15 sHPP on Neretvica River

Sarajevo, April 2018

15 sHPP on Neretvica River
Location

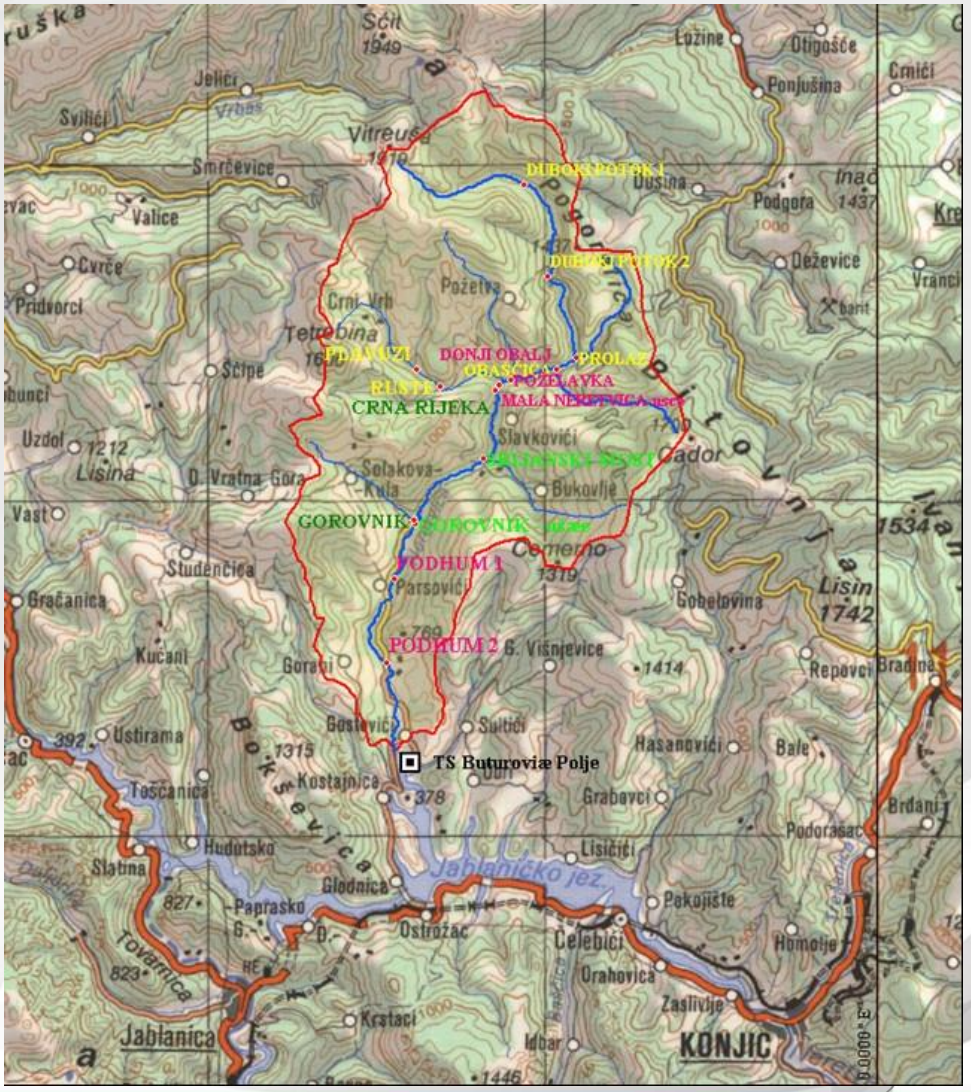
Located in municipality of Konjic

On Neretvica River which

draining a catchment

area of aprox. 136km^2

Position of anticipated power plants



15 sHPP on Neretvica River
Basic data

Red. Br.	Faza	Naziv mHE	Installisana Snaga MW	Moguća Godišnja Proizvodnja GWh	Planirani rok za realizaciju
	Faza I				
1	Faza IA	MHE Srijanski Most	3,030	13,540	Maj'18-Ap'19
2	Faza IA	MHE Gorovnik Ušće	3,427	16,316	
	Faza IA	Ukupno	6,457	29,856	
3	Faza IB	MHE Crna Rijeka	2,113	8,340	Jan'19-Dec'19
4	Faza IB	MHE Gorovnik	0,859	2,993	
	Faza IB	**Ukupno**	**2,972**	**11,333**	
	Faza I	**Ukupno**	**9,429**	**41,189**	
	Faza II				
5	Faza II	MHE Podhum 1	2,046	7,966	
6	Faza II	MHE Podhum 2	2,482	10,269	
7	Faza II	MHE Donji Obalj	1,865	8,245	Jul'19-Jul'20
8	Faza II	MHE Poželavka	0,367	1,207	
9	Faza II	MHE Male Neretvice -ušće	1,106	4,851	
	Faza II	**Ukupno**	**7,866**	**32,538**	
	Faza III				
10	Faza III	MHE Obaščica	1,586	5,858	
11	Faza III	MHE Duboki Potok 2	3,776	14,084	
12	Faza III	MHE Ruste	0,374	1,118	Jan'20-Dec'20
13	Faza III	MHE Plavuzi	0,395	1,233	
14	Faza III	MHE Prolaz	0,349	1,123	
15	Faza III	MHE Duboki Potok 1	0,725	2,706	
	Faza III	**Total**	**7,205**	**26,122**	
		UKUPNO PROJEKAT 15 MHE na Neretvici	**24,500**	**99,849**	

UNDER IMPLEMENTATION

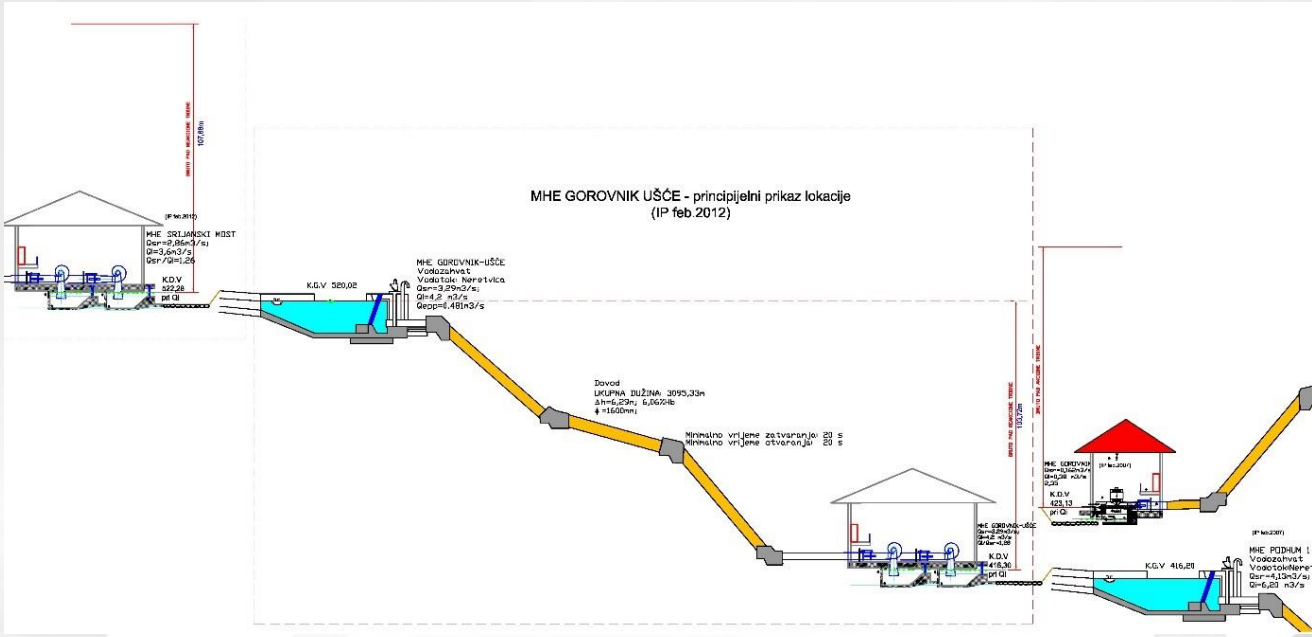
15 sHPP on Neretvica River
Description of the project

