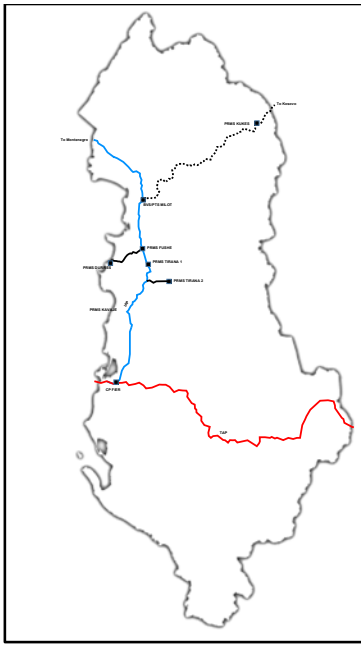
ecosystems, landscape and protected areas)	Birds Special Protected Area Natural Spiritual and Monumental Protected area of Gazimestan (category I IUCN); Rivers and forest ecosystems	Avoiding direct and indirect adverse impacts on the natural monuments, protected areas and ecosystems.
Impact on cultural sites	Natural Spiritual and Monumental Protected area of Gazimestan (cultural and spiritual zone) The shrine of Sultan Murat (cultural heritage in the architectural category of objects/buildings(;	Avoiding any possible impact on the Natural Spiritual and Monumental Protected area of Gazimestan Avoiding direct and indirect adverse impacts on the natural monuments and cultural heritage monuments,
Impact on the physical environment (air, water and soil).	Vegetation clearance and damage of endemic plant species during construction activities, Aesthetics impact associated with vegetation clearing and construction of above ground installations. Constraints on land use or expropriation of impacted properties Land changes associated with the erosion and sedimentation along pipeline routes;	Proper refinement of the pipeline corridor to avoid forested areas or areas of high agricultural value; The engaged heavy machinery should be maintained and controlled regularly, in order to minimise the emission impacts; Transportation of the heavy equipment and materials should be accomplished during the low traffic activities; An alternative route for local people should be previously constructed; All heavy machineries should be controlled for technical safety, air emissions for non-stationary sources, noise limit values and to respect working hours; Maximize the local employment and procurement to increase the positive impact on the socioeconomic conditions of the region.
Impacts on human settlements	For nearly 35 km the pipeline runs in the vicinity of	Proper refinement of the pipeline corridor to avoid as

	human settlements creating some limitations for the future extension of these settlements. Over 30 settlements are directly affected	much as possible the residential properties or areas of high agricultural value; Minimize as much as possible the impact of machineries during the clearing and grubbing in the forested areas and agricultural land Minimize as much as possible the noise and disturbance and respect the seasonal constrains
Impacts on commercial and industrial areas	The prospective pipeline corridor crosses 64 times the major highways and other roads of regional and local importance, railways, industrial and businesses zones.	Proper refinement of the pipeline corridor in consultation with KEK to avoid as much as possible the important locations of industrial areas. Avoiding direct and indirect adverse impacts on the infrastructure. Industrial and business zones

Conclusion: Based on the table above it result that the construction of the ALKOGAP within the territory of Kosovo is feasible from the environmental and social point of view if the necessary mitigation measures are undertaken.

6 Financial and Economic Analysis

Since Albania currently has no major gas transmission network, the present evaluation assumed that ALKOGAP would be implemented after the future construction of IAP and the gas transmission system up to Fushe-Kruje, according to the report "Priority Investment Project Transmission Pipelines from IAP to Tiranë and Durrës, Pre-feasibility Study[10]"



Gas consumption area	
Tirana, Durres, Fushe Kruje	
Gas transmission network length	
18.20 klm (IAP section not included)	
Gas consumption	
2020	11.6 mcm
2040	332.3 mcm
Financial indicators	
Long term Transmission Charge	0.0259 eur/cm (ALB-National network)
	0.009 eur/cm (IAP-Albanian section)
Levelised Cost	0.0246 eur/cm
FIRR	8%

Figure 6-1: The Albanian planned gas transmission network before ALKOGAP

6.1 The Project Baseline Scenarios

The baseline scenario, defined in the previous sections of the report, include a 24" gas interconnector between Albania and Kosovo with gas consumption in Kosovo limited to 1 bcm in 2040.

In addition, the financial analysis examined two business models:

- Variant A: Transmission assets ownership, investment duties, operating activities as well as maintenance and the other operating activities would be divided between the national TSOs in Albania (Albgaz) and in Kosovo (to be established), according to the physical location of the assets. To this extend, the analysis was divided in two sections, one for the gas pipeline section located in Albania and the other in Kosovo.

- Variant B: ALKOGAP will be constructed and managed by an SPV. To this extend, the analysis considered the two sections as a whole.

[10] WBIF Infrastructure Project Facility Technical Assistance 4 (IPF 4), WB11-ALB-ENE-01: Gas Master Plan for Albania & Project Identification Plan, Priority Investment Project Transmission Pipelines from IAP to Tiranë and Durrës, Pre-feasibility Study, April 2017.

On the other hand, the economic assessment considered the project only as a whole.

6.2 The Incremental Approach

In order to assess the feasibility (both financial and economic) of ALKOGAP, the incremental approach was used by comparing the without and with the implementation of the pipeline.

This approach requires that a counterfactual scenario is defined as what would happen in the absence of the project. In cases where a project consists of a completely new asset, as in the ALKOGAP case, the counterfactual scenario is one with no operations.

In order to assess the incremental gas flows, the following were taken into consideration:

Albanian Gas Market

- The gas market includes the areas located near the border with Kosovo (Kukes).
- The transit gas flows include the future gas consumption in Kosovo.

Kosovar Gas Market

- The total projected gas consumption in Kosovo (residential, service and industrial sector).
- The gas flows for DH, including CHP.
- The use of gas for power generation plant of 500 MW.

Therefore, the incremental gas flows had as follows:

Table 6-1: Incremental gas flows per country

Year	Albanian Gas Market			Kosovar Gas Market		
	Domestic Market	Transit	Total	Domestic Market	Gas volumes for DH incl CHP	Total
	Gas Flows (in '000 cm)					
2021	391	177,329	**177,720**	73,995	103,334	**177,329**
2022	515	202,409	**202,924**	92,279	110,130	**202,409**
2023	679	232,572	**233,252**	115,200	117,372	**232,572**
2024	899	269,059	**269,958**	143,968	125,091	**269,059**
2025	1,192	313,438	**314,630**	180,121	133,317	**313,438**
2026	1,580	365,705	**367,285**	225,800	139,905	**365,705**
2027	2,098	430,305	**432,403**	283,487	146,818	**430,305**
2028	2,790	510,540	**513,330**	356,467	154,073	**510,540**
2029	3,715	610,645	**614,360**	448,958	161,687	**610,645**
2030	4,035	693,319	**697,354**	523,642	169,676	**693,319**
2031	4,396	788,986	**793,382**	612,592	176,395	**788,986**
2032	4,818	903,431	**908,249**	720,052	183,379	**903,431**
2033	5,318	1,000,000	**1,005,318**	809,360	190,640	**1,000,000**
2034	5,912	1,000,000	**1,005,912**	801,812	198,188	**1,000,000**
2035	6,247	1,000,000	**1,006,247**	793,964	206,036	**1,000,000**
2036	6,590	1,000,000	**1,006,590**	787,157	212,843	**1,000,000**
2037	6,963	1,000,000	**1,006,963**	780,125	219,875	**1,000,000**
2038	7,368	1,000,000	**1,007,368**	772,861	227,139	**1,000,000**
2039	7,809	1,000,000	**1,007,809**	765,357	234,643	**1,000,000**
2040	8,292	1,000,000	**1,008,292**	757,605	242,395	**1,000,000**

The annual gas consumption was derived from the potential annual consumption volumes, as they were estimated and presented in Section 3, adjusted by an annual gas connection penetration rate. For the purpose of the present evaluation, it was assumed the connection rate by sector gradually increase from 10% in first year of operations to the maximum level (100%) after 10 years.

