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REGIONAL STRATEGY FOR SUSTAINABLE HYDROPOWER IN THE WESTERN BALKANS

Background Report No. 1

Past, present and future role of hydropower

Final Draft 3

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Contents

List of abbreviations and symbols

Abbr. & Symbols	Description / Meaning
ALB	Acronym used for Albania
a.s.l.	Above sea level
BiH	Acronym used for Bosnia and Herzegovina
BR	Background Report
CO2	Carbon Dioxide
CP	Contracting Party
DER	HPP with derivation
DG NEAR	Directorate-General for Neighbourhood and Enlargement Negotiations
EAF	Ecologically Acceptable Flow
EBRD	European Bank for Reconstruction and Development
EC	European Commission
ECS	Energy Community Secretariat
EIA	Environmental Impact Assessment
ELEM	Elektrani na Makedonija (a power utility of the former Yugoslav Republic of Macedonia)
EIB	European Investment Bank
EnC	Energy Community
EP BiH	Elektroprivreda Bosne i Hercegovine (a power utility of Federation BiH)
EPCG	Elektroprivreda Crne Gore (a power utility of Montenegro)
EP HZHB	Elektroprivreda Hrvatske Zajednice Herceg Bosne (a power utility of Croatian Community of Herceg Bosna)
EPS	Elektroprivreda Srbije (a power utility of the Republic of Serbia)
ERS	Elektroprivreda Republike Srpske (power utility of Republika Srpska)
ESIA	Environmental and Social Impact Assessment
EU	European Union
FBiH	Federation of Bosnia and Herzegovina, entity of Bosnia and Herzegovina
FEA	Final Expert Assessment
GDP	Gross Domestic Product
FIT	Feed-in tariff
GHG	Greenhouse gases
HPP	Hydro power plant
ICPDR	International Commission for the Protection of the Danube River
IDMS	Information and Document Management System
IFC	International Finance Corporation
IFI	International Financing Institution
IHA	International Hydro Association
IPA	Instrument for Pre-accession
IPF	Infrastructure Project Facility
IPF3	Infrastructure Project Facility - 3rd Technical Assistance Window
KESH	Korporata Elektroenergjitike Shqiptare (a power utility of Albania)
KfW	Kreditanstalt fuer Wiederaufbau
KOS	Acronym used for Kosovo
MCA	Multi-Criteria Assessment (a methodology used in the sub-project)

Abbr. & Symbols	Description / Meaning
MKD	Acronym used for the former Yugoslav Republic of Macedonia
MNE	Acronym used for Montenegro
Mott MacDonald-IPF Consortium	The Consortium carrying out the sub-project under WBIF-IPF3
NGO	Non-governmental organisation
RB	River Basin
RES	HPP with reservoir (water accumulation)
RES	Renewable energy source
REV	Reversible HPP
RHPP	Reversible Hydro Power Plant
ROR	Run-of-river HPP
RS	Republika Srpska, Entity of Bosnia and Herzegovina
SFRJ	Social Federal Republic of Yugoslavia
SEA	Strategic Environmental Assessment
SER	Acronym used for Serbia
sHPP	Small hydro power plant
TA	Technical Assistance
ToR	Terms of Reference
UN	United Nations
UNECE	United Nations Economic Commission for Europe
WBEC-REG-ENE-01	WBIF designation of this sub-project
WB(g)	World Bank (Group)
WBIF	Western Balkans Investment Framework
WB6	Western Balkans consisting of 6 countries: Albania, Bosnia and Herzegovina, Kosovo, the former Yugoslav Republic of Macedonia, Montenegro and Serbia
WFD	Water Framework Directive (Directive 2000/60/EC)

List of Tables

List of Figures

0 Preamble

The REGIONAL STRATEGY FOR SUSTAINABLE HYDROPOWER IN THE WESTERN BALKANS[1] — referred as "the Study" — is a sub-project under implementation by the WBIF-IPF3 Consortium led by Mott MacDonald, with the European Commission, DG NEAR D.5, being the Contracting Authority for the WBIF-IPF3 contract.

The six Western Balkans beneficiary countries comprise Albania, Bosnia and Herzegovina, the former Yugoslav Republic of Macedonia, Kosovo*, Montenegro and Serbia - the WB6 region.

The work programme of the Study includes 13 Tasks as stipulated in the Terms of reference (ToR):

- **Task 1: Hydropower role (past and future) in the regional and national context;**
- Task 2: Assessment of the current situation in the institutional-organisational framework relevant for hydropower development;
- Task 3: Assessment of the current situation in the legal-regulatory framework relevant for hydropower development;
- Task 4: Assessment of hydrology baseline, water-management by country and by river basin with transboundary issues;
- Task 5: Grid connection issues in network development context;
- Task 6: Identification of HPP projects and acquiring relevant information for the HPP inventory and investment planning;
- Task 7: Environmental, Biodiversity and Climate Change Analysis on (i) river basin level and (ii) country-level of identified hydropower schemes;
- Task 8: Establishment of the central GIS database;
- Task 9: Development of a web-based GIS application;
- Task 10: Multi-Criteria Assessment (MCA) of prospective hydropower projects;
- Task 11: Drafting of Regional Action Plan on Hydropower Development and compilation of Final report on the Study;
- Task 12: Establishment of IT-supported Information and Document Management System (IDMS);
- Task 13: Training and dissemination of Study results.

The Study deliverables encompass separate Background reports (BR) that focus on specific technical issues in professional areas related with hydropower sector development, e.g.:

- **Background report n° 1 (BR-1) – Past, present and future role of hydropower**
- Background report n° 2 (BR-2) – Hydrology, integrated water resources management and climate change considerations
- Background report n° 3 (BR-3) – Environment considerations
- Background report n° 4 (BR-4) – Regulatory and institutional guidebook for hydropower development
- Background report n° 5 (BR-5) – Transboundary considerations
- Background report n° 6 (BR-6) – Grid connection considerations
- Background report n° 7 (BR-7) – Inventory of planned hydropower plant projects
- Background report n° 8 (BR-8) – Identification of potential sustainable hydropower projects

This Background report no. 1 (BR-1), is the output and deliverable of Task 1. In addition, a stand-alone annex (Annex 2) has been prepared and appended to this report, which examines financing options for large

*This designation is without prejudice to positions on status, and is in line with UNSCR 1244 and the ICJ Opinion on the Kosovo Declaration of Independence.

[1] The designated WBIF code of this sub-project is WBEC-REG-EN-01.

hydropower project implementation in the Western Balkans. While this activity was not expressly prescribed by the ToR, this annex was developed for completeness, and has relevance to both the WB6 countries and IFIs.

Enlargement process

The EU Enlargement process is the accession of new countries to the European Union (EU). It proved to be one of the most successful tools in promoting political, economic and societal reforms, and in consolidating peace, stability and democracy. The EU operates comprehensive approval procedures that ensure new countries will be able to play their part fully as members by complying with all the EU's standards and rules (**the *"EU acquis"***). The conditions of memberships are covered by the Treaty on European Union.

Each country moves **step by step** towards EU **membership as it fulfils its commitment**s to transpose, implement and enforce the Acquis.

The EU relations with the Western Balkans countries take place within a special framework known as the **Stabilisation and Association Process (SAP)** in view of stabilising the region and establishing free-trade agreements. To this end, all WB6 countries have signed contractual relationships (bilateral **Stabilisation and Association Agreements, or SAAs**) which entered into force, depending on the country, between 2004-2016.

The **accession negotiations** are another step in the accession process where the Commission monitors the candidate's progress in meeting its commitments on 35 different policy fields (chapters), such as transport, energy, environment and climate action, etc., each of which is negotiated separately.

At the time of writing (November 2017), there are four WB6 countries that have been granted **Candidate Country** status: the former Yugoslav Republic of Macedonia, Montenegro, Serbia and Albania, while Bosnia and Herzegovina and Kosovo have the status of **Potential Candidate** countries at this date. With two countries, Montenegro and Serbia, the **accession negotiations** have already started and several of the chapters of the EU *acquis* have been opened.

To benefit from EU financing for projects, each country **should respect the EU legislation relevant to that project,** even if the national legislation has not been yet fully harmonised with the EU acquis.

The "Regional Strategy for Sustainable Hydropower in the Western Balkans" aims to set guidelines for a sustainable development of hydropower in the Western Balkans.

EU Acquis relevant to the Study

In the context of this Study, **the most relevant thematic areas are spread mainly over two Acquis Chapters** (15 on Energy and 27 on Environment) relating to water resources, energy, hydropower development and environmental aspects including climate change.

- Chapter 15 Energy Acquis consists of rules and policies, notably regarding competition and state aid (including in the coal sector), the internal energy market (opening up of the electricity and gas markets, promotion of renewable energy sources), energy efficiency, nuclear energy and nuclear safety and radiation protection.
- Chapter 27 relates to 10 sectors / areas: 1 - Horizontal Sector, 2 - Air Quality Sector, 3 - Waste Management Sector, 4 - Water Quality Sector, 5 - Nature Protection Sector, 6 - Industrial Pollution Sector, 7 - Chemicals Sector, 8 - Noise Sector, 9 - Civil Protection Sector, and 10 - Climate Change Sector.

Commission President Juncker said in September 2017 in his State of the Union address that: *"If we want more stability in our neighbourhood, then we must also maintain a credible enlargement perspective for the Western Balkans".* To Serbia and Montenegro, as frontrunner candidates, the perspective was offered that they could be ready to join the EU by 2025. This perspective also applies to all the countries within the region. This timeline also corresponds to the period for preparing such major infrastructures and their lifetime. Consequently, WB6 countries have to demonstrate now that they are and will develop sustainable hydropower according to EU rules.

Relevant pieces of EU legislation and international agreements

Hydropower development should be done while respecting relevant EU legislation and international agreements to which the WB countries are Parties. This includes:

- Renewable Energy (Renewable Energy Directive 2009/28/EC)
- Energy Efficiency Directives (2012/27/EU; 2010/30/EU; 2010/31/EU)
- Environmental Impact Assessment Directive (Directive 2011/92/EU as amended by Directive 2014/52/EU) and Strategic Environmental Assessment Directive (Directive 2001/42/EC)

- Water Framework Directive (Directive 2000/60/EC)
- Habitats Directive (Directive 92/43/EEC) & Birds Directive (Directive 2009/147/EC)
- Floods Directive (Directive 2007/60/EC)
- Paris Agreement on climate change
- Aarhus Convention (the UNECE Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters)
- Espoo Convention (the UNECE Convention on Environmental Impact Assessment in a Transboundary Context)
- Berne Convention (the Berne Convention on the Conservation of European Wildlife and Natural Habitats)

The framework conditions and legal obligations for hydropower development stem from the EU acquis and international obligations, the implementation of which should be supported through the Energy Community Treaty (to which all of the WB6 countries are signatories) as well as International River Basin Organisations.

As **Contracting Parties (CPs) to the Energy Community Treaty (ECT),** the WB6 countries have obligations and deadlines to adopt and implement acquis closely related to the energy sector / market development and environment such as:

- Electricity (Directive concerning common rules for the internal market in electricity (Directive 2009/72/EC); Regulation on conditions for access to the network for cross-border exchanges in electricity (Regulation (EC) 714/2009); Regulation on submission and publication of data in electricity markets (Regulation (EU) 543/2013))
- Security of supply (Directive concerning measures to safeguard security of electricity supply and infrastructure investment (Directive 2005/89/EC)
- Infrastructure (Regulation on guidelines for trans-European energy infrastructure (Regulation (EU) 347/2013)
- Energy Efficiency Directives (2012/27/EU; 2010/30/EU; 2010/31/EU)
- Renewable Energy (Renewable Energy Directive 2009/28/EC)
- EIA Directive (Directive 2001/92/EU);
- SEA Directive (Directive 2001/42/EC);
- Birds Directive (Directive 79/409/EEC);
- Directive on environmental liability with regard to the prevention and remedying of environmental damage (Directive 2004/35/EC as amended by Directive 2006/21/EC, Directive 2009/31/EC)
- Large Combustion Plants Directive 2001/80/EC

Note: We recognise that close coordination between the energy, environment and climate change legislation and policies is necessary in the context of sustainable hydropower development.

However, to avoid duplications in the BRs, issues related to the WFD and Floods Directives are addressed in more detail in BR-2 (Hydrology, integrated water resources management and climate change considerations) and BR-5 (Transboundary considerations), respectively while all other Directives (in addition to the WFD and Flood Directives) comprising the EU environmental legislative package (Habitats, Birds and SEA/EIA) are addressed in more detail in BR-3 (Environment considerations),

Small Hydropower Plants in the Regional Strategy for Sustainable Hydropower in the Western Balkans

While the 390 small hydropower plants in the Western Balkans 6 region represent almost 90% of all hydropower plants, they only produce 3-5% of the total hydropower generation and constitute 7% of the total hydropower capacity, most of hydropower energy and capacity in the region being delivered by the large hydropower plants.

This raises the question of the role of small hydro power plants and the pertinence of further developing such infrastructures. Their contribution to the global energy production and security of supply, or to the renewable energy sources targets, is extremely limited. In parallel, their impacts on the environment are severe, as they create multiple interruptions in water flows and fish passages, increase habitat deterioration and require individual road access and grid connections. Furthermore, while most of these small hydropower plants were commissioned after 2005, when the state-support schemes – mainly feed-in tariffs – which will be phased out after 2020 and hence it is expected that the private sector interest in developing small hydropower plants will diminish significantly.

Due to the large number of small hydropower existing plants and projects, and due to the questions on their role and pertinence, the Regional Strategy for Sustainable Hydropower in the Western Balkans focused on major hydropower contributors to the power system, that is to say large hydropower plants of a capacity above 10 MW. Nevertheless, wherever possible, small hydropower plants have also been addressed in the study.

1 Introduction

1.1 Background

The Western Balkan countries are abundant with water resources. In Europe, they represent among some of the most water-rich with respect to the amount of water available per person (10,600 m3/cap, which is twice the European average).

Among several other water uses and purposes (e.g. agriculture, irrigation, tourism & recreation, drinking water supply etc.), the potential energy of water in river systems is used for the production of electricity in hydro power plants (HPPs) of various types: reservoir, derivation, run-of-river and reversible HPPs, which cover both peak- and base-load demand for electricity, together with providing ancillary services, stabilising electricity networks, etc.

In the Western Balkans, there is still a large and as yet unexploited potential to generate electricity from these recognised rich hydrological resources. Based on various sources, it is estimated that, depending on the country, between approximately 43-85% of the technical hydropower potential remains currently unexploited. There are considerable differences in both available hydro potential as well as in historical hydropower sector development, from no more than about 75 MW of hydropower capacity being installed in Kosovo, to approximately 670 MW in the former Yugoslav Republic of Macedonia, 1,840 MW in Albania, 2,180 MW in Bosnia and Herzegovina and 3,160 MW in Serbia (the status as of end-December 2016). This amounts to around 8,600 MW in total in the Western Balkans (WB) 6 region, represented by 57 HPPs larger than 10 MW and 387 HPPs smaller than 10 MW (444 in total).

According to our survey and the database established to catalogue HPPs, the 57 larger HPPs represent approximately 93% of the installed hydropower capacity (and approx. 97% in terms of electricity generated from hydropower in the last 15 years) while the other 387 small HPPs (SHPPs) make up the remaining 7% in terms of capacity and 3% in terms of average annual generation, respectively.

An important historical factor is that about 90% of the presently installed hydropower capacity was constructed and commissioned in the former Social Federal Republic of Yugoslavia (SFRJ) before 1990 (of which 7.6% even before 1955), with only 10% being developed in the years after its disintegration.

Hydropower development used to be an asset of the former SFRJ. The country had its own research, engineering and industrial base which could plan, design, procure and construct any equipment used in HPPs, for both large or SHPPs. HPP technology was even an export product of SFRJ, primarily exported to developing (non-aligned) countries of the world.