The Project is consisting of 15 run-of-river hydropower plants

Investment cost
50 mil EUR

Project payback period
10 years

Implementation period
3 years



The principal view of one plant

15 sHPP on Neretvica River
Status of Project Documentation

- Environmental Impact Assesment
- Environmental permit for 15 sHPP
- Preliminary Water permits for 15 sHPP
- Urban permits for 4 sHPP
- Main design for 4 sHPP
- Tenders of 2 sHPP for Equipment supply/installation and Civil works are issued

15 sHPP on Neretvica River
Expected effects of project implementation

- Supporting in regional stability of electricity supply
- Contribution to economic growth and development of the local communities infrastructure and living standard
- Increasing in electricity generation from renewable resources dispositional in the region and contribution to the total decrease of greenhouse gas concentrations

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District Heating of Sarajevo City and Sourounding Places from TPP Kakanj

Sarajevo, April 2018

The motives and objectives of the project

- The project aims to **extend the network of heating energy supply** areas to/from Sarajevo and Kakanj.
- The motive of the **introduction of high-efficiency cogeneration in the product portfolio** of the company to improve the environmental aspects of the production of electricity and heat.
- Creating **conditions for the implementation of the provisions of the Directive on the energy of efficiency (Directive 2012/27/EU).**
- The implementation of this project would lead to the **reduction of CO_2** emissions, the most important greenhouse gas that is emitted through the combustion of fossil fuels and other substances made up of carbon in the energy sector, **one of the priority sectors of the EU strategy on adaptation to climate change.**

Opportunities and capacity of TPP blocks Kakanj

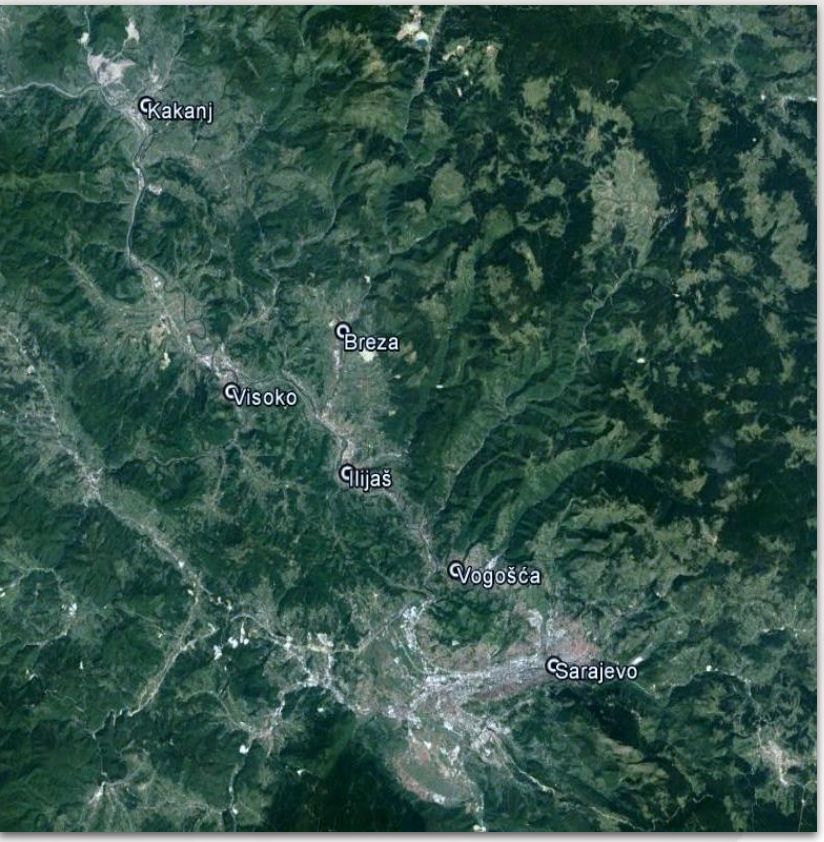
Review of opportunities and the available capacity in Kakanj in 2040

	MWe	MWt
TPPK Block 1	-	-
TPPK Block 2	-	-
TPPK Block 3	-	-
TPPK Block 4	-	-
TPPK Block 5	118	150
TPPK Block 6	118	150
TPPK Block 7	230	300
TPPK Block 8*	300-350	300
Total (dynamic)	466-580	600

* The replacement block (η = 42%) - Technological solution in the planning stage (data according to the preliminary design - 2010)

→ annual index of primary energy savings> 10% (based on calculation parameters)

Opportunities and capacity of hot water pipline



Source: Google earth

Automatic control operation with steering-control system.
The main dispatch center: *TPP Kakanj*
Auxiliary control room: *Vogošća*

Heat consumption area:
Visoko, Breza, Ilijas, Vogosca, Sarajevo

Basic data of the hot water pipelines:

	Main hot water pipeline	**Branche hot water pipeline**
Route	Kakanj - Sarajevo	-
Route via	Koridor Vc	-
Length	46 km (which 3.95 km above the ground)	39 km
Power	300 MWt	-
Dimensions	DN350 – DN800	DN25 - DN700
Temperature regim	150/75°C	150/75°C
Design temperatures	-18°C	-18°C
Type of pipe	Steel pre-insulated pipes	Steel pre-insulated pipes

The financial framework

Investment costs (CAPEX)	
Adjusting TPP Kakanj blocks *	26.930.000,00 KM
Hot water pipeline	169.827.000,00 KM
Branche hot water pipelines	59.790.000,00 KM
Total	229.617.000,00 KM

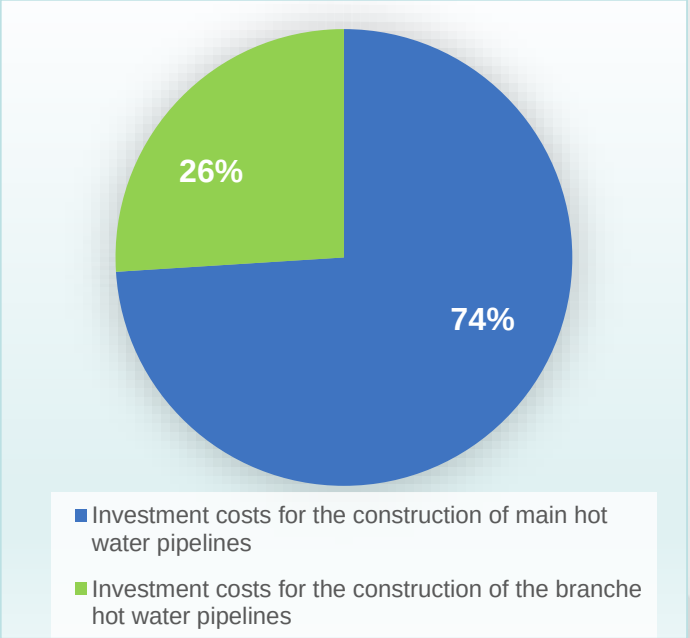
* Treated as a separate cost of the project - a separate project.