6.3 Financial Analysis and Assessment

The financial analysis represents the financial approach from the point of view of the investor. It aims to determine the project's profitability for the key stakeholders and verify the project's financial sustainability.

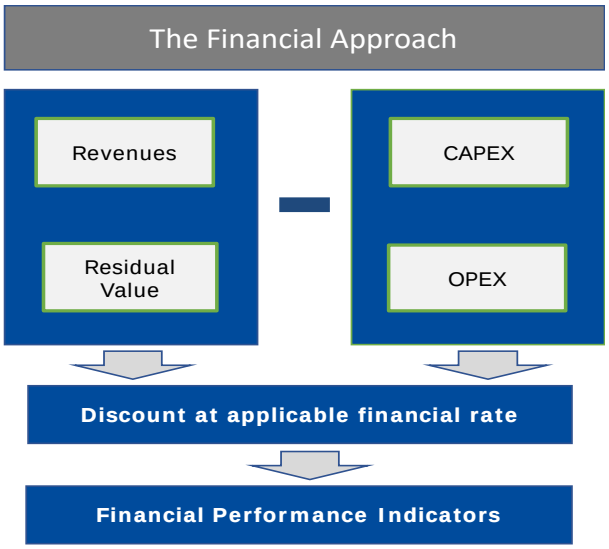
6.3.1 Methodology & Basic Assumptions

The financial analysis has been carried out through subsequent, interlinked, accounts i.e. total investment costs, total operating costs and revenues, sources of financing and working capital needs. In order to approach that, the cash flow forecasts of the project have been considered.

The methodology used for assessing the financial profitability of the project is the DCF approach. This implies the following assumptions:

- Only cash inflows and outflows are considered (depreciation, reserves and other accounting items which do not correspond to actual flows are disregarded);
- Cash flows are considered in the year in which they occur and over a 20-year reference period;
- The residual value of the investment is taken into account in the last year of the considered time horizon; this value reflects the difference between the estimated actual economic useful life of the project and the reference period considered for the analysis;

- Since the forecasted cash flows occur during different years, the time value of money is considered and future cash flows are discounted back to present by using an appropriate financial discount rate.



In order to assess the project financial viability, the following performance indicator was used.

- The **FIRR** rule is a guideline for evaluating whether to proceed with a project or investment. The FIRR rule states that if the internal rate of return on a project or an investment is greater than the minimum required rate of return, then the project or investment should be pursued. Conversely, if the FIRR is lower than the minimum, then the other course of action is required in order not to reject it. Such action concerns the financing of the project with grants.

  The FIRR is calculated according to the formula

$$\sum_{t=0}^{n} \left[\frac{A_t}{(1+r)^t} \right] = 0$$

  where:

  - A_t net cash flow for the period t
  - n time period for which the cash flows expected
  - $\sum$ sum of the discounted cash flows from the end

- The **Long-term transmission charge** that generates the required revenue to achieve a certain internal rate of return. The natural gas transmission activity would be regulated by the National Energy Authority so to allow the TSO to recover the justified costs and earn a return on the Regulatory Asset Base based on the expected transmitted volumes.

  The long-term transmission charge is calculated using the FIRR formula by applying a required rate (*r*).

- The **Levelised cost** of gas transmission, which is considered as the constant unit cost (per cm) of a payment stream that has the same present value as the total cost of building and operating the specific investment over its life.

  The levelised cost is calculated by dividing the PV[11] of the capital expenditure and the operational, maintenance and financing costs by the PV of the gas volumes.

$$\frac{PV\ (Capex) + PV(Opex)}{PV(Gas\ volumes)}$$

It should be noted that, for the assessment of the section in Albania, the FIRR and the levelised cost were calculated, whereas for the section in Kosovo as well as for the entire pipeline, the long-term transmission charge and the levelised cost were assessed.

The assessment of the future cash flows was based on the following assumptions:

- **Time perspective of the project**:
  - Operation period within which the project is economically viable is assumed to be 20 years;
  - Construction period is estimated to 2 years construction works;
  - Data based at prices of the year 2018 and remains stable during the evaluation period;
- **Inflation:** Inflation impact has not been considered (i.e. real terms)
- **Exchange Rates:** Exchange rates effect between local currencies and euro were not taken into account
- **Taxes**:
  - Corporate tax rate equal to 15% in Albania and 10% in Kosovo;
  - VAT is not included;
- **Financial Discount Rate**: 8% according to the Albanian GMP.

Total gas transmission costs and gas retail price in Kosovo
The total cost for the gas transported from the Albanian border to Kosovo can be modeled by subtracting an indicative gas retail price in Kosovo from the gas price at the Albanian border and any related distribution costs. Regarding the indicative gas retail price in Kosovo, the basic assumption was that gas will be priced by applying a discount rate to the electricity

[11] The PV is defined as the current worth of a stream of cash flows given a specified rate of return. Future cash flows are discounted at the discount rate according to the following formula:

$$A_0 = \frac{A_1}{(1+r)} + \frac{A_2}{(1+r)^2} + \frac{A_3}{(1+r)^3} + ... + \frac{A_n}{(1+r)^n}$$

price. According to EUROSTAT, the minimum discount between gas retail price and electricity price among the countries monitored by the Institute is close to 40%. Taking into account that currently the average electricity price in Kosovo is approx. 0.064 eur/ kwh, an indicative price for gas of 0.039 eur/kwh was derived.

Furthermore, due to the absence of gas price at the Albanian border, this was approached by using the one in the Italian market. The average gas price for the last quarter of 2017 and the first quarter of 2018 in Italy was 0.0193 eur/kwh (source: Quarterly Report on European Gas Markets, Market Observatory for Energy, Volume 10 & 11, DG Energy).

Finally, distribution cost for Kosovo market was assumed at the level of 0.13 eur/cm.

Given that the long-term transmission charge for the Albanian section of IAP was calculated at 0.009 eur/cm[12], the total transmission costs for whole ALKOGAP should be at the level of 0.041 eur/cm.

6.3.2 Investment costs and financing sources

The investments costs include the capital Investments and the interest during construction. The initial capital investment costs are presented in the relevant section of this report). The breakdown and the construction dynamics of costs are listed on the table below:

Table 6-2: CAPEX dynamics

(in '000 eur)	Pipe Size	Pipeline Section in ALB			Pipeline Section in KOS			TOTAL
		2019	2020	Total	2019	2020	Total	
Capital Investment	DN600	90,006	60,004	150,010	36,575	24,383	60,958	210,968
Interest during Construction		0	600	600	0	244	244	844
Total		**90,006**	**60,604**	**150,611**			**61,202**	**211,812**
financed by:								
Equity				30,002			12,192	42,194
Bank Debt				120,608			49,010	169,619

The depreciation of the Capital Investment is determined by a straight-line method of fixed assets write-off on the basis of their expected technical life, i.e. useful lives of fixed assets, which in this case is assumed to be 30 years on average.

Reinvestment costs for the replacement of devaluated assets were not taken into account since it was assumed that the economic life of the assets exceeds the duration of the reference period.

Regarding the financing structure, two main financing sources were considered for the development of the project: debt and equity at a ratio 80%-20% applied for each section. The indicative financing terms in both sections have as follows:

- Grace Period — 2 yrs. (i.e. construction period)
- Loan Duration — 15 yrs. (including grace period)
- Annual Interest Rate (%) — 6-month euribor + 1%

[12] FS and ESIA for the Ionian – Adriatic Pipeline, WB5-REG-ENE-03, COWI-IPF, 2014

6.3.3 Operating costs

The following table outlines the underlying assumptions for the calculation of the projected incremental operating and maintenance expenses per section. For the Variant B, in which ALKOGAP was assessed as a whole, the operating costs were calculated as the total of the two sections.

