This project is funded
by the European Union

REGIONAL HYDRO MASTER-PLAN
(Hydropower Development Study in the Western Balkans)

Progress report

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RECG @ ECS Vienna, 07 March 2017

Objective and Purpose

WBEC-REG-ENE-01

The **overall objective** of this **regional project** (client: DG NEAR) is to contribute to fostering the harnessing of environmentally and climate change sustainable hydropower generation in the WB6 region in line with strategic objectives of the European Union and the ECT obligations of its Contracting Parties.

The **purpose** of the intervention is the development of a study determining a list of hydro power project (HPP) development priorities by (i) river basin, (ii) type of planned HPP facilities (storage, run-of-river, reversible), through which the remaining hydro-power potential in the region will be evaluated, according to the following priority:

1. Repair, refurbishment, upgrade and rehabilitaion of existing HPPs
2. Sustainable greenfield HPPs

Timeplan – important Study stages and events

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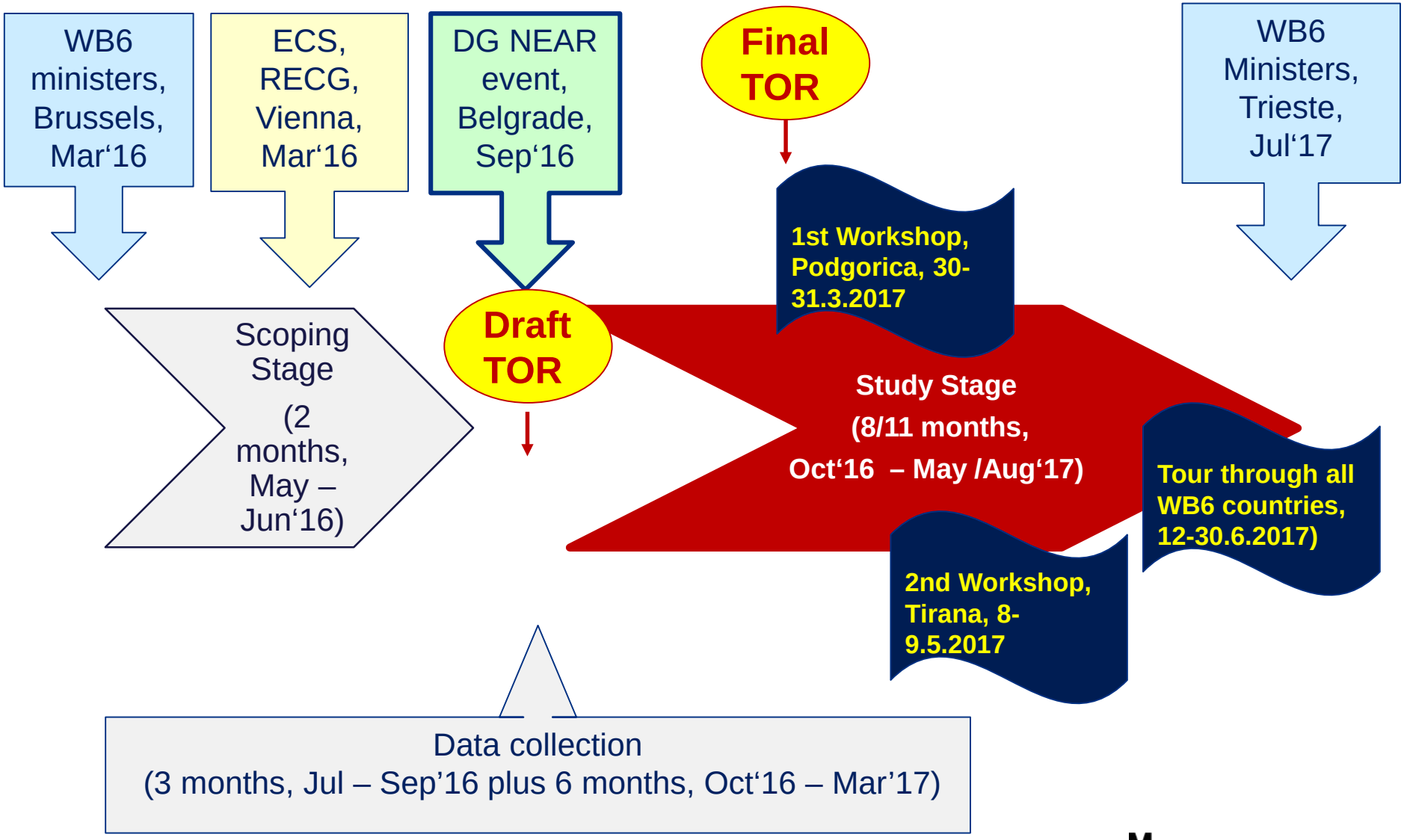

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Terms of Reference (TOR)

Minor amendments

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- **Partial redefinition of the objective and purpose**
  - „Contribute“ to sustainable HPP development (objective)
  - Focus on (1st priority) repair, refurbishment, upgrade and rehabilitation of existing HPPs, and (2nd priority) sustainable greenfield HPPs
- Strengthen the importance of full transposition and (stepwise) implementation of **EU Water Framework Directive** (WFD) as policy platform for HPP planing, aiming at proposing HPP development projects consisting of:
  1. **Refurbishment projects** aiming at improving operational safety, HPP capacity & availability and the environment at existing HPPs of more than 10MW of capacity in the WB6 region (55 facilities)
  2. **Refurbishment projects** aiming at prolonging service life time of existing HPPs, where applicable, including possible improvements of the environment
  3. “Highly recommended” **greenfield projects** based on our Multi-Criteria Assessment (MCA) of new HPP candidates from a long-list of identified projects in the WB6 region (approx. 400).
- Amendment of task on dissemination of results:
  - 2 Workshops
  - Round-tour to all WB6-countries

Terms of Reference (TOR)

What cannot be provided by the Study

- The Study shall not address the following issues and cannot provide the following results, for which **national institutions or public or private or mixed entities** are typically responsible in accordance with specific national legislation or regulations in place in the WB6 countries:
  - **New Integrated River Basin Management Plan** (IRBMP)
  - **SEA** at the river basin level or programme level, **EIA or ESIA** at the project level
  - **New (pre)feasibility studies** (including technical redesign existing HPP schemes)
  - **Consideration of small HPPs at the individual power plant or tributary level** – no new cadastres of sHPPs
  - **Quantitative assessment of cumulative effects** of main rivers (in terms of water discharges, transport of sediments and fishery issue
  - **National hydropower master-plan**
  - **"No-go" zones established**
  - **New comprehensive research / analysis of biodiversity and habitats** ((25) River and (Sub)River Basins in the Study)
- The Study results are **recommendations rather than any mandatory solutions** for the WB6 countries.

Project organisation

3 type of experts

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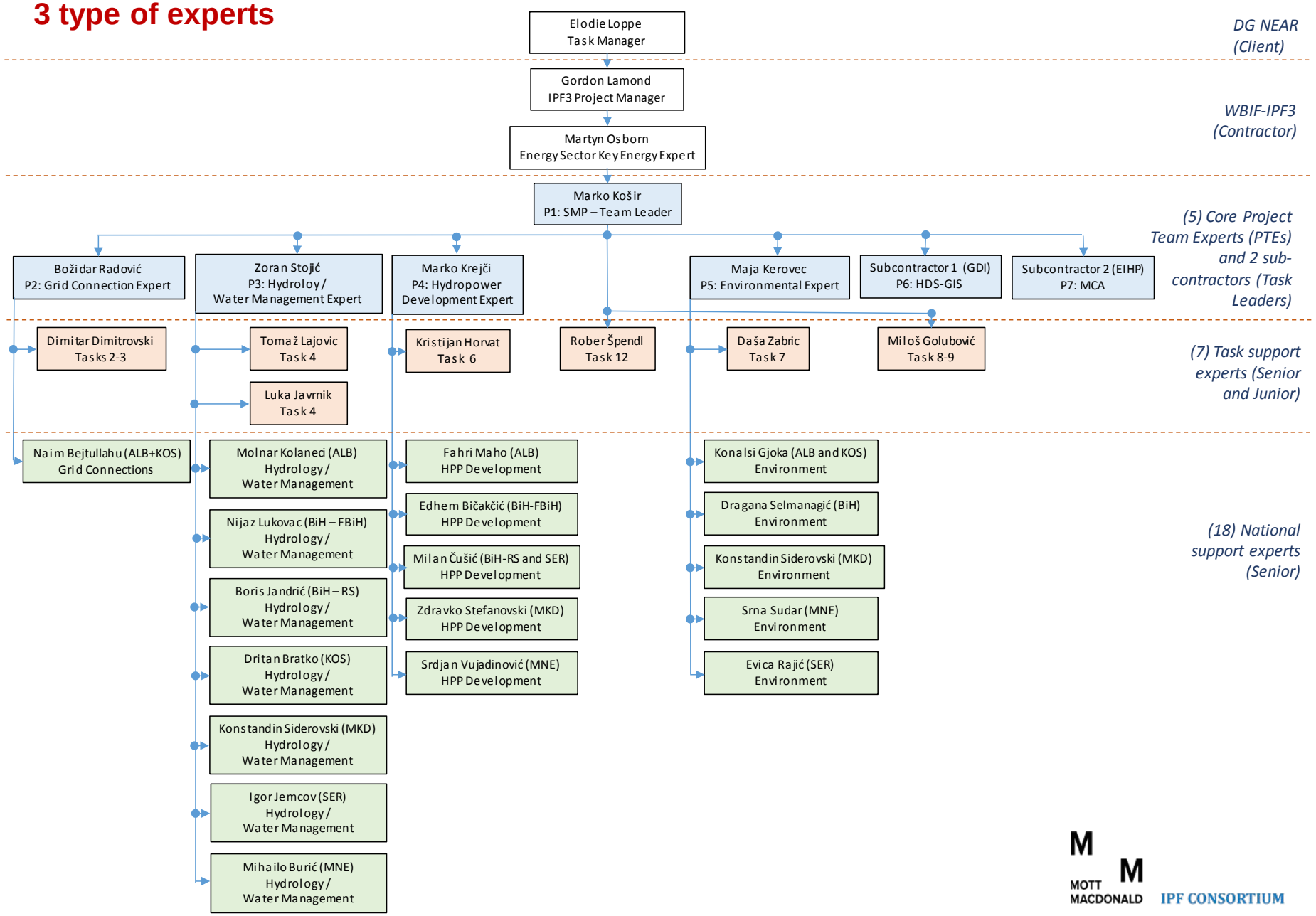

