Workshop on
WATER-FOOD-ENERGY-ECOSYSTEMS NEXUS ASSESSMENT IN THE SAVA RIVER BASIN

Sectoral goals in the Sava River Basin

B&H : Strategic orientation in energy sector

Zagreb, 4.3.'14.

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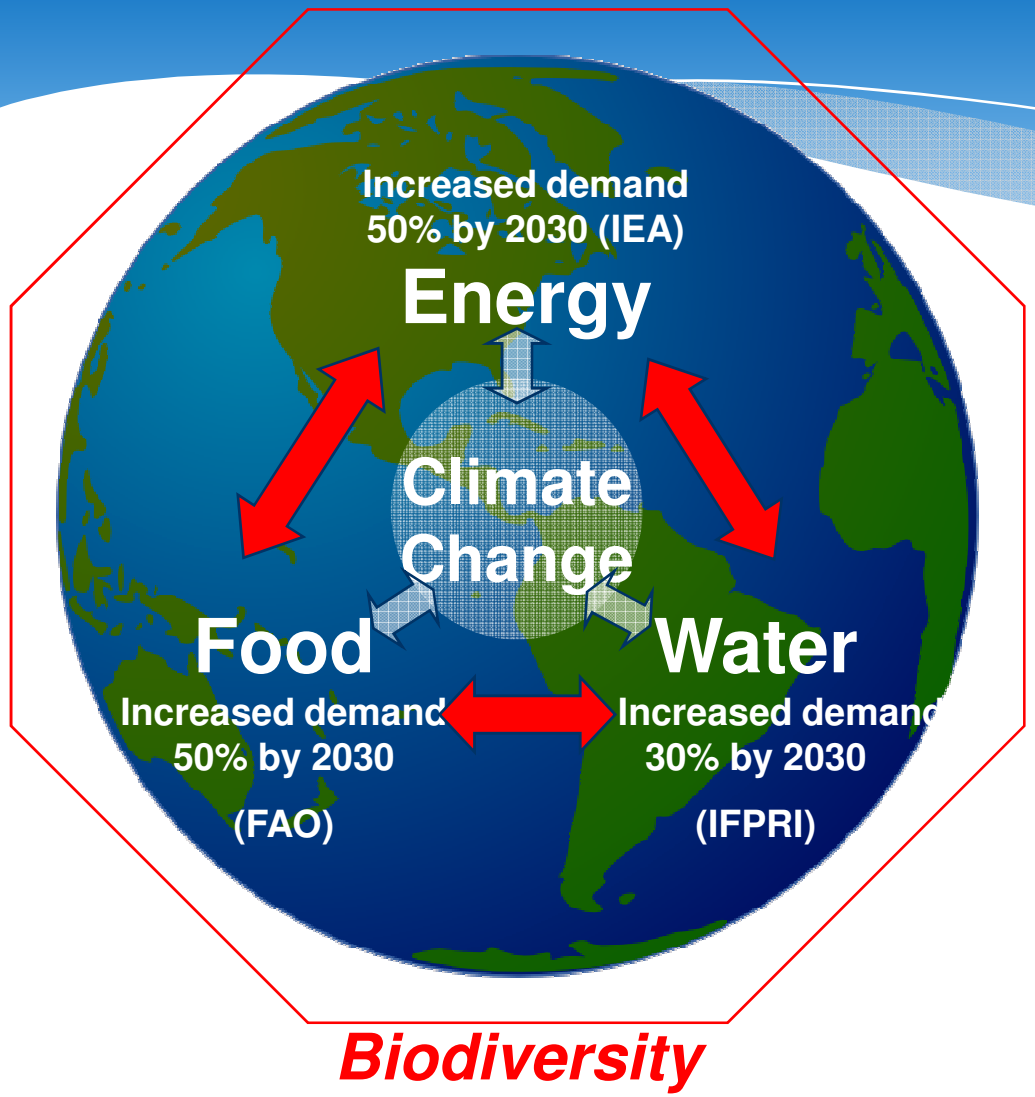
Key Questions