Table 6-3: Operating expenses

Opex Item	Unit	Section in ALB	Section in KOS
Labour cost			
No. of employees	number	20	100
Avg monthly salary	euro/month	500	800
Annual Growth Rate	%	1.50%	1.50%
Maintenance cost			
% at year 1	% of CAPEX	0.50%	0.50%
Max %	% of CAPEX	1.50%	1.50%
Annual increase (step)	%	0.05%	0.05%
Insurance Costs	% of CAPEX	0.50%	0.50%
Gas transmission losses (per section)	% of gas transported	0.53%	0.47%
Gas transmission losses (total ALKOGAP)	% of gas transported	1.00%	
Energy costs	% of gas consumption	0.40%	0.40%
Price of gas for self-consumption	euro/cm	0.32	0.35
Right of way			
Route width for the right of way acquisition	m	10	10
Right of way acquisition costs	eur/m2	0.17	0.17
Overheads	% of total expenses	10.00%	10.00%

6.3.4 Working capital

The additional cash flow for working capital needs was calculated by applying the following assumptions that have been based on historical data:

- average time outstanding for the account receivables, 60 days;
- average time of payment for the account payables, 30 days.

6.3.5 Residual value

This value represents the ability of the infrastructure to generate future costs and revenues beyond the first twenty years of operation that consists the period under examination, until the end of its technical life. Considering the long life of such an asset, its potential to generate future benefits, is supposed to be at least equal with its remaining non-depreciated value.

Residual value was calculated as follows: $Rv = (Av - D)$

where:

- Rv is the Residual value
- Av is the Initial value of the asset
- D is the accumulated depreciation of the asset during the time horizon of the analysis

ALKOGAP (section in ALB)	50,204 th. eur.
ALKOGAP (section in KOS)	20,401 th. eur.
ALKOGAP	70,604 th. eur.

6.3.6 Financial cash flow statements

Table 6-4: Projected cash flow statement – Variant A': Section in ALB

Indicative Project Time	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Contruction Period			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Operating Period	0	0																				
Operating Activities																						
Total Revenues	0	0	20,790	21,443	22,229	23,179	24,336	25,323	25,954	25,972	25,996	26,005	26,014	26,025	26,038	26,053	26,062	26,071	26,080	26,091	26,102	26,115
Total Operating Costs	0	0	-2,896	-3,008	-3,127	-3,253	-3,388	-3,515	-3,628	-3,714	-3,800	-3,886	-3,971	-4,057	-4,143	-4,229	-4,315	-4,401	-4,486	-4,572	-4,658	-4,745
Corporate Taxes	0	0	0	-1,750	-1,845	-1,959	-2,097	-2,264	-2,407	-2,499	-2,502	-2,507	-2,509	-2,512	-2,514	-2,517	-2,521	-2,509	-2,497	-2,486	-2,475	-2,464
Change in Working Capital	0	0	-3,180	-98	-119	-146	-179	-152	-95	4	3	6	5	5	5	5	6	6	5	5	5	5
Net Cash Flows from Operations	0	0	14,715	16,587	17,137	17,822	18,673	19,392	19,825	19,764	19,697	19,618	19,539	19,461	19,385	19,311	19,232	19,167	19,102	19,038	18,974	18,912
Investments Activities																						
Investment Costs	-90,006	-60,004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Senior Debt: IdC	0	-600	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cash Flow from Investment Activities	-90,006	-60,604	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cashflow before Funding	-90,006	-60,604	14,715	16,587	17,137	17,822	18,673	19,392	19,825	19,764	19,697	19,618	19,539	19,461	19,385	19,311	19,232	19,167	19,102	19,038	18,974	18,912
Financial Activities																						
Funding																						
Equity Contribution	30,002	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Seniior Debt	60,004	60,604	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	90,006	60,604	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cash available to Debt Service	0	0	14,715	16,587	17,137	17,822	18,673	19,392	19,825	19,764	19,697	19,618	19,539	19,461	19,385	19,311	19,232	19,167	19,102	19,038	18,974	18,912
Debt Service																						
Interest paid	0	0	-1,206	-1,113	-1,021	-928	-835	-742	-649	-557	-464	-371	-278	-186	-93	0	0	0	0	0	0	0
Principal Repayment	0	0	-9,278	-9,278	-9,278	-9,278	-9,278	-9,278	-9,278	-9,278	-9,278	-9,278	-9,278	-9,278	-9,278	0	0	0	0	0	0	0
Total	0	0	-10,484	-10,391	-10,298	-10,205	-10,113	-10,020	-9,927	-9,834	-9,741	-9,649	-9,556	-9,463	-9,370	0	0	0	0	0	0	0
Net Cashflow	**0**	**0**	**4,232**	**6,196**	**6,839**	**7,616**	**8,560**	**9,372**	**9,898**	**9,930**	**9,955**	**9,969**	**9,983**	**9,998**	**10,015**	**19,311**	**19,232**	**19,167**	**19,102**	**19,038**	**18,974**	**18,912**

Table 6-5: Projected cash flow statement – Variant A': Section in KOS

Indicative Project Time	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Contruction Period			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Operating Period	0	0																				
Operating Activities																						
Total Revenues	0	0	9,698	10,001	10,366	10,807	11,344	11,799	12,088	12,088	12,088	12,088	12,088	12,088	12,088	12,088	12,088	12,088	12,088	12,088	12,088	12,088
Total Operating Costs	0	0	-3,768	-3,873	-3,991	-4,122	-4,272	-4,407	-4,511	-4,563	-4,615	-4,667	-4,719	-4,772	-4,825	-4,878	-4,932	-4,986	-5,040	-5,095	-5,149	-5,205
Corporate Taxes	0	0	0	-510	-545	-588	-640	-704	-758	-791	-789	-787	-785	-782	-780	-778	-775	-767	-759	-751	-743	-735
Change in Working Capital	0	0	-1,285	-41	-50	-62	-76	-64	-39	4	4	4	4	4	4	4	4	4	4	4	5	5
Net Cash Flows from Operations	0	0	4,646	5,577	5,780	6,035	6,356	6,625	6,780	6,738	6,689	6,639	6,588	6,538	6,487	6,436	6,385	6,339	6,293	6,246	6,200	6,153
Investments Activities																						
Investment Costs	-36,575	-24,383	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Senior Debt: IdC	0	-244	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cash Flow from Investment Activities	-36,575	-24,627	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cashflow before Funding	-36,575	-24,627	4,646	5,577	5,780	6,035	6,356	6,625	6,780	6,738	6,689	6,639	6,588	6,538	6,487	6,436	6,385	6,339	6,293	6,246	6,200	6,153
Financial Activities																						
Funding																						
Equity Contribution	12,192	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Seniior Debt	24,383	24,627	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	36,575	24,627	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cash available to Debt Service	0	0	4,646	5,577	5,780	6,035	6,356	6,625	6,780	6,738	6,689	6,639	6,588	6,538	6,487	6,436	6,385	6,339	6,293	6,246	6,200	6,153
Debt Service	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Interest paid	0	0	-490	-452	-415	-377	-339	-302	-264	-226	-189	-151	-113	-75	-38	0	0	0	0	0	0	0
Principal Repayment	0	0	-3,770	-3,770	-3,770	-3,770	-3,770	-3,770	-3,770	-3,770	-3,770	-3,770	-3,770	-3,770	-3,770	0	0	0	0	0	0	0
Total	0	0	-4,260	-4,222	-4,185	-4,147	-4,109	-4,072	-4,034	-3,996	-3,959	-3,921	-3,883	-3,845	-3,808	0	0	0	0	0	0	0
Net Cashflow	**0**	**0**	**386**	**1,355**	**1,595**	**1,888**	**2,246**	**2,553**	**2,746**	**2,742**	**2,730**	**2,718**	**2,705**	**2,692**	**2,679**	**6,436**	**6,385**	**6,339**	**6,293**	**6,246**	**6,200**	**6,153**