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Task & Deliverables Logistics and Progress

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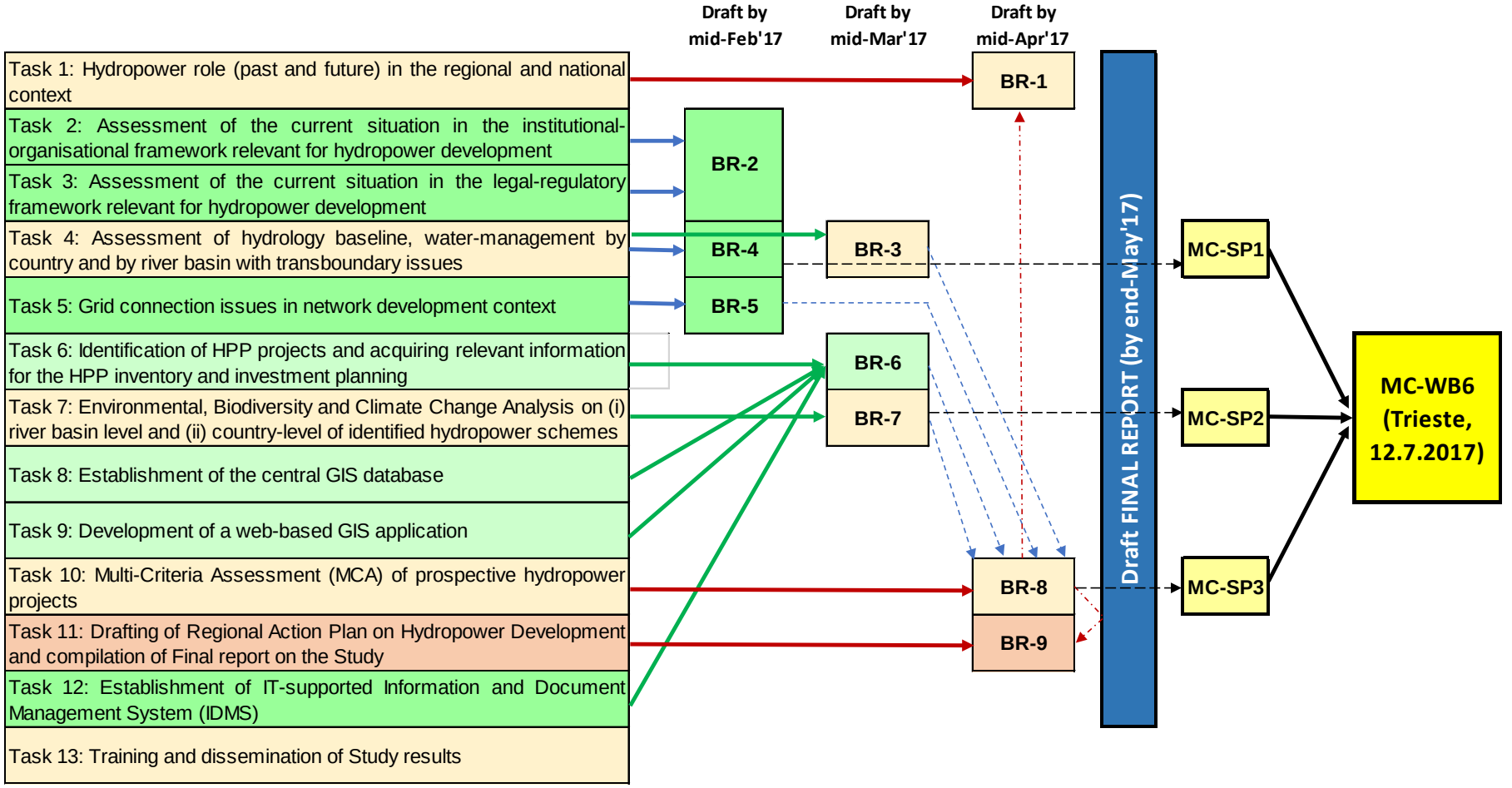

Completed

Great progress

Medium progress

Less progress

MC-SP1: Strategy paper to Ministerial Council WB6 'On Transboundary Issues"

MC-SP2: Strategy paper to Ministerial Council WB6 'On Guidelines for Integration of Environmental Issues in HPP Planning in WB6"

MC-SP3: Strategy paper to Ministerial Council WB6 'On Priority Investment Projects (rehabilitations and greenfield HPP projects)"

BR-1 'On the Role of Hydropower in the Past and Prospects in the Future by 2030/2050'

BR-2 'On Gap Analysis of the Legal-Regul. and Instit.-Organ.-Framework Rel. for Hydropower Dev.'

BR-3 'On Baseline Data on Hydrology and Water Management Issues'

BR-4 'On Transboundary Issues in the WB6 Region'

BR-5 'On Grid Connection Issues Related to Prospective HPP projects'

BR-6 'On Inventory of Rehabilitation and Prospective HPP Projects, GIS and IDMS'

BR-7 'On Environmental Analysis'

BR-8 'On Multi-Criteria Assessment of HPP Projects – Portfolio of HPP Investments'

BR-9 'On Regional Action Plan on the Hydropower Development'

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Progress and tangible results (from 1 October 2016 to end February 2017) by Task structured around (9) Background Reports (BR)

BR-1 Past and Future Role of HPPs in WB6

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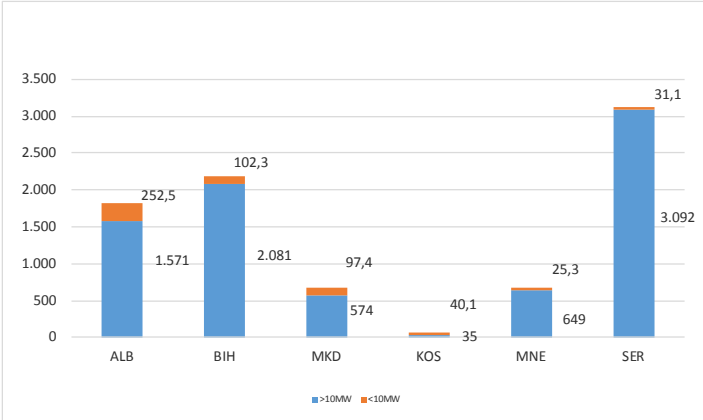
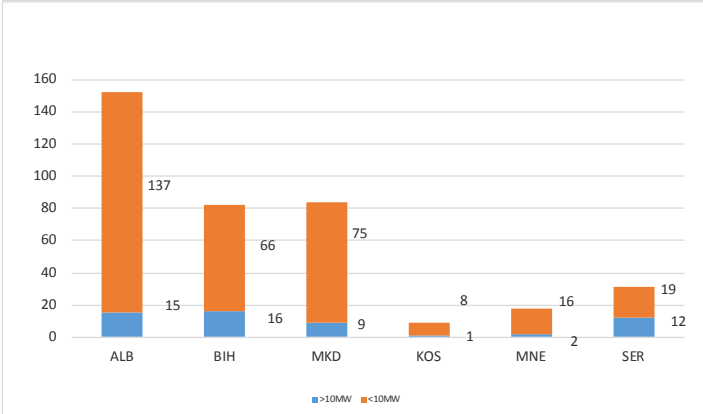
Existing HPPs (as of 31.12.2017)

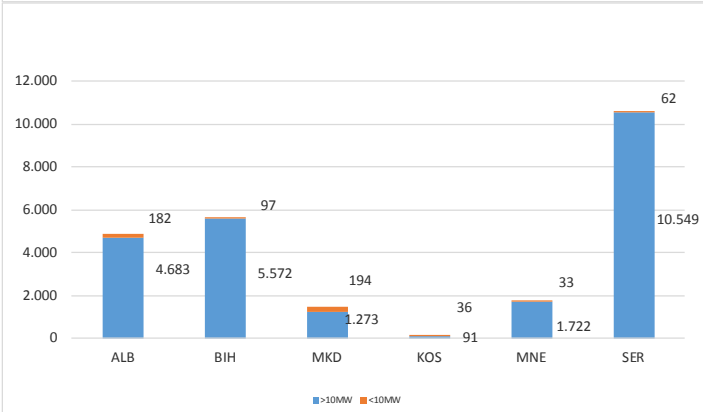
Number of hydro power plants (-, %)							
		>10MW	(%)	<10MW	(%)	Total	(%)
1	ALB	15	*27,3*	137	*42,7*	152	*40,4*
2	BIH	16	*29,1*	66	*20,6*	82	*21,8*
3	MKD	9	*16,4*	75	*23,4*	84	*22,3*
4	KOS	1	*1,8*	8	*2,5*	9	*2,4*
5	MNE	2	*3,6*	16	*5,0*	18	*4,8*
6	SER	12	*21,8*	19	*5,9*	31	*8,2*
	WB6	**55**	*100,0*	**321**	*100,0*	**376**	*100,0*
	Share	***14,6***	***(%)***	***85,4***	***(%)***	***100***	***(%)***

Installed capacities in hydro power plants (MW, %)							
		>10MW	(%)	<10MW	(%)	Total	(%)
1	ALB	1.571	*19,6*	252	*46,0*	1.824	*21,3*
2	BIH	2.081	*26,0*	102	*18,6*	2.183	*25,5*
3	MKD	574	*7,2*	97	*17,7*	671	*7,8*
4	KOS	35	*0,4*	40	*7,3*	75	*0,9*
5	MNE	649	*8,1*	25	*4,6*	674	*7,9*
6	SER	3.092	*38,6*	31	*5,7*	3.123	*36,5*
	WB6	**8.001**	*100,0*	**549**	*100,0*	**8.550**	*100,0*
	Share	***93,6***	***(%)***	***6,4***	***(%)***	***100***	***(%)***