Operational costs (OPEX)	
Supply / heat production	24,31 KM/MWh
Main and brache hot water pipelines*	11.506.000,00 KM

* The average annual growth rate of the costs of 0.12%.

Revenues	
Revenues *	58,84 KM/MWh

* The price of heat at the entrance of the hot-water system of KJKP Toplane Sarajevo.



Percentage ratio of investment costs for the construction of the main hot-water and branche hot-water pipelines

Energy benefits

- The achievement of high efficiency cogeneration
- Increasing security of supply thermal energy
- Providing diversification of heat sources
- The release of depending on a single energy source (imported gas)
- Fully used local natural resources
- Primary energy savings in cities
- Improving the image of cities through the introduction of high-efficiency heating based technologies, with the contribution of energy efficiency at the regional and national level
- Contribution to sustainable heating system in cities

Environmental benefits

Improving the environmental aspects of the local and wider level:

- reducing particulate emissions
  (At the level of TPP Kakanj - **measures already implemented**)
- reduce emissions of NOx and SO_2
  (At the level of Kakanj - measures in the plan, from **2018 to 2027 NERP**)
- reduction of CO_2 emissions
  (Significant effects by **replacing individual furnaces and existing boilers**)

Environmental effects for the period 2016-2040:

Emisions	
CO_2	**- 6.328.320,91 t**
SO_2	**- 105.813,37 t**
NO_x	**- 10.807,46 t**
PM	**- 1.122,81 t**

Conclusions

- **Lower price of thermal energy**
  → heat price at the point of connection to the heating network of KJKP Toplane Sarajevo, much lower than the production cost of thermal energy in KJKP Toplane Sarajevo based on imported natural gas
- **The possibility of optimizing cost efficiency for heating**
- **The funds remain in the payment system of BiH**
- **Fully used local natural resources**
  → contribution to the development of the mines / alternative breeding fast-growing biomass
  → contribution to the development of the biomass market (planned projects kosagorijevanja)
- **Job creation and the development of skills of workers in the construction phase of hot water pipelines**
- **Creating conditions for the construction of a high-efficiency cogeneration of Block 8 in TE Kakanj**

- Implementation of the project creates a framework for the development of **high efficiency cogeneration** in primary energy savings based on a useful heat.
- The project has good financial performance for a given model of financing the realization of the project at a ratio of 20% of its own funds and 80% of loan funds by applying a discount rate of 8% → **NPV 48,291,090.90 KM**, payback period 9 years, and the relative flexibility in terms of analysis sensitivity.
- Elektroprivreda BiH with this project creates the conditions for the country to comply the provisions of the **Directive on the energy of efficiency (Directive 2012/27 / EU).**

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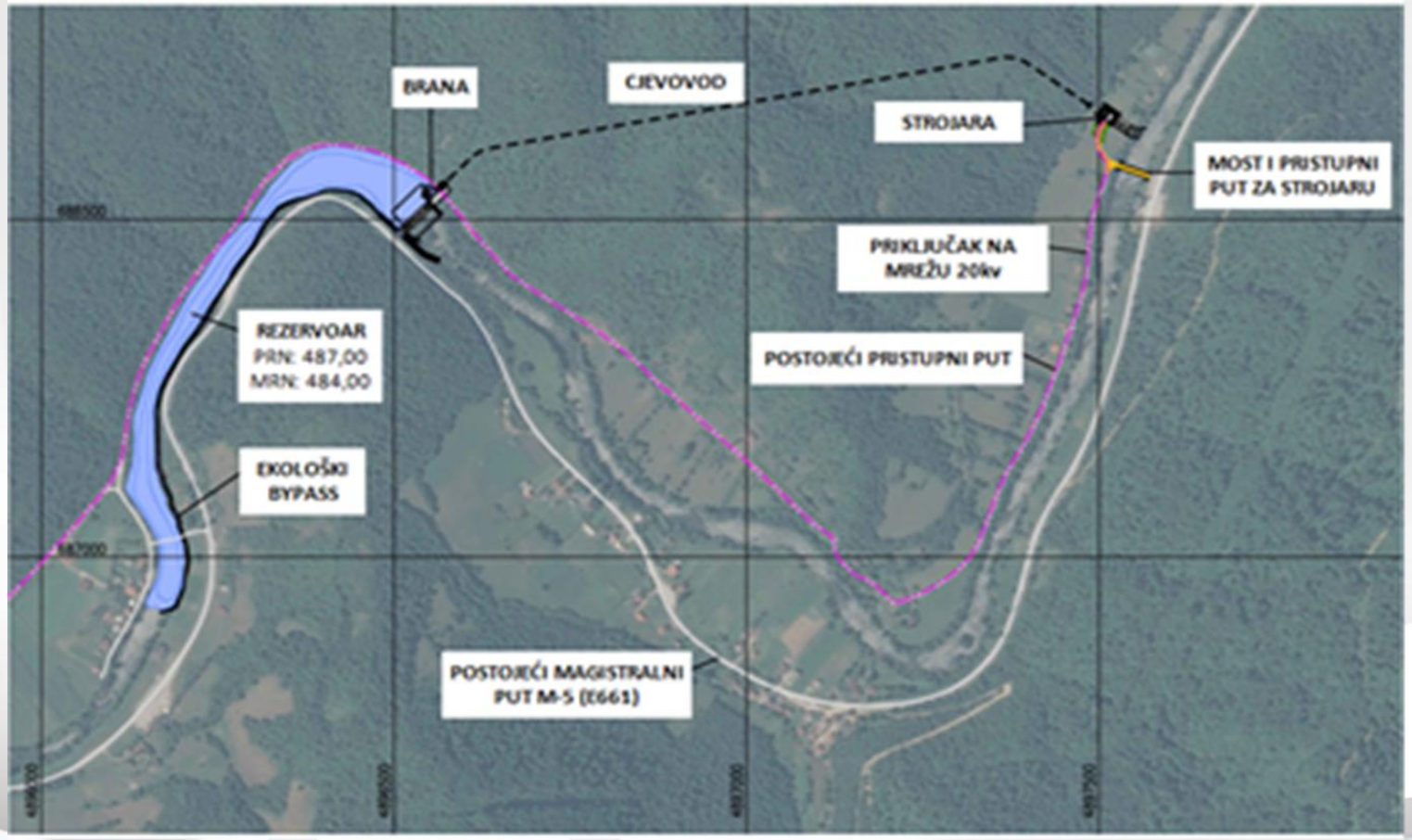
HPP BABINO SELO