The term “hydropower potential”, its definition and practical meaning has many interpretations in practice. This contentious understanding is often an element of debate in general public circles as well as among professionals and has even been used for manipulation and tendentious interpretation by several lobbying groups who have conflicting objectives. However, one aspect is perfectly clear, that the further “hydropower potential” development possibilities, under the current and foreseeable circumstances throughout the WB6 region, deserves thorough analysis within this project. The challenging questions, among others, at this departure point therefore include:

- Hydropower potential, its classification and practical meaning and the level of its utilisation to date;
- The dynamics of HPP construction in the past six decades – i.e. the past and present role of hydropower generation;
- The prospects for a coordinated and combined approach between (i) rehabilitation of existing HPPs as the first priority and the additional need for (ii) sustainable greenfield HPP projects so as to meet RES-policy objectives;
- The resulting scope for hydropower penetration in the electricity supply balance up to 2030 and beyond (2050) – which is the future role of hydropower generation throughout the WB6 region.

In analysing the options for sustainable hydropower development in the region, a balanced approach is required, considering both the recognised WB6 country-specific and regional obligations and constraints, related to: spatial planning, the environment and climate change, social aspects, implementation maturity and the technical / economics / financial aspects of HPP candidates.

1.2 Objectives of this background report

The overall objective of BR-1 is to set the scene for a comparative analysis of the past and future role of hydropower in electricity supply at both the regional (WB6) and the individual country level, to provide strategic views on:

- Plans for meeting ever-increasing electricity demand;
- HPP construction and HPP market penetration dynamics;
- The share of RES-E and in particular, hydropower, within the overall RES-E contribution to the electricity supply mix;
- A scenario of the possible combined share of developed hydropower potential up to 2030 and beyond (2050), delivered via a combination of (i) existing HPPs (large and small), (ii) additional yield by rehabilitation of existing HPPs, (iii) greenfield HPP projects (large and small);
- The prospective contribution of HPPs to the regional electricity market and their role in the technical operation of the power system.

The specific goals of Task 1 of the TOR, of which this background report (BR-1) is the output, are to accomplish the following planned results:

A/1 Excel-based Database of Existing HPPs by country is established. The DB consists of all large and small HPPs as per their status at the of end December 2016. Data include among others: GIS coordinates, key technical characteristics and annual power generation in their entire lifetime since their commissioning, together with the status of possible rehabilitation / reconstruction plans.

A/2 Role of hydropower generation in the broader electricity supply/demand contexts (past and long-term future) is assessed together with specific advantages of hydropower generation (e.g. ancillary services), electricity market development opportunities and combat against climate change.

1.3 Activities undertaken and methodology adopted

In fulfilling the requirements of Task 1, the Consultant performed the following specific activities and methodological approach:

Activity 1.1: Establishment of the Database on existing hydro power plants in the WB6 region

Initial data were collected and an analysis was made of that data during the Scoping Stage (May-June 2016). The observations revealed that certain discrepancies exist with respect to the existing HPPs in the WB6 countries. Many HPPs have been the subject of rehabilitation following war damage in former Yugoslavia, or their maintenance has been neglected for a significant period. The characteristics of these HPPs have changed after re-commissioning. Particularly contradictory data were for average annual production and net available capacities, while the typically missing or lacking data included; (1) information on annual production over their long-term periods of service in the past, (2) the status and plans regarding prospective rehabilitation or reconstruction measures, and (3) their specific geographic coordinates needed for the HMP-GIS system development (see also Task 8).

During the Scoping Phase, the Consultant developed an Excel model to establish a database (DB) of the existing HPPs by country, which was communicated to the WB6 countries (ministries and power utilities). This partially-completed activity in the rather short Scoping Stage was extensively continued throughout the whole Study Stage to date, by enhancing the DB and by introducing additional Excel-based tools. These tools were introduced to connect and understand two closely related issues: the assessment of the hydro potential and the HPPs developed to utilise such potential.

During the Study Stage (since October 2016), the DB of existing HPPs and the inventory of hydropower potential were finalised to the extent possible. This was achieved thanks to close collaboration with the power utilities that operate the existing fleet of HPPs and the national authorities that are regarded as possessing the best estimates of the hydropower potential, and after many iterations, to ensure that the DB contains reliable data, which is used further in the Study and for reference.

While undertaking these activities, the following issues were identified:

a) DB of existing HPPs:

- The 8 power utilities in the region[2] demonstrated different levels of interest and commitment for cooperation with the Study, ranging from exemplary cooperation to a very much more hesitant attitude (as the HPP operators did not see any direct benefits to them arising from the study), which resulted in some utilities only starting to cooperate late, in February 2017. Consequently, those "later" utilities provided data that differs in terms of scope and quality, which therefore impacts the overall statistics for the region.
- Ministries representing the owner of national power generation utilities (the State) in most cases have traditionally limited capacities and other priorities than to assist the Consultant in this project;
- Other stakeholders (e.g. TSO/DSO, energy regulators, market operators etc.) do not have comprehensive data, as they regularly only collect data and maintain their registries for selected data categories and purposes (e.g. guarantee of origin, licenses, qualified producers etc.);
- National statistical offices do not have very detailed or disaggregated data, neither do the international sources (e.g. IEA), who operate entirely with data provided by such offices.
- We consider that particularly deficient / unreliable data were provided on locations / coordinates for HPPs (input to HDS-GIS system), environmental data (possible location in protected areas, fish passes and minimal water flows) and on small HPPs in general (location, planned annual output, actual production in the past etc.).

b) Assessment of the hydropower potential:

- In general, there are no institutions at the national level in charge of this issue, which is cross-sectoral (natural resources / water economy, energy etc.). Water authorities, ministries and power utilities use various sources and possess different opinions;
- Many reference sources used were developed in former SFRJ and have not been updated since then, or are generally quite outdated, and to some extent data sources were developed following different methodologies;
- The conditions that impact the additional or remaining hydropower potential have changed in the last 2-3 decades. Most rivers and river basins have become cross-border rivers and (sub)river basins in the new political arrangements that followed the disintegration of former Yugoslavia. This cross-border effect makes splitting of the hydropower potential between WB6 countries additionally complicated or even disputed (a typical transboundary issue, see BR-5 for details);
- Consequently, an answer to the contentious question about "the share / the extent hydropower potential is utilised by a country at present" is even more difficult to assess and is often disputed even within the country.

The Excel-based tools are ready to absorb any new updates on HPPs and hydropower potential assessments with an aim of providing the most up-to-date statistics on these elements, but this requires that the data providers mentioned above fulfil the basic need – i.e. provide high-quality and full-coverage data and information. Although we did not get all up to date info, we are confident the presented results are the best possible estimates at present. Many information sources (local and international) were consulted in the data collection process, comparative analysis carried out, together with our expert judgement which was required in conditions of identified lack of data convergences.

The sensitivity of individual data categories relating to imperfect data and/or coverage is further discussed later in this report.

National experts in each country were deployed to facilitate the demanding process of data collection and verification. Data verification is particularly important because it ensures that the final DB seems to be the most comprehensive resource on existing HPPs in the WB6 region that currently exists. The verification process also

[2] KESH of Albania, EPBIH, EP HZHB and MH ERS of Bosnia and Herzegovina, ELEM of the former Yugoslav Republic of Macedonia, KEK of Kosovo, EPCG of Montenegro, and EPS of Serbia.

means that certain discrepancies with other available sources (e.g. IEA statistics, ENC reports, RiverWatch interactive map (2015), IRENA report (January 2017) etc.) can be better understood.

Extra attention was paid to the collection of data, plans and investment requirements for rehabilitating / reconstructing existing HPPs. In contrast to new HPP projects, refurbishment projects are considerably more likely to happen, and are usually “win-win” investment opportunities, resulting in the prolonged lifetime of already depreciated power generation facilities. Rehabilitation will assure ongoing low-cost generation, and will safeguard reliable and highly efficient HPP operation. However, the preparations for rehabilitations are typically made by the in-house technical maintenance staff of HPPs, and this planning process is constrained by these staff not having all the required data or project information. The planning of rehabilitations asks for inspections of technical performance of installed equipment over the long term, critical identification of the opportunities for repairs and improvements, development of rehabilitation project plans in all the classic senses of project development (specification of goods and services, project implementation / management plans, financing etc.) as well as comparisons of rehabilitation project investments with other investment opportunities that a utility or operator may consider. Expectations that any environmental improvement or mitigation measures are included in the scope of rehabilitations is considered to be an additional requirement, where operators & utilities used to “business as usual” may not demonstrate the desired level of commitment to make any environmental interventions, which have a cost and do not result in tangible benefits to the operator. In the Consultant’s opinion:

- Data provided for already completed (partial or full) rehabilitation of HPPs, as well as planned measures for future rehabilitations, are not at the same or a sufficient level of detail;
- From the information obtained, it is sometimes difficult to assess the main purpose of interventions, whether to improve safety and operations, or to prolong the service-life time of the plants, or both (sometimes there is even no need to distinguish);
- The level of information presented makes it impossible to ascertain whether the plant envisaged for rehabilitation will be fully rehabilitated, and can be expected to continue its service for another 40 years, for example, or if additional measures will be required during the 40-year extension-of-life period;
- However, the reported completed and planned HPP rehabilitations can at least serve as an indicative plan for rehabilitations in the WB6. In doing so, then one can conclude that most utilities are already worryingly late in their preparations for extension-of-life rehabilitations, all of which are required in the period up to 2030 as most large HPPs were commissioned before 1990.

Finally, additional efforts were made in collecting data on the existence and operation of fishpasses together with data on minimal water discharge flows (to be used in the assessment of ecologically acceptable flows) at existing HPPs.

Activity 1.2: Prospective electricity balances with an emphasis on hydropower generation (until 2020/2030 with outlook for 2050)

The Consultant met with local stakeholders (ministries, regulators, TSO/DSOs and HPP operators / power utilities), to obtain their latest information on their power sector strategies, policies and action plans, to supplement the publicly-available materials available on the websites of the respective organisations. There are strategic planning documents (strategies, action plans, e.g. NREAPs, 10-year Development Plans of TSOs) prepared in most WB6 countries. However, these plans address the medium-term time horizon only, in the best case for the next 10-15 years, or to 2030, while the economic lifetime of HPPs is typically 40+ years, and which is normally extended to several more decades in practice.

The European Commission's “Energy Roadmap 2050” (2011) sets out four main routes to a more sustainable, competitive and secure energy system by 2050: energy efficiency, renewable energy, nuclear energy and carbon capture and storage. Decarbonising the energy system is technically and economically feasible and the contribution of RES-E sector in this respect is considerable. In this context, hydropower generation in the WB6 region seems to be a promising opportunity, due to the considerable untapped hydro-potential in the region. However, “*investments for a period of several decades have to be made soon, and policies that promote a stable business climate which encourages low-carbon investments must begin to be made today*.” (https://ec.europa.eu/energy/en/topics/energy-strategy/2050-energy-strategy).

Based on a review of strategic planning documents at the national level and in direct discussions with relevant local institutions, the Consultant assessed the hypothetical development of the hydropower sector in the future for individual WB6 countries. Based on the application of a well-tested and respected simulation (a "bottom-up" energy demand planning model complemented with expert judgement), an electricity demand forecast to 2030, with a long-term outlook for 2050, was developed. It is to be noted that none of the existing WB6 strategic planning documents in the energy sector address this longer time horizon. Based on this demand forecast, an estimate of possible hydropower contribution to the electricity supply mix was prepared, based on the results of the Multi-Criteria Assessment (MCA&FEA) of greenfield HPP candidates in Task 10 / BR-8. The hydropower contribution to the supply mix is based on an important assumption, that all existing HPPs will be rehabilitated reasonably on time in order to be fit to continue their service till 2050 at least at the current level of available capacity and output – i.e. the current fleet of HPPs should not degrade over time.

The future sustainable hydropower development strategy therefore relies on hydropower contributing to meeting future electricity demand by (in priority order):

1. Rehabilitating existing HPPs (large and small) thus prolonging their service lifetime for another 40 years, if possible, together with any additional capacity and output obtained after the rehabilitation. All possible environmental protection / improvement measures should be explored and possibly implemented alongside the technical rehabilitation of the facilities;
2. Developing additional capacities in greenfield HPP projects (large and small) provided such projects demonstrate sustainable solutions from the environmental and societal points of view.

In this way, hydropower can and should play a significant role in the regional power system development, and it is made possible through the rich natural resources regarding the hydropower potential of the region, notwithstanding the prospective impacts of climate change on rainfall, which are elaborated in BR-2. Hydropower will in future play a decisive role and contribute to: (i) safeguarding the security of electricity supply, and (ii) the achievement of various national policy targets (RES share in GFEC[3], CO2 reduction etc.), even though no mandatory targets are presently set for the period beyond 2020.

Hydropower generation is assessed as part of the future electricity generation mix and possible complementary production in thermal power plants, the production volume of which is likely to gradually diminish due to (i) decommissioning, (ii) reduced power generation regimes after the implementation of Directive 2001/80/EC on the limitation of emissions of certain pollutants into the air from large combustion plants (after the general implementation deadline of 31.12.2017), (iii) growing reservations of key investors to continue with the unpredictable coal-for-power business, associated with possible CO2-coupons revenue recovery in ETS in the EU.

Because the scope of the Study was hydropower development, other non-hydropower sources which include other renewables-based electricity sources (RES-E) like wind, solar, biomass etc. have not been explicitly analysed. Further electricity market developments and improved implementation conditions for RES-E could also stimulate interest in investing in new HPPs as well as other RES-E technologies.

Due to the very unpredictable long-term future and obvious huge uncertainties, the Consultant applied a robust approach to develop an aggregated electricity demand forecast for the WB6 as a whole. In this assessment, the Consultant has considered GDP and population growth as the main demand generators as well as structural changes, fuel and technology substitutions in end-use. Energy efficiency measures by sector, penetration of modern technologies and changing living standards and mobility patterns were also considered. The results were checked with respect to benchmarks in terms of the expected decrease in energy intensities as well as overall energy consumption per capita as experienced elsewhere in Europe.

The estimated possible hydropower generation development identified in Task 10, in conjunction with the electricity demand growth scenario in this task, represent the electricity demand-supply balance and allow the estimation of the magnitude of HPP sector development to 2030 and beyond (2050).

1.4 Links with other tasks / background reports of the Study

Task 1 is linked with the following other tasks and BRs either as a provider of inputs to or a recipient of data, information and results from them. Thus, Task 1 is:

- Recipient from Task 4 (hydrology) / BR-2 in terms of deploying a common and harmonised system of hydrography (rivers, river basins and sub-river basins etc.) in WB6;

[3] GFEC – Gross Final Energy Consumption.

- Provider to the assessment of possibilities and needs for rehabilitations of existing HPPs in Task 6 (inventory of HPP projects, both rehabilitations and greenfield ones) / BR-7;
- Provider to Task 7 (environment) / BR-3 with respect to information on fish passes and minimal water flows of existing HPPs;
- Provider to the central GIS database and application (Tasks 8-9 / BR-7);
- Recipient of results from Task 10 (MCA&FEA) / BR-8, based on which electricity balances are established in Task 1;
- Provider to Task 11 (regional Action Plan), which is Annex 1 to the Final report.

2 Classification of hydro power plants

In terms of technological strengths, HPPs have very high efficiency compared to other power plants. They have a very long economic lifetime (40 years +) with possibilities for lifetime extension and lesser impact on the environment (particularly with respect to emissions and the contamination of air, soil and water, but that may not hold true for potential negative impacts on nature preservation), low production cost, less maintenance and flexibility in operation and control.

With respect to possible technological weaknesses and SEA/EIA/ESIA considerations, the main drawbacks of HPPs are higher initial construction cost and in many cases the land requirement for the construction of a reservoir, which may lead to landscape, environmental and social impacts such as resettlement that are difficult to mitigate. For hydropower programmes, master / action plans and similar energy policy initiatives that impact multiple sectors at a strategic level, a SEA is required in full accordance with EU legislation. The SEA Directive has already been transposed to national legislation in all WB6 countries. At a later stage in the development process, an EIA or ESIA is required at the project level, which is within the responsibility of the project developer to present to the national authorities and possibly the financial institution for approval.