Table 6-6: Projected cash flow statement – Variant B': ALKOGAP

Indicative Project Time	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Contruction Period			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Operating Period	0	0																				
Operating Activities																						
Total Revenues	0	0	26,036	26,854	27,838	29,028	30,477	31,713	32,503	32,526	32,556	32,566	32,578	32,592	32,608	32,627	32,638	32,649	32,661	32,674	32,689	32,704
Total Operating Costs	0	0	-6,314	-6,523	-6,747	-6,990	-7,257	-7,504	-7,712	-7,850	-7,990	-8,128	-8,266	-8,405	-8,545	-8,685	-8,824	-8,964	-9,105	-9,246	-9,387	-9,529
Corporate Taxes	0	0	0	-1,097	-1,170	-1,259	-1,367	-1,499	-1,610	-1,682	-1,683	-1,685	-1,686	-1,686	-1,687	-1,687	-1,688	-1,675	-1,662	-1,650	-1,637	-1,624
Change in Working Capital	0	0	-3,761	-117	-143	-176	-216	-183	-113	8	7	10	9	9	9	8	10	10	10	9	9	9
Net Cash Flows from Operations	0	0	15,961	19,117	19,777	20,603	21,637	22,527	23,068	23,001	22,889	22,763	22,635	22,510	22,385	22,263	22,135	22,019	21,904	21,788	21,674	21,560
Investments Activities																						
Investment Costs	-126,581	-84,387	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Senior Debt: IdC	0	-844	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cash Flow from Investment Activities	-126,581	-85,231	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cashflow before Funding	-126,581	-85,231	15,961	19,117	19,777	20,603	21,637	22,527	23,068	23,001	22,889	22,763	22,635	22,510	22,385	22,263	22,135	22,019	21,904	21,788	21,674	21,560
Financial Activities	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Funding	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Equity Contribution	42,194	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Seniior Debt	84,387	85,231	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	126,581	85,231	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cash available to Debt Service	0	0	15,961	19,117	19,777	20,603	21,637	22,527	23,068	23,001	22,889	22,763	22,635	22,510	22,385	22,263	22,135	22,019	21,904	21,788	21,674	21,560
Debt Service	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Interest paid	0	0	-1,696	-1,566	-1,435	-1,305	-1,174	-1,044	-913	-783	-652	-522	-391	-261	-130	0	0	0	0	0	0	0
Principal Repayment	0	0	-13,048	-13,048	-13,048	-13,048	-13,048	-13,048	-13,048	-13,048	-13,048	-13,048	-13,048	-13,048	-13,048	0	0	0	0	0	0	0
Total	0	0	-14,744	-14,613	-14,483	-14,352	-14,222	-14,091	-13,961	-13,830	-13,700	-13,569	-13,439	-13,309	-13,178	0	0	0	0	0	0	0
Net Cashflow	**0**	**0**	**1,217**	**4,504**	**5,294**	**6,251**	**7,415**	**8,436**	**9,107**	**9,171**	**9,189**	**9,193**	**9,196**	**9,201**	**9,207**	**22,263**	**22,135**	**22,019**	**21,904**	**21,788**	**21,674**	**21,560**

6.3.7 Financial performance indicators

- Variant A - Section in ALB: For this section, the performance indicators were estimated as follows:

FIRR	4.8%
Levelised Cost	0.035 eur/cm

Since the acceptability criterion was that the FIRR should not been lower than 8%, grant financing should be considered in order to avoid any tariff increase which would affect negatively the market size.

The above is supported by the calculation of the levelised cost, which was higher than the one which was assumed before the implementation of ALKOGAP (0.0246 eur/cm).

- Variant A - Section in KOS: For this section, the performance indicators were calculated as follows:

Long-term transmission charge	0.0195 eur/cm
Levelised Cost	0.0186 eur/cm

Since the total transmission cost were estimated at 0.041 eur/cm and the cost for the Albanian section at 0.0246 eur/cm, the long-term transmission charge for gas transported in Kosovo should not exceed 0.016 eur/cm. Therefore, the scenario does not meet the acceptability criterion and external financing support is needed.

- Variant B - ALKOGAP: For the whole pipeline, the performance indicators were calculated as follows:

Long-term transmission charge	0.0544 eur/cm
Levelised Cost	0.0535 eur/cm

In this scenario the total transmission cost of 0.041 eur/cm is the threshold for the long-term transmission charge for gas transported from the entry point in Albania to Kosovo. Therefore, this variant does not meet the acceptability criterion and external financing support is needed.

6.3.8 Financial Sensitivity Analysis

Financial sensitivity analysis has been conducted by changing the following input variables:

- Investment Costs
- Operating Expenses
- Gas Flows

Since the Levelised Cost is considered as a life-cycle cost indicator, commonly used to gauge long-run unit costs, it was used to examine the effect of changing the above variables by +/- 10-50%.

- Variant A - Section in ALB

Table 6-7: Financial sensitivity analysis-Section in ALB

Δ%	Investment costs	O&M costs	Incremental Gas Flows
-50%	0.019	0.032	0.070
-40%	0.022	0.033	0.058
-30%	0.025	0.034	0.050
-20%	0.029	0.034	0.044
-10%	0.032	0.035	0.039
0%	**0.035**	**0.035**	**0.035**
10%	0.039	0.036	0.032
20%	0.042	0.037	0.030
30%	0.046	0.037	0.028
40%	0.049	0.038	0.026
50%	0.052	0.038	0.024

The threshold for the levelised cost of 0.0246 eur/cm can be achieved either by decreasing the investment costs by at least 30% or the operating expenses by way more than 50%. Increasing the gas flows cannot be feasible due to the capacity limitation of the pipeline.

- Variant A - Section in KOS

Table 6-8: Financial sensitivity analysis-Section in KOS

Δ%	Investment costs	O&M costs	Incremental Gas Flows
-50%	0.012	0.016	0.036
-40%	0.013	0.016	0.030
-30%	0.015	0.017	0.026
-20%	0.016	0.018	0.023
-10%	0.017	0.018	0.021
0%	**0.019**	**0.019**	**0.019**
10%	0.020	0.019	0.017
20%	0.021	0.020	0.016
30%	0.023	0.020	0.015
40%	0.024	0.021	0.014
50%	0.026	0.021	0.013

The threshold for the long-term transmission charge of 0.016 eur/cm can be achieved either by decreasing the investment costs by at least 20% or the operating expenses by more than 50%. Increasing the gas flows cannot be feasible due to the capacity limitation of the pipeline.

- Variant B - ALKOGAP

Table 6-9: Financial sensitivity analysis-ALKOGAP

Δ%	Investment costs	O&M costs	Incremental Gas Flows
-50%	0.030	0.047	0.104
-40%	0.035	0.049	0.087
-30%	0.039	0.050	0.075
-20%	0.044	0.051	0.066
-10%	0.049	0.052	0.059
0%	**0.053**	**0.053**	**0.053**
10%	0.058	0.055	0.049
20%	0.063	0.056	0.045
30%	0.068	0.057	0.042
40%	0.072	0.058	0.039
50%	0.077	0.059	0.037

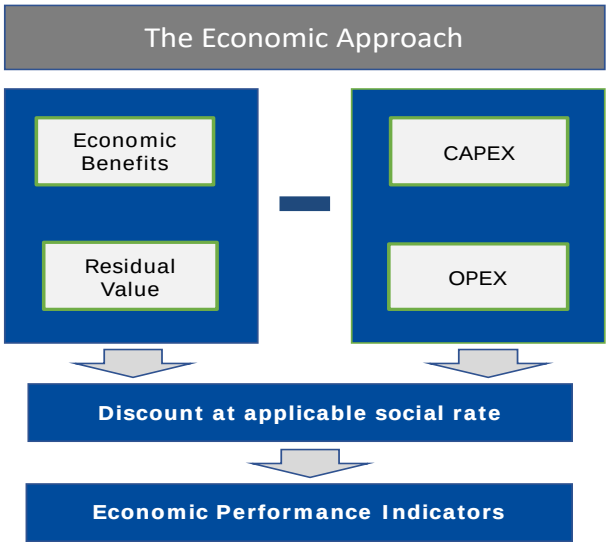
Based on the above table, the threshold for the long-term transmission charge of 0.041 eur/cm can be achieved either by decreasing the investment costs by at 20% or the operating expenses by more than 50%. Increasing the gas flows cannot be feasible due to the capacity limitation of the pipeline.