Sarajevo, April 2018

HPP Babino Selo
Project location and concept

HPP Babino Selo is located on Vrbas River
The location of the dam is 7 km downstream of Municipality Donji Vakuf



HPP Babino Selo
Basic technical data

Normal (maximum) back water level	487 m a.s.l.
Usable reservoar capacity	137.000 m³
Length of reservoar	1,09 km
Height od dam above natural ground	8,0/13,5 m
Width of dam in weir crest	10,50 m
Length of dam in weir crest	94,50 m
Installed flow	28 m³/s
Designed head	10 m
Number of units	2
Maximum power of the power plant	6,17 MW
Annual production of el. energy	23,65 GWh

HPP Babino Selo
Investment cost 28 mil EUR
Status of Project Documentation

- Tehnical part of Feasibility study
- Geological investigation on the field
- Enviromental and social scoping study
- The assessment of critical habitats of the Vrbas River is underway for prepare the Enviromental and social impact assessments

HPP Babino Selo
Expected effects of project implementation

- Supporting in regional stability of electricity supply
- Contribution to economic growth and development of the local communities infrastructure and living standard
- Increasing in electricity generation from renewable resources dispositional in the region and contribution to the total decrease of greenhouse gas concentrations

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MHE KAKANJ 1

Sarajevo, April 2018

1. PREDMET ULAGANJA (OBJECT OF INVESTMENTS)

- Prilikom izgradnje TE Kakanj napravljena je pregrada(brana) na rijeci Bosni sa ciljem podizanja nivoa rijeke Bosne i stvaranja uslova za uvođenja rashladne vode u blokove TE Kakanj.
- During the construction of TPP Kakanj barrier (dam) on the Bosna River was built with the aim of raising the level of the river Bosnia and the creation of conditions for the introduction of cooling water in blocks of TPP Kakanj
- U koritu Bosne je izgrađena niska betonska brana sa kotom prelivne ivice 386,50 m.n.m.
- Within the trough of Bosnia low concrete dam with overflow edge angle 386.50 m above the sea level was built
- Oblik poprečnog presjeka prelivne ivice je Krigerov. Voda se slobodno preliva preko brane na dužini od 48,5 m. Da bi se omogućilo dodatno izdizanje nivoa pri malim vodama, na lijevom boku brane je izgrađeno sedam (7) tablastih ustava dimenzija 4 x 4 metra, koje se pri većim proticajima dižu i omogućavaju evakuaciju velikih voda. Na desnom boku brane je izgrađena riblja staza kroz koju se ispušta nekoliko stotina litara vode u sekundi
- The shape of the cross section of the overflow edge is Kriger's one. The water is free to flow over the dam at a distance of 48.5 m. In order to enable further elevation of the level at low water, on the left side of the dam was built seven (7) sliding gates of dimensions 4 x 4 m, which are being raised at higher flow rates and enable the evacuation of high water. On the right side of the dam was built fish path through which it is discharged several hundred liters of water per second
- Na sreću, a što je i rijedak slučaj u praksi, može se konstatirati da je rijeka Bosna na tretiranom lokalitetu (vodozahvat HE u krugu TE Kakanj) hidrološki izučena – obzirom da par kilometara uzvodno postoji hidrološka stanica sa dugogodišnjim nizom sistemskih hidroloških osmatranja vodostaja i mjerenja protoka – VS Dobrinje.

- Fortunately, which is a rare case in practice, it can be concluded that the river Bosna in the treated site (water intake HE within Kakanj) hydrology investigations - considering that a few kilometers upstream there hydrological stations with long series of systematic observations of water levels and measurements flow - VS Dobrinja.
- Tako, kako bi saznali neophodne hidrološke parametre za relevantno projektiranje HE, izvršena je Standardna hidrološka statistička obrada dugogodišnjeg niza podataka sa VS Dobrinje na rijeci Bosni.
- So, to find out the necessary hydrological parameters for the relevant design HE, made the standard hydrological statistical analysis of long-time series of data with VS Dobrinja on the Bosna River.
- Obzirom na blizinu profila vodozahvata HE (nema značajnog međudotoka) – svi proračunati parametri za VS Dobrinje su mjerodavni za profil vodozahvata HE
- Given the proximity of the water intake HE profile (no significant overflow) - all calculated parameters for VS Dobrinja are relevant to the profile of the water intake HE
- U Tabeli br.1 dat su srednji godišnji protoci na VS Dobrinje.
- In Table 1 gives the average annual flow on the VS Dobrinja.

Tabela br.1

VS / Vodotok	Period obrade	Fsl. (km^2)	Qsr.god. (m^3/s)	MINQsr.god. (m^3/s)	MAKSQsr.god. (m3/s)
Dobrinje / Bosna	1958-1988	2677	59,0	40,6 (1961 g.)	88,1 (1978 g.)

Na slici br.1 dat je izgled postojeće pregrade (brane) na rijeci Bosni sa vodozahvatom za termoelektranu.