Generally, HPPs can be classified based on their:

- hydraulic features (conventional, reversible (REV) or pumped storage (PS) etc.);
- operational features (base, medium, peak load);
- presence or absence of water storage (storage / reservoir (RES), run-of-river (ROR) with and without water basin);
- location of machine house (derivative (DER) etc.);
- capacity (micro, mini, small (SHPP), medium, large, super large);
- head (low, medium, high, very high).

A) Classification based on the hydraulic features

Based on the hydraulic features, hydro power plants can be classified into 4 (four) types:

- Conventional HPPs

  These plants utilise the hydraulic energy of the flowing water of the rivers by deploying different schemes and technological solutions (RES, ROR, DER) how to utilise the head and water masses – potential and kinetic energy of water.

- Pumped storage plants (reversible HPPs - RHPP)

  In this type of HPPs the same water is utilised again and again by pumping back during the off-peak hours. They are mainly used to meet the peak demand for electricity.

- Tidal power plants

  These power plants produce electric energy from the tides of the seas (Irrelevant for WB6 region due to low tides in Adriatic Sea).

- Depression power plants

  In this type of power plant, water is diverted into a natural topological depression which provides head for the plant. Water is diverted from ample resources such as seas. It is a rare type of power plant. (Note: this type of power plants exists in Egypt.)

The Study addresses only conventional and reversible HPPs.

B) Classification based on the operation

- <u>Base-load HPPs</u>

  These types of plants are involved in continuous power generation. Simply speaking, conventional hydroelectric power plants are base load plants.

- <u>Peak-load plants</u>

  If the power plant is operated only to meet the peak demand, then it is called a *peak load plant*. In general, pumped storage power plants are peak load plants.

The Study addresses all types of HPPs, including both base- and peak-load HPPs.

C) Classification based on storage (water reservoir)

By considering the presence of storage reservoirs, HPPs can be classified into power plants having a storage reservoir (that can collect seasonal or monthly water flows) and those without a storage reservoir. If there is a natural water flow throughout the year, there is less need to have a reservoir as the HPP can operate on a daily flow basis ("run-of-river" HPPs). Under such conditions, a mini reservoir or pond that takes care of day to day fluctuations is sufficient storage. Along a river, the overall hydro potential can best be utilised by a combination of storage and run-of-river HPPs. In this case, typically the first HPP contains storage which accumulates water over a longer period of time, followed by a cascade of run-of-river type HPPs that utilise the daily water flow discharges from the first plant and the last HPP in the cascade is typically a run-of-river with water basin, where the task, apart from generating power, is also to regulate the final discharge of the whole cascade to the river, which is important for several downstream users (fishery, flora/fauna, agriculture / irrigation purposes etc.).

The Study addresses all types of HPPs, both those with storage and without.

D) Classification based on plant capacity

With respect to types of HPPs and capacity ranges, only indicative definitions (see the following table) and no absolute standard definitions exist. Therefore, in practice, each country defines in its own legislation / regulations the exact meaning of capacity ceilings by type of HPPs.

Type	Capacity
Micro hydro HPPs	< 100 kW
Mini hydro HPPs	100 kW to 1MW
Small HPPs	1 MW to a few MW
Medium HPPs	More than a few MW
Large / Super large HPPs	Up to / more than 1,000 MW

In most Western Balkan countries, the national legislation and regulations recognise HPPs to be small if their installed capacity does not exceed 10 MW. Exceptions are in Kosovo and Serbia, where power generators up to 15 MW and even 30 MW, respectively, are entitled to benefit from state-support schemes (e.g. FIT) having the status of "privileged producers".

The Study addresses both HPPs that exceed 10 MW of installed capacity on an individual basis (called "Large HPPs") as well as those with less than 10 MW of installed capacities (called "small HPPs") on an aggregate or "per-county" basis.

E) Classification based on head

Based on the available head hydro power plants are classified into the following:

Type	Head
Low head plants	< 15 m
Medium head plants	15 – 70 m
High head plants	70 – 250 m
Very high head plants	More than 250 m

- <u>High head power plants</u>

Due to the height, a small amount of water can produce a large amount of power and this type of HPP enables the operator to receive a high revenue for energy and power (in an integrated power market where the provision of ancillary services – e.g. regulation and various power system reserves – is valued highly). Therefore, these types of plants are very economical but require a very high initial investment cost due to demanding construction works. The reservoir is found at the top of the mountain and the power house is found at the foot. For high head plants, a water catchment area of small capacity is sufficient. If the water from one stream is not sufficient, more intake water can be diverted from the neighbouring streams.

- Medium head plants

  Due to lower heads, a larger volume of water is typically required in this type of power plant. The reservoir capacity will need to be large. In these power plants, water is carried from the reservoir to the penstock through the forebay. There is no need for a surge tank as the forebay itself acts as a surge tank.

- Low head plants

  Low head plants require a larger volume of water than high and medium head plants to produce the same amount of power. The reservoir capacity will be large.

The Study addresses HPPs of all head sizes.

3 Database of existing HPPs

3.1 Structure of DB

The database (DB) of existing HPPs was developed for the Study to be fully informed about the past developments in hydropower in the WB6 Region and to develop a clear starting point for the future hydropower development. For that purpose, an Excel-based model of the DB was developed, which was presented to and discussed with most ministries and all power utilities in the region during July and August 2016. The approach to data collection within the project was not to collect data and information from intermediary sources (e.g. statistical offices, websites or other reports) but from the original sources directly. Following the collection of the data, the project team asked the data providers to verify all data contained within the DB, which is regarded as a value-added activity within this exercise.

Data and information were collected for this task i.e. to facilitate this background report, as well as for further use by other tasks and BRs.

The complete list of “data categories**”** collected during the data collection campaign are the following:

1. Name of hydro power plant [-]
2. Latitude and longitude of engine house of the HPP [vary between systems]
3. HPP Operator [-]
4. HPP Owner [-]
5. River / Tributary, on which the HPP is located [-]
6. Appropriate Basin or (Sub)River Basin [-]
7. Plant type (either ROR -run-of-river, RES – reservoir-type (with turbine at DAM or with DER - derivation, REV - reversible) [-]
8. Total reservoir storage volume in the case of RES [mill m3]
9. Number and structure of units [n x N MW]
10. Year when HPP entered commercial operation [year]
11. Whether HPP is located in a Protected Area – PA [yes / no]
12. Type of PA if the previous answer is “yes” [-]
13. Installed capacity (P_{max}) as of end-December 2016 [MW]
14. Average annual output (W_a) [GWh]
15. Net electricity production per year since its commissioning till 2015 [GWh]
16. Rehabilitation plans of the operator / owner (past and future), including:
    a. Comment on major rehabilitations undertaken since commissioning[4]
    b. Comment on major rehabilitation plans in the future, including
        i. Anticipated plans[5]
        ii. Anticipated capacity increase resulting from the intervention [MW]
        iii. Anticipated electricity output increase resulting from the intervention [GWh]

[4] List major rehabilitation works and/or equipment rehabilitated and/or replaced since its commissioning and when was this done (year). If the installed capacity and planned annual output of the HPP changed after such rehabilitation as compared to original design values, please mention the new values for MW and W_a.

[5] Has the operator/owner any concrete plans at present for major rehabilitation works and/or equipment rehabilitation and/or replacement, to be implemented when (year), and at what estimated investment cost? Will the installed capacity and planned annual output change and to what values? Note, "rehabilitation" denotes any of the following interventions: (i) rehabilitation, (ii) revitalisation or (iii) reconstruction with or without additional capacity and output.

iv. Investment costs of the rehabilitation [mill EUR]

v. Other key effects / results of rehabilitation? Any environmental improvement measures planned? [-]

17. Fish-related issues and residual / ecologically acceptable flow, including:
    a. Is the HPP equipped with functional fish pass? [yes / no]
    b. Is fish pass planned in case of rehabilitation? [yes / no]
    c. Is residual flow or ecologically acceptable flow (EAF) determined for the HPP? If "yes", state the value [-]

On this basis, the following derived data were calculated:

18. Capacity factor (= $W_a/(P_{max}$ x 8,760) [%]
19. Output in 2015 [GWh]
20. Average output in the last 15 years (2001-2015) [GWh/a]
21. Average annual output in the last 25 years (1991-2015) [GWh/a]
22. Maximum annual output (and year) since its commissioning [GWh], [year]
23. Average Capacity factor in the last 15 years [%]
24. Average capacity factor in the last 25 years [%]

It was planned that data are collected for all HPPs in the WB6 that existed on 31 December 2016, separately for (i) HPPs of more than 10 MW and (ii) less than 10 MW, or for large and small HPPs respectively, according to the adopted classification in the Study.

The data providers (mainly utilities and partially also ministries supported by project team national experts deployed in the Study) reported on **444 HPPs, of which 57 are “large” HPPs and 387 are “small” SHPPs**, the results of which are reported in detail further in Section 3.

Selected primary data and derived information for large HPPs are summarised in Tables 3.1-3.2, while selected data for small HPPs by WB6 country are shown in Table A1-1 in Annex 1.

Table 3.1: Selected primary data for 57 large HPPs in WB6 (part 1 of 2)

SN1	SN2	Plant	HPP Operator (-)	Owner (-)	River / Tributary (-)	Basin or (Sub)River Basin (-)	Plant type 3) (-)	Total reservoir storage - volume (mill m3)	Number and structure of units (nxN MW) 4)	Entered into commercial operation (year)
		Albania (ALB)								
1	1	Drin River cascade / Fierza	Korporata Elektroenergjitike Shqiptare sh.a (KESH)	not identified	Drin	Drin-Bune	RES	2.350,0	Francis 4*125 MW	1976
2	2	Bistrica 1 and 2 cascade	Hec Bistrica 1 dhe 2 sha	Kurum International sha (owned by Kurum Holding A.S.)	Bistrica	Bistrica	ROR	n.a.	n.a.	1962
3	3	Drin River cascade / Komani	KESH	not identified	Drin	Drin-Bune	RES	188,0	Francis 4*150MW	1985
4	4	Drin River cascade / Vau i Dejes	KESH	not identified	Drin	Drin-Bune	RES	310,0	Francis 5*50MW	1970
5	5	Uleza and Shkopeti cascade 1	Kurum International Sh.A.	Kurum International sha (owned by Kurum Holding A.S.)	Liqeni i Ulzes	Mat	RES	10,0	4xKaplan 6.25 MW	1954
6	6	Uleza and Shkopeti cascade 2	Kurum International Sh.A.	Kurum International sha (owned by Kurum Holding A.S.)	Liqeni i Shkopeti	Mat	RES	124,0	4xFrancis 6.0 MW	1956
7	7	Drin River Cascade / Ashta 1	Energji Ashta Shpk	VERBUND and EVN	Drin	Drin-Bune	ROR	n.a.	45xpropoller 0.438MW	2013
8	8	Drin River Cascade / Ashta 2	n.a.	n.a.	Drin	Drin-Bune	ROR	n.a.	45xpropoller 0.6338 MW	2013
9	9	Vlushe	"Hec Vlushe " shpk	Mr. Reoland Jegeni	Corovode	Osumi	DER	n.a.	2-Pelton Vert - 7.1 MW	2014
10	10	Sllabinje (Fterre Sarande)	shpk	Mr. Naimir Kurti	Shkumbin	Shkumbin	ROR	n.a.	1*3.8MW)	2012
11	11	Martanesh (Bulqize)	"Albanian Power" shpk	Mr. Zeljko Kokolj	Zalli i okshtunit	n.a.	DER	n.a.	n.a.	2012
12	12	Pobreg	"Energy Plus" shpk	Mr. Sokol Meqemeja	Luma	Drin	DER	n.a.	n.a.	2013
13	13	Llapaj	"Gjo.Spa.POWER" shpk	Mr. Silvio Allamandi	Bushtrica	Drin	ROR	n.a.	2xPelton 6.81 MW	2012
14	14	Bele 2	ALB ENERGY	Mr, Pellumb Beta	Luma	Drin	ROR	n.a.	3xFrancis 3.7MW	2015
15	15	Tervol	HEC TERVOL	Mr. Feti Mehmeti	Holte	Devoll	ROR	n.a.	2MW	2012
16	16	Okshtun+Ternove+Lubalesh 1	DITEKO shpk	Mr. Shkelqim Golli	Zalli i okshtunit	Drin	RES	10,7	3xPelton 5 MW	2016
17	17	Lubalesh2+Gjorice	DITEKO shpk	Mr. Shkelqim Golli	Zalli i okshtunit	Drin	ROR	n.a.	3xFrancis 3.7 MW	2014
		Bosna and Herzegovina (BiH)								
18	1	Mostarsko Blato	EP HZHB	EP HZHB	Lištica	Neretva	ROR	1,6	2x30	2010
19	2	Višegrad	ERS / HE na Drini	ERS / HE na Drini	Drina	Sava	ROR	161.000,0	3x105	1989
20	3	Peč Mlini	EP-HZHB	EP-HZHB	Tihaljina	Adriatic	ROR	0,8	2x15.9	2004
21	4	Jajce 1	EP-HZHB	EP-HZHB	Pliva	Vrbas	ROR	24,0	2x30	1957
22	5	Bočac	ERS / HE na Vrbasu	ERS / HE na Vrbasu	Vrbas	Sava	RES	52,1	2x55	1981
23	6	Rama	EP-HZHB	EP-HZHB	Rama	Neretva	RES	487,0	1x81.8; 1x95.7	1968
24	7	Jablanica	EPBIH	EPBIH	Neretva	Neretva	RES	318,0	6x30	1955
25	8	Grabovica	EPBIH	EPBIH	Neretva	Neretva	ROR	19,8	2x57	1982
26	9	Salakovac	EPBIH	EPBIH	Neretva	Neretva	ROR	68,1	3x70	1982
27	10	Una-Kostela	EP-BIH	EP-BIH	Una	Sava	ROR	0,0	4x2.5	1954
28	11	Čapljina	EP-HZHB	EP-HZHB	Trebišnjica	Trebišnjica	ROR	7,1	2x210	1979
29	12	Jajce 2	EP-HZHB	EP-HZHB	Vrbas	Sava	ROR	3,9	3x10	1954
30	13	Trebinje 1	ERS / HE na Trebišnjici	ERS /HE na Trebišnjici	Trebišnjica	Trebišnjica	RES	1.227,6	2x54; 1x63	1968
31	14	Mostar	EP-HZHB	EP-HZHB	Neretva	Neretva	ROR	10,9	3x24	1997
32	15	Dubrovnik G2	ERS / HE na Trebišnjici	ERS /HE na Trebišnjici	Trebišnjica	Trebišnjica	RES	15,7	1x126	1965
33	16	Bogatići	ERS / ED Pale	ERS / ED Pale	Željeznica	Bosna	ROR	0,0	2x4	1947
		The former Yugoslav Republic of Macedonia (MKD)								
34	1	Kalimanci	EVN Macedonia Elektrani DOOEL	EVN AG	Bregalnica	Vardar	RES	127,0	2x6.9	1970
35	2	Vrben	JSC Macedonian Power Plants (A.D ELEM)	JSC Macedonian Power Plants (A.D ELEM)	Korab	Vardar	ROR	N/A	2x6.4	1959
36	3	Shpilje (also Špilje)	JSC Macedonian Power Plants (A.D ELEM)	JSC Macedonian Power Plants (A.D ELEM)	Radika	Black Drin	RES	506,0	3x28	1969
37	4	Tikvesh	JSC Macedonian Power Plants (A.D ELEM)	JSC Macedonian Power Plants (A.D ELEM)	Reka Crna	Vardar	RES	479,6	2x28.62; 2x28.02	Two units in 1968. Two units in 1981
38	5	Vrutok	JSC Macedonian Power Plants (A.D ELEM)	JSC Macedonian Power Plants (A.D ELEM)	Korab	Vardar	RES	376 Mavrovo Lake	4x41.4	1973
39	6	Raven	JSC Macedonian Power Plants (A.D ELEM)	JSC Macedonian Power Plants (A.D ELEM)	Korab	Vardar	ROR	376 Mavrovo Lake	3x7.2	1973
40	7	Globočica	JSC Macedonian Power Plants (A.D ELEM)	JSC Macedonian Power Plants (A.D ELEM)	Black Drin	Black Drin	RES	55,3	2x21	1965
41	8	Kozjak	JSC Macedonian Power Plants (A.D ELEM)	JSC Macedonian Power Plants (A.D ELEM)	Treska	Vardar	RES	550,0	2x42	2004
42	9	Sveta Petka (Matka 2)	JSC Macedonian Power Plants (A.D ELEM)	JSC Macedonian Power Plants (A.D ELEM)	Treska	Vardar	RES	9,0	2x18	2012
		Kosovo (KOS)								
43	1	Ujmani	POE Iber Lepenc HPP	not identified	Lepenac, Ibar	Morava	RES	n.a.	2x17.5 MW	1979
		Montenegro (MNE)								
44	1	Perućica	EPCG	EPCG	Zeta	Morača	RES	225,0	5x38; 2x58.5	1960
45	2	Piva	EPCG	EPCG	Piva	Drina	RES	880,0	3x114	1976
		Serbia (SER)								
46	1	Bajina Bašta	EPS	EPS	Drina	Drina	RES	340,0	4x105	1966
47	2	Uvac	EPS	EPS	Uvac, Lim	Drina	ROR	213,0	1x36	1979
48	3	Potpeč	EPS	EPS	Lim	Drina	ROR	44,0	3x17	1967
49	4	Djerdap 1 (Iron Gate 1)	EPS	EPS	Danube	Danube	ROR	2.550,0	3x176.3; 3x190	1972
50	5	Djerdap 2 (Iron Gate 2)	EPS	EPS	Danube	Danube	ROR	868,0	10x27	1985
51	6	Pirot	EPS	EPS	Visocica	Danube	RES	170,0	2x40	1990
52	7	Kokin Brod	EPS	EPS	Uvac, Lim	Drina	RES	273,0	2x11	1962
53	8	Vrla 1-4 (HPP Vlasina)	EPS	EPS	Vlasinsko jezero, Vlasina	Južna Morava	RES	176,0	1x10.5; 3x11.2; 1x12.8; 1x13.3; 1x13.6; 2x14.3; 1x16.6	1955
54	9	Lisina (REV HPP)	EPS	EPS	Lisina, Vlasina	Morava	REV	10,0	2x14	1977
55	10	Bistrica	EPS	EPS	Uvac, Lim	Drina	RES	7,6	2x51	1966
56	11	RHE Bajina Bašta	EPS	EPS	Drina	Sava	REV	170,0	2x307	1982
57	12	Zvornik	D-LH d.o.o	EPS	Drina	Sava	ROR	89,0	4x24	1955 / Rev 2016