6.4 Economic Analysis and Assessment

The aim of the Economic Analysis is to investigate the impact to society's economic well-being of the additional volumes of natural gas made available by the project. To this extent, the analysis is focused on the project as a whole.

6.4.1 Methodology & Basic Assumptions

The economic analysis covers the 20 years period that has been selected as the financial analysis horizon. On the cost side, the same investment and operating costs used in the financial analysis were applied since they were deemed to adequately reflect social opportunity costs. On the benefit side, financial revenues of the project were disregarded and instead the project's economic benefits were estimated and taken into account. Once costs and benefits were specified, the DCF approach was used for assessing the economic profitability of the project, including the residual value.



Based on the projected economic cash flows, the following performance indicators were calculated:

- ENPV, which should be greater than zero;
- EIRR, which should be greater than the economic discount rate; and
- EB/C ratio which should be greater than one.

The assessment of the future economic cash flows was based on the same assumptions as in the financial analysis, with the following differentiations:

- Economic discount rate of 4%; and
- Corporate taxes were not taken into account.

6.4.2 Economic Impacts

The construction of a new gas supply route generally increases the gas supply capacity and makes additional volumes of gas available to the economy on local and regional level. Incremental gas demand generated by the project will be derived mainly from Kosovo, where there is no gas supply and in short term it is not envisaged from any other source.

As regards the monetization of the economic impacts, it was assumed that the volumes of gas supplied substituted the consumption of alternative fuels (e.g lignite, wood, pellet, LFO and LPG). On this basis, the benefits to the society can be measured by monetizing the impact of the following factors:

- The avoidance of costs related to the use of replaceable fuels;
- The avoidance of greenhouse gas emissions (GHG); and
- The avoidance of emissions of other polluting compounds.

In order to estimate the monetized value of the above impacts, the following were specified:

- Mix of Replaceable Fuels. Based on Market Background Analysis, the type and share of each replaceable fuel was determined. Following that, the assumptions applied were as presented in below table.

Table 6-10: Mix of replaceable fuels by economic sector

Economic Sector	Coal	Wood	Pellet	LFO	LPG
Residential sector	47%	49%	0%	1%	3%
Service (Public buildings)	51%	29%	5%	11%	4%
Service (Private buildings)	50%	27%	8%	12%	4%
Industrial sector	50%	17%	0%	33%	0%
Gas to Power Sector	100%	0%	0%	0%	0%

- Calorific Values of gas and alternative fuels used for conversion. All fuel quantities were converted into energy equivalents (kWh and/or GJ) in order to allow comparison and determine the amounts of potentially replaceable fuels.
- Differences in efficiencies were also considered when determining the amounts of replaceable energy from alternative fuels (coal 70%, LFO-LPG-wood & pellet 80% and gas 90%).

Impact from the avoidance of costs related to the use of alternative fuels

The net impact of this replacement can be monetised as the difference between purchase costs of gas and purchase cost of replaceable fuels, for the quantities required to produce the same amount of energy.

- Fuel costs: The following fuel costs expressed in eur/kwh were applied:
  - Lignite 0.010
  - Wood 0.025
  - Pellet 0.034
  - LFO 0.079
  - LPG 0.097
  - Gas[13] 0.039

A summary of the impact from the costs related to the use of alternative fuels is presented below:

Table 6-11: Impact from the avoidance of costs related to the use of alternative fuels

Pipe Size	Sector	Total for the period	Average for the period	NPV
		'in '000 eur		
DN 600	Residential	-1,046,557.0	-52,327.8	-634,993.7
	Service (Public buildings)	-68,956.6	-3,447.8	-39,251.6
	Service (Private buildings)	33,212.5	1,660.6	19,014.7
	Industrial	43,602.7	2,180.1	24,418.7
	Total avoided costs	**-1,038,698.4**	**-51,934.9**	**-630,811.9**

Impact from greenhouse gas emissions (GHG)

Compared to other fossil fuels, natural gas has the lowest carbon content and is a relatively cleaner source of energy. In order to monetise the net impact from the reduction in greenhouse gas emissions (CO2, CH4 and N2O), the estimated CO2 emissions to be generated by gas were compared to those estimated to be generated by the replaceable fuels, in order to produce equivalent energy.

- CO2 emission factors multiplied by the replaceable amount in GJ for each fuel according to IPCC “Guidelines for National Greenhouse Gas Inventories”.
  - Gas 723.42 kg/GJ
  - Pellet 47.16 kg/GJ

[13] Consultant’s estimation

- Lignite	1,200.27	kg/GJ	- LFO	938.99	kg/GJ
- Fuelwood	37.41	kg/GJ	- LPG	941.85	kg/GJ

- The forecast cost of CO2 was estimated in a range of 20 EUR per ton in 2021 to 73 EUR per ton in 2040.

A summary of the impact from greenhouse gas emissions per 1,000 tons is presented below:

Table 6-12: Impact from greenhouse gas emissions

Pipe Size	Sector	Total for the period	Average per year	NPV
		'in tons		
DN 600	Residential	17,317.2	865.9	9,714.4
	Service (Public buildings)	6,867.6	343.4	3,909.2
	Service (Private buildings)	14,910.3	745.5	8,536.3
	Industrial	45,998.2	2,299.9	25,760.3
	Total avoided emissions	**85,093.2**	**4,254.7**	**47,920.2**
	Total avoided costs *(in '000 eur)*	**4,700,574.4**	**235,028.7**	**2,500,852.6**

Impact from emissions of other polluting compounds

Emissions of other polluting matters (NOx, SO2 and PM2.5) were also included in the analysis and monetised. As for CO2 emissions, this impact was monetised by comparing the estimated emissions of these compounds to be generated by gas to those estimated to be generated by the replaceable quantities of fuels.

- NOx, SO2 and PM2.5 emission factors in kg/GJ multiplied by the replaceable amount in GJ for each fuel according to IPCC “Guidelines for National Greenhouse Gas Inventories”.

	NOx	SO2	PM2.5 emissions
• Lignite	3.89	294.12	1,586.72
• Biomass (Fuelwood)	0.74	0.01	1,625.42
• Biomass (Pellets)	0.94	0.01	903.01
• diesel	2.59	8.82	44.58
• LPG	1.30	0.06	40.22
• Natural Gas	1.94	0.55	35.14

- Average damage values, calculated on the basis of MethodEx data and weighted with the Kosovo GDP.

A summary of the impact from the emissions of other polluting compounds is presented below:

Table 6-13: Impact from emissions of other polluting compounds

Pipe Size	Sector	Total for the period	Average per year	NPV
		'in tons		
DN 600	Residential	5,877,555.2	267,161.6	3,297,133.9
	Service (Public buildings)	708,100.7	32,186.4	403,066.4
	Service (Private buildings)	1,609,168.8	73,144.0	921,272.2
	Industrial	2,676,369.0	121,653.1	1,498,842.9
	Total avoided emissions	**10,871,193.6**	**494,145.2**	**6,120,315.3**
	Total avoided costs *(in '000 eur)*	**2,804,830.6**	**127,492.3**	**1,578,959.9**

Impact from gas disruptions

Since ALKOGAP will be the sole gas infrastructure in Kosovo, issues related to security of supply and gas source diversification became important. Under that situation, any disruptions along the route caused by infrastructure failure or other, will endanger gas supply. Related to that, the N-1 calculation with ALKOGAP in operation is zero in Kosovo because there is only one gas supply infrastructure source available.