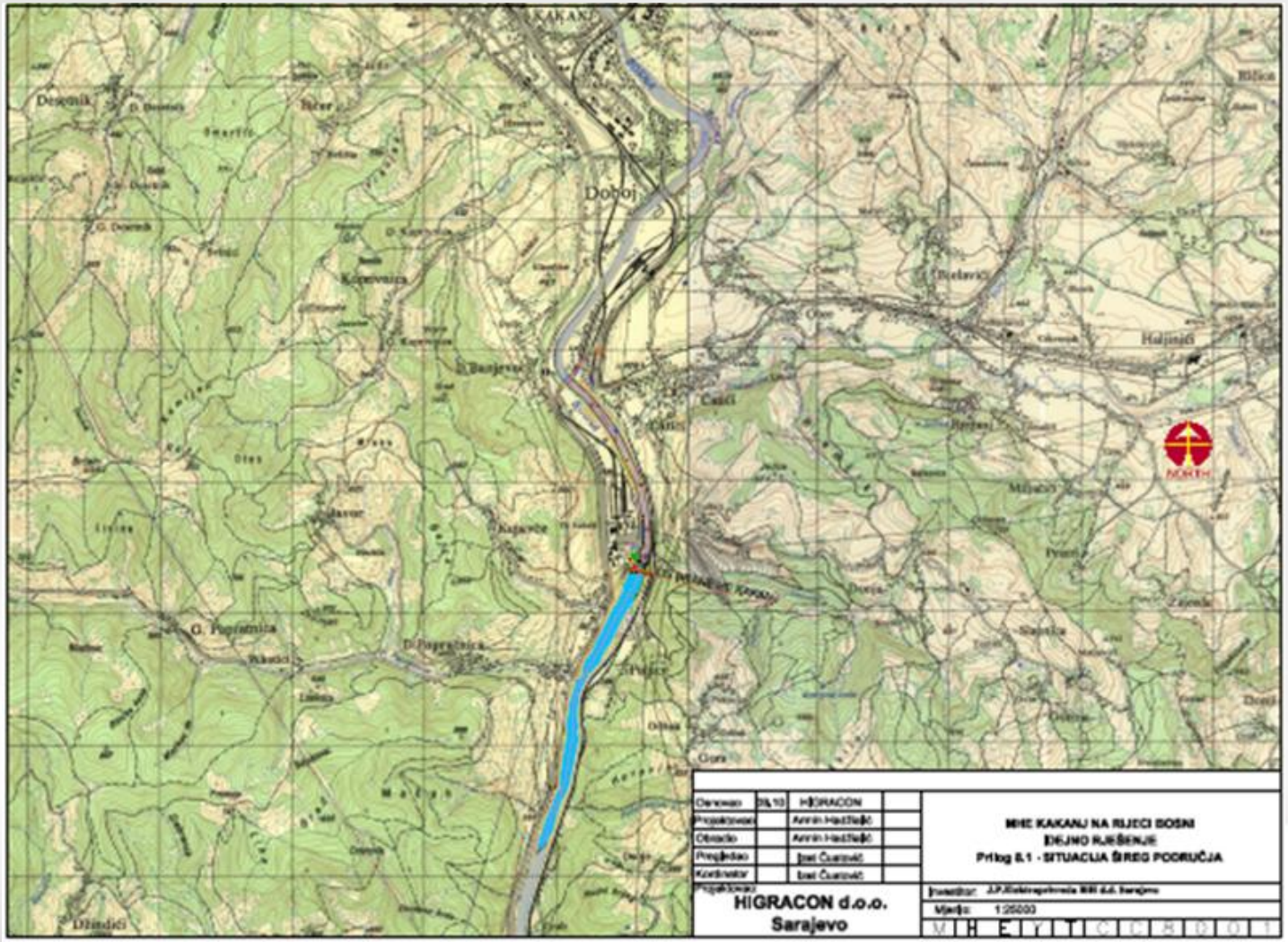
The picture No. 1 is given the appearance of existing barriers (dams) on the Bosna River from the water intake for the power plant

Slika br.1- Postojeća brana (Figure br.1- existing dams)

2. LOKACIJA MHE KAKANJ 1
(LOCATION OF sHPP Kakanj 1)

- Lokacija predviđenog postrojenja MHE Kakanj i akumulacija nalazi se na rijeci Bosni na teritoriji općine Kakanj u Zeničko-Dobojskom kantonu. Prostor koji može biti pod uticajem projekta MHE Kakanj proteže se uz rijeku Bosnu na potezu između naselja Dobrinja i Ćatići i to na postojećoj pregradi (brani)-vodozahvata za termoelektranu Kakanj.
- Location of scheduled plant of sHPP Kakanj and accumulation is located on the Bosna River in the municipality of Kakanj (in Zenica-Doboj county). The space that can be influenced by the project MHE Kakanj stretches along the Bosna River in the area between Dobrinja and Ćatići and to the existing bulkhead (defending) –water intake for Kakanj thermal power plant.
- Prostor je ograničen izgrađenim saobraćajnim koridorima magistralnog puta M17, autoputa A1 i željezničkom prugom Doboj-Sarajevo.
- Space is limited with built transport corridors of the M 17, A1 motorway and railway Doboj-Sarajevo.

LOCATION OF sHPP Kakanj 1



- Hidroelektrana MHE Kakanj je planirana kao pribransko postrojenje na rijeci Bosni, odnosno koristi postojeću lokaciju pregrade (brane) za vodozahvat TE Kakanj i prema procjenama iz Idejnog rješenja može imati sljedeće osnovne karakteristike:
- Hydro power plant Kakanj is planned as a dam plant on the river Bosna, and uses the existing location barriers (dams) for water intake Kakanj and according to estimates from conceptual design can have the following basic characteristics:

Table 2 - Main technical data

Small hydropower plant		Var 3
Average yearly flow	Q_{sr} (m^3/s)	59
Installed flow	Q_i (m^3/s)	90
Upper water level	(mn.m)	389,5
Lower water level	(mn.m)	383,3
Available bruto fall	H_{br} (m)	6,2
Fall losses in the pipelines	Δh (m)	0,18
Neto fall of the plant	H_{neto} (m)	6,02
Power of the plant	N_i (kW)	4.560
Yearly electricity generation	E_{god} (MWh)	22.036

- The planned installed power of sHPP Kakanj is 4.56 MW, while the average annual energy production is estimated at around 22 GWh.
- Planirani ulazak u pogon je 2019 godine. (The planned start of the operation is ~~was~~ 2019. ~~years~~)

3. OSNOV (THE INTRODUCTION)

- JP Elektroprivreda BiH d.d.-Sarajevo je u skladu sa relevantnim direktivama EU iskazala interes za izgradnju novih hidroenergetskih kapaciteta i povećanje učešća hidroenergije u ukupnoj proizvodnji elek. energije.
- Elektroprivreda BiH dd Sarajevo has, in line with the relevant EU directives, expressed interest in the construction of new hydropower capacities and for increase of the participation of hydropower in total electricity production
- U Planu izgradnje novih postrojenja za proizvodnju električne energije iz obnovljivih izvora JP Elektroprivreda BiH d.d.-Sarajevo je uvrstila i hidroelektranu MHE Kakanj na rijeci Bosni.
- In the Plan for construction of new plants for the production of electricity from renewable sources Elektroprivreda BiH dd Sarajevo has involved also hydro plant Kakanj on the Bosna River
- Procjenjuje se da su potrebna sredstva u iznosu od oko 1,5 milion KM za izradu Studije izvodljivosti sa istražnim radovima i prethodnom procjenom uticaja na okoliš, izradu Idejnog projekta i izradu Studije uticaja na okoliš. Za ovo je sredstva obezbjedila JP EP BiH.
- It is estimated that the necessary funds amount cca. 1.5 million KM for a making feasibility study with exploration activities and preliminary environmental impact assessment, preliminary design and preparation of the Environmental Impact Study. For this, funds were ensured by Elektroprivreda BiH
- JP Elektroprivreda BiH d.d.-Sarajevo, je 2010. godine uradila Idejno rješenje MHE Kakanj i iste godine je urađena i revizija ovog rješenja.
- Elektroprivreda BiH dd Sarajevo, in 2010 did Preliminary Design of sHPP Kakanj and in the same year the revision of this design was done.
- Prema Idejnom rješenju MHE Kakanj usvojena optimalna veličina instalisanog protoka od 90 m^3/s (Var 3)
- According to the Conceptual Design of sHPP Kakanj adopted optimal size of installed flow amounts 90 m^3/s (Option 3)
- Izvršena je optimizacija investicionih ulaganja i dat je njihov ukupan iznos od 21,0-30 milion KM (cca 11-15 mil €).
- The optimization of capital investments was done and is given the total amount of 21.0 -30 million KM (approximately 11-15 million €).