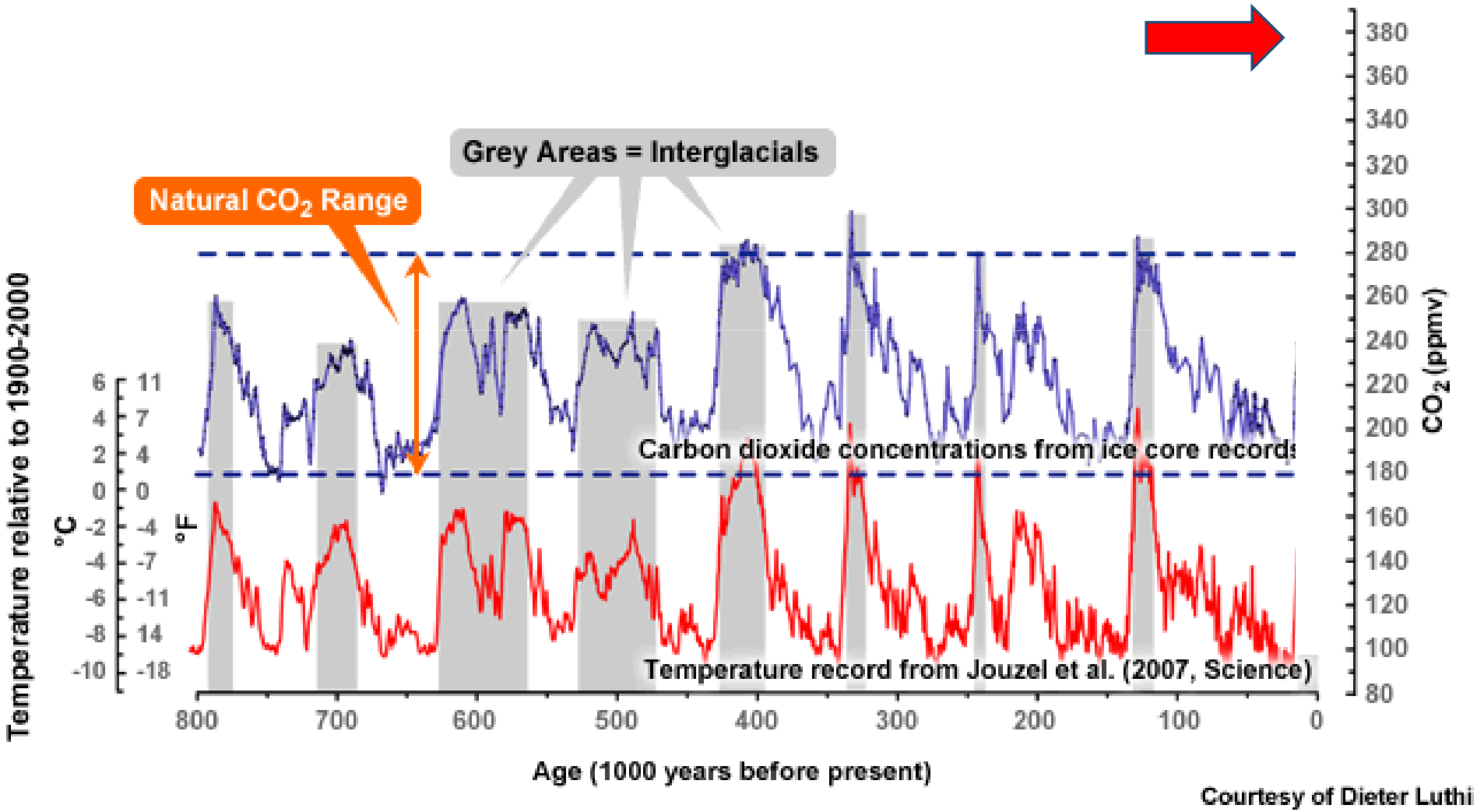


1. Can 9 billion people be fed equitably, healthily and sustainably?
2. Can we cope with the future demands on water?
3. Can we provide enough energy to supply the growing population coming out of poverty?
4. Can we mitigate and adapt to climate change?
5. Can we do all this in the context of redressing the decline in biodiversity and preserving ecosystems?

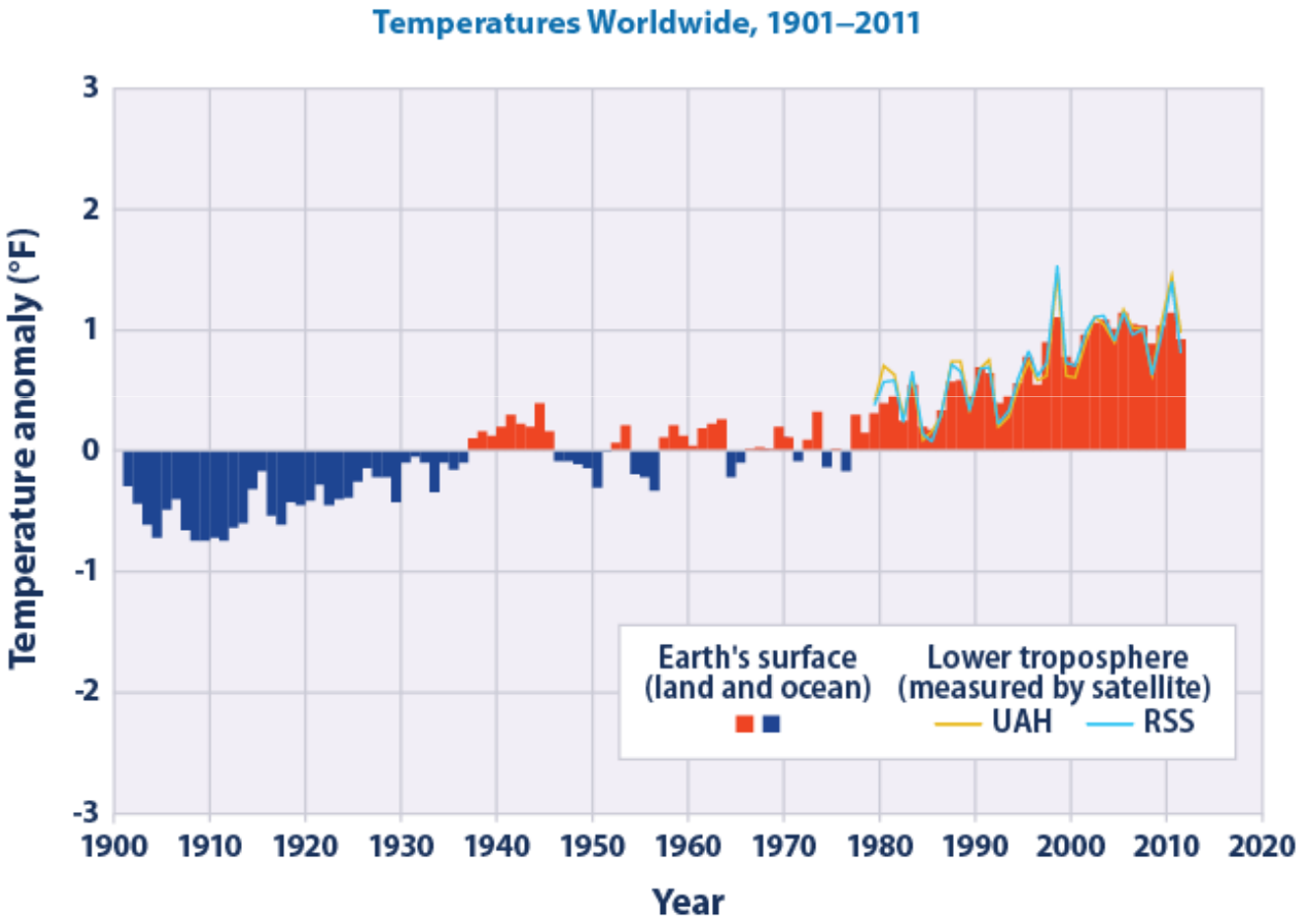
The Perfect Storm?

USA EPA, 2012

Could the warming be natural?