For the purpose of modelling the gas demand disruption and assuming that the gas transmission system in the region is fully integrated, the expected impacts were calculated as the economic value of the avoided gas interruption (VoLL), multiplied by the probability of the interruption, its duration and the expected volume of interrupted supply for each year.

In more detail, the monetization of the above effect was reached under the following assumptions:

- High gas market demand conditions;
- Duration of a potential supply disruption: 14 days;
- Probability of occurrence: 5% (1 in 20 years period), on the basis of historical data in Europe; and
- VoLL equal to 3 eur/cm

Table 6-14: Impact from gas disruption

		Total for the period
DN 800	Disrupted Gas Quantities	**31.5 mcm**
	Economic Impacts	**-94.4 mil. eur.**

6.4.3 Economic cash flows and performance indicators

Following the benefits that have been analysed in the previous section, the calculation of the economic benefits and costs on an annual basis are presented below:

Table 6-15: Economic cash flows

Year	Economic Impacts & other inflows					Project Costs		Net Economic cashflows
	Fuel Switching Impact	Greenhouse Gases	Other Polluting Compounds	Gas Disruption	Residual Value	Investment cots	Operating Expenses	
	'in '000 eur							
2019	0	0	0	0	0	-126,030	0	**-126,030**
2020	0	0	0	0	0	-84,860	0	**-84,860**
2021	-14,067	21,773	36,762	-741	0	0	-4,470	**39,257**
2022	-15,935	27,344	41,967	-905	0	0	-4,678	**47,794**
2023	-18,139	34,598	48,227	-1,104	0	0	-4,901	**58,680**
2024	-20,751	44,114	55,800	-1,348	0	0	-5,144	**72,671**
2025	-23,859	56,688	65,012	-1,646	0	0	-5,410	**90,785**
2026	-27,414	72,943	75,871	-2,012	0	0	-5,700	**113,688**
2027	-31,694	94,728	89,294	-2,458	0	0	-6,027	**143,843**
2028	-36,862	124,128	105,970	-3,004	0	0	-6,400	**183,832**
2029	-43,123	164,070	126,779	-3,671	0	0	-6,833	**237,222**
2030	-50,237	203,100	143,918	-4,485	0	0	-7,213	**285,084**
2031	-58,754	251,502	163,775	-5,491	0	0	-7,632	**343,400**
2032	-69,087	300,253	187,531	-6,723	0	0	-8,106	**403,869**
2033	-78,509	345,364	207,689	-7,839	0	0	-8,528	**458,177**
2034	-78,547	362,936	207,810	-7,768	0	0	-8,668	**475,764**
2035	-78,564	381,272	207,877	-7,694	0	0	-8,807	**494,084**
2036	-78,582	400,534	207,946	-7,630	0	0	-8,947	**513,321**
2037	-78,603	420,779	208,020	-7,565	0	0	-9,087	**533,546**
2038	-78,628	442,061	208,102	-7,497	0	0	-9,227	**554,811**
2039	-78,656	464,433	208,191	-7,428	0	0	-9,368	**577,173**
2040	-78,688	487,953	208,289	-7,357	70,297	0	-9,509	**670,985**

The economic analysis was carried out on the basis of the discounted cash-flow methodology by applying the social discount rate of 4% and the following indicators of economic profitability were calculated.

EIRR	35.51%
ENPV	3.2 bil. eur.
EB/C Ratio	12.1

The economic performance indicators revealed that the impact of ALKOGAP to society's economic well-being is very positive. Although the fuel switching effect had a negative impact i.e. gas price is relatively higher than the majority of replaceable fuels (lignite, wood), the benefits to the environment prevailed far and away. The latest was attributed to the fact that gas will replace the use of other much more polluting fuels.

6.4.4 Economic sensitivity analysis

Given the uncertainty that is normally associated with the estimation of economic values over a long-time horizon, a sensitivity analysis was performed on the results of the economic analysis. The analysis allowed the determination of the 'critical' parameters of the project, whose variations, positive or negative, have the greatest impact on economic performance. The following critical parameters were investigated regarding their impact on the ENPV:

- Investment Costs;
- Operating Expenses;
- Incremental Gas Flows; and
- Polluters' Impact.

The table below shows the estimated elasticity and the switching value of the ENPV with respect to the above variables:

Table 6-16: Economic sensitivity analysis

Elasticity	
Investment cost	0.06%
O&M costs	0.03%
Incremental gas flows	1.10%
C02 emission impact	0.78%
NOx emission impact	0.00%
SO2 emission impact	0.21%
PM2.5 emission impact	0.28%
Switching value	
Investment cost	-
O&M costs	-
Incremental gas flows	8.8%
C02 emission impact	-
NOx emission impact	-
SO2 emission impact	-
PM2.5 emission impact	-

Changes of the different input variables do not have a significant impact on the project's economic performance due to the high level of the performance indicators. Only the incremental gas flows can be considered as critical (they had the most significant impact on the ENPV), the switching value implied that if this variable falls down to almost 9% of the existing level, the project would still be economically breaking-even.

6.4.5 Security of supply: N-1 Criterion

The indicator describes the technical ability of gas infrastructure to satisfy exceptionally high gas demand in a country, in the event of disruption of the single largest infrastructure. An N-1 indicator literally shows what part of the maximum daily gas demand can be satisfied if there is a disruption in a country's largest gas supply infrastructure; the higher the indicator is, the better the resilience. A value of at least one indicates full security in this regard.

Compliance with Infrastructure standard to safeguard security of supply is calculated based on the N-1 formula provided in Regulation (EU) 994/2010. The N-1 criterion is fulfilled if the ratio exceeds 100 per cent. N indicates the total number of supply sources whereas 1 represents a single largest infrastructure. Article 6 of the Regulation states that every Member State has to have an ability to satisfy total gas demand of the calculated area in the event of disruption of the single largest infrastructure.

$$N-1[\%] = \frac{EP_m + P_m + S_m + LNG_m - I_m}{D_{max}}$$

whereby:

- 'D_{max}' means total daily gas demand (in million cubic meters per day or mcm/day) of the calculated area during a day of exceptionally high gas demand occurring with a statistical probability of once in 20 years.

- 'EP_m': technical capacity of entry points (in mcm/day), other than production, LNG and storage facilities covered by P m, S m and LNG m, means the sum of technical capacity of all border entry points capable of supplying gas to a calculated area.
- 'P_m': maximal technical production capability (in mcm/day) means the sum of maximal technical daily production capability of all gas production facilities which can be delivered to entry points in a calculated area.
- 'S_m ': maximal technical storage deliverability (in mcm/day) means the sum of maximal technical daily withdrawal capacity of all storage facilities which can be delivered to entry points of a calculated area, taking into account their respective physical characteristics.
- 'LNG_m': maximal technical Liquefied Natural Gas (LNG) facility capacity (in mcm/day) means the sum of maximal technical daily send-out capacities at all LNG facilities in a calculated area, taking into account critical elements like offloading, ancillary services, temporary storage and re-gasification of LNG as well as technical send-out capacity to the system.
- 'I_m': means a technical capacity of a single largest gas infrastructure (in mcm/day) with the highest capacity to supply the calculated area. When several gas infrastructures are connected to a common upstream or downstream gas infrastructure and cannot be separately operated, they shall be considered as one single gas infrastructure

The N-1 calculation with ALKOGAP in operation is zero because there is only one gas supply infrastructure source available. However, it should be noted that, although N-1 is zero in the examined period, the supply balance (peak demand – all import capacity) is positive through all analysed years.

It shall be mentioned that in order to raise N-1, the construction of at least two distinct gas infrastructures is necessary. Moreover, the N-1 criterion is met in case that each of the two distinct gas infrastructures, has a capacity which is equal or greater than the demand.