4. RAZLOZI I CILJEVI, OČEKIVANI EFEKTI ULAGANJA (REASONS AND OBJECTIVES, EXPECTED EFFECTS AND INVESTMENTS)

Postrojenje MHE Kakanj je prevashodno energetski objekat i njegove energetske mogućnosti su sagledane u energetsko-ekonomskim analizama što se pokazalo u Idejnom rješenju:

- sHPP Kakanj is primarily an power facility and its energy possibilities are analyzed in the energy-economic analysis which was shown in the Conceptual Design
- U "Podlogama za izradu idejnog rješenja MHE Kakanj" usvojena je kota uspora 389,5m n.m. Ova kota traži ukupno najmanju površinu plavljenja i najmanje troškove otkupa i odšteta duž razmatranog poteza, pa se u pogledu uticaja na površinu može smatrati najprihvatljivijom.
- In the Background for the conceptual design of sHPP Kakanj adopted backwater level is 389,5 m above the sea level. This level requires a minimum surface flooding and minimal costs of purchase and compensation along the considered area, so in terms of impact to the surface area it can be considered as the most acceptable.
- Usvojeno idejno tehničko rješenje evakuacionih organa obezbjeđuje optimalnu fleksibilnost u radu postrojenja, omogućava relativnu brzu manipulaciju sa nivoom u akumulaciji i nanajbolji način osigurava zahtjevane uslove u vrhu akumulacije pri evakuaciji velikih voda.
- Adopted preliminary technical concept of evacuation objects provides optimum flexibility in operation, enables relatively quick manipulation of the level in the accumulation and in a best possible way ensures the required conditions in the top of the accumulation during the evacuation of high water.

- Obzirom na povoljnost lokacije pregradnog profila - brane i strojare MHE Kakanj, raspoloživi pad postrojenja, kota uspora akumulacije MHE Kakanj te regulacija korita nizvodno od MHE Kakanj predstavlja tehnički opravdano i energetski ekonomično rješenje.
- Due to the advantage of location of dam profile - dam and powerhouse of sHPP Kakanj, disposable plant, level of backwater of sHPP Kakanj and regulation of the riverbed downstream of sHPP Kakanj represent technically justified and energy economical solution.
- Određen je instalisani protok: Qi = 90 m³/s i srednja godišnja radna voda Q_{isk} = 59 m³/s.
- There has been calculated installed flow: Q = 90 m³/s and the average annual working water Q_{isk} = 59 m³/s
- Sa energetskog aspekta usvojeno postrojenje ima moguću godišnju proizvodnju od 22,04 GWh
- From an power point of view adopted plant has a potential annual production of 22,04 GWh
- Sa ekonomskog stanovišta, specifične investicije za ova postrojenja ne prelaze 0,9 KM/kWh(0,45€/kWh), što predstavlja ekonomski izuzetno povoljno hidroenergetsko postrojen
- From an economic standpoint, specific investments for those plants do not exceed 0,9 KM/kWh (0,45 €/kWh), which is economically extremely favorable hydropower plant

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UNIT 8-350 MW
TPP KAKANJ

Sarajevo, April 2018

Location

- Replacement Units shall be built on the existing site of TPP Kakanj

KEY CHARACTERISTICS AND ADVANTAGES OF THE PROJECT

- Construction of the Unit 8 is providing replacement for the existing units, which shall be shut down by the year 2024 or 2030 (4×32MW, 1×110MW)
- Construction of the Unit 8 is providing continuous production of coal and restructuring of the "Kakanj (70%), Breza (20%), Zenica (10%)" coalmines, part of Concern JP EPBiH
- Unit 8 shall be designed as cogeneration unit, providing long-term supply of heat energy to the nearby cities
- Increased energy efficiency and accordingly reduced emission of greenhouse gases (units that will be shutdown have efficiency of around 30%, and the new Unit 8 will have in condensing regime 42 % and in cogeneration regime over 70% efficiency)
- Unit 8 shall be designed in compliance with best available techniques (BAT) in accordance with the IPPC Directive, which assures the emission of all pollutants to be below the limit values and according to the legislation of EU and B&H

BASED ON COMPLETED INVESTMENT AND ENVIRONMENTAL DOCUMENTATION ALL ESSENTIAL APPROVALS AND PERMITS ARE OBTAINED

- Preliminary water approval, Agency for Sava river basin
- Environmental permit, Federal Ministry of Environment and Tourism
- Certificate for connection of Unit 7 to Electrical Grid in B&H, NOS BiH (ISO BIH – Independent System Operator in B&H)
- Urban planning permit, Federal Ministry of Physical Planning
- Conditions for connection to the transmission network of 400 kV, Elektroprijenos BiH.
- The decision to extend Urban planning permit, Federal Ministry of Physical Planning
- Water approval, Agency for Sava river basin
- Previous building permit for construction, Federal Ministry of Physical Planning

OPTIMAL POWER AND TECHNOLOGY

Power	cca 350 MW
Production	1755 GWh (for 6.500 h of operation)
Efficiency	42% (in co- generation mode >70%)
Coal	12.874 kJ/kg
Coal Consumption	1,5 million tons/year

- Emission

SO2	< 150 mg/Nm^3
Nox	< 200 mg/Nm^3
Dust	< 10 mg/Nm^3

- According to the current project, it is foreseen technology of Fluidized Coal Combustion, 300 MW, parameters 566/566ºC and 167/40 bar, efficiency > 39%
- Innovation of the existing Preliminary Design is in progress with the aim of applying modern technologies for coal combustion and environmental protection. Accordingly, block 8 will be approximately 350 MW and have a minimum efficiency of 42% and will meet all the latest environmental requirements.

THE FINANCIAL ASPECT OF INVESTMENT

- Investment cost in construction of Unit 8
  cca **550 million EUR**

- Average cost price of produced electric energy
  (coal price of 2,43 EUR/GJ) 42,66 EUR/MWh

- Investment cost in construction of Unit 8 with Coalmine
  cca **650 million EUR**

Implementation of the project will be through Project Partnership model. Selection of Project partner will be through international open tender procedure.