Electricity generation in hydro power plants, 2001-2015 (GWh, %)							
		>10MW	(%)	<10MW	(%)	Total	(%)
1	ALB	4.683	*58,5*	182	*33,2*	4.865	*19,9*
2	BIH	5.572	*69,6*	97	*17,6*	5.669	*23,1*
3	MKD	1.273	*15,9*	194	*35,4*	1.468	*6,0*
4	KOS	91	*1,1*	36	*6,5*	127	*0,5*
5	MNE	1.722	*21,5*	33	*5,9*	1.755	*7,2*
6	SER	10.549	*131,9*	62	*11,3*	10.611	*43,3*
	WB6	**23.891**	*298,6*	**603**	*110,0*	**24.495**	*100,0*
	Share	***97,5***	***(%)***	***2,5***	***(%)***	***100***	***(%)***



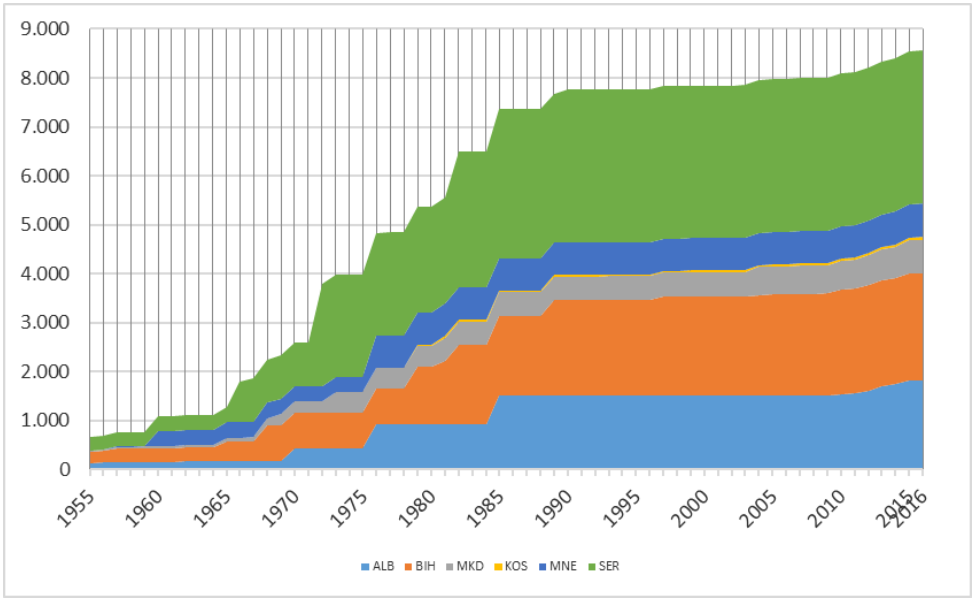




BR-1 Past and Future Role of HPPs in WB6

WBEC-REG-ENE-01

Dynamics of HPP commissioning in WB6, 1955-2015 (MW)

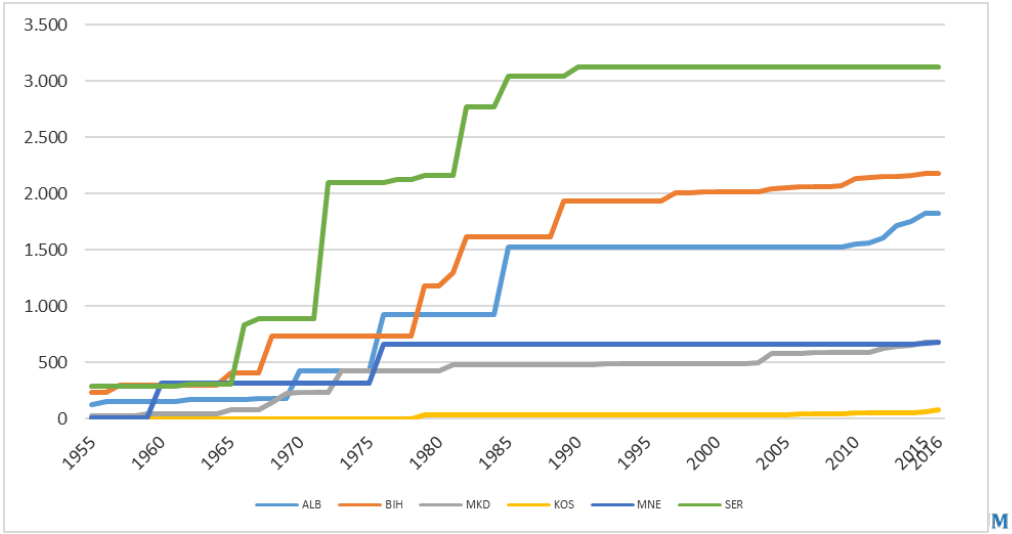


Average HPP-capacity addition achieved during 1955-1990 was **202 MW** per annum while in the period 1990-2015 it dropped to mere **31 MW** per annum.

Reasons can be attributed to:

- "Best" HPPs already implemented,
- Disintegration of former SFRJ followed by wars in the '90s,
- End of central planning and coordinated water management, lack of cooperation between newly established states,
- Lack of financial capacity of power utilities / states for investment intensive projects,
- Growing investment risks in emerging market conditions, and
- Continued unresolved transboundary issues

Period	MW	%	MW/a
Before 1955	667	7,8	
During 1955-1990	7.081	82,8	202,3
During 1991-2016	802	9,4	30,8
Total	8.550	100,0	



BR-1 Past and Future Role of HPPs in WB6

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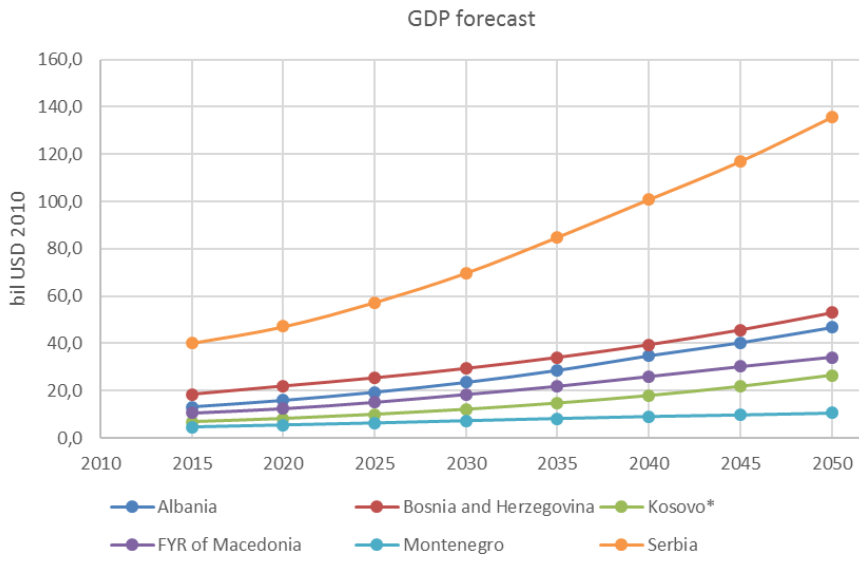
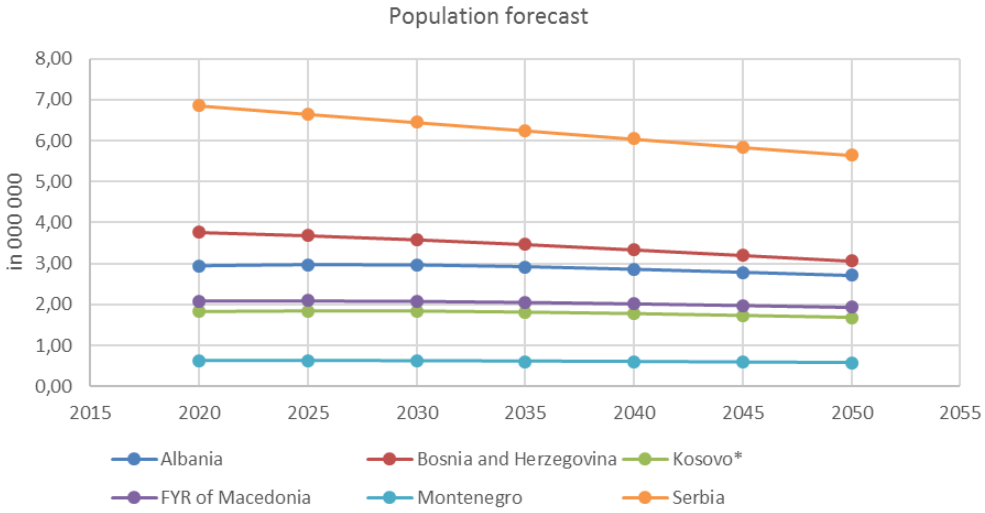
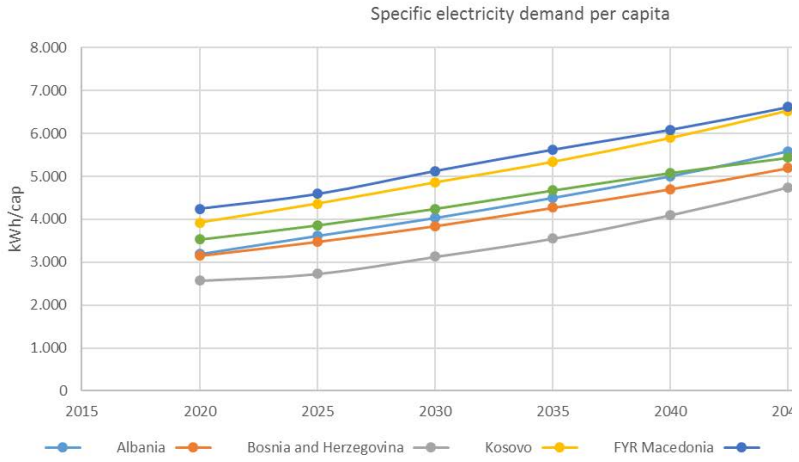
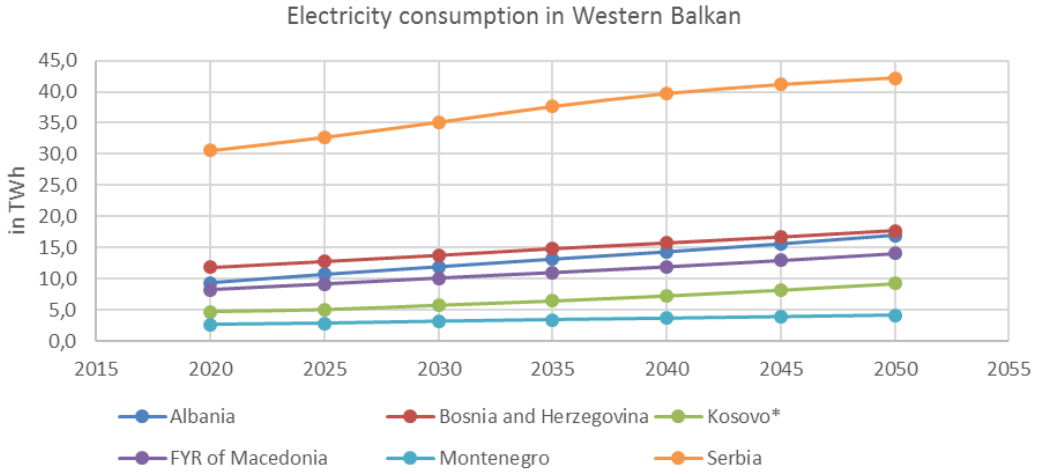
Electricity demand forecast in WB6 by 2050