6.5 The Impact of a 500 MW Gas Power Plant

This section analyses the impact to the financial and economic indicators of the additional gas consumption needed for the 500 MW power generation plant.

6.5.1 Incremental gas flows

The additional gas volume needed for the power plant results to the following:

- The gas consumption increases during the first years of operation of ALKOGAP, when the gas penetration of the other sectors in the market is low.
- The specific gas quantities represent more stable, more secure and less vulnerable flows compared to the ones of the remaining gas market.

The following tables present the incremental gas flows for the two pipe size scenarios under consideration.

Table 6-17: Incremental gas flows including 500 MW power plant per country

Year	Albanian Gas Market			Kosovar Gas Market		
	Domestic Market	Transit	Total	Domestic Market incl DH	500 MW Power Plant	Total
	Gas Flows (in '000 cm)					
2021	391	802,329	**802,720**	177,329	625,000	**802,329**
2022	515	827,409	**827,924**	202,409	625,000	**827,409**
2023	679	857,572	**858,252**	232,572	625,000	**857,572**
2024	899	894,059	**894,958**	269,059	625,000	**894,059**
2025	1,192	938,438	**939,630**	313,438	625,000	**938,438**
2026	1,580	976,142	**977,722**	351,142	625,000	**976,142**
2027	2,098	1,000,000	**1,002,098**	375,000	625,000	**1,000,000**
2028	2,790	1,000,000	**1,002,790**	375,000	625,000	**1,000,000**
2029	3,715	1,000,000	**1,003,715**	375,000	625,000	**1,000,000**
2030	4,035	1,000,000	**1,004,035**	375,000	625,000	**1,000,000**
2031	4,396	1,000,000	**1,004,396**	375,000	625,000	**1,000,000**
2032	4,818	1,000,000	**1,004,818**	375,000	625,000	**1,000,000**
2033	5,318	1,000,000	**1,005,318**	375,000	625,000	**1,000,000**
2034	5,912	1,000,000	**1,005,912**	375,000	625,000	**1,000,000**
2035	6,247	1,000,000	**1,006,247**	375,000	625,000	**1,000,000**
2036	6,590	1,000,000	**1,006,590**	375,000	625,000	**1,000,000**
2037	6,963	1,000,000	**1,006,963**	375,000	625,000	**1,000,000**
2038	7,368	1,000,000	**1,007,368**	375,000	625,000	**1,000,000**
2039	7,809	1,000,000	**1,007,809**	375,000	625,000	**1,000,000**
2040	8,292	1,000,000	**1,008,292**	375,000	625,000	**1,000,000**

6.5.2 Financial performance indicators

Based on the pre-mentioned gas flows, the financial performance indicators were estimated as follows:

- Variant A - Section in ALB

FIRR	10.1%
Levelised Cost	0.021 eur/cm

- Variant A - Section in KOS

Long-term transmission charge	0.0121 eur/cm
Levelised Cost	0.0116 eur/cm

- Variant B - ALKOGAP

Long-term transmission charge	0.0324 eur/cm
Levelised Cost	0.0321 eur/cm

The above results indicate that, if the 500 MW power plant was included, all the scenarios met the set thresholds and therefore no external support is needed.

Moreover, financial sensitivity analysis has been conducted by changing the CAPEX and the incremental gas flows variable.

Table 6-18: Financial sensitivity analysis including the 500 MW power plant

Δ%	Variant A': Section ALB		Variant A': Section ALB		Variant B': ALKOGAP	
	Investment costs	Incremental Gas Flows	Investment costs	Incremental Gas Flows	Investment costs	Incremental Gas Flows
-50%	0.011	0.041	0.008	0.022	0.018	0.061
-40%	0.013	0.034	0.008	0.019	0.021	0.052
-30%	0.015	0.029	0.009	0.016	0.024	0.045
-20%	0.017	0.026	0.010	0.014	0.027	0.039
-10%	0.019	0.023	0.011	0.013	0.029	0.035
0%	**0.021**	**0.021**	**0.012**	**0.012**	**0.032**	**0.032**
10%	0.023	0.019	0.012	0.011	0.035	0.029
20%	0.025	0.018	0.013	0.010	0.038	0.027
30%	0.027	0.016	0.014	0.009	0.040	0.025
40%	0.029	0.015	0.015	0.009	0.043	0.024
50%	0.030	0.014	0.016	0.008	0.046	0.022

6.5.3 Economic performance indicators

Following the benefits that have been analysed in the previous sections, the calculation of the economic benefits and costs on an annual basis are presented below:

Table 6-19: Economic cash flows with the addition of a 500 MW power plant

Year	Economic Impacts & other inflows					Project Costs		Net Economic cashflows
	Fuel Switching Impact	Greenhouse Gases	Other Polluting Compounds	Gas Disruption	Residual Value	Investment cots	Operating Expenses	
	'in '000 eur							
2019	0	0	0	0	0	-126,581	0	**-126,581**
2020	0	0	0	0	0	-85,231	0	**-85,231**
2021	-167,255	21,773	125,757	-751	0	0	-6,314	**-26,789**
2022	-169,122	27,344	130,962	-914	0	0	-6,523	**-18,254**
2023	-171,327	34,598	137,223	-1,114	0	0	-6,747	**-7,368**
2024	-173,939	44,114	144,796	-1,358	0	0	-6,990	**6,623**
2025	-177,046	56,688	154,008	-1,656	0	0	-7,257	**24,736**
2026	-180,511	69,419	161,883	-2,021	0	0	-7,504	**41,266**
2027	-182,610	81,510	166,894	-2,224	0	0	-7,712	**55,859**
2028	-182,613	89,661	167,026	-2,154	0	0	-7,850	**64,070**
2029	-182,616	98,751	167,202	-2,082	0	0	-7,990	**73,265**
2030	-182,631	108,370	167,266	-2,005	0	0	-8,128	**82,871**
2031	-182,650	118,940	167,338	-1,941	0	0	-8,266	**93,421**
2032	-182,674	125,093	167,424	-1,875	0	0	-8,405	**99,562**
2033	-182,704	131,596	167,525	-1,806	0	0	-8,545	**106,066**
2034	-182,741	138,480	167,646	-1,735	0	0	-8,685	**112,964**
2035	-182,758	145,593	167,712	-1,661	0	0	-8,824	**120,062**
2036	-182,777	153,071	167,781	-1,598	0	0	-8,964	**127,513**
2037	-182,798	160,943	167,856	-1,532	0	0	-9,105	**135,365**
2038	-182,822	169,233	167,937	-1,465	0	0	-9,246	**143,638**
2039	-182,850	177,964	168,026	-1,396	0	0	-9,387	**152,357**
2040	-182,883	187,161	168,124	-1,325	70,604	0	-9,529	**232,153**

Based on the projected economic cash flows, the economic performance indicators were estimated as follows:

EIRR	25.09%
ENPV	1.2 bil. eur.
EB/C Ratio	2.9

The economic performance indicators revealed that the impact of the power plant to society's economic well-being is positive. However, they were estimated at a

significant lower level than in the case without the power plant due to the change of the mix of the replaceable fuels.