Table 3.2: Selected primary data and derived data for 55 large HPPs in WB6 (part 2 of 2)

SN1	SN2	Plant	Entered into operation (Year)	Capacity (MW)	Output (GWh)	Capacity Factor (Design CF) (%)	Average output in last 15 years (GWh)	Average CF in last 15 years (CF15) (%)	Difference (CF15 - Design CF) (%)	Average output in last 25 years (GWh)	Average CF in last 25 years (CF25) (%)	Difference (CF25 - CF15) (%)	Maximum ouput (and year) since its commissioning (GWh)	(Year)
		Albania (ALB)												
1	1	Drin River cascade / Fierza	1976	500,0	1.544,0	35,3	1.466,0	33,5	-1,8	1.373,7	31,4	-2,1	2.668,7	2010
2	2	Bistrica 1 and 2 cascade	1962	22,5	119,6	60,7	128,7	65,3	4,6	15,4	7,8	-57,4	137,0	2009
3	3	Drin River cascade / Komani	1985	600,0	1.722,0	32,8	1794,4	34,1	1,4	1.801,8	34,3	0,1	2.872,7	2010
4	4	Drin River cascade / Vau i Dejes	1970	250,0	880,0	40,2	952,4	43,5	3,3	930,7	42,5	-1,0	1.511,2	2010
5	5	Uleza and Shkopeti cascade 1	1954	25,2	105,4	47,7	111,2	50,4	2,6	26,7	12,1	-38,3	150,0	2010
6	6	Uleza and Shkopeti cascade 2	1956	24,0	70,3	33,4	70,8	33,7	0,3	17,0	8,1	-25,6	120,0	2010
7	7	Drin River Cascade / Ashta 1	2013	22,2	180,0	36,0	216,3	111,2	75,2	216,3	111,2	0,0	236,8	2015
8	8	Drin River Cascade / Ashta 2	2013	34,2	165,0	55,1	0,0	0,0	-55,1	0,0	0,0	0,0	0,0	2015
9	9	Vlushe	2014	14,2	44,8	36,0	12,2	9,8	-26,2	6,1	4,9	-4,9	17,5	2015
10	10	Sllabinje (Fterre Sarande)	2012	13,8	43,5	36,0	31,0	25,6	-10,4	31,0	25,6	0,0	37,7	2013
11	11	Martanesh (Bulqize)	2012	10,5	33,1	36,0	15,0	16,3	-19,7	20,0	21,7	5,4	21,9	2015
12	12	Pobreg	2013	12,7	40,1	36,0	28,1	25,2	-10,8	21,1	18,9	-6,3	36,4	2015
13	13	Llapaj	2012	13,6	43,0	36,0	36,1	30,3	-5,7	144,5	121,1	90,8	53,3	20,3
14	14	Bele 2	2015	11,0	34,7	36,0	0,0	0,0	-36,0	n.a.	n.a.	n.a.	n.a.	n.a.
15	15	Tervol	2012	12,0	37,8	36,0	32,9	31,3	-4,7	7,9	7,5	-23,8	39,8	2013
16	16	Gjorica cascade / Okshtun+Ternove+Lubalesh 1	2016	15,0	47,1	36,0	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
17	17	Gjorica cascade / Lubalesh2+Gjorice	2014	10,9	34,2	36,0	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
		Total ALB		**1.591,7**	**5.144,6**	**36,9**	**4895,1**	**35,1**	**-1,8**	**4.612,2**	**33,1**	**-2,0**		
		Bosna and Herzegovina (BiH)												
18	1	Mostarsko Blato	2010	60,0	160,0	30,4	89,3	17,0	-13,4	n.a.	n.a.	n.a.	168,8	2013
19	2	Višegrad	1989	315,0	1.108,0	40,2	987,4	35,8	-4,4	930,9	33,7	-2,0	1.283,0	2010
20	3	Peč Mlini	2004	30,6	76,0	28,4	72,0	26,9	-1,5	n.a.	n.a.	n.a.	123,7	2010
21	4	Jajce 1	1957	60,0	247,0	47,0	217,3	41,3	-5,7	181,9	34,6	-6,7	303,0	2014
22	5	Bočac	1981	110,0	307,0	31,9	275,0	28,5	-3,3	275,7	28,6	0,1	353,9	2010
23	6	Rama	1968	160,0	731,0	52,2	664,6	47,4	-4,7	606,3	43,3	-4,2	885,0	2010
24	7	Jablanica	1955	180,0	770,0	48,8	742,9	47,1	-1,7	686,3	43,5	-3,6	1.019,1	2010
25	8	Grabovica	1982	114,0	334,0	33,4	284,6	28,5	-4,9	267,3	26,8	-1,7	407,3	2010
26	9	Salakovac	1982	210,0	410,0	22,3	423,0	23,0	0,7	344,7	18,7	-4,3	668,2	2010
27	10	Una-Kostela	1954	10,1	48,5	54,6	46,3	52,1	-2,5	44,9	50,6	-1,5	58,5	2014
28	11	Čapljina	1979	440,0	400,0	10,4	302,5	7,8	-2,5	276,5	7,2	-0,7	794,2	2010
29	12	Jajce 2	1954	30,0	157,0	59,7	149,1	56,7	-3,0	129,1	49,1	-7,6	184,7	2010
30	13	Trebinje 1	1968	171,0	395,0	26,4	447,5	29,9	3,5	414,0	27,6	-2,2	794,0	2010
31	14	Mostar	1997	72,0	310,0	49,2	237,6	37,7	-11,5	177,3	28,1	-9,6	320,3	2010
32	15	Dubrovnik G2	1965	108,0	660,5	69,8	604,8	63,9	-5,9	553,6	58,5	-5,4	832,0	1978
33	16	Bogatići	1947	10,0	28,3	32,3	28,4	32,4	0,1	28,4	32,4	0,0	39,0	2004
		Total BiH		**2.080,7**	**6.142,3**	**33,7**	**5572,1**	**30,6**	**-3,1**	**5.079,0**	**27,9**	**-2,7**		
		The former Yugoslav Republic of Macedonia (MKD)												
34	1	Kalimanci	1970	13,6	25,0	21,0	25,4	21,3	0,3	27,3	22,9	1,6	56,1	2010
35	2	Vrben	1959	12,8	38,0	33,9	35,4	31,6	-2,3	36,0	32,1	0,5	60,0	2010
36	3	Shpilje (also Špilje)	1969	84,0	272,0	37,0	288,3	39,2	2,2	271,2	36,9	-2,3	518,9	2010
37	4	Tikvesh	Two units in 1968. Two units in 1981	116,0	144,0	14,2	157,3	15,5	1,3	139,7	13,7	-1,7	327,0	2010
38	5	Vrutok	1973	165,6	350,0	24,1	350,5	24,2	0,0	330,2	22,8	-1,4	665,7	2010
39	6	Raven	1973	21,3	42,0	22,5	39,6	21,2	-1,3	37,9	20,3	-0,9	76,6	2010
40	7	Globočica	1965	42,0	180,0	48,9	185,6	50,5	1,5	175,5	47,7	-2,8	292,2	2010
41	8	Kozjak	2004	82,0	130,0	18,1	140,4	19,5	1,5	n.a.	n.a.	n.a.	250,9	2010
42	9	Sveta Petka (Matka 2)	2012	36,4	43,0	13,5	50,9	16,0	2,5	n.a.	n.a.	n.a.	75,8	2015
		Total MKD		**573,7**	**1.224,0**	**24,4**	**1273,4**	**25,3**	**1,0**	**1.217,0**	**24,2**	**-1,1**		
		Kosovo (KOS)												
43	1	Ujmani	1979	35,0	87,2	28,4	90,9	29,7	1,2	85,0	27,7	-1,9	115,5	2010
		Total KOS		**35,0**	**87,2**	**28,4**	**90,9**	**29,7**	**1,2**	**85,0**	**27,7**	**-1,9**		
		Montenegro (MNE)												
44	1	Peručica	1960	307,0	1.065,0	39,6	950,7	35,4	-4,3	916,2	34,1	-1,3	1.435,0	2010
45	2	Piva	1976	342,0	860,0	28,7	771,8	25,8	-2,9	745,4	24,9	-0,9	1.286,0	2010
		Total MNE		**649,0**	**1.925,0**	**33,9**	**1722,5**	**30,3**	**-3,6**	**1.661,6**	**29,2**	**-1,1**		
		Serbia (SER)												
46	1	Bajina Bašta	1966	422,4	1.710,0	46,2	1518,9	41,0	-5,2	1.486,8	40,2	-0,9	1.834,3	1996
47	2	Uvac	1979	36,0	70,6	22,4	59,5	18,9	-3,5	60,4	19,2	0,3	84,3	2006
48	3	Potpeč	1967	54,0	170,1	36,0	198,3	41,9	6,0	192,9	40,8	-1,1	250,1	2010
49	4	Djerdap 1 (Iron Gate 1)	1972	1.206,0	5.730,0	54,2	5444,1	51,5	-2,7	5.517,1	52,2	0,7	6.467,2	1996
50	5	Djerdap 2 (Iron Gate 2)	1985	270,0	1.440,0	60,9	1465,9	62,0	1,1	1.394,6	59,0	-3,0	1.613,4	2014
51	6	Pirot	1990	80,0	170,0	24,3	109,5	15,6	-8,6	104,9	15,0	-0,6	211,9	2010
52	7	Kokin Brod	1962	22,5	46,0	23,3	56,9	28,9	5,5	57,1	29,0	0,1	89,8	2010
53	8	Vrla 1-4 (HPP Vlasina)	1955	128,5	285,5	25,4	294,9	26,2	0,8	290,9	25,9	-0,4	462,0	2010
54	9	Lisina (REV HPP)	1977	28,6	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0
55	10	Bistrica	1966	104,0	241,4	26,5	323,2	35,5	9,0	332,6	36,5	1,0	510,1	2000
56	11	RHE Bajina Bašta	1982	614,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0
57	12	Zvornik	1955 / Rev 2016	125,6	416,6	37,9	475,1	43,2	5,3	466,5	42,4	-0,8	575,1	2010
		Total SER		**3.091,6**	**10.280,2**	**47,9**	**9946,3**	**46,4**	**-1,6**	**9.903,8**	**46,2**	**-0,2**		
		Total WB6		**8.021,7**	**24.803,3**	**38,4**	**23.500,3**	**36,4**	**-2,0**	**22.558,5**	**34,9**	**-1,5**		

3.1.1 Assessment of coverage / completeness of provided data

The following Table 3.3 summarises the Consultant's indicative assessment of the coverage / completeness of provided data in the DB.

Table 3.3: Coverage / completeness of provided data by "data category"

Data category		ALB	BiH	MKD	KOS	MNE	SER
1	Lists and names of HPPs *)						
	Lists and names of HPPs **)						
2	Latitude and longitude of engine house of the HPP *)						
	Latitude and longitude of engine house of the HPP **)						
3-4	HPP Operator / Owner * **)						
5-6	River / Tributary, Pertaining Basin or (Sub)River Basin *) **)						
7	Plant type *) **)						
8-9	Total reservoir storage volume / number and structure of units *)						
10	Commissioning year *)						
	Commissioning year **)						
11-12	Location with respect to protected areas / type of PA *)						
13	Installed capacity as of end-December 2016 *) **)						
14	Average annual output *)						
	Average annual output **)						
15	Net electricity production per year since its commissioning till 2015 *)						
	Net electricity production per year since its commissioning till 2015 **)						
16/a	On rehabilitations undertaken since commissioning (large HPPs) *)						
16/I - 16/iii	On anticipated rehabilitation plans, possible capacity and output increases, investment costs *)						
16/iv	On environmental improvement measures planned *)						
17/a	The state of equipment with fish passes *)						
17/b	Planning of fish passes in case of rehabilitation *)				n.a.		
17/c	Determination of residual flow or EAF *)						

*Note: *) Large HPPs, **), small HPPs, n.a. - not applicable.*

Legend on assessed completeness of provided data

Score	Meaning
	All requested data provided
	Majority of data provided, with minor data gaps
	Average – half of requested data provided
	Data partially provided, with major data gaps
	No data provided

Commentary and conclusions: Data for large HPPs are fairly well covered, while the data for small HPPs still demonstrate gaps and deficiencies, because certain information (on annual output, commissioning year and actual production) are missing. The reasons for this may be attributed to the fact that a significant number of small HPPs are privately-owned, which limited access to information. Furthermore, several HPPs do not receive state-support (FIT) and are therefore not covered by the registries of privileged producers that are typically maintained by electricity market operators. Deficient data include information on (i) rehabilitations (past and planned), (ii) planned environmental measures associated with such plans and information on fish passes and residual flows for HPPs constructed in the past (or environmentally acceptable flows (EAF) for most recently commissioned ones), while information on protected areas demonstrates incompleteness / unreliability. In general, we are confident that the data and information in the DB still could be improved, particularly for Albania but partially also for Serbia.