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BR-2 L&R and I&O Framework and Gap Analysis

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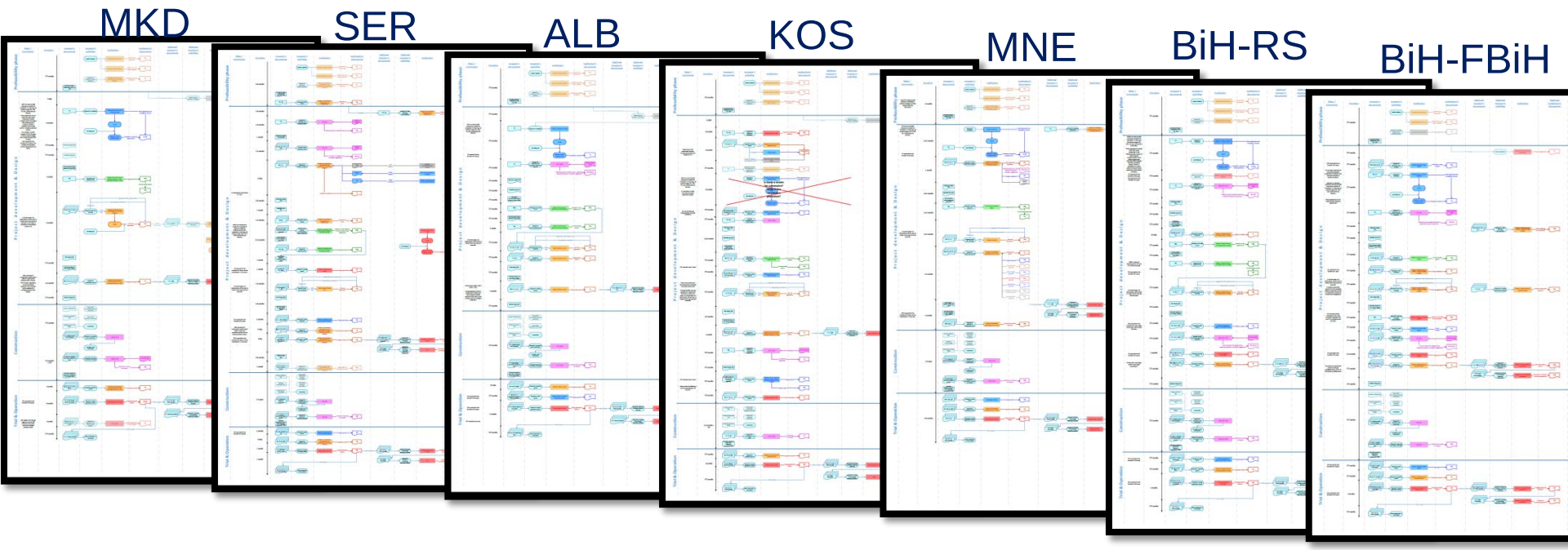
IOLR Diagrams for all 6 jurisdictions developed (+RS in BiH)

- **Unified methodology** applied
- **Comparative analysis**: aspects of location& construction permits, concession & water resources, grid connection, environmental permitting
- **Development process divided** into: prefeasibility, development & design, construction, trial & operation



BR-3 Baseline Hydrology and Water Management

WBEC-REG-ENE-01

River Basin Classification applied in the Study

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BR-3 Baseline Hydrology

Classification of hydrographic elements:

(4) drainage basins,

(13) watersheds,

(17) river basins,

(10) (sub)river basins,

(26) rivers,

(77) tributaries 1, and

(25) tributaries 2.

DRAINAGE BASIN (DB)	WATERSHED (WS)	River Basin (RB)	(Sub) River Basin (SRB	River	Tributary 1	Tributary 2	Affiliation to WB6-countries: ALB	BIH	KOS	MKD	MNE	SER
BLACK SEA	DANUBE	Velika Morava /SER/	Zapadna Morava /KOS,	Ibar								
			Južna Morava /SER/	Južna Morava								
					Nišava	Temska						
					Vlasina							
		Timok /SER/		Timok	Crni Timok	Zlotska						
					Beli Timok	Griška						
						Surlijški Timok						
						Trgoviški Timok						
		Temštica /SER/		Temštica								
					Visočica							
		Sava /BIH, CRO, MNE, SER/	Drina /BIH, MNE, SER/									
				Drina								
					Rastošnica							
					Osanica							
					Bistrica							
					Crhotina							
					Lim	Djuričko						
						Grnčar						
						Kaludarska						
						Ljesnica						
						Sekularska						
						Trebačka						
						Uvac						
						Visočica						
						Zlorečica						
				Piva								
					Vrbnica							
					Tusina							
					Bukovica							
					Bijela							
				Tara								
			Bosna /BiH/	Bosna								
					Željeznica							
					Kalića							
					Babina r.							
					Fajnička r.							
					Krivaja	Strupčanica						
						Bioštica						
						Okija						
					Spreča							
			Vrbas /BiH/	Vrbas								
					Bistrica							
			Una /BIH, CRO/	Una								
					Jezernica							
					Sana							
ADRIATIC SEA	TREBIŠNJICA	Trebišnjica /BIH, CRO/		Trebišnjica								
					Tihaljina							
	NERETVA	Neretva /BIH,CRO/		Neretva								
					Rama							
	BOJANA / BUNA	Morača /MNE/		Morača								
					Zeta							
					Mala rijeka							
					Cijevna							
		Drin-Bune /ALB/	Bune/Bojana /ALB/	Bojana/Bune								
					Gjader							
			Drini/ALB/	Drini								
					Curraj							
			White Drin, Drini i Berthe /ALB, KOS/	White Drin, Drini i								
					Drini i Berthe							
					Lumebardhi i Decani							
					Restelica							
					Lum i Istogut							
					Dikance							
			Black Drin, Drini i Zi /ALB, MKD/	Black Drin, Drini i Zi								
					Shale							
					Lumi i Zi							
					Borjes							
					Luma	Caje						
					Zalli i Okshtunit							
					Valbona							
					Gomsige	Tetaje						
					Nikaj (Drin-Bune)							
					Radika							
	MAT	Mat /ALB/		Mat								
					Sete							
					Mat (Milot; Kurbin)							
					Fan i Madh	Mati						
					Mirdite							
					Fan i Vogel							
					Prroni i Gjurajve							
	ISHEM	Ishem /ALB/	-	Ishem		-						
					Gjole							
					Zeze							
					Dushna							
	ERZEN	Erzen /ALB/		Erzen								
					Rodicina							
					Sheja e Libazhd							
					Zalli i Lunikut							
	SHKUMBIN	Shkumbin /ALB/		Shkumbin								
					Bushtrices							
					Qarrishte							
					Gostime (Shkumbin)							
	SEMAN	Seman /ALB/		Seman								
					Osumi							
					Devolli	Shishtavecit and Rekes						
					Cemerica (Devolli)	Verces						
	VJOSA /AOOS	Vjose /ALB, GRE/		Vjosa								
					Smokthine							
					Drinos							
					Sarantaporos							
IONIAN SEA	BISTRICE	Bistrice /ALB/		Bistrice								
AEGEAN SEA	AXIOS / VARDAR	Vardar /MKD, GRE/										
				Vardar								
					Rakita r.							
					Sapunčica							
					Zrnovska							
					Korab							
					Lepenac							
					Treska							
					Madinar r. and							
					Lepenac	Psaca						
					Pcinja	Kriva Lakavica						
					Topolka and Babuna							
					Bregalnica	Dosnica						
					Reka Cna							
					Bosava							
	STRUMICA	Strumica /MKD, BUL/		Strumica								
4	13	17	10	26	77	25	TOTAL					