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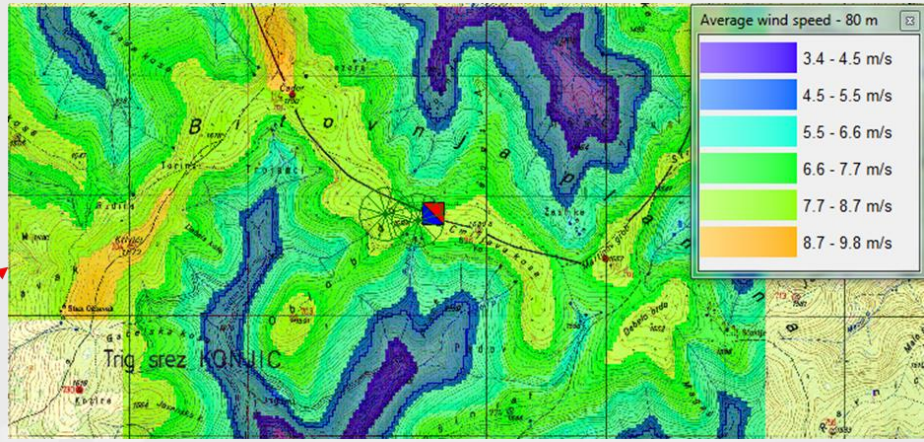
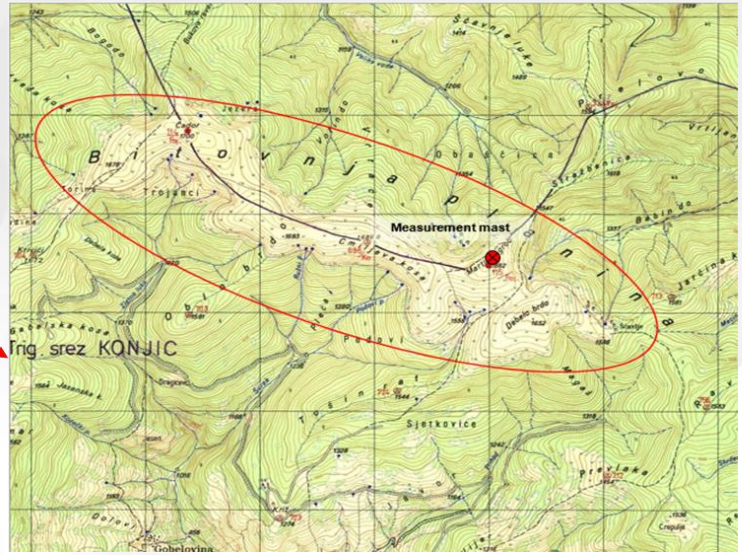
Wind power plant - Bitovnja

Sarajevo, April 2018

Project Location





Basic Information

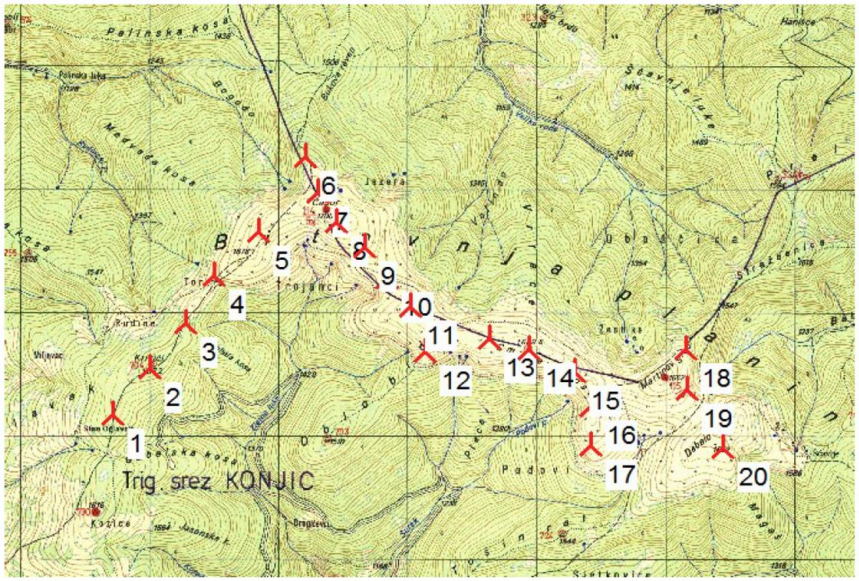
Measurement campaign

- More than 2 years measurements
- 3 met mast installed, with heights: 30m, 60m and 36m
- Measurements in accoradnce with IEC 61400-12 and MEASNET recommendations
- First class equipment, calibrated anemometers
- Measured average wind speed at 30m: cca. 6,85 m/s
- Measured average wind speed at 60m: cca. 7,25 m/s
- Extrapolated average wind speed at 80m: cca. 8,5 m/s

Preliminary Layout

Preliminary wind farm parameters

- Based on available space and longterm correlated measured values
- Total installed power: up to 60 MW
- Wind turbine individual capacity: 2 MW – 3 MW
- Wind turbine class: I A or I B
- Capacity factor (average): 28,2%



Project´s´status

- Measurements done
- Preliminary layout prepared
- Pre-Feasibility Study prepared
- The Municipality expressed its support
- Activities undertaken for concession obtaining
- Preliminary grid connection solution – in progress
- Enviromental permit obtained

Economic and Financial Parameters

CAPEX:

- Specific investment: cca. 1.323.700 €/MW
- Total investment: cca. 67.078.400 €

- IRR: 7,83% - 10,38% (based on P90)
- IRR – FCF: 11,58% – 16,65% (based on P90)
- NPV: 3,863,168 € – 19,637,889 € (based on P90)

OPEX:

- Total annual operation and maintenance costs: cca. 1.745.000 €/year

Electricity purchase price according to the feed-in tariff system in Federation of Bosnia and Herzegovina	[€/MWh]	75,50
The period during which the electricity is sold at the guaranteed purchase price	[years]	12
Electricity purchase price after 12 years	[€/MWh]	54,04
Income from CO_2 emission trading	[€/MWh]	0,50
Financing terms – loan equity	[%]	50%
Interest rate	[%]	4
Discount rate	[%]	7
Expected lifetime of the wind farm	[years]	25

Note: ***Financing sources are not finally determined and will consist of own funds, new investor, loan, grant***
JP EP BiH is open to various forms of cooperation

Concluding remarks

- Bitovnja location is extremely favourable for the construction of a wind farm.
- The Bitovnja wind power plant would have a positive impact on the environment, especially in terms of CO_2 emission decrease, as well as SOx, NOx and particulate matter emission decrease.
- Although there is a regulatory set up in place for the development of wind power projects, and that a national target has been agreed upon for an installed capacity in 2020 of 230MW wind power, it is still a challenge to develop and construct wind power projects in BiH.
- The project has already received the support of the municipality of Konjic
- Land of the future wind farm is declared as pasture land of fourth category and is owned by the Forestry Prenj Ltd. Konjic, so that the process of land expropiration will not constitute an obstacle.
- Enviromental permit has been already obtained.

Future activities

Meanwhile, JP EP BiH has already applied for a urban permit permit and the concession.

Based on previous experience in the preparation of documentation for other wind farm projects, we consider that the further preparation of documents should be carried out simultaneously, such as:

- ***Additional wind measurments, Birds and bats survey, ESIA - Environmental & Social Impact Assessment,*** *Preliminary design, Study of connecting to the network, GAP analysis, Waste management plan, ESAP - Environmental Action Plan and Social Development, SEP – Stakeholders engagement plan, The basis for the tender documents, Transport study, Geological exploration*

  (Required time for these activities is 20-24 months and estiamted costs are 700.000 € - 750.000 €)