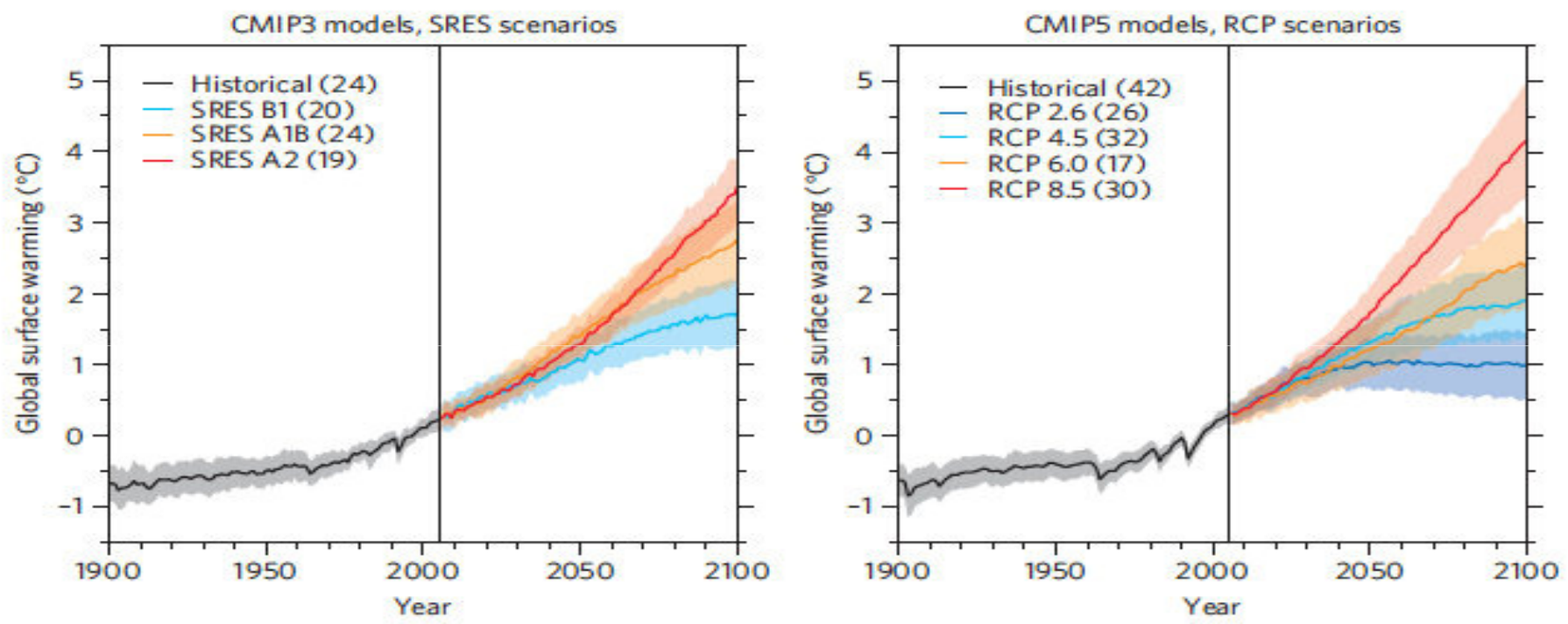


Global temperatures are on the rise.



Data source: NOAA (National Oceanic and Atmospheric Administration). 2012. National Climatic Data Center. Accessed April 2012. www.ncdc.noaa.gov/oa/ncdc.html.

For more information, visit U.S. EPA's "Climate Change Indicators in the United States" at www.epa.gov/climatechange/indicators.