Increasing distance from the Sea (DB) to the Tributary

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BR-4 Transboundary Issues

(9) Specific Transboundar Cases identified and analysed

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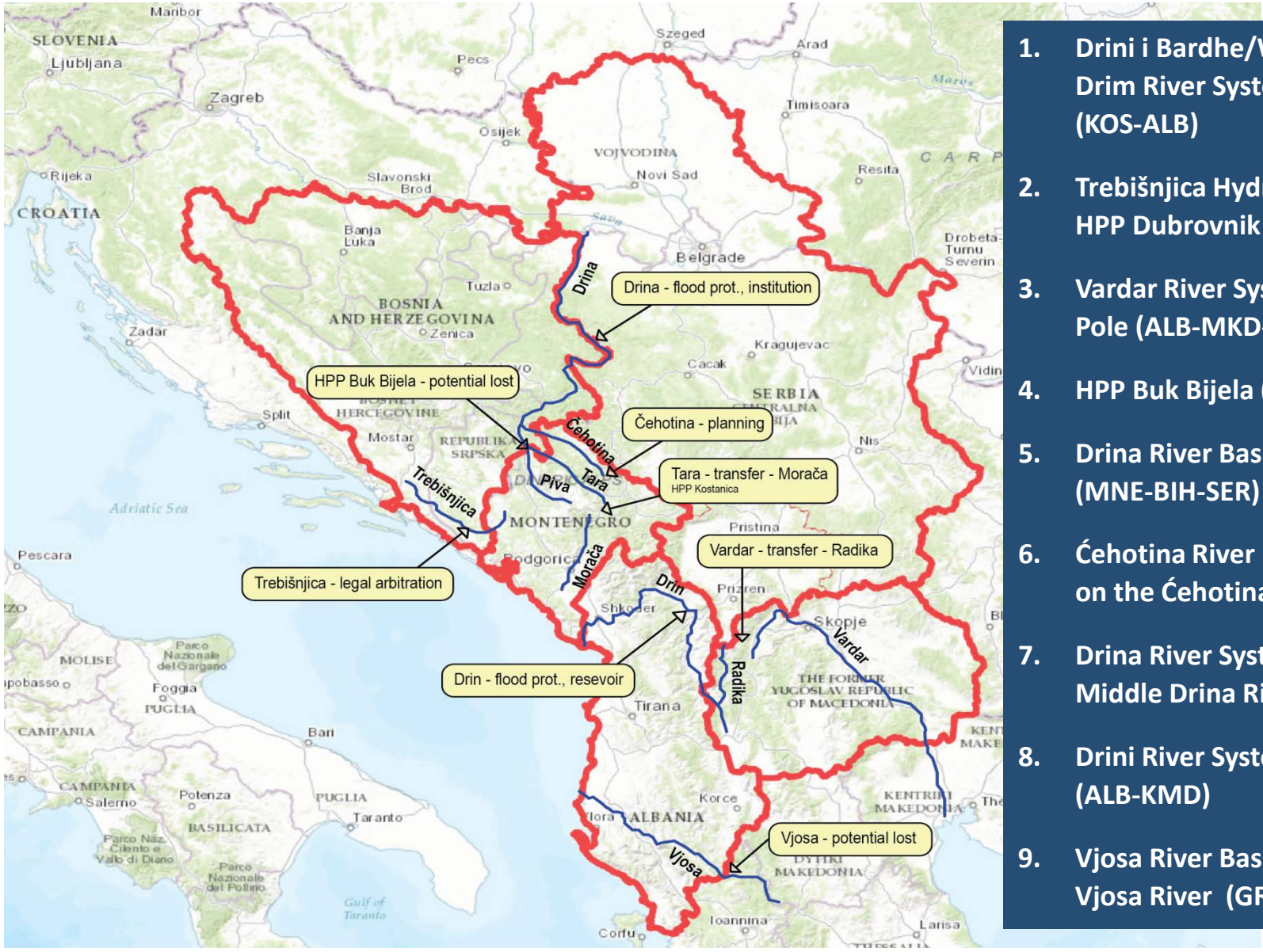


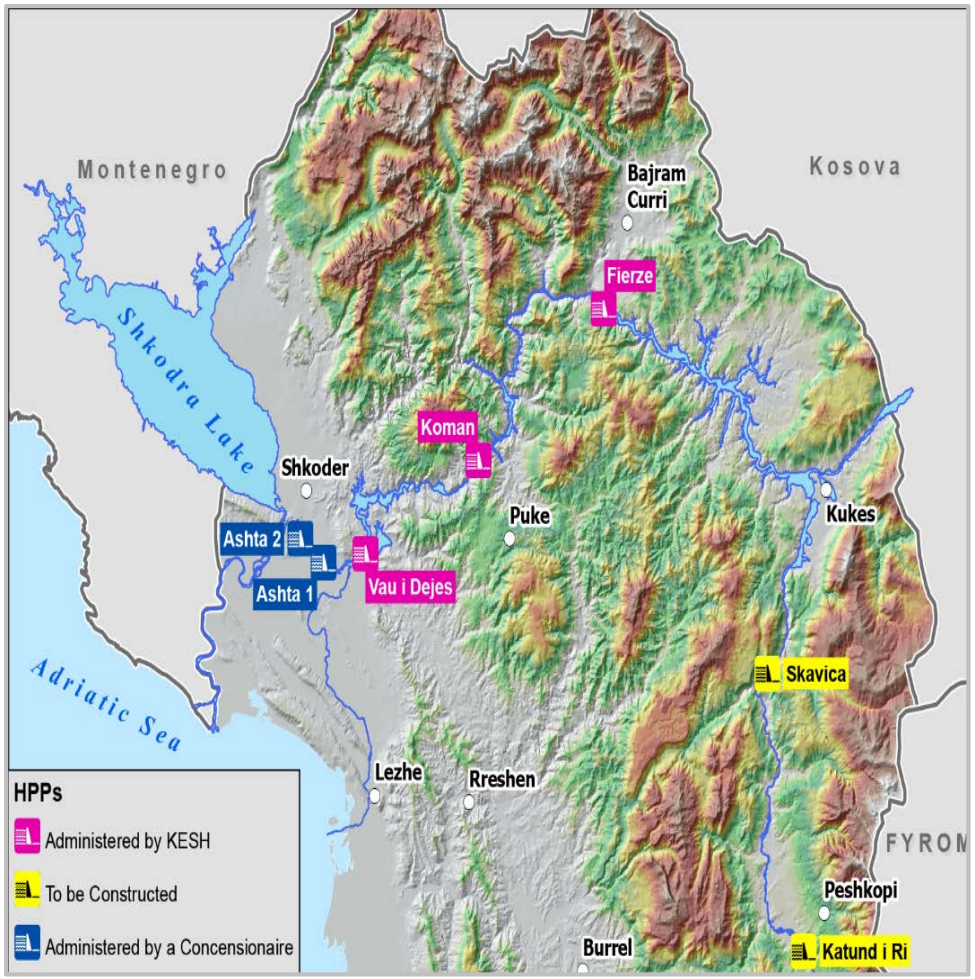
1. Drini i Bardhe/White Drin/Beli Drim River System - HPP Zhur (KOS-ALB)
2. Trebišnjica Hydropower Scheme – HPP Dubrovnik 2 (CRO-BIH-MNE)
3. Vardar River System - HPP Lukovo Pole (ALB-MKD-GRE)
4. HPP Buk Bijela (BIH-MNE-SER)
5. Drina River Basin - HPP Koštanica (MNE-BIH-SER)
6. Ćehotina River Basin - HPP Chain on the Ćehotina River (MNE-BIH)
7. Drina River System - HPPs along Middle Drina River (SER–BIH)
8. Drini River System - HPP Skavica (ALB-KMD)
9. Vjosa River Basin - HPP Chain on Vjosa River (GRE-ALB)

BR-4 Transboundary Issues
(2) Platforms

- **Legal platform for resolving transboundary issues within Energy Community action**, administered by the Energy Community Secretariat. **European Commission shall join forces with the Energy Community Secretariat and make a compelling offer to the countries and territories involved**.
- Transboundary issues in hydropower have two platforms, on the basis of which it resolving is possible.:

  (1) under the above-proposed **mediation of Energy Community,**

  (2) another platform is a legal act which provides **regulation in a planning phase - Water Framework Directive (WFD)**.

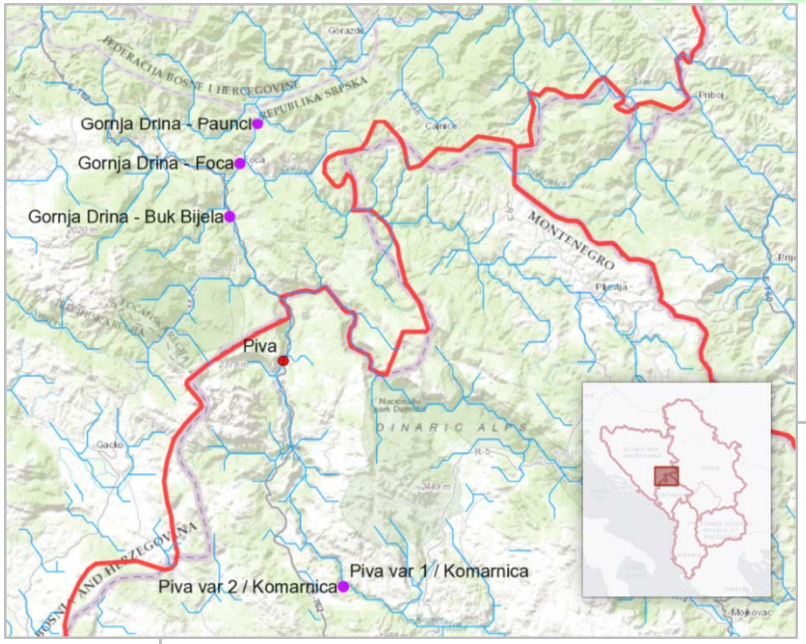


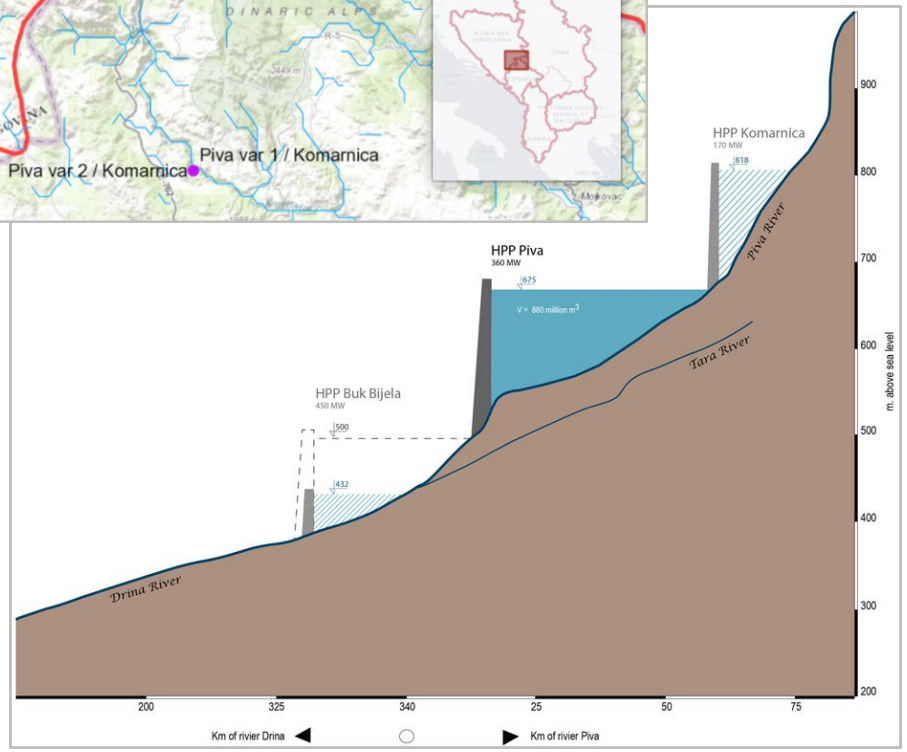
BR-4 Transboundary Issues

Lessons learned

- Until present, transboundary issues in WB6 Region were predominately dealt with **water quality aspects and to some extent biodiversity**, while hydropower sector and power potential development remained behind any useful baseline.