Moreover, the table below shows the estimated elasticity and the switching value of the ENPV with respect to the input variables:

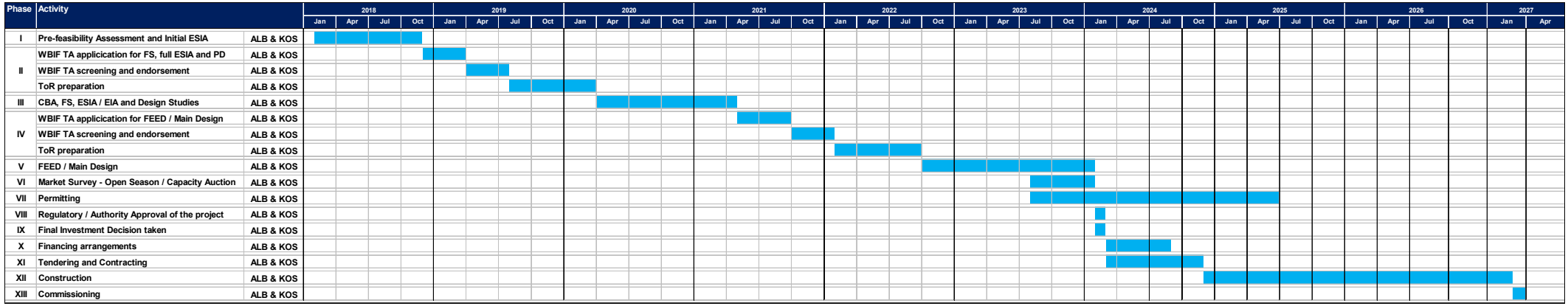
Table 6-20: Economic sensitivity analysis including the 500 MW power plant

Elasticity	
Investment cost	0.17%
O&M costs	0.35%
Incremental gas flows	1.45%
C02 emission impact	1.00%
NOx emission impact	0.02%
SO2 emission impact	1.22%
PM2.5 emission impact	1.14%
Switching value	
Investment cost	-
O&M costs	-
Incremental gas flows	31.1%
C02 emission impact	0.2%
NOx emission impact	-
SO2 emission impact	18.0%
PM2.5 emission impact	12.2%

7 Project Implementation Plan

Gas interconnector from Milot in Albania to Prishtina in Kosovo

Diameter		DN600 (24")
Operating pressure		82 bar
Length	in Albania	113 km
	in Kosovo	99 km
Capacity per year		1 bcm
Custody Transfer Metering Stations		2 pcs
Block Valve Stations		16 pcs
Pig Launching-receiving Stations		6 pcs
Regulation and Measuring Stations		4 pcs
Telemetric System for Monitoring		



8 Next Steps

Present study report is elaborated on a pre-feasibility level as well as the environmental and social assessment which is elaborated at an initial evaluation level.

To gain full knowledge about the feasibility and sustainability of the gas transmission pipeline from Albania to Kosovo it is recommended to develop a Gas Master Plan for Kosovo. A GMP for Kosovo should provide detailed knowledge about the potential gas market in Kosovo, through assessment of distribution systems feasibility for consumption centres in Kosovo, as well as potential gas interconnectors to neighbouring countries and the impact on the regional gas infrastructure, i.e. the design criteria for IAP.

After development of the GMP for Kosovo a full detailed feasibility study should be carried out including a full Environmental and Social Impact Assessment in accordance with both the Albanian legislation as well as the legislation in Kosovo.

Below is the Consultants proposal to upgrade the present study to a full feasibility study and the EISA screening to a full ESIA.

8.1 Feasibility study requirements

Content according to Guide to CBA of Investment Projects, E.C./DG-REGIO (7/2008), E.C./Europe Aid Cooperation Office, PCM Guidelines (3/2004). A template for the FS structure is provided in Annex 27.

8.2 ESIA requirements

This section mentions the formal steps required by both Albanian and Kosovo environmental authorities in the next development stages of the project.

8.2.1. Albania

Based on the above sections the project requires a Screening decision on the EIA level to which it will be submitted in its next development phases. The screening decision will be based on the findings of an Initial Environmental and Social Evaluation report (this document).

This conclusion is in compliance with the provisions of the project's ToR and IR.

8.2.2. Kosovo

Based on the above sections, the project requires for the next phases a full ESIA.

The ESIA will be based on the findings of an Initial Environmental Evaluation report (this report), and should be prepared in two phases:

> Phase 1 – Scoping Phase, primarily focused on identifying in detail the impacts to be assessed, how to assess them, and which of the impacts are most significant and important, as well as consideration of the certain

geographical area of influence for the environmental and social parameters. This phase included public consultations on the Scoping Report.

On the next development stages of the proposed project, relevant stakeholders should be consulted, such as:

- Ministry of Trade and Industry, which might be affected by the pipeline route (Business park in Upper Korrotice Village).
- Ministry of Environment and Spatial Planning and respective Municipality Directorates, in order that this corridor is taken into consideration during the update of the territory plan or development plan, protected areas and surface water;
- Ministry of Youth Culture and Sports, and other relevant bodies within this Ministry.
- Ministry of Agriculture, Forest and Rural Development, in order to get their opinion and feedback related to the irrigation and their development plans and policies for the irrigation canals and systems along the route
- Representatives of Kosovo Energy Corporation (KEK) about future development of industrial sites in Krushevc and whether the pipeline may hinder or boost the development of this area.
- Communities along the route within 2 km of the pipeline route;
- Government departments;
- Academics;
- International and National NGO's.

Other national and local authorities (local governments, institutions covering archaeological/cultural, geology, water resources, agricultural land, forests, industry, etc., issues), should also give their opinion / preferences on the considered gas corridor options during the detailed design and final refining of the gas pipeline route.

Phase 2 – Environmental and Social Impact Assessment – based on the findings of the Scoping Phase and consultations – focusing on the actual impact assessment and the identification of proposed environmental and social mitigation and monitoring measures to inform the development of specific management plans in the future.

9 References

9.1 List of Relevant National Legislation

Access to information is an important success factor for the project. The following studies and other background information were identified and initially analysed during the preparation of this document:

- Pre-feasibility Study for Albania to Kosovo Gas Pipeline (ALKOGAP). Inception Report. COWI-IPF Consortium, 2018
- Gas Master Plan for Albania and Project Identification Plan, COWI-IPF Consortium, MIE, 2016
- PFS and ESIA Screening for Transmission Pipelines from IAP to Tirana and Durres, COWI-IPF Consortium, MIE, 2016
- Strategic Environmental Assessment for the Albanian Gas Master Plan, COWI-IPF Consortium, MIE, 2017
- FS and ESIA for the Ionian – Adriatic Pipeline, COWI-IPF Consortium, Albanian Ministry of Infrastructure and Energy, 2014
- National Agency of Protected Areas, Albania (http://www.akzm.gov.al/)
- Law 81/2017 “On Protected Areas” (in Albanian)
- The legislation on spatial planning and development, the environmental protection and permitting legislation in Kosovo;
- South East Europe: Regional Gasification Study, January 2009, World Bank, ESMAP, PPIAF and KfW. Developed by Developed by Economic Consulting Associates Limited, UK;
- South East Europe Gas to Power, Interim Report, World Bank, Energy Community and WBIF. Economic Consulting Associates Limited, UK, 2015;
- Kosovo’s Energy Sector Laws: Law on Energy no.05/L-081 of July 2016; Law on natural Gas no.05/L-081 of July 2016; and Law on Energy Regulator no. 05/L-084 of July 2016;
- Kosovo’s energy sector secondary legislation relevant to natural gas and to this PFS – Regulations; Administrative Instructions issued by Energy regulator and MED;
- LAW No. 03/L-025 On Environmental protection, LAW No.03L–233 nature protection, LAW No. 03L-214 EIA, Law No.03L –230 on strategic environmental assessment and other laws and administrative instructions relevant to the project.
- Kosovo Biodiversity Assessment, May 2003
- The red book of vascular flora in Kosovo
- Strategy and Action Plan for Biodiversity
- Emissions of Greenhouse gases in Kosovo 2008 - 2013

- Kosovo Strategy for Cultural Heritage and Cultural Heritage in south east Europe: Kosovo
- Report on the State of Nature in Kosovo 2008-2009
- TAP scoping report
- Law No. 02/L-88 on cultural heritage
- Energy Strategy of Kosovo 2017-2026;
- Heating Strategy of Kosovo 2011-2018;
- Annual and long-term energy balances of Kosovo.

10 Annexes

Please see separate document