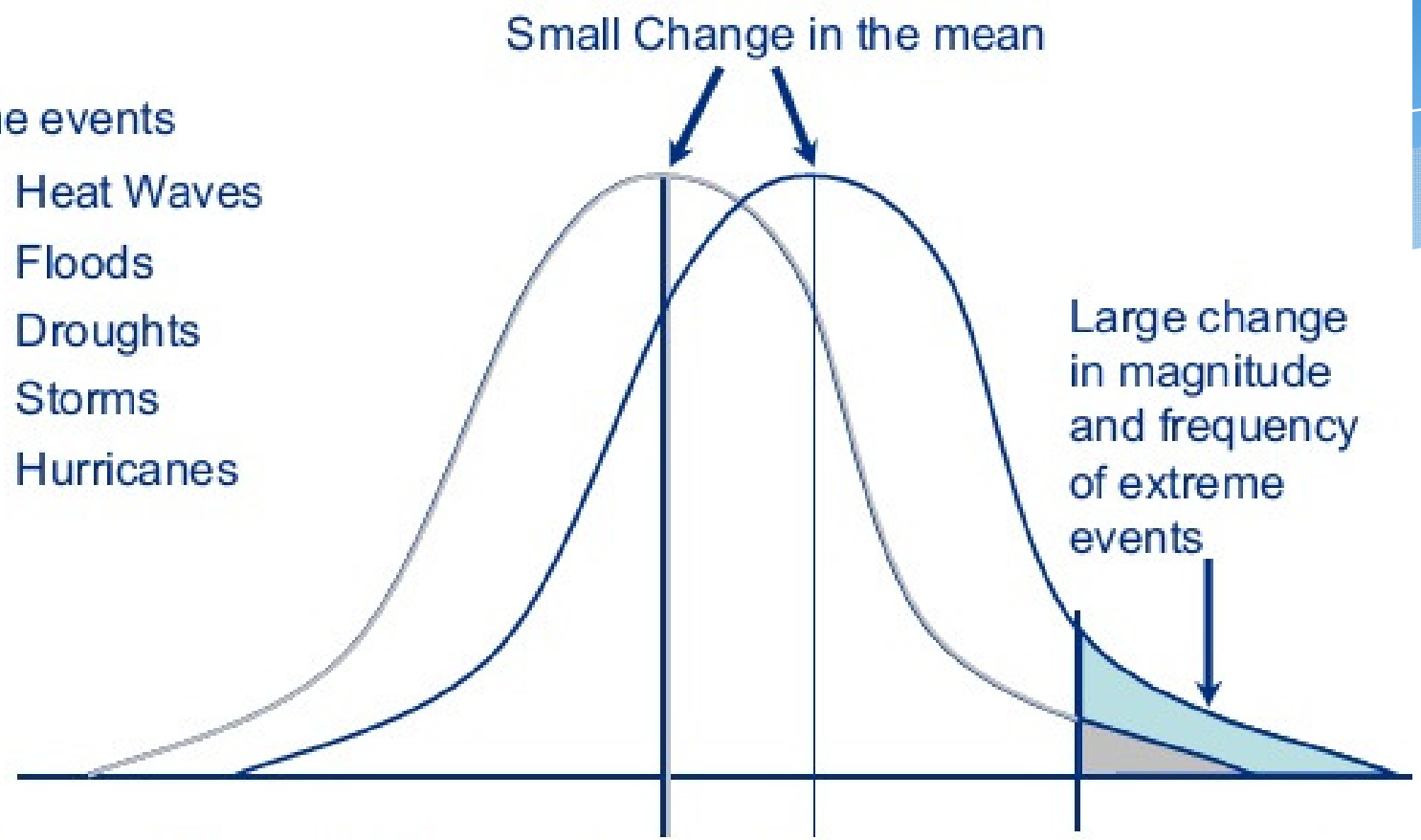


Source: Knutti & Sedlacek (2012)

Changes in Extreme Events

Extreme events

- Heat Waves
- Floods
- Droughts
- Storms
- Hurricanes



With a small change in the mean, frequencies can rise rapidly

Mott MacDonald

- Produce more fuel-efficient vehicles
- Reduce vehicle use
- Improve energy-efficiency in buildings
- Develop carbon capture and storage processes
- Triple nuclear power
- Increase solar power
- Decrease deforestation/plant forests
- Improve soil carbon management strategies

(USA Strategy)

Content

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- Hydropower potential in B&H
- Climate change and water demand
- Measures of adaptation
- Environmental Flow sub-law
- Construction of hydropower plants in B&H
- Advantages of hydropower over the other sources
- Conclusion

Introduction

- total surface area of 51,197 km²
- seven river basins (75.5% belong to the Black Sea ,24.3% to the Adriatic Sea catchment)
- average annual precipitation is about 1,250 mm, which is 1,155 m³/s or 57% of total precipitation

Hydropower potential in B&H

- energy resources are coal and hydropower
- total installed capacity of generation facilities in B&H is 3,803 MW (15 large HPPs with 2058 MW and 4 TPPs with 1745 MW of installed capacity)

Hydro Power Plants	Total installed capacity (MW)
Trebinje I	180
Trebinje II	8
Dubrovnik (BiH+Hr.)	216
Čapljina	420
Rama	160
Jablanica	180
Grabovica	115
Salakovac	210
Mostar	72
Mostarsko blato	60
Jajce I	60
Jajce II	30
Bočac	110
Višegrad	315
Peć-Mlini	30

Thermal Power Plants	Installed Capacity (MW)
Tuzla	715
G3	100
G4	200
G5	200
G6	215
Kakanj	450
G5	110
G6	110
G7	230
Gacko	300
Ugljevik	280

Hydropower potential in B&H

- total HP potential is estimated at 6,126 MW installed capacity
- exploitation of hydropower is less than 40% of the total usable potential
- 14 operational HPP and series of small HPP
- small HPP in B&H (1004.63 MW and 3.520GWh on an annual basis, which represents 12.64% of the total HPP of B&H

Climate change and water demand

- decrease in summertime precipitation 2031-2060 (Mediterranean)
- specific research has not been conducted in B&H on the influence of climate change on hydrology, water resources and water management systems
- B&H needs to invest in water infrastructure
- renewable energy sources

Measures of adaptation

- water reservoirs (accumulation and retention) - flood control, creation of water reservoirs for dry periods, water supply, irrigation, navigation, fish-farming, recreation,electricity production...
- bulkheads
- hydropower accounts for about 17 percent of the world's total electricity generation
- the development of small hydropower plants (HPPs) is the most promising source of renewable energy in B&H at the moment

Environmental Flow sub-law

- a new law on Environmental Flow (WWF and CESD) has been officially endorsed by the FBiH during January 2013
- ensure sufficient quantities of water for all users, from humans and industry to fish and other flora and fauna in its rivers and lakes
- B&H has made a commitment to align to standards and policies required by the EU (with the intention to join the EU)
- the adopted by-law is not an obstacle to development (e.g. hydropower development), but it provides a sustainability framework which takes into account the needs of all users

Construction of hydropower plants in B&H

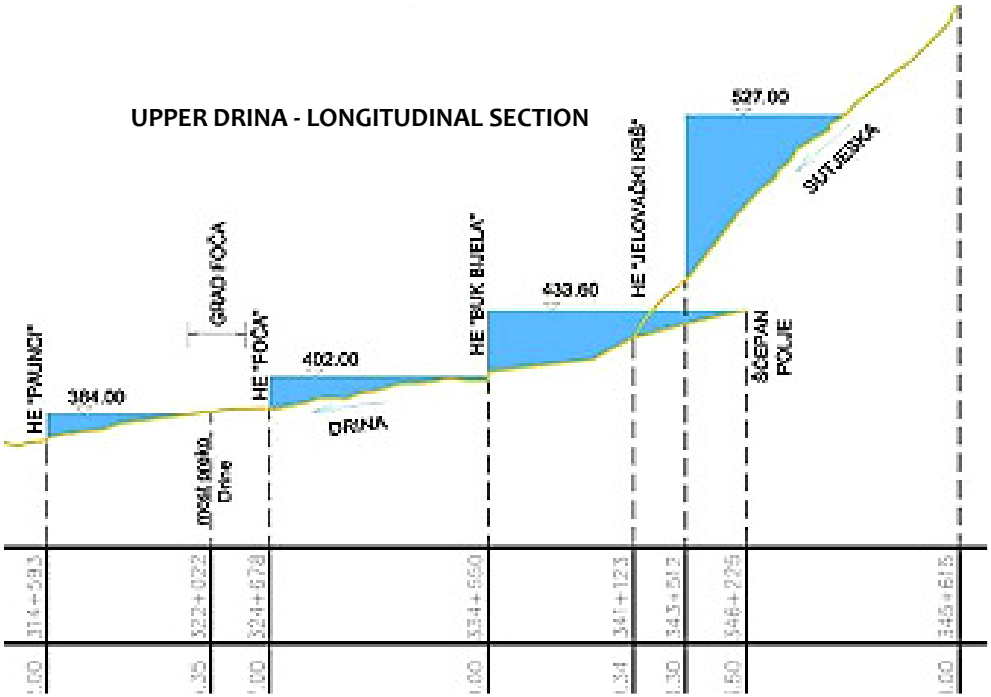
- Upper Drina river and its tributaries

HPP Paunci	
Location	Foča, Drina river
Installed power (Pi)	36.64 MW
Total electricity generation per year (E)	154.12GWh