3.2 Past and present status of HPPs in WB6

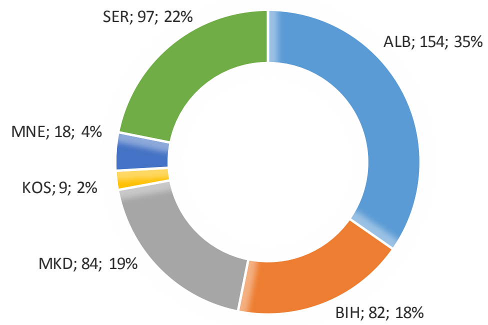
In Sections 3.2.1-3.2.4, some main data categories from the DB are highlighted and discussed.

3.2.1 Number and structure of existing HPPs

Table 3.4 and Figure 3.1 show the number and structure of existing HPPs by country, separately for large and small HPPs.

Table 3.4: Number and structure of HPPs (status: end-December 2016)

SN	Country	>10MW		<10MW		Total	
		(no.)	*(%)*	(no.)	*(%)*	(no.)	*(%)*
1	Albania	17	*29.8*	137	*35.4*	154	*34.7*
2	Bosnia and Herzegovina	16	*28.1*	66	*17.1*	82	*18.5*
3	The former Yugoslav Republic of Macedonia	9	*15.8*	75	*19.4*	84	*18.9*
4	Kosovo	1	*1.8*	8	*2.1*	9	*2.0*
5	Montenegro	2	*3.5*	16	*4.1*	18	*4.1*
6	Serbia	12	*21.1*	85	*22.0*	97	*21.8*
	Total WB6	**57**	*100.0*	**387**	*100.0*	**444**	*100.0*
	Share	*12.8%*		*87.2%*		*100.0%*	



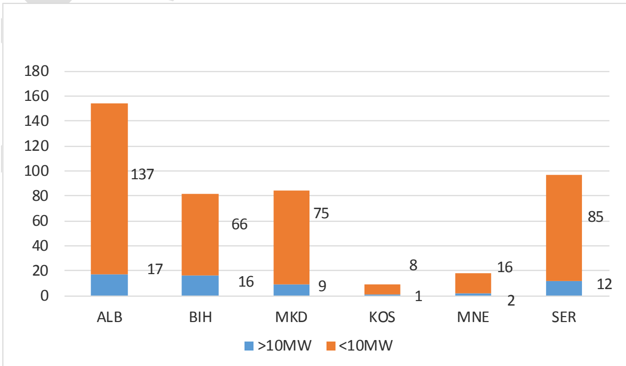


Figure 3.1: Number of existing hydro power plants by capacity range and country

As at end-December 2016, there were 57 large HPPs that represent no more than 13% in terms of the number of existing HPPs. Most large HPPs (17 or 30%) were in Albania, followed by 16 in BiH, 12 in Serbia and 9 in the former Yugoslav Republic of Macedonia, while Montenegro and Kosovo contribute with 2 HPPs and 1 HPP, respectively.

The very high number of small HPPs, 387 SHPPs or 87%, might give a wrong initial impression about the importance of small HPPs in electricity supply, therefore, the contribution of small HPPs in terms of installed capacities and energy output still needs to be further discussed (see the following sections).

In terms of the number of HPPs, Albania highly dominates in the region with 154 HPPs (35%), particularly since as many as 154 small HPPs (35%) are located there. Most of them have been commissioned in the last 5 years.

From the ownership point of view, the status is shown in Table 3.5. Forty-two large HPPs (74%) are owned and operated by typical state-owned power generation utilities, while the share of private owners of small HPPs is strongly on the side of private ownership (88% or 343 small HPPs are privately owned). In Albania, 14 large HPPs out of 17 HPPs are privately owned and only 3 HPPs by the national power utility (KESH), while in the other 5 countries practically all HPPs are owned and operated by the state utilities (EPBIH, EP HZHB, ERS, ELEM, Water Utility Iber Lepenc of Kosovo, EPCG, EPS).

Table 3.5: HPPs by ownership structure

Country	ALB		BiH		MKD		KOS		MNE		SER	
Ownership	State *)	Priv.	State	Priv.	State	Priv.	State	Priv.	State	Priv.	State	Priv.
Large HPPs	3 (KESH)	14	4 (EPBiH) 7 (EPHZHB) 5 (ERS)	0	1 (EVN) 8 (ELEM)	0	1	0	2 (EPCG)	0	11 (EPS)	1
Share	*18%*	*82%*	*100%*	*0%*	*100%*	*0%*	*100%*	*0%*	*100%*	*0%*	*92%*	*8%*
Small HPPs	0	137	5 (ERS) 5 (EPBiH)	56	11 (EVN)	64	0	8	5	11	18 (EPS)	67
Share	*0%*	*100%*	*15%*	*85%*	*15%*	*85%*	*0%*	*100%*	*31%*	*69%*	*21%*	*79%*

*Note: *) Denotes major public utilities.*

3.2.2 Installed capacities in existing HPPs

Based on data collected in the Study and after verification by the regional power utilities, we concluded there was **8,605 MW of installed hydropower capacity as of end-December 2016.** Our DB integrated data for many recently-commissioned small HPPs, particularly in Albania and BiH, as well as new plants commissioned in the former Yugoslav Republic of Macedonia during the last 3 years. It is worth noting that some other data sources report on slightly different values, e.g. (i) the figures for "existing capacities" from the RiverWatch DB estimate that 7,022 MW (-18%) was installed in hydropower generation as of Dec.'15, and (ii) the Energy Community, GlobalData and IRENA data (based on IEA Statistics) report on 8,858 MW (+3%) being installed. According to the latter source, hydropower represented 49.2% of all power generation capacities and 96.4% of total RES-E capacities (solar, wind, hydro, biomass, other) in the WB6 in 2015 (Figure 3.2).

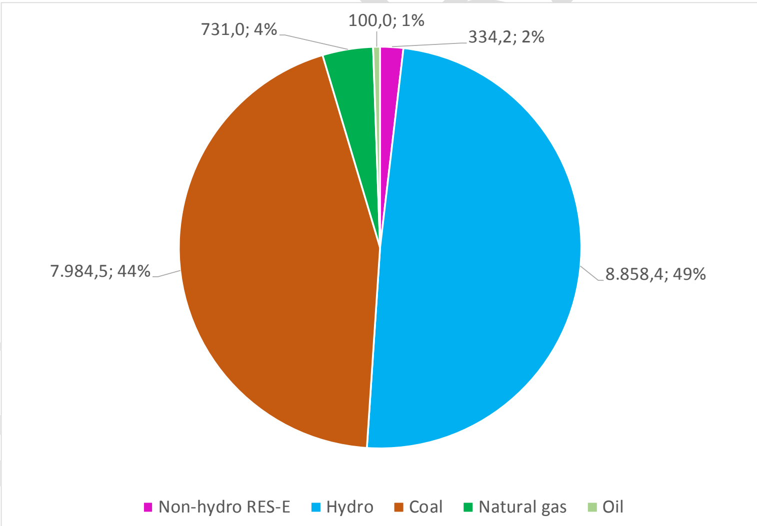


Figure 3.2: Structure of power generation capacities in WB6 in 2015 (MW, %)

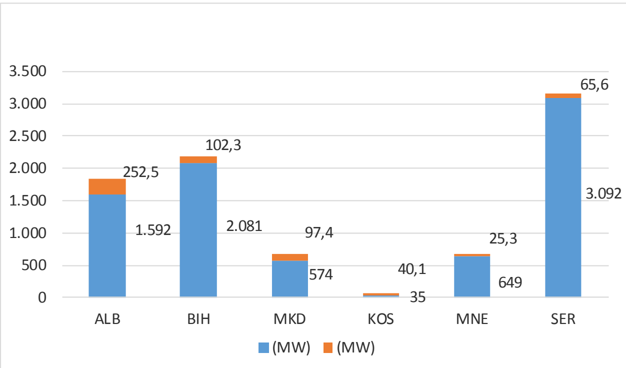
As shown in Table 3.6 and Figure 3.3, the 8,605 MW of installed capacities included 8,022 MW (93% in terms of installed capacity) in 57 HPPs (13% in terms of the number) of more than 10 MW of installed capacity and 583 MW (7%) in 387 hydro power plants (87%) of less than 10 MW of installed capacity.

In terms of installed capacities, Serbia is currently taking the lead with 37% (3,157 MW) of the total WB6 capacities being installed there, followed by BiH (2,183 MW, 25%) and Albania (1,824 MW, 21%). In the regional context, the other three countries represent less than 10% of total installed capacity each (Montenegro: 8%, the former Yugoslav Republic of Macedonia: 8% and Kosovo: 1%).

Table 3.6: Installed capacities in existing HPPs by capacity range and country (status: end-December 2016), MW and %

SN	Country	>10MW		<10MW		Total	
		(MW)	(%)	(MW)	(%)	(MW)	(%)
1	Albania	1,592	*19.8*	252	*43.3*	1,844	*21.4*
2	Bosnia and Herzegovina	2,081	*25.9*	102	*17.5*	2,183	*25.4*
3	The former Yugoslav Republic of Macedonia	574	*7.2*	97	*16.7*	671	*7.8*
4	Kosovo	35	*0.4*	40	*6.9*	75	*0.9*
5	Montenegro	649	*8.1*	25	*4.3*	674	*7.8*
6	Serbia	3,092	*38.5*	66	*11.3*	3,157	*36.7*
	Total WB6	**8,022**	*100.0*	**583**	*100.0*	**8,605**	*100.0*
	Share	*93,2%*		*6,8%*		*100,0%*	

Regarding small HPPs, of the total 583 MW installed in the WB6, Albania holds the largest share of installed capacities at 43%, followed by Bosnia and Herzegovina (18%), the former Yugoslav Republic of Macedonia (17%) and Serbia (11%), while Kosovo and Montenegro contribute with less than 10%, notably 7% and 4%, respectively.



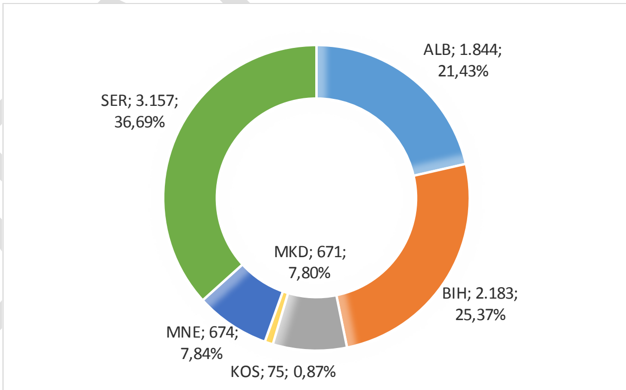


Figure 3.3: Installed hydropower generation capacities by capacity range and country (MW) (status: end-December 2016)

3.2.3 Dynamics of construction / commissioning of HPPs

The dynamics of the construction / commissioning of new HPPs of all capacity ranges by country in the long-term past (1955-2016) is shown in Figure 3.4 (separately for large and small HPPs) and in Figure 3.5 for all HPPs by country. Knowing the status of capacities as shown above, Serbia, BiH and Albania were most active and productive.

From the regional perspective, showing the cumulative values of hydropower capacities in Figure 3.6, another very useful indicator is that about 90% (7,739 MW) of the present capacity of 8,605 MW has been constructed and commissioned in the former SFRJ before 1990, and only 10% (866 MW) after its disintegration. The average capacity addition achieved during 1955-1990 was 202 MW per annum while in the period 1991-2016 it dropped to mere 33 MW per annum. The reasons can be attributed to:

- The “Best” HPPs have already been implemented,
- Disintegration of former SFRJ followed by wars in the ’90s,
- The end of central planning and coordinated water management, lack of cooperation between the newly-established states,
- Lack of financial capacity of power utilities / states for investment intensive projects,
- Growing investment risks in emerging market conditions,
- Continued unresolved transboundary issues, and
- Increasing environmental concerns and increasingly demanding legislation and regulations.

This demonstrates that the sector has been considerably underdeveloped in the last 25 years in all countries, despite having natural resources available, the hydropower sector being permanently prioritised in most of the national strategic planning documents (strategies, action plans etc.) and the fact that there is considerable know-how and relevant industry available in the region. The situation has been only partially improved in the region due to Albania, the former Yugoslav Republic of Macedonia and Bosnia and Herzegovina in the last 3-5 years. Figure 3.6 also demonstrates that the share of small HPPs in the overall capacities is very marginal.

Out of 57 large HPPs in WB6, 26 HPPs are of reservoir-type (RES), 26 run-of-river (ROR), 3 derivative (DER) and 2 reversible (REV).

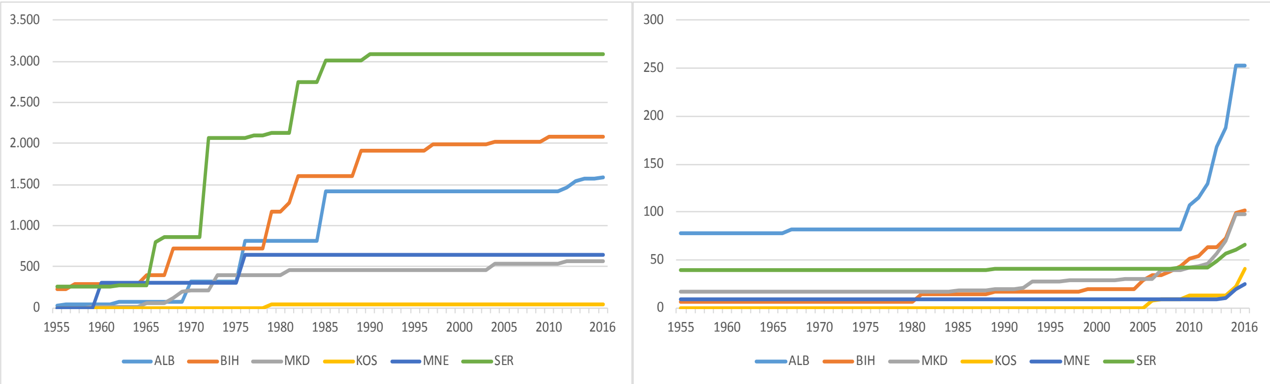
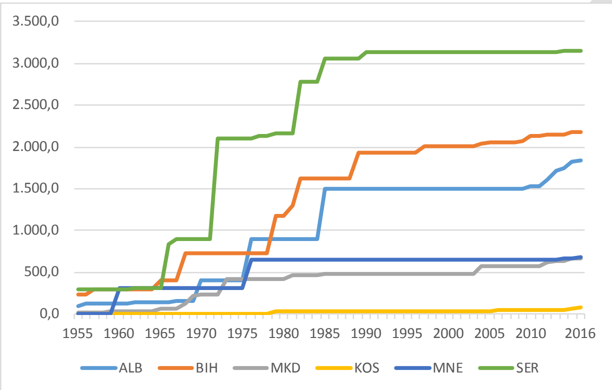


Figure 3.4: Development of installed hydropower capacities over time (1955-2016) and country for large (left fig.) and small HPPs (right fig.), MW



It is obvious that the increase of installed capacities in the last years was primarily due to new small HPPs. During the last 15-year period (2002-2016), 379 MW in large HPPs and 403 MW in small HPPs were commissioned, while in the last 5-year period (2012-2016), 206 MW in large HPPs and 307 MW in small HPPs.

Large HPPs (379 MW) included: HPP Peč Mlini–30.6 MW in BiH and HPP Kozjak – 82.0 MW in MKD (both in 2004), HPP Mostarsko blato – 60.0 MW in BiH (2010), HPPs of 49.9 MW (Sllabinje, Martanesh, Tervol and Llapaj) in ALB and HPP Sveta Petka – 36.4 MW in MKD (both in 2012), HPPs of 65.7 MW (Ashta 1-2, Pobreg) (2013), HPP Vlushe – 14.2 MW and HPP Lubalesh2+Gjorice – 10.9 MW (2014), HPP Bele 2 – 11.0 MW (2015) and HPP Okshtun+Tervole+Lubalesh 1 of 15.0 MW (2016) – all in ALB).