- The **greatest negligence is noticed in sharing hydropower potential**, so transboundary cases remained where they were or at best went to worse by sizing down of **best reservoir locations (like Buk Bijela or Skavica**).





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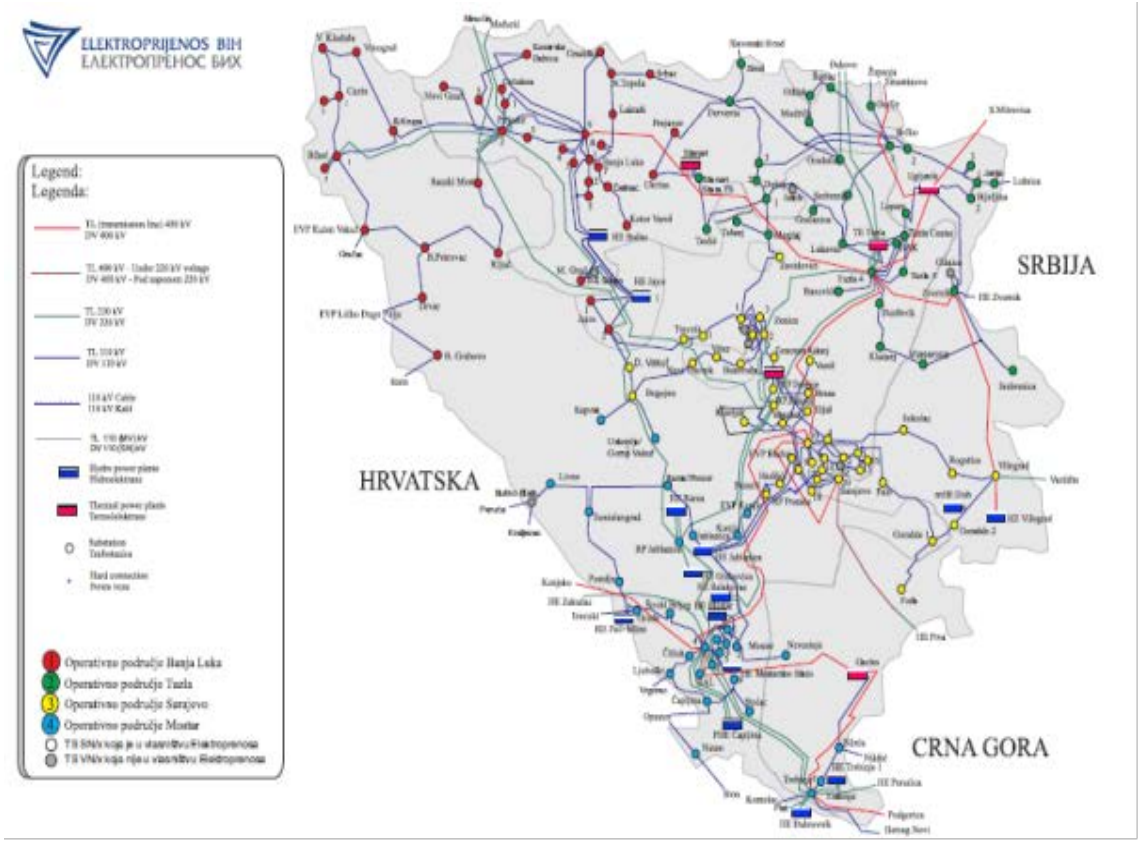
BR-5 Grid Connections Issues

Transmission Network

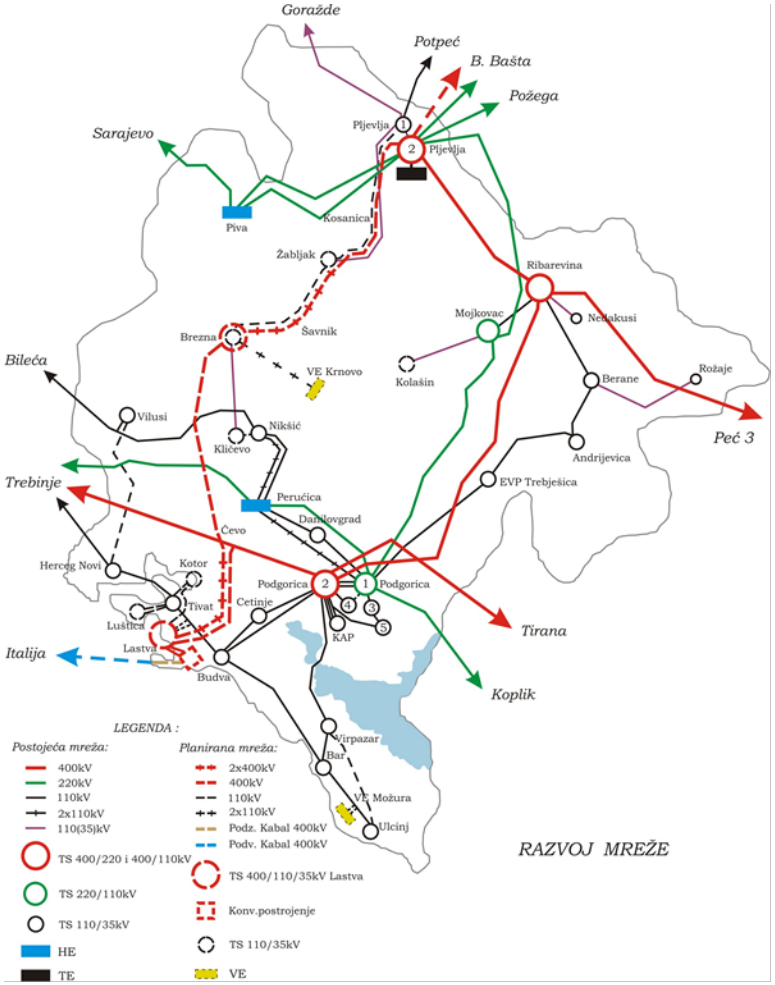
- **Transmission network capacities and facilities will never be a constraint** for HPP projects.
- All new HPP projects connected to the transmission network:
  - **increase overall stability** of the regional power system operations,
  - **improve power system control** capacities, and
  - **increase opportunities for integration of other RES** generation facilities, such as wind and solar generation.



BR-5 Grid Connections Issues

Distribution Network

- **Capacity of the distribution networks in the region is <u>insufficient</u> to facilitate growing demand for connection of small HPPs**
- Additional burden for already weak networks is from other RES and distributed generation facilities in general
- Distribution operators are in the unbundling process following opening of the retail market in the region
- Distribution networks require significant reinforcements in:
  - Network facilities
  - Control facilities,
  - Human resources
- Distribution Codes are getting improved, but still far away from transmission
- Certain differences across the region, but **connection costs are almost by default paid by the Investor**, including necessary network reinforcements