HPP Foča	
Location	Foča, Drina river
Installed power (Pi)	51.7 MW
Total electricity generation per year (E)	183.62 GWh

HPP Buk Bijela	
Location	Foča, Drina river
Installed power (Pi)	114.6 MW
Total electricity generation per year (E)	369.4 GWh

HPP Sutjeska	
Location	Sutjeska river
Installed power (Pi)	25 MW
Total electricity generation per year (E)	90.19 GWh



Upper Drina river and its tributaries

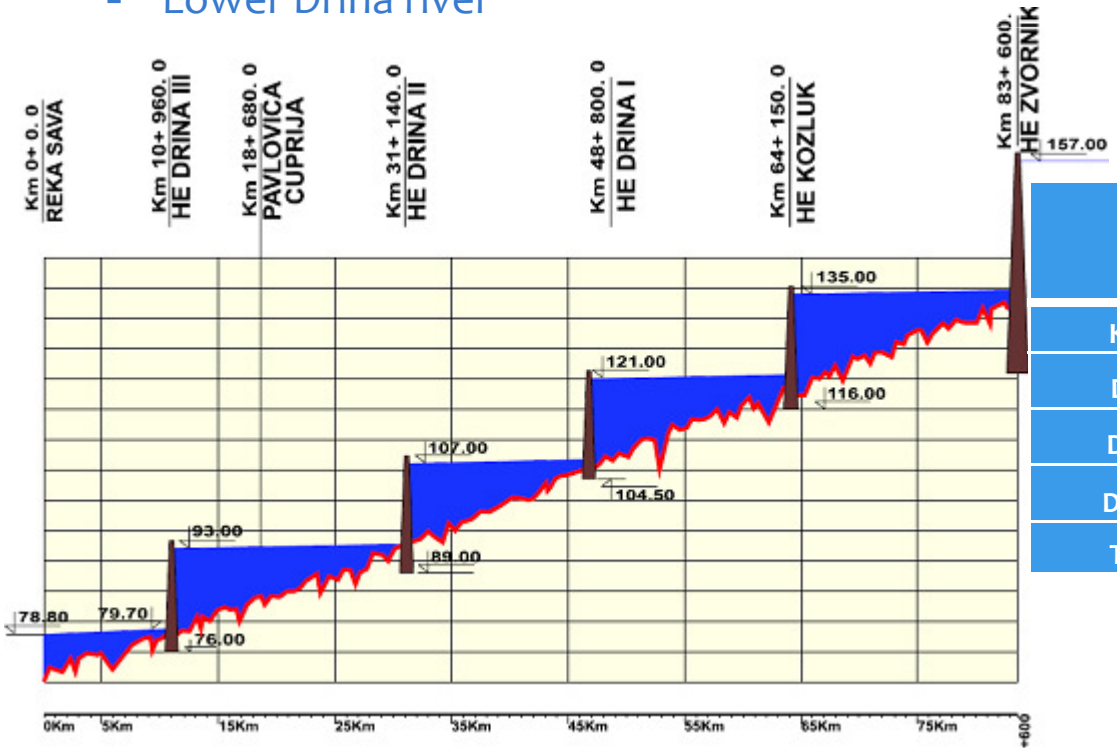
HPP Ustiklina- Goražde	
Location	Ustikolina, Drina river
Type	Run-of-river, plant insade dam
Installed power (Pi)	3x21.2=63.6 MW
Total electricity generation per year (E)	255 GWh
New Yobs (operation and maintance)	40

HPP Mrsovo	
Location	Lima river
Installed power (Pi)	43.8 MW
Total electricity generation per year (E)	165.16 GWh

Mid Drina river

HPP	Installed power (Pi)	Total electricity generation per year (E)
Rogačica	140	538.1
Srednje Tegare	126	475
Mala Dubravica	122	434
TOTAL	**388**	**1429.1**

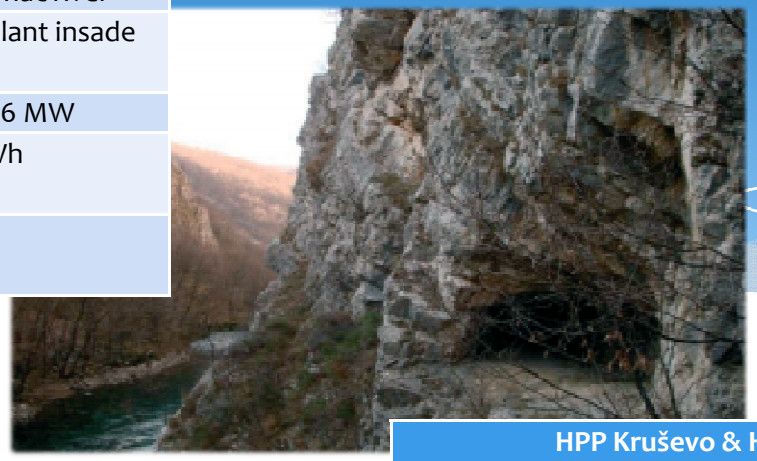
Lower Drina river



HPP	Installed power (Pi)	Total electricity generation per year (E)
Kozluk	93.4	396.5
Drina I	93.4	396.5
Drina II	93.4	396.5
Drina III	93.4	396.5
TOTAL	373.6	1586

Unac river

HPP Unac- Martin Brod	
Location	Martin Brod,Unac river
Type	Accumulation, plant insade dam
Installed power (Pi)	2x36.8 =73.6 MW
Total electricity generation per year (E)	259 GWh
New Yobs (operation and maintance)	35