Figure 3.5: Development of installed hydropower capacities over time (1955-2016) and country (large and small HPPs together), MW

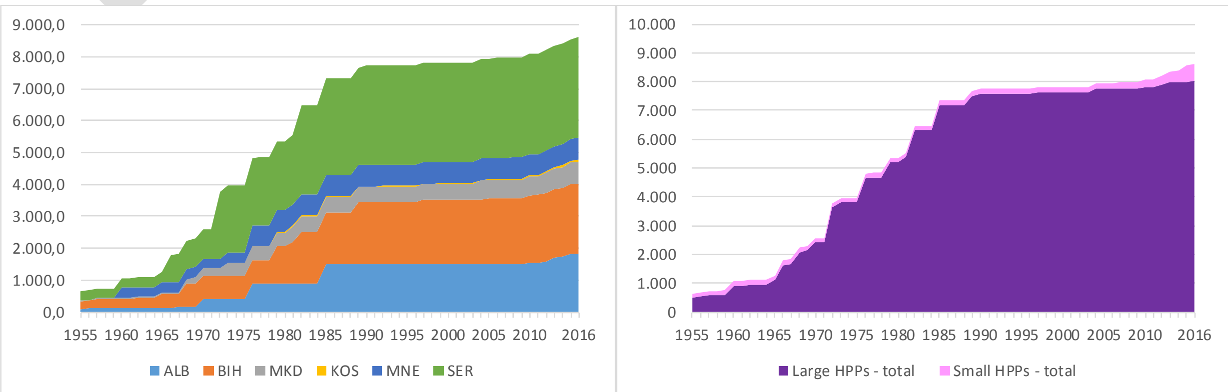


Figure 3.6: Development of cumulative hydropower capacities over time by country and distinction between large and small HPPs (1956-2016), MW

Various hydropower capacity additions either since 1956 or since 2001 till 2016 are shown in Figures 3.7-3.9.

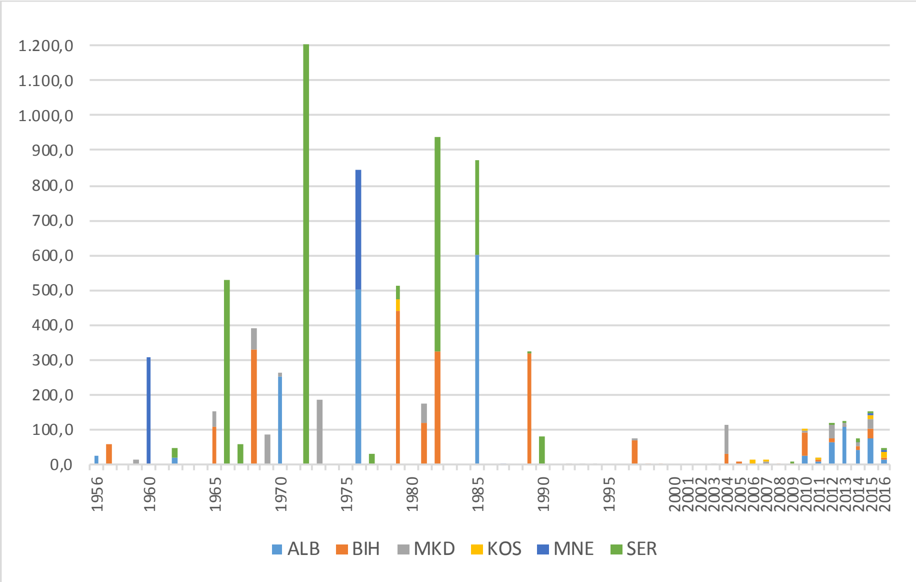


Figure 3.7: Hydropower capacity additions by year and country – all HPPs (1956-2016), MW

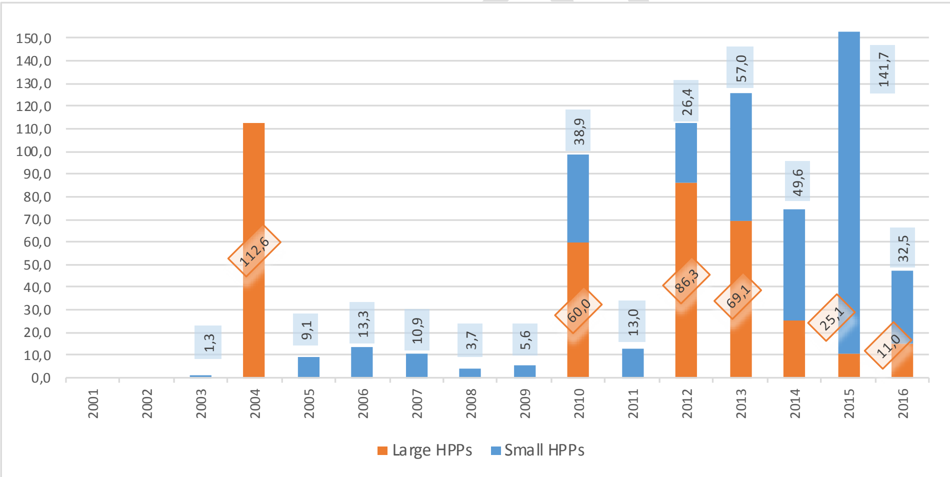


Figure 3.8: Hydropower capacity additions by year – large and small HPPs (2001-2016), MW

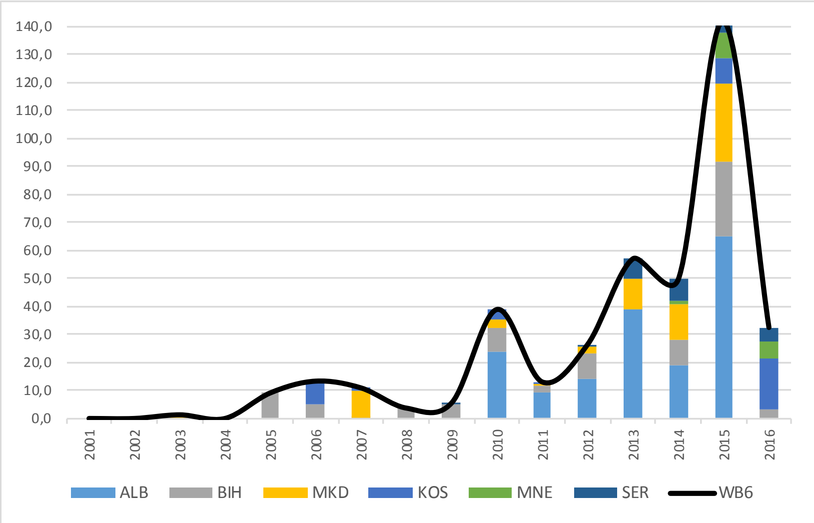


Figure 3.9: Small HPPs capacity additions by year and country (2001-2016), MW

3.2.4 Development of hydropower generation over time

Hydropower generation in large and small HPPs over different time horizons is shown in Figures 3.10.3-13. The amount of electricity generated in HPPs is a function of available capacity, demand for electricity but primarily, of specific hydrological conditions.

Table 3.7: Average annual hydropower generation in existing HPPs by capacity range and country in the last fifteen years (2001-2015), GWh/a and %

SN	Country	>10MW		<10MW		Total	
		(GWh)	*(%)*	(GWh)	*(%)*	(GWh)	*(%)*
1	Albania	4.895	*20,8*	182	*30,2*	5.077	*21,1*
2	Bosnia and Herzegovina	5.572	*23,7*	97	*16,0*	5.669	*23,5*
3	The former Yugoslav Republic of Macedonia	1.273	*5,4*	194	*32,2*	1.468	*6,1*
4	Kosovo	91	*0,4*	36	*5,9*	127	*0,5*
5	Montenegro	1.722	*7,3*	33	*5,4*	1.755	*7,3*
6	Serbia	9.946	*42,3*	62	*10,3*	10.008	*41,5*
	Total WB6	**23.500**	*100,0*	**603**	*100,0*	**24.104**	*100,0*
	Share	*97,5%*		*2,5%*		*100,0%*	

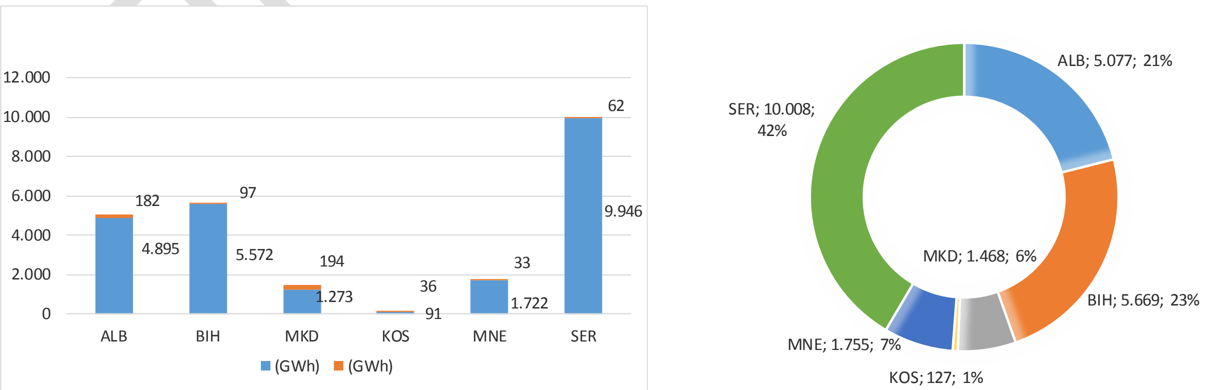
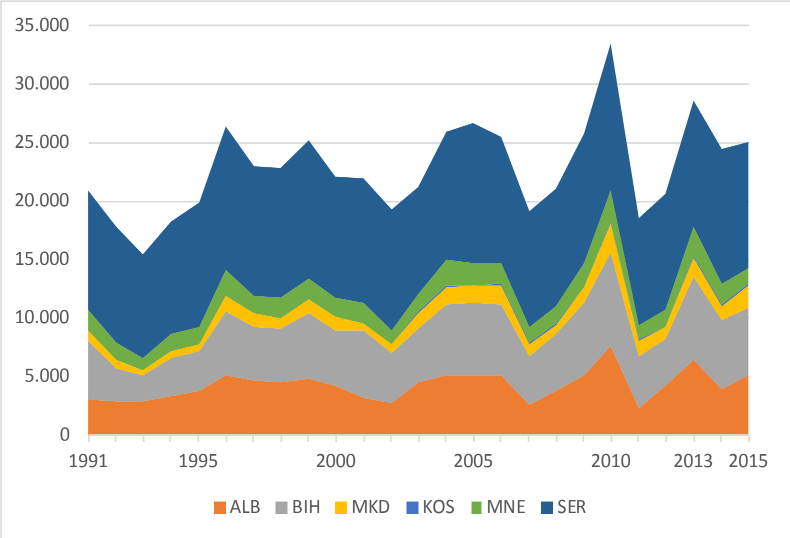
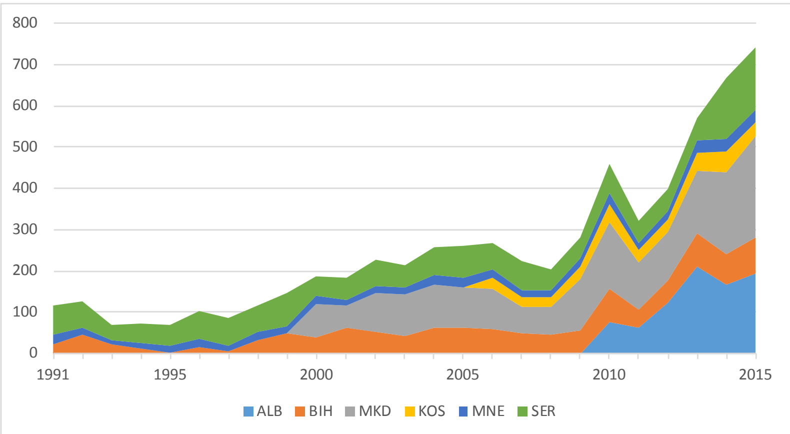


Figure 3.10: Average annual hydropower generation by country in the last 15 years (2001-2016), GWh/a



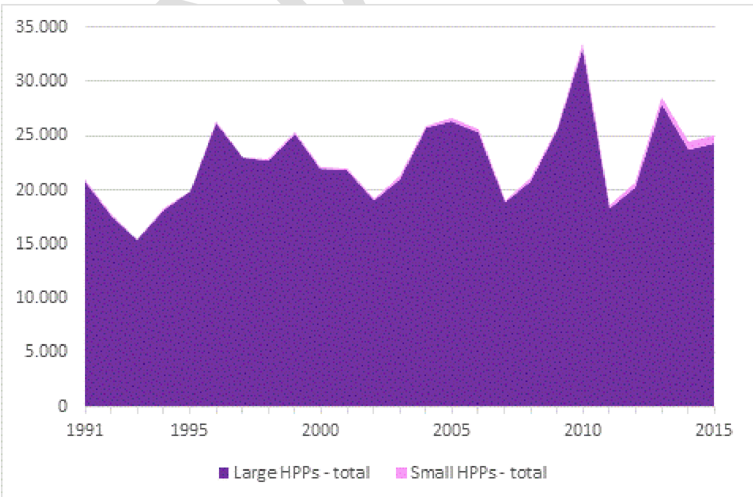
Hydropower generation typically fluctuates considerably depending on the hydrological conditions in the year. For 32 of the large 57 HPPs (56%), the year 2010 represented the absolute maximum in power generation since their commissioning. The second-best year was 2013 and the third-best year was 2005.

Figure 3.11: Hydropower generation – all HPPs by country in the last 25 years (1991-2016), GWh



Power generation in small HPPs gradually increased over time, along with increased capacities in small HPPs, especially after 2005 (see also Figure 3.6). A considerable increase in Albania after 2010 can be noted when more than 80 new small HPPs were commissioned during 2010-2016.

Figure 3.12: Hydropower generation – small HPPs by country in the last 15 years (1991-2016), GWh



In comparative terms, power generation in small HPPs has not contributed substantially (approx. 3% during 2001-2015) to the overall power supply from hydropower sources, despite the considerably higher number of such facilities (87% in 2016).

Figure 3.13: Hydropower generation – large and small HPPs in the last 25 years (1991-2016), GWh

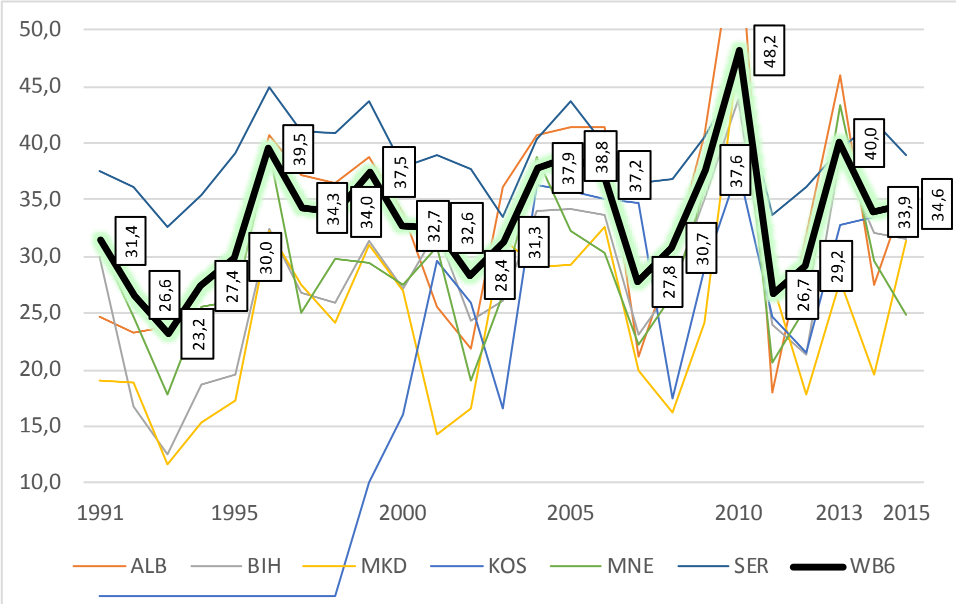


Figure 3.14: Average capacity factors of large HPPs by country in the last 25 years (1991-2016), %

Fluctuations of the average capacity factors[6] of large HPPs by country over time (1991-2015) is shown in Figure 3.14. At the same available capacity, capacity factors are logically higher in conditions of better hydrology and consequently, also result in higher power generation.