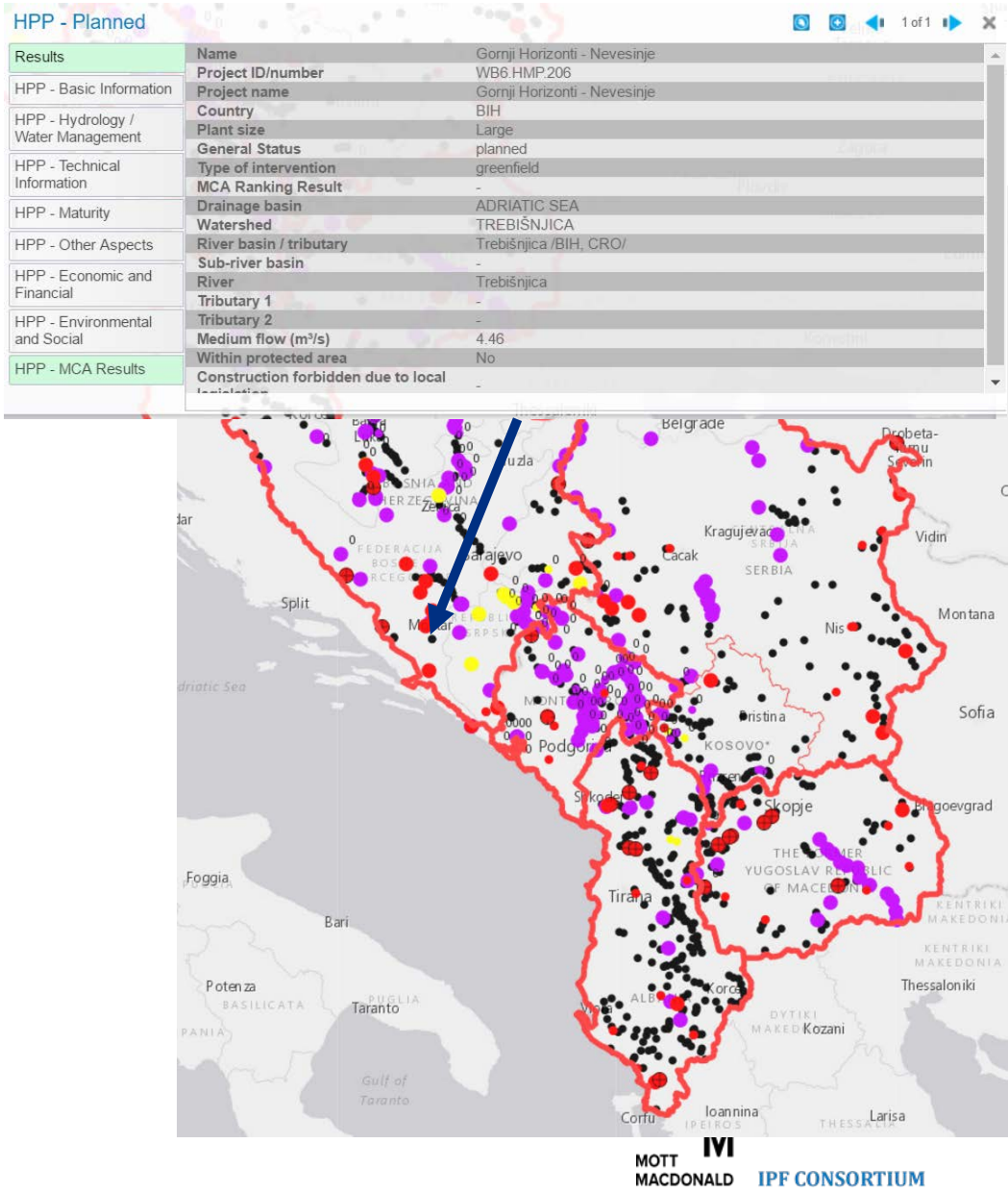


BR-6 Rehabilitation and Greenfield HPP Project, GIS and IDMS

WBEC-REG-ENE-01

HPP-DB Preliminary Findings I

- Data collected on **HPP projects over 10MW**, on the following:
  - general,
  - technical,
  - environmental & social,
  - hydrology & water management,
  - economic & financial,
  - maturity
- Total **480 projects** over 10 MW identified. 154 eliminated due to: i) insufficient data, ii) alternative projects
- Total **326 projects** selected for further analysis („Screening“), of which in ALB (232), BIH (37) MNE (17), MKD (17), KOS (3) and SER (21)



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BR-6 Rehabilitation and Greenfield HPP Project, HDS-GIS and IDMS

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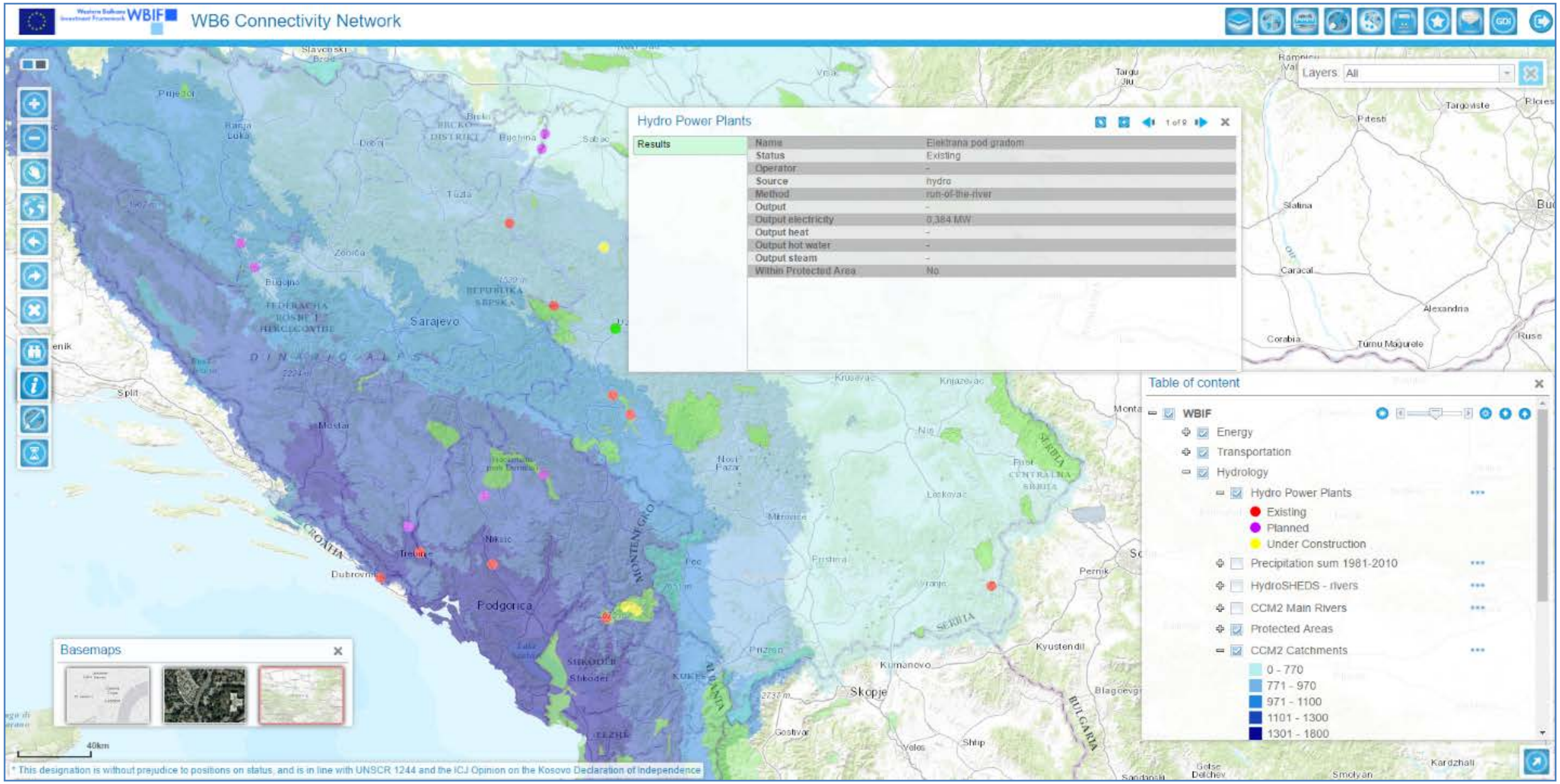
On HDS-GIS Database and Web GIS Application



Relevant HPP-related **central GIS database** is established and Hydropower Development Study GIS (HDS-GIS) application is developed, populated with data and operational. The **HDS-GIS application** includes maps / several layers that facilitate HPP projects planning and presentation.

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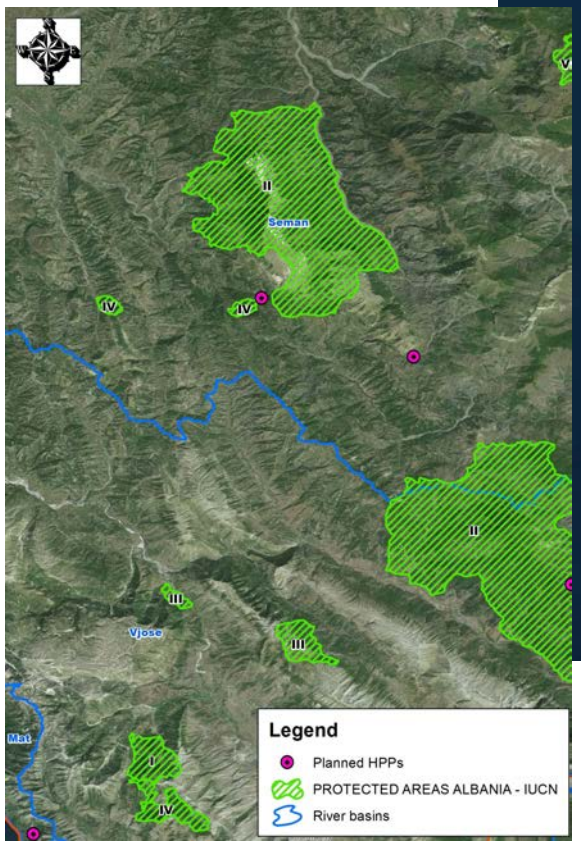
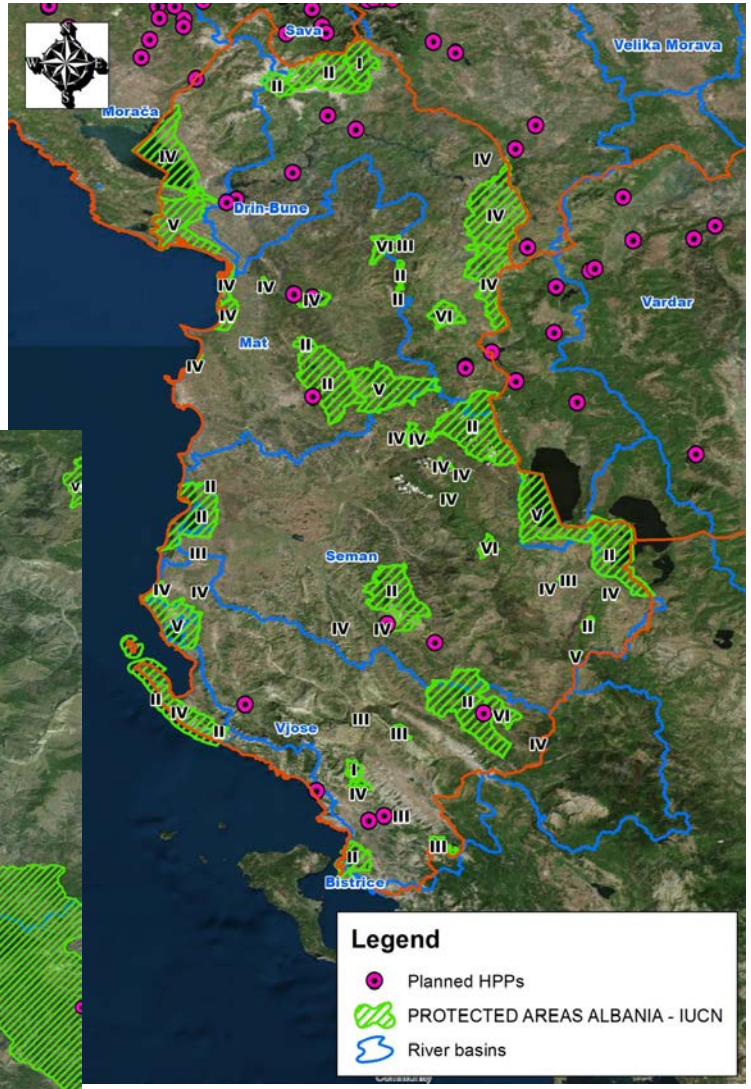
BR-7 Environmental Analysis

Conducted Activities

- **Analysis of national SEA/EIA legal procedures / practices** in WB6 countries,
- Description of **protected areas,**
- **Baseline description** of important features of chosen (25) river basins,
- **GIS data collected for environmental analysis**: protected areas, Corine landcover, settlements, riverbasins,
- **Fish fauna inventory and residual flow legislation analysis**, GIS layers with species distribution.