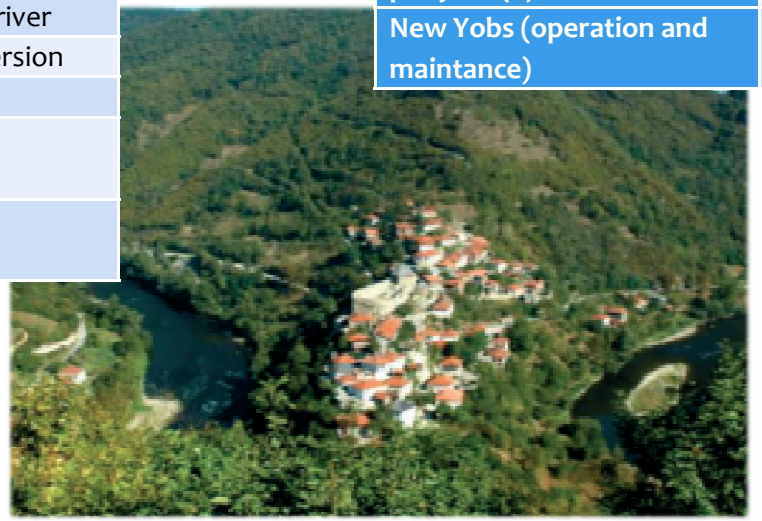


Bioštica river

HPP Kruševo & HPP Zeleni Vir - Olovo	
Location	Olovo, Bioštica river
Type	Accumulation, diverion
Installed power (Pi)	9.75+2.13 MW
Total electricity generation per year (E)	21.72+8.40 GWh
New Yobs (operation and maintance)	20

Bosna river

HPP Vranduk - Zenica	
Location	Vranduk,Bosna river
Type	Run-of-river, diversion
Installed power (Pi)	19.56 MW
Total electricity generation per year (E)	96.38 GWh
New Yobs (operation and maintance)	20



Sana river

HPP Čaplje - Sanski Most	
Location	Čaplje, Sana river
Type	Compensation for HPP Vrhpolje, plant inside dam
Installed power (Pi)	3x4=12 MW
Total electricity generation per year (E)	56.8 GWh
New Yobs (operation and maintance)	15

HPP Vrhpolje - Sanski Most	
Location	Vrhpolje, Sana river
Type	Peak, plant insade dam
Installed power (Pi)	79.4 MW
Total electricity generation per year (E)	157.5 GWh
New Yobs (operation and maintance)	60

Vrbas river

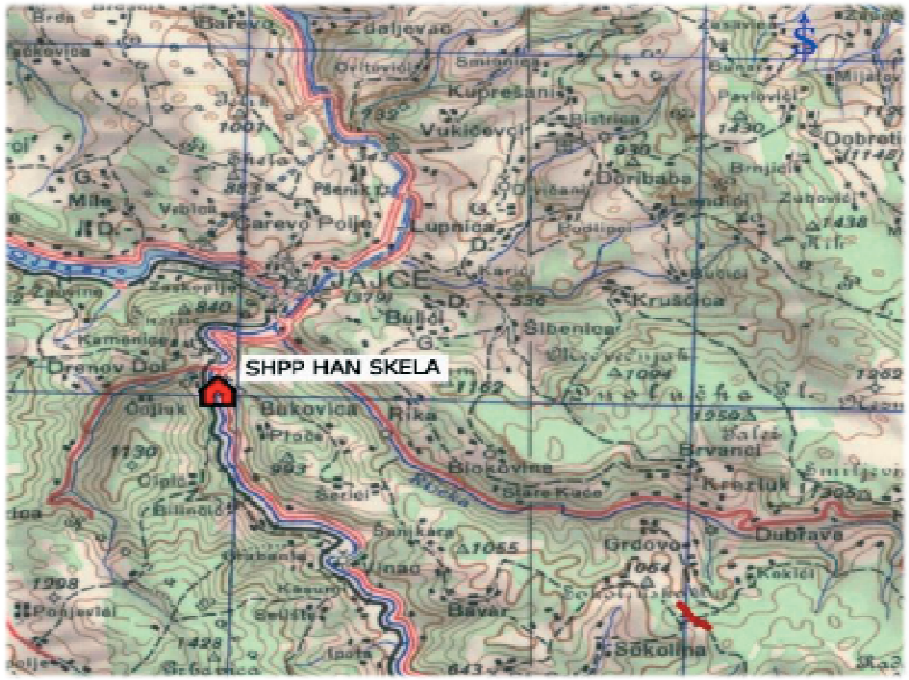
HPP Vinac - Jajce	
Location	Vinac, Vrbas river
Type	Run-of-river
Installed power (Pi)	11.5 MW
Total electricity generation per year (E)	61.3 GWh
New Yobs (operation and maintance)	15

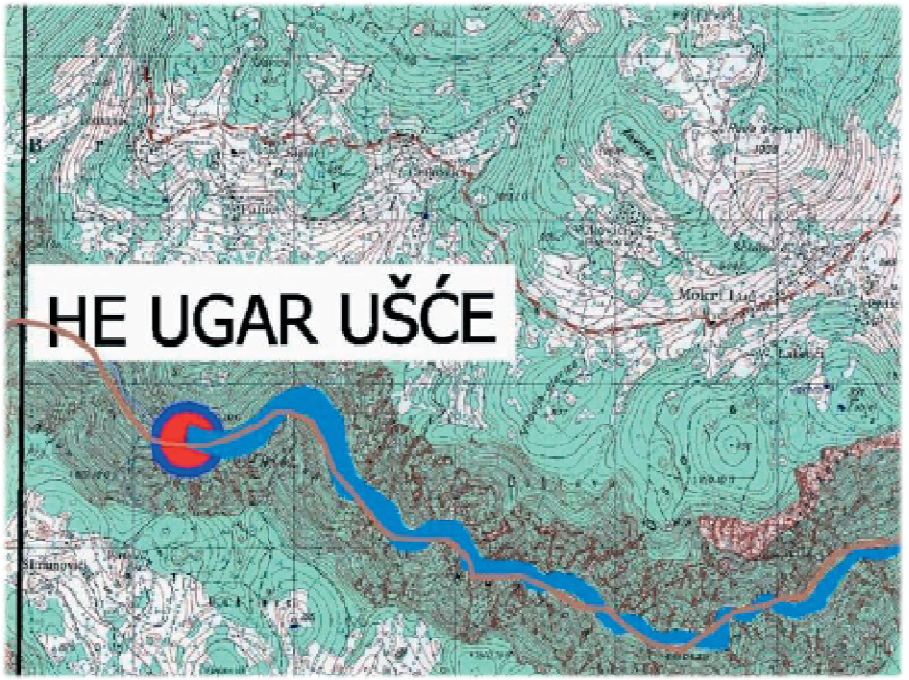
HPP Babino Selo - Donji Vakuf	
Location	Vinac, Vrbas river
Type	Run-of-river
Installed power (Pi)	11.5 MW
Total electricity generation per year (E)	59.9GWh
New Yobs (operation and maintance)	15