The fact that capacity factors have not deteriorated on average in the last fifteen years suggests that so far, there has been no visible and proven reduction of generation due to the already presumed impacts of climate change. However, the last decade demonstrates that there were considerable differences between wet and dry years (Figure 3.14).

Comparison between the average capacity factors of large HPPs by country is shown in Table 3.8 (see Table 3.2 for individual HPPs), where three values are shown and compared: (i) average nominal capacity factor (based on design values), (ii) average capacity factors based on actual electricity generation in the last 15 years (2001-2016) and (iii) average capacity factors based on actual electricity generation in the last 25 years (1991-2016). The conclusion would be that the average capacity factor in the region has increased in the last decade by 1.5%; however, it has still not reached the nominal one (38.1%).

Table 3.8: Comparison of average capacity factors of all HPPs by country, %

Country	Capacity factor (design value) (1)	Average capacity factor – last 15 years (2)	Average capacity factor – last 25 years (3)	Difference (4) = (2) – (3)
Albania	36.9	35.1	33.2	+2.0
Bosnia and Herzegovina	33.7	30.6	27.9	+2.7
The former Yugoslav Republic of Macedonia	24.4	25.3	24.2	+1.1
Kosovo	28.4	29.7	27.7	+1.9
Montenegro	33.9	30.3	29.2	+1.1
Serbia	47.9	46.4	46.2	+0.2
WB6	38.1	36.4	34.9	+1.5

[6] Capacity factor = Wa / (Pmax x 8,760).

3.2.4.1 Statistics of hydropower generation in WB6 (1971-2014)

Hydropower is an important electricity producer in the WB6 region. In Figure 3.15, the volume of hydropower generation and its share in electricity production for both the individual countries and the region as a whole (due to multiple changes in the political landscape some data are not available) for the years 1971 to 2014 is shown. To have methodologically comparable figures for all countries, the official statistics of IEA (Status of May 2017) have been used for this purpose.

In all observed years (1971-2014), in Albania, hydropower generation represented almost 100% of total electricity production in the country and only in the period 1999-2007, it was up to 5% less.

Due to its substantial dependence on hydropower, which is typically connected to annual hydrological conditions, further impacted by climate change, Albania in particular is very vulnerable in its security of electricity supply. Albania had to purchase electricity because of heavy drought and high temperatures that hit the Western Balkans countries this summer (2017), which caused lowered water levels in all rivers. A similar situation was experienced also in other WB6 countries; however, these are less dependent on hydropower in the overall generation mix, and are consequently less exposed to the annually fluctuating hydrological situation. Moreover, it is worth emphasizing that the future availability of water will also impact other sectors using the same water resources (agriculture, tourism, drinking water etc.) that are subject to climate change impacts.

The former SFRJ, despite considerable capacity additions in hydro, was regularly losing its hydro share in the power generation mix over time, from some 55% in 1971 to 30% in 1990.

From 1990 onwards, the situation in individual successor countries of SFRJ is shown in Figure 3.15. In the period 1990-2014, at the regional level, hydropower generation represented 25-54% of total power generation. Despite rather marginal capacity additions over time, as discussed above, this figure obviously varied by quite some extent, primarily due to different hydrological conditions / hydropower yield in individual years and specific conditions in thermal power generation, the output of which varied due to the complete or partial unavailability of thermal power plants for several reasons (e.g. major overhauls, rehabilitations, outages due to war damages etc.).

At the country level, the share of hydropower generation in total power generation was the following (average values during the last 10-year period of 2005-2014, for which IEA statistics are available): Albania (99.4%), Bosnia and Herzegovina (38.5%), the former Yugoslav Republic of Macedonia (21.8%), Kosovo (2.2%), Montenegro (58.9%), and Serbia (49.2%). For annual fluctuations, see Figure 3.16.

In the lower part of Figure 3.15, it is possible to observe the development in annual hydropower generation by country, which in combination with the upper part of the figure can lead to conclusions on the extent of progress in hydropower generation over time. In addition, it is possible to assess the true impact of hydrology on annual production, knowing that the level of installed capacities in the region was not increased substantially in the same period.

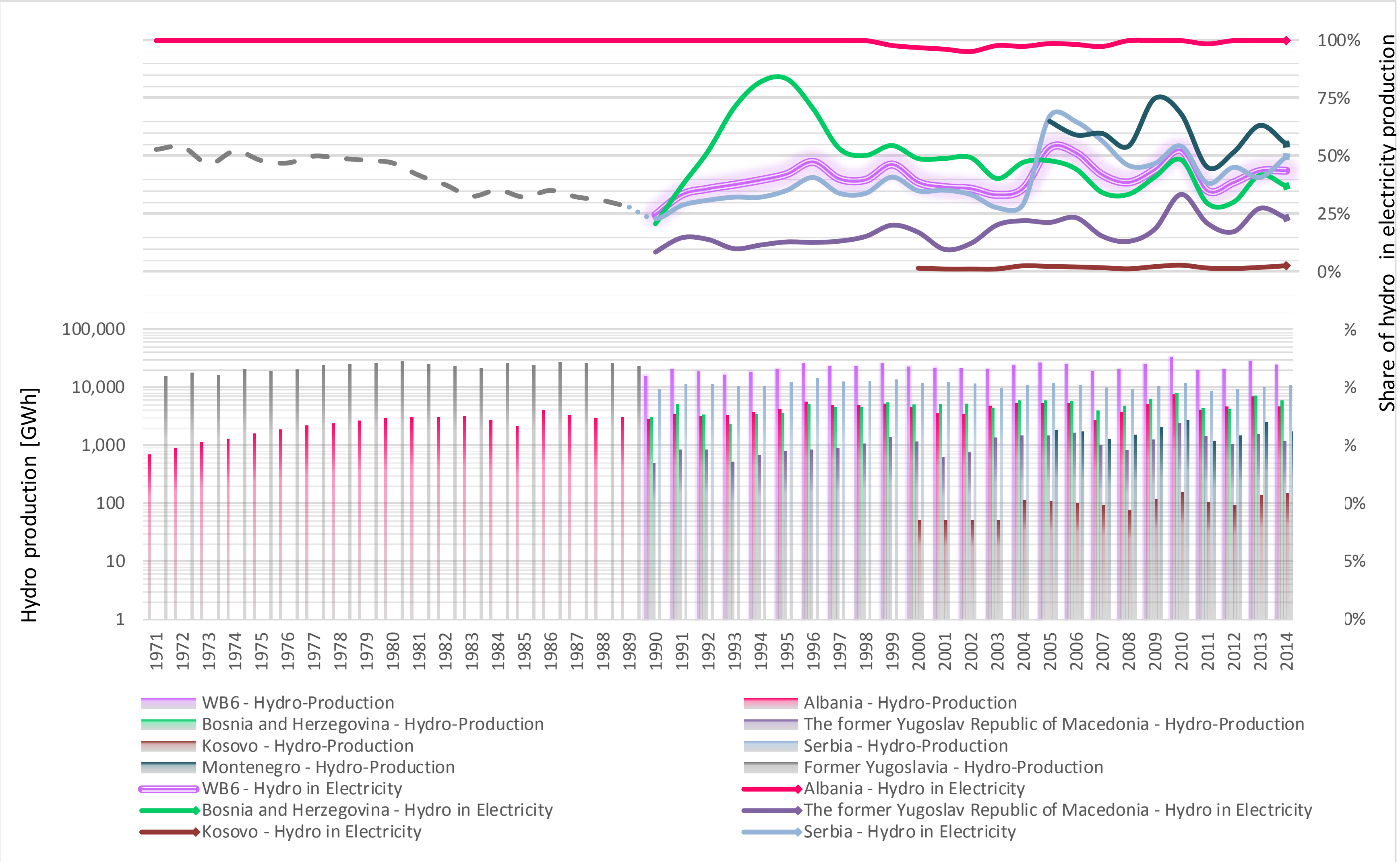
Figure 3.17 shows hydropower generation, total electricity generation, net electricity import-export of the WB6 region and final electricity demand in the WB6 region in the last 10-year period (2005-2014) (source: IEA statistics).

In the 10-year period observed, final electricity consumption grew from 51,742 GWh (2005) to 56,929 GWh (2014) or by 10.0%, which denotes an average annual growth rate of 1.1%. In 2011, electricity demand was the highest, 59.825 GWh (or 15.6% higher than in 2005) and it has demonstrated a downward trend since then. However, such development is assessed as transitory and short-term demand behaviour (see Section 7 for the assessment of future electricity demand trends).

Hydropower generation in the mentioned period typically reflects hydrological conditions, which are also subject to climate change impacts. In 2010, it reached the long-term absolute maximum values for most large HPPs and in 2013, the second highest values.

The WB6 region is a net importer of electricity except in years with high hydropower generation. Since non-hydropower generation (coal-, oil- and gas-fired thermal power plants, CHPs and minimal other RES-E generation: PV, wind and biomass) demonstrated increasing generation over time as shown in Figure 3.17, without considering electricity consumption and production of HPPs, years with higher hydropower generation represented lower net import of the WB6 region and even an opportunity for power export in those years.

In conclusion, hydropower positively contributes to electricity supply in the WB6 and reduces its dependence on power imports. In good hydrological years, WB6 is a net exporter of power thus contributing to integrated electricity markets elsewhere outside the WB6 region including the EU markets.



Source: IEA Statistics (May 2017)

Figure 3.15: Hydropower generation volume and its share in total electricity production by country (1971-2014)

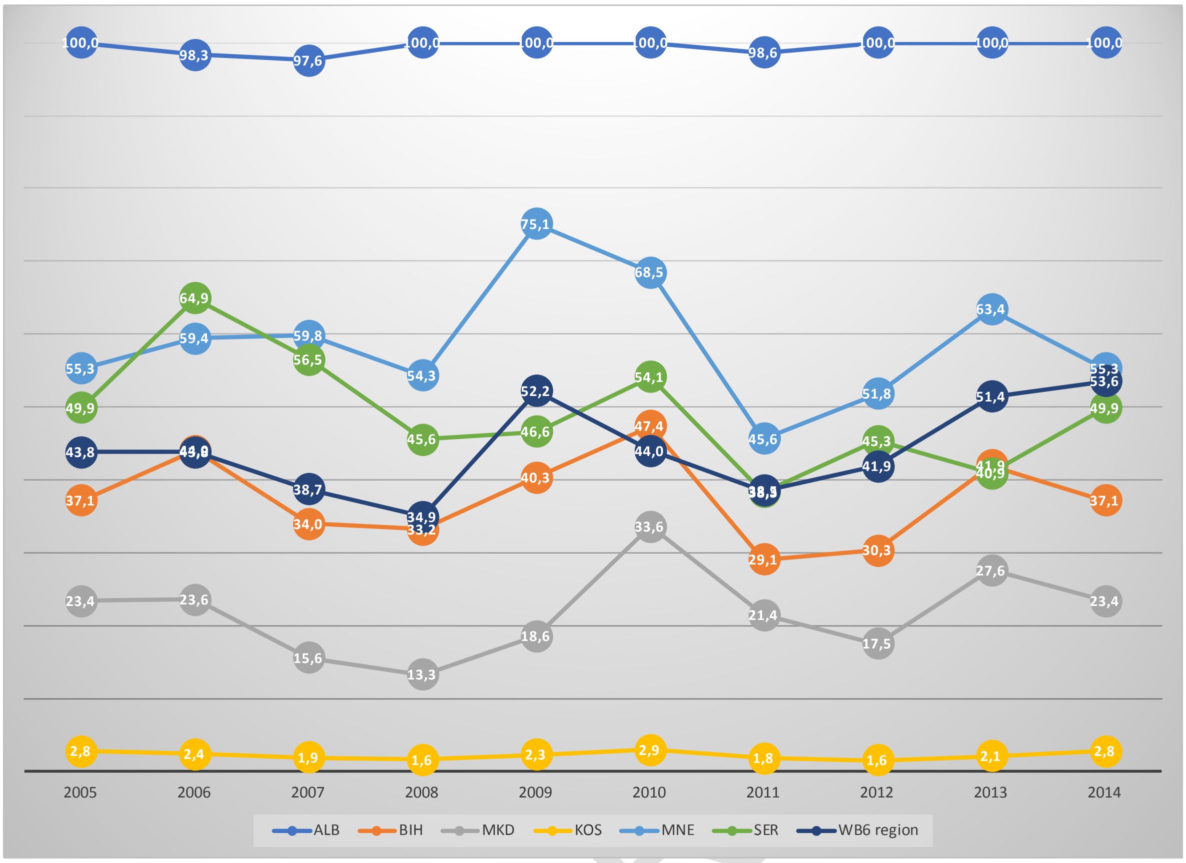


Figure 3.16: Hydropower generation share in total electricity production by country in the last 10 years (2005-2014)

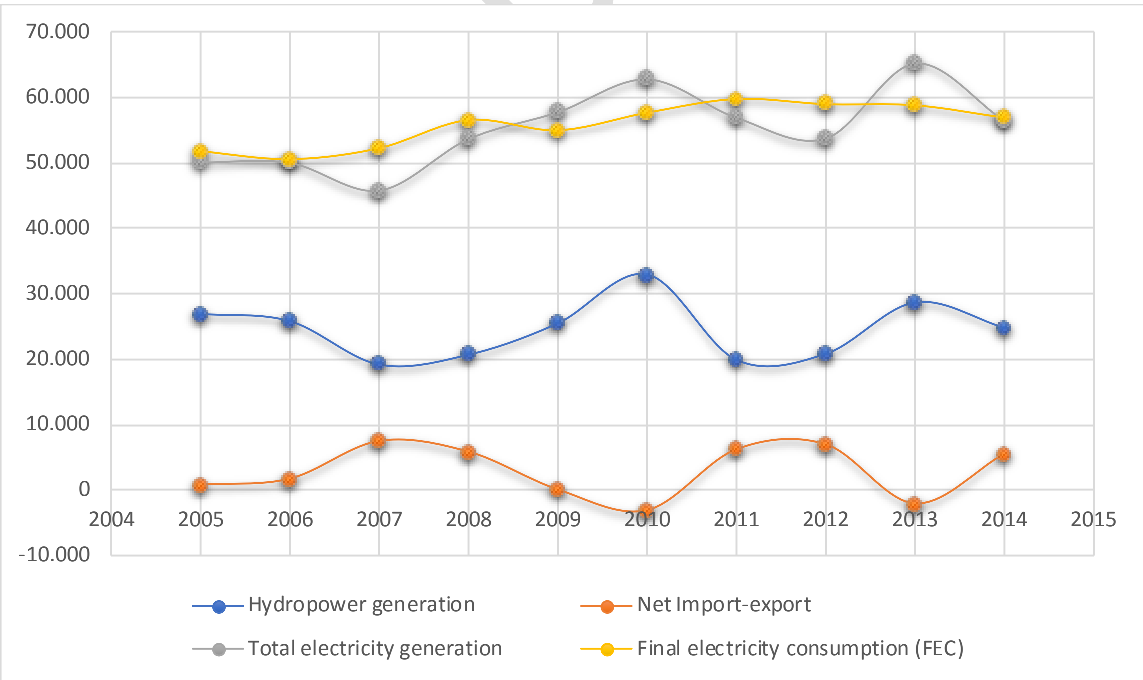


Figure 3.17: Hydropower generation, total electricity generation, final electricity demand and net electricity import-export in WB6 in the last 10 years (2005-2014), GWh