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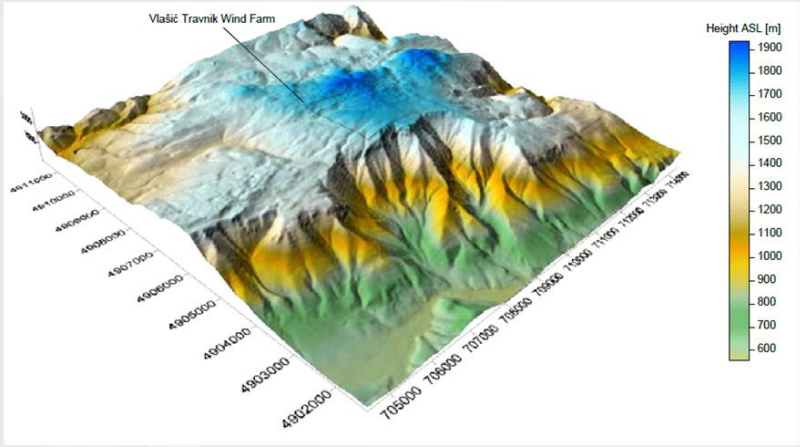
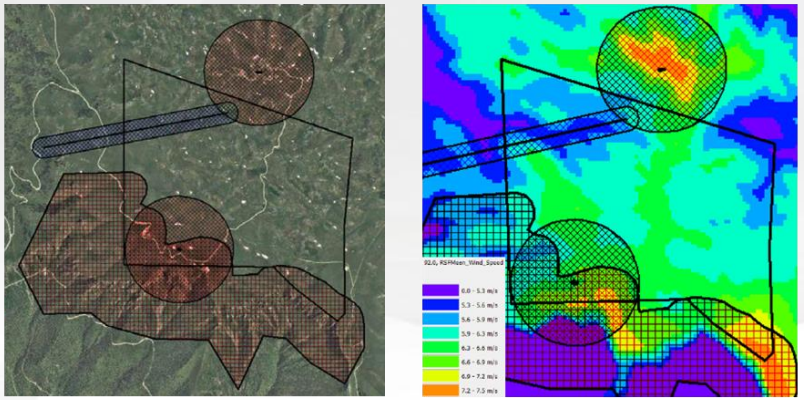
Wind power plant - Vlasic

Sarajevo, April 2018

Project Location



3D surface map of the Vlašić Wind Farm site and its surroundings



The site concession area (thick lines), restriction areas (hatched) and wind resource map at 92m AGL

Basic Information

Measurement campaign

- More than 2 years measurements
- 3 met mast installed, with heights: 30m (Vlašić II), 60m (Vlašić III) and 80m (Vlašić III)
- Measurements in accoradnce with IEC 61400-12 and MEASNET recommendations
- First class equipment, calibrated anemometers
- Based on the data from the 80 m mast a wind shear analysis has been carried out, and the result is applied on the 3 years data from the original Vlašić II and Vlašić III masts including long-term corrections. This results in an estimated long-term average Weibull distribution and mean wind speeds at 92 m AGL at the location of the Vlašić III onsite met mast:
    - Mean Weibull A, 92 m AGL: 7.90 m/s
    - Mean Weibull k-parameter, 92 m AGL: 1.8203
    - Mean wind speed (Weibull), 92 m AGL: 7.01 m/s
    - Average wind speed (arithmetic), 92 m AGL: 7.02 m/s

Preliminary Layout

Preliminary wind farm parameters

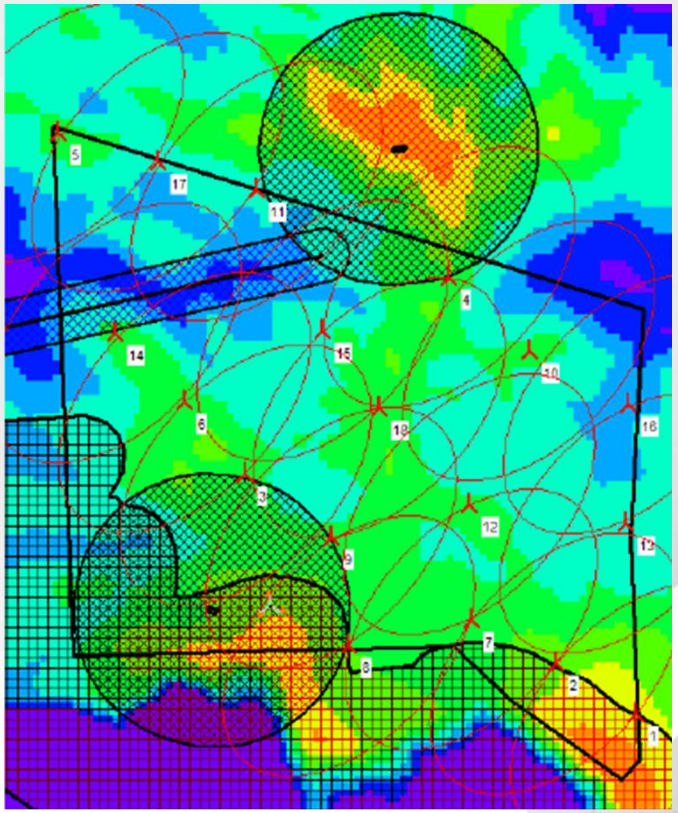
- Based on available space and longterm correlated measured values
- Total installed power: up to 50 MW
- No. of WTGs: 15 - 18
- Wind turbine individual capacity: 2.4 MW – 3.3 MW
- Wind turbine class: II A or III A
- Capacity factor (average): 28,2%

Project´s´status

- Measurements done
- Investment technical documentation done

(Feasibility Study, Birds and Bats survey, Transport study, ESIA, ESAP, GAP analysis, Grid connection study...)

- The Municipality expressed its support
- Enviromental permit obtained



Layout – 18 WTGs

Economic and Financial Parameters

CAPEX:

- Specific investment: cca. 1.335.350 €/MW
- Total investment: cca. 66,099,838 €

- IRR: 5,37% - 7,81% (based on P90)
- IRR – FCF: 6,7% – 11,56% (based on P90)
- NPV: 3,301,365 € – 3,490,407 € (based on P90)

OPEX:

- Total annual operation and maintenance costs: cca. 1.485.000 €/year

Electricity purchase price according to the feed-in tariff system in Federation of Bosnia and Herzegovina	[€/MWh]	75,50
The period during which the electricity is sold at the guaranteed purchase price	[years]	12
Electricity purchase price after 12 years	[€/MWh]	54,04
Income from CO_2 emission trading	[€/MWh]	0,50
Financing terms – loan equity	[%]	50%
Interest rate	[%]	4
Discount rate	[%]	7
Expected lifetime of the wind farm	[years]	25

Note: ***Financing sources are not finally determined and will consist of own funds, new investor, loan, grant***
JP EP BiH is open to various forms of cooperation

Concluding remarks

- Vlašić location is extremely favourable for the construction of a wind farm.
- The Vlašić wind power plant would have a positive impact on the environment, especially in terms of CO_2 emission decrease, as well as SOx, NOx and particulate matter emission decrease.
- Although there is a regulatory set up in place for the development of wind power projects, and that a national target has been agreed upon for an installed capacity in 2020 of 230MW wind power, it is still a challenge to develop and construct wind power projects in BiH.
- The project has already received the support of the municipality of Travnik
- JP EP BiH has already obtained an environmental permit

Future activities

- It is recommended to create a new project specific company (SPV) before commencement of tendering the project or latest at commissioning and start of operation.
- Commencing the process of obtaining rights as soon as possible in order to ensure that the rights are in place when actual construction begins.

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