River basin Vrbas

HPP Han Skela - Jajce	
Location	River Vrbas, Jajce
Type	Run-of-river
Installed power (Pi)	2x6=12 MW
Total electricity generation per year (E)	52 GWh
New Yobs (operation and maintance)	10

HPP Ugar Ušće	
Location	River Vrbas, Jajce
Type	Run-of-river
Installed power (Pi)	2x5,8=11.6 MW
Total electricity generation per year (E)	33.188 GWh
New Yobs (operation and maintance)	7

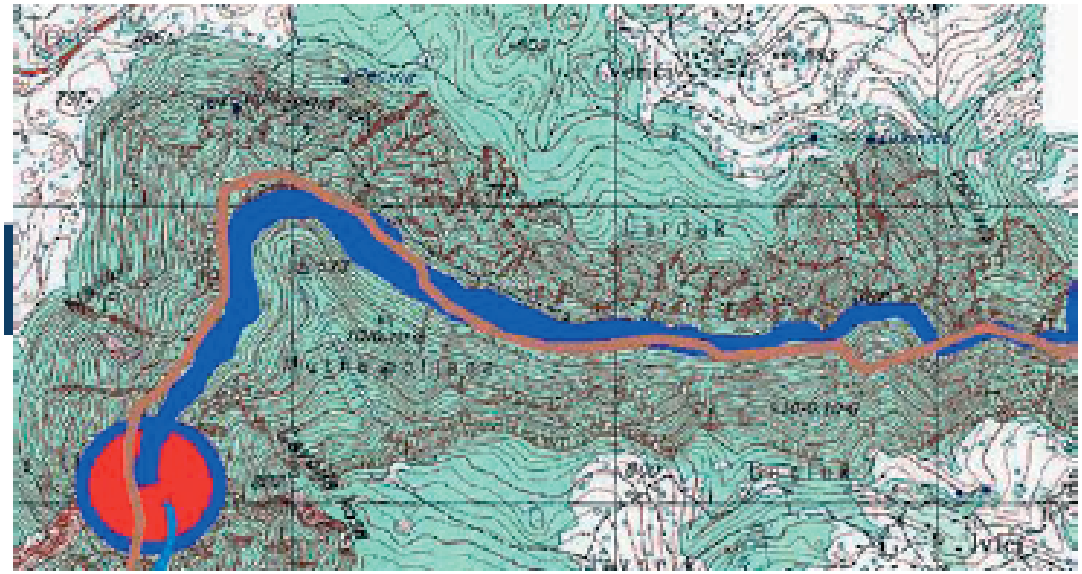




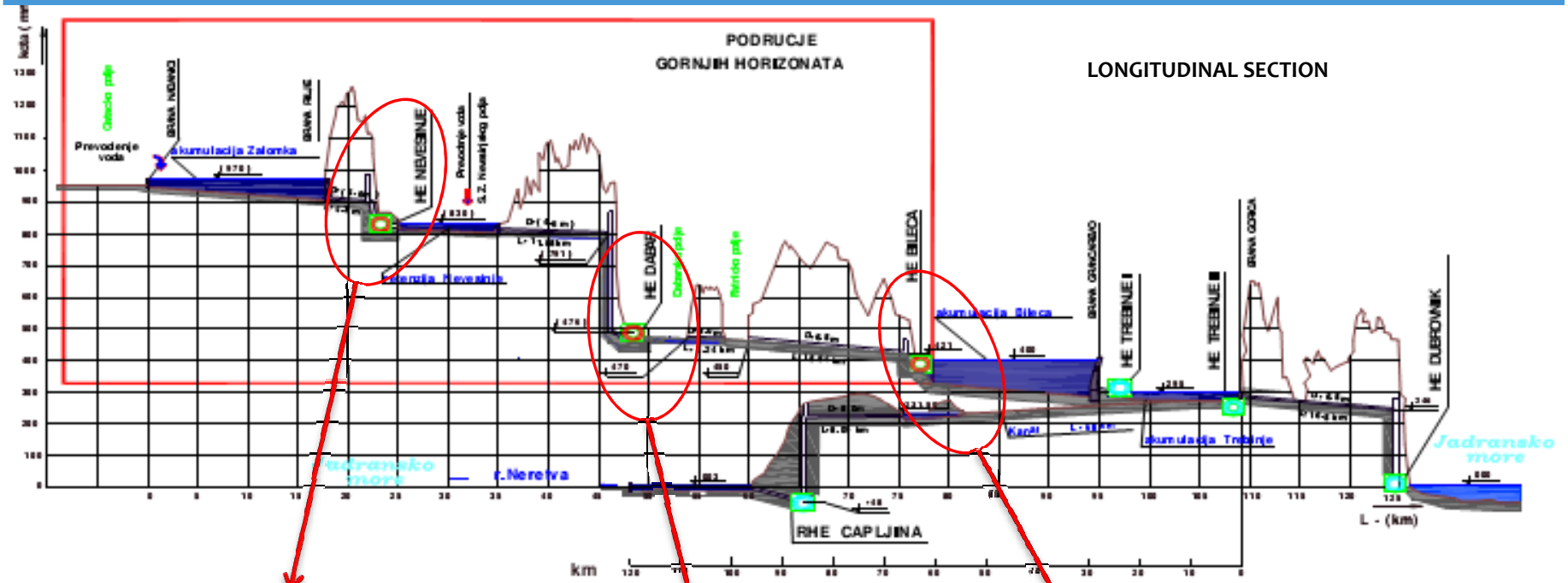
River basin Vrbas

HPP Vrletna kosa	
Location	RiverUgar, Jajce
Type	Run-of-river
Installed power (Pi)	2x5,6=11.2 MW
Total electricity generation per year (E)	22.538 GWh
New Yobs (operation and maintance)	7