3.3 Summary of key observations

- Hydropower has always been and remains an important source of electricity production in the WB6 region, for many decades as the only RES-E producer while other RES-E technologies (wind, PV, biomass etc.) have not yet been significantly utilised.
- Hydropower generation vs. total power generation (IEA Statistics):
  - The hydropower share in 2014 amounted to 44%, with an average in the last 10-year (2005-2014) period of 40%;
  - During 2005-2014, however, the share varied from 35% (2011) to 54% (2005);
  - Average values during the last 10-year period of 2005-2014, for which IEA statistics are available: Albania (99.4%), Bosnia and Herzegovina (38.5%), the former Yugoslav Republic of Macedonia (21.6%), Kosovo (2.2%), Montenegro (59.8%), and Serbia (51.0%).
- Hydropower generation fluctuates depending on current hydrological conditions. For 32 of the large 57 HPPs (56%), the year 2010 represented the absolute maximum in power generation since their commissioning. The second-best year was 2013 and the third-best year was 2005.
- Hydropower generation vs. final electricity consumption (IEA Statistics):
  - The hydropower generation ratio vs. final electricity consumption in 2014 throughout the WB6 region (44%) was something above the last 10-year (2005-2014) average of 40%;
  - During 2005-2014, however the share varied from 33% (2011) to 57% (2010);
  - There are considerable variations between the 6 WB countries, from 3% in Kosovo to 72% in Albania.
- During 2005-2014, final electricity consumption grew from 51,742 GWh (2005) to 56,929 GWh (2014) or by 10.0%, which denotes an average annual growth rate of approx. 1%. In 2011, electricity demand was the highest, 59.825 GWh (or 15.6% higher than in 2005) and it has demonstrated a downward trend since then. However, this trend is considered transitory and short-term demand behaviour, primarily as a result of energy efficiency measures.
- At the end-2015, there were 8,858 MW of installed power generation capacity in hydro power plants (HPP), which represented nearly half (49%) of all installed power generation capacities in the WB6. The remaining capacities were coal (44%), gas (4%) and quite minor other RES-E technologies (wind, PV, biomass) – 3% (IEA Statistics).
- Historic hydropower development:
  - About 90% (7,739 MW) of the present capacity of 8,605 MW (Study survey) has been constructed and commissioned in the former SFRJ before 1990, and only 10% (866 MW) after its disintegration;
  - The average capacity addition achieved during 1955-1990 was 202 MW per annum while in the period 1991-2016 it dropped to a mere 33 MW per annum.
- Structure of HPPs:
  - As at end-December 2016, the 8,605 MW of total installed capacities included 8,022 MW (93% in terms of installed capacity) in 57 large HPPs and 583 MW (7%) in 387 hydro power plants of less than 10 MW of installed capacity;
  - 57 large HPPs of more than 10 MW represent 13% in terms of the number of existing HPPs;
  - During 2001-2015, 57 large HPPs generated 97.5% of power generated in all hydro power plants. Consequently, the contribution of small HPPs to security of electricity supply and to meeting the national RES targets was marginal at best;
  - Regarding small HPPs, in total 583 MW installed in the WB6, Albania holds the largest share of installed capacities at 43%, followed by Bosnia and Herzegovina (18%), the former Yugoslav Republic of Macedonia (17%) and Serbia (11%), while Kosovo and Montenegro contribute with less than 10%, notably 7% and 4%, respectively.
- Hydropower positively contributes to electricity supply security in the WB6 and reduces its dependence on power imports (note: the WB6 was a net importer of electricity during 2005-2014). However, in good hydrological years, certain WB6 countries become net exporters of power thus contributing to the WB6 market (under development) and integrated electricity markets elsewhere outside the WB6 region including the EU markets.

4 Hydropower potential in Western Balkans

4.1 Classification of hydropower potential

The maximum possible production yield from a hydrological resource is determined as the **theoretical (hydropower) potential.** It is determined by the quantity of rainfall that falls on ground at a certain altitude a.s.l. thus creating potential energy by the position of water masses that, unless stored in an accumulation basin, is converted into the kinetic energy of water flows in rivers. The maximum theoretical potential of a certain river basin is then the sum of that potential energy and to a much lesser extent the kinetic energy of all accumulated / moving waters from tributaries to the main river streams.

However, such a theoretical potential has a more scientific than practical value, as numerous limitations apply, from the spatial planning perspective (e.g. protected zones – national parks, other infrastructure requirements, water supply and agricultural areas, living habitats and recreation areas etc.), technical, environmental, economic and market perspectives. Consequently, the theoretical potential is gradually downsized to the reality – which is the actual potential. Depending on the type of limitations, more frequently used terms for such potentials are **technically exploitable, economically exploitable, market or even "sustainably" exploitable** potentials, for which the above spatial planning and ecological constraints have been considered.

Technical potentials may differ between different literature sources / authors because of different methodologies and assumptions used. The "standard methodology" typically used for the assessment of technical hydro potential by water authorities comprises of two main approaches. One is the conceptualisation of the hydropower development options in a river basin with the exclusion of river sections where interference with the river section is not possible while another, more elaborate approach is the calculation of the energy potential per each kilometre of river section (multiplication of head and flow per each) and adding these sections where applicable (excluding protected river sections), without any consideration of the constraints governing the technical solution of the hydropower plants.

Technical potential particularly assumes the application of a portfolio of presently available mature technologies when exploiting the available theoretical potential. Technical limitations mean that not all theoretical potential can be developed with presently known technologies and techniques. It should be noted that technical energy potential does not represent the energy quantity provided to electricity grid, due to the fact there is always a factor to apply to consider the energy losses in the energy conversion process.

Economic potential is that part of technical potential which is economically feasible and financially viable in the prevailing present and foreseeable future conditions and limitations.

For the assessment of market potential, one should also consider locally specific market conditions, in a competitive environment against other alternatives and the various impediments related to "doing business" in a country.

"Sustainability" is attributed to hydropower due its renewable energy characteristic, while additional sustainability for planned HPP projects is typically demanded from the point of view of (i) the environment, including climate change, (ii) the social acceptability of HPP projects, (iii) spatial planning adequacy, (iv) floodwater control and (v) the multipurpose use of water from the same source (e.g. drinking water, agriculture / irrigation, recreation, etc.), which is considered a "public good", therefore it cannot be used for power generation exclusively.

It should be emphasized that some hydro power schemes do have an unrecoverable impact on the landscape, fishery, fauna and flora in downstream areas, agriculture/irrigation, transport routes, development of industrial and human habitat areas.

Such impact may be in some cases positive (the fight against floods and river flow regulation) but especially if associated with large dam schemes, water reservoirs and environmental/spatial planning conflicts with protected areas (national parks, Ramsar, Emerald, Natura 2000 and others) they may also negatively affect society and the environment. Therefore, a coherent and thorough application of all relevant assessments (e.g. SEA/EIA/Appropriate Assessment under Article 6(3) of the Habitats Directive for Natura 2000 areas or equivalent areas under the Emerald network/Article 4.7 of the Water Framework Directive) as well as the assessment of transboundary aspects must be seen as a prerequisite for sound, sustainable strategic planning and project design in hydropower.

In accordance with its objective, the Study looks at that part of the additional - **remaining technical potential that can be sustainably developed** in the future, in line with the above sustainability principles. Greenfield projects, identified as candidates in BR-7, are checked against such criteria by deploying a multi-criteria analysis (MCA) in conjunction with Final Expert Assessment as described in BR-8.

Unfortunately, in the WB6 countries, there is typically no single competent institution that would be responsible for a consistent and up-to-date assessment of hydropower potential at the country level, and which would be based on a bottom-up assessment of such resources starting at the most disaggregate level: river / tributary, sub-river basin, river basin etc. On the other hand, top-down (aggregate) assessments of the potential often end up in overoptimistic and very high estimates of the remaining potential.

The following typical cases explain several approaches that considerably differ from the above-mentioned "standard methodology", which makes the assessments hard to compare and consistent:

- Power generation utilities that plan new HPPs consider technical potential as an opportunity for the construction of a portfolio of HPP projects that they wish to promote. Such a portfolio may even include several variants, some more demanding and potentially expensive schemes may be already eliminated etc.;
- Ministries may have different strategies than power utilities, which support "their" projects, and may promote also HPP projects for third party financiers (the private sector). Consequently, their view of technical potential differs from those of the utilities as well as from that assessed by the standard methodology;
- For some, potential seems to be understood as an opportunity to construct additional HPPs and produce additional own RES-E electricity which would cover the current deficit in electricity supply regardless of the economic effects;
- Some technical potentials are also disputed between countries sharing the same river basin and represent a "transboundary issue" as addressed in BR-5;
- More constraining assumptions, which have the result of reducing the technical potential over time. Thus, as time passes, the technical potentials demonstrate downsizing trends, because, for example, some sites may have become blocked by protected zones, the required space has already been used for other purposes, there may be conflicts with other planned infrastructure (railways, highways, power lines etc.);
- Assessments of technical potential may encounter numerous problems and gaps, for example tributaries are usually not considered due to a lack of data and thus opportunities for the construction of primary small HPPs will be missed as well; such assessments are usually done by concessionaires who are supposed to carry out additional measurements and propose the final technical solutions; in some countries, cadastres of small HPPs are being carried out (Albania, Serbia), on the basis of which technical potential could be assessed in a better way;
- Finally, the planning of water resources is the basis for the assessment of technical hydro potential, where hydropower is just one of the multiple possible uses of water resources, therefore, multi-sectoral interests are strongly present in the process.

Our attempt in the Study to assess technical potential in a bottom-up manner by providing assessments based on discussions with local utilities, ministries, initially showed inconsistent results, the reason being in the vast differences in the methodologies and approaches applied by stakeholders. However, in our endeavours to assess the technical potential as well as to assess the current use of such potential, we finally managed to obtain reasonably-balanced assessments. This was possible through studying background documents prepared by water authorities, some of which were prepared quite some time ago but not yet outdated, together with information contained in various energy strategies in the countries and finally, use of the expert judgement technique.

It would be extremely difficult to analyse the root causes of the differences in technical hydro potential obtained in recent studies. Our approach is that there is no real need to do so, because technical hydro potential is a relatively weak planning tool when applied across several countries. Each country has differing data available and has, in turn, used different approaches in addressing it. What has been obtained by this exercise is an indication of the available hydropower for future HPP development opportunities.

The Study therefore establishes the possibilities for sustainably developing the remaining technical hydro potential in the region by taking in full consideration the limiting factors arising from valid, pertinent legislation and regulations present in individual WB6 countries with respect to planning of hydro power projects, protection of the environment and the combat against climate change, spatial planning and the power sector in general. These framework conditions are governed by applicable EU environmental legislation (Water Framework Directive, Floods, Habitats, Birds, SEA and EIA Directives) as well as EU Climate Change policy commitments, and HPP development sustainability guidelines of major international sector stakeholders (IHA, ICPDR, IFIs).

4.2 Utilised, additional (remaining) and total technical hydropower potential in WB6

For the Study, a unique classification of hydrographic elements has been introduced (BR-2), which among others addresses 18 river basins (RB), 10 sub-river basins (SRB) and 3 selected rivers (Drina, Piva, Tara) in the WB6 countries. The so-called "bottom-up" approach in the assessment of technical hydropower potentials of WB6 water-course was applied, with such potential reported for individual rivers, SRBs and eventually RBs.

The used technical potential (UTP) denotes the sum of average annual outputs (i.e. design values) of all HPPs as of end-December 2016, including large and small HPPs, and it is **26,629 GWh**. By adding the remaining / additional technical potential (ATP) (where potential for small HPPs is included in data for the former Yugoslav Republic of Macedonia and partially for Montenegro only), which amounts at **45,342 GWh**, the total technical potential (TTP) is obtained amounting to – **71,971 GWh**.[7] Table 4.1[8] shows the breakdown of respective technical potentials by WB6 country and their shares in both UTP and ATP.

Table 4.1: Summary of total, used and remaining hydropower potential by country

Country	Total technical potential (TTP)	Used technical potential (UTP)		Additional technical potential (ATP)	Share in ATP
	(GWh)	(GWh)	(%)	(GWh)	(%)
Albania	10,273	5,940	58	4,333	10
Bosnia and Herzegovina	24,351	6,535	27	17,816	39
The former Yugoslav Republic of Macedonia	9,786	1,443	15	8,343	18
Kosovo	423	203	48	220	1
Montenegro	6,648	2,000	30	4,648	10
Serbia	20,489	10,507	51	9,982	22
Total	**71,971**	**26,629**	**37**	**45,342**	**100**

According to Table 4.1, Albania has most UTP (58%), followed by Serbia (51%), while the former Yugoslav Republic of Macedonia, Bosnia and Herzegovina and Montenegro have the least utilised UTP vs. TTP.

[7] Source: Based on data from strategic planning documents and national authorities in WB6 region.

[8] Note: If we compare the ATP assessed by the Study with some other sources published recently, e.g. the IRENA study entitled "Cost-Competitive Renewable Power Generation" (January 2017), it is evident that IRENA considers considerably higher hydropower potentials in data categories, (i) TTP – 103.4 TWh vs. 71.9 TWh in the Study, (ii) ATP – 68.4 TWh vs. 45.3 TWh, and (iii) even in UTP – 35.0 TWh vs. 26.6 TWh. It is worth noting that IRENA considers that 26.8 TWh of its additional full technical potential would be cost-competitive potential (ACCP) in accordance with the methodology applied in its report. That implies that approx. 60% of remaining potential in the study (45.3 TWh) would fall into this category.

5 Prospects for hydropower development in WB6 in the context of regional electricity markets

5.1 SWOT

The SWOT analysis outlined in Table 5.1 has been used to assess the departure point for future hydropower development in WB6.

Table 5.1: Strengths / Weaknesses / Opportunities / Threats (SWOT) analysis

STRENGTHS	WEAKNESSES
• High share of hydropower in the power generation mix in the WB6 (in the past as well as likely to remain in future). • Hydropower's flexibility • Hydropower is the most flexible RES-E generation • Remarkable, proven and long tradition in HPP technology in the Region • Hydropower is the most reliable renewable power generation source that ensures predictable and guaranteed low electricity prices in the long-run • Long-term predictable production costs and selling prices	• Legal and regulatory gaps and imperfections • Very complicated and lengthy concessioning, permitting and licensing procedures in most WB6 countries • Quality lacking in EIA / public consultations • Poor political continuity and long-term commitment of frequently changing governments • Lack of interest of international financiers in participating in the ownership structures of regional power utilities, to invest in large HPPs • Multiple users of water resources (multipurpose utilisation of water) with conflicting objectives • Incapability of states and power utilities (in state-ownership) to take a considerable stake in capital-intensive greenfield HPP projects
OPPORTUNITIES	**THREATS**
• High share of still unutilised hydropower potential in all WB6 countries • Hydropower production efficiently substitutes the need for polluting thermal power generation • GHG emissions reduction benefits • Improved Security of electricity supply • Technological development offers multiple improvements • Intraday markets opportunities for hydropower • New scheduling and operation principles • Economic recovery and social stability, multiple macro-economic benefits • Clear and visible demonstration of "National interest" by political structures	• Environmental and social risks if HPPs are improperly planned; the importance of assessment and mitigation is not sufficiently recognised • Reduced duration of output (gradually lowering capacity factor of HPPs) • Improper local understanding of the need for consideration of applicable EU directives (WFD, Habitats (Natura 2000), Birds, SEA and EIA directives), constituting an integrated framework • Limited readiness for transboundary cooperation and mutual planning at River (Sub) Basin level • Financial risk for investors in conditions of presently low electricity market prices • Transboundary issues. Unsolved and possibly continued transboundary issues, in most