Spatial analysis – map example

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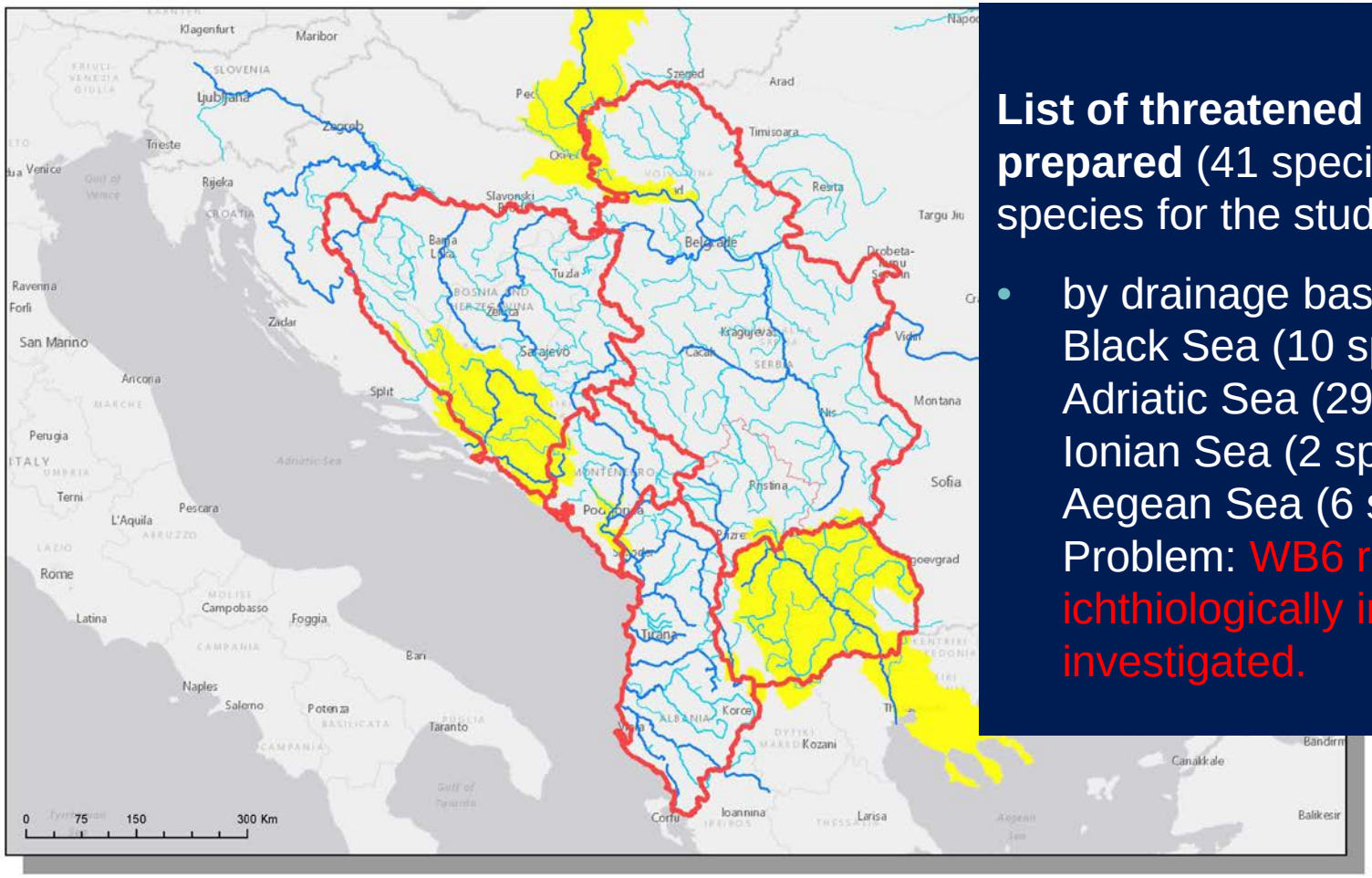
BR-7 Environmental Analysis

Ichthyologic analysis - 2



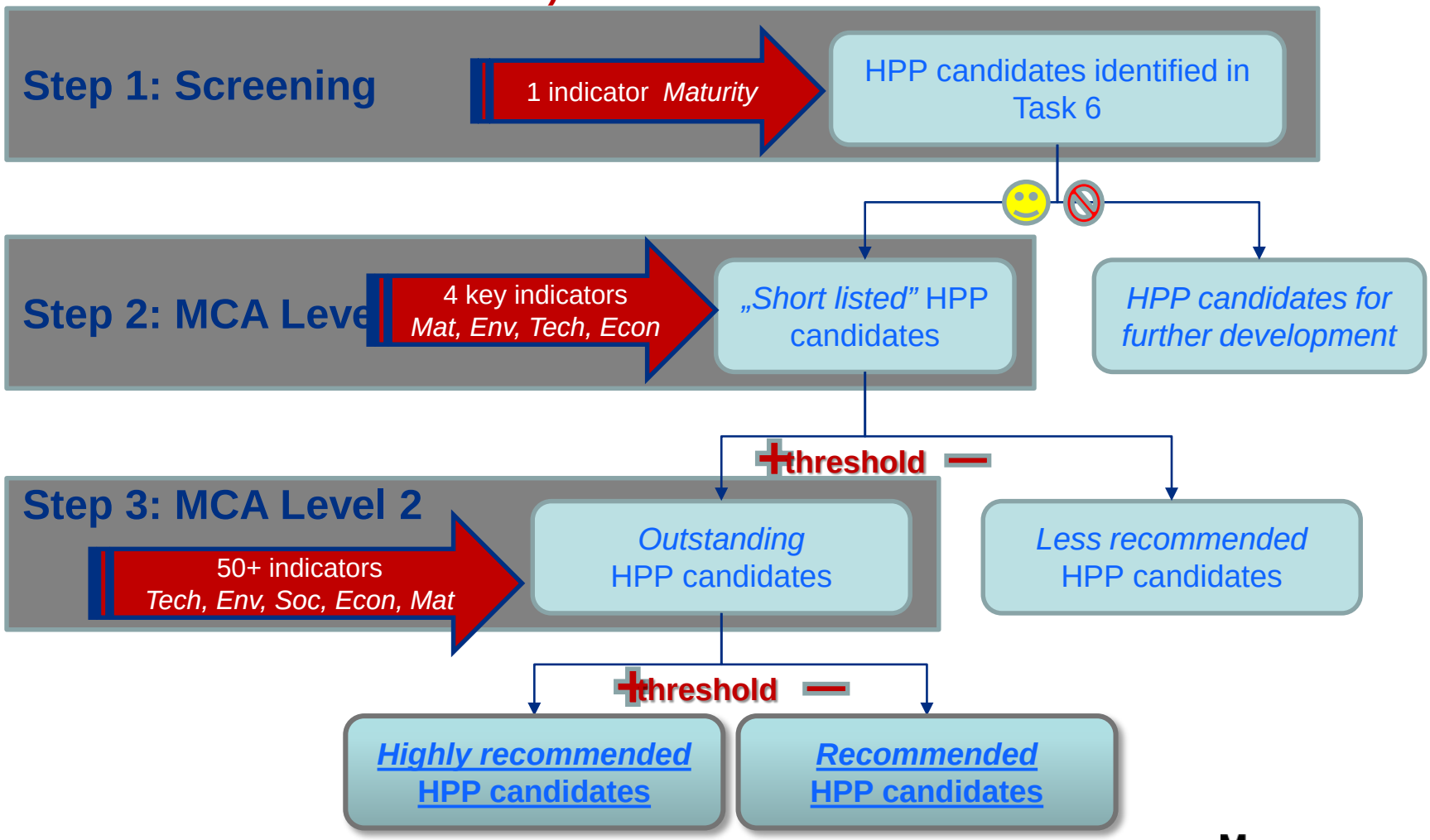
List of threatened species was prepared (41 species) – key species for the study:

- by drainage basins (DB): Black Sea (10 species), Adriatic Sea (29 species), Ionian Sea (2 species), Aegean Sea (6 species). Problem: WB6 region is ichthiologically insufficiently investigated.

BR-8 Multi-Criterial Assessment (MCA) of greenfield HPP projects

WBEC-REG-ENE-01

Assessment Approach and Methodology (3-step, each next step more detailed and data intensive)



Outcome: HPP candidates ranked into groups

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Its characteristics:

- A **concise document** on max. 20 pages
- Summarizing **main conclusions and recommendations** from all BRs (i.e. BR-1 to BR-8)
- Providing concrete **proposals for follow-up actions** at both (i) **horizontal - regonal** (WB6) level as well as (ii) by **individual WB6-country**
- To be prepared as the last BR in the Study (by end-April'17)

Last steps in the Study:

- Based on completed (9) BRs, draft **Final Report** wll be prepared (by end-May'17)
- Draft Final report will be presented to all (6) beneficiary countries during a **tour to WB6-countries** scheduled for 3 weeks (2 countries per week) during 12-30 June 2017
- Based on comments and feedback during the tour, **Final Draft of the Final Report** will be prepared by August 2017

WBIF-IPF 3 Consortium

Thank you for your attention!

MOTT MACDONALD

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