HPP Ivik	
Location	RiverUgar, Jajce
Type	Run-of-river
Installed power (Pi)	2x5,6=11.2 MW
Total electricity generation per year (E)	21.883 GWh
New Yobs (operation and maintance)	7



Hydrosistem Trebišnjica river



HPP Nevesinje	
Location	Nevesinje
Installed power (Pi)	60 MW
Total electricity generation per year (E)	100.6 GWh

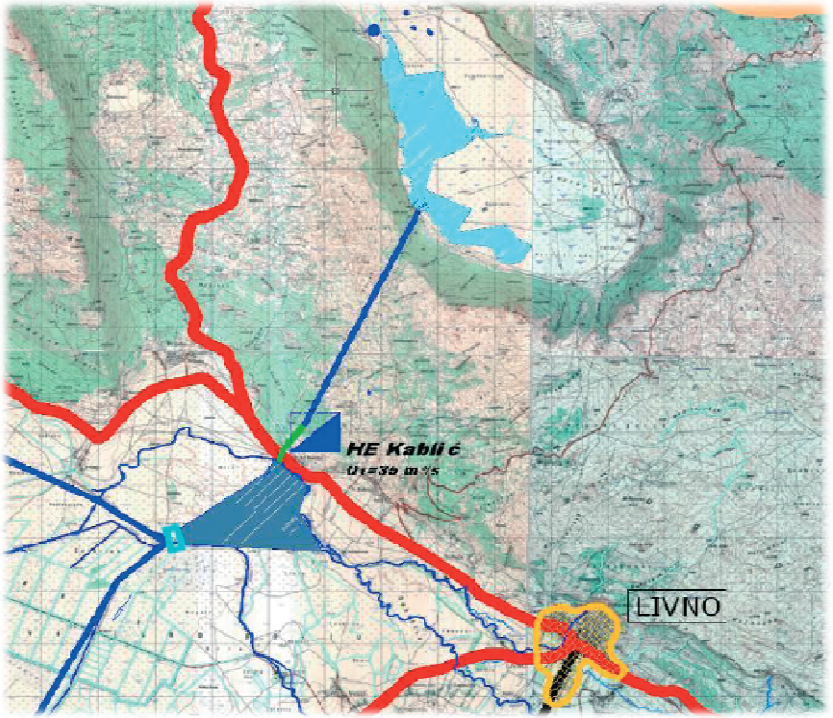
HPP Bileća	
Location	Bileća
Installed power (Pi)	33 MW
Total electricity generation per year (E)	116.40 GWh

HPP Dabar	
Location	Nevesinjsko polje
Installed power (Pi)	160 MW
Total electricity generation per year (E)	270.6 GWh

River basin Upper Cetina

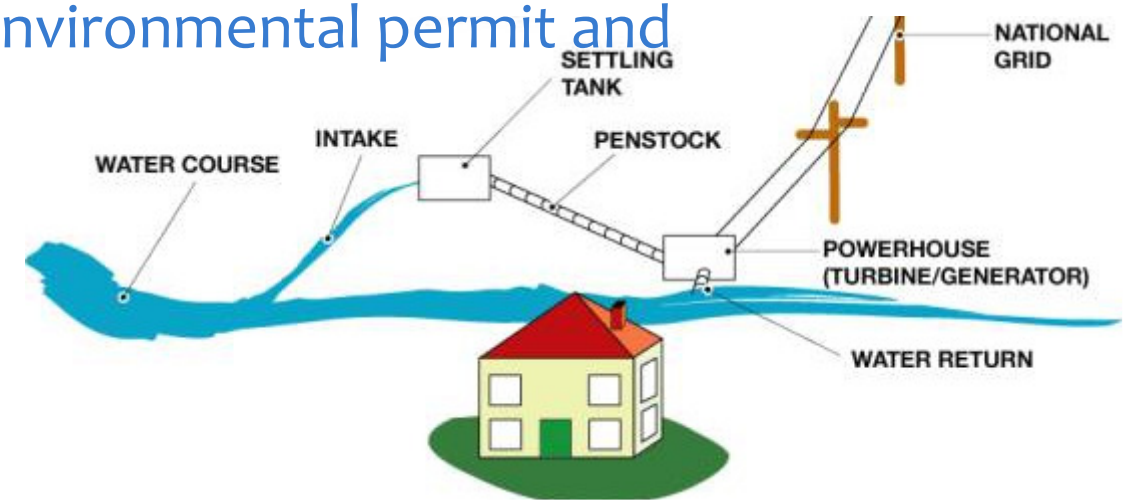
PSPP Vril - Tomislavgrad	
Location	R. Šuica, Duvanjsko field
Type	Pumped storage
Installed power (Pi)	2x26=52 MW
Total electricity generation per year (E)	95.42 GWh
New Yobs (operation and maintance)	25

PSPP Kablić-Livno	
Location	Glamočko and Livanjsko field
Type	Pumped storage
Installed power (Pi)	2x26=52 MW
Total electricity generation per year (E)	73.44 GWh
New Yobs (operation and maintance)	25



Advantages of hydropower over the other sources

- good solutions exists, it is possible to avoid negative impacts
- small, low and micro hydropower facilities
- designing, management, enforcement over environmental permit and maintenance



Conclusion

- increased use of hydropower would not only be justified from an economic point of view, but would also have positive environmental repercussions

- utilization of hydropower energy resources for providing electricity would significantly encourage the development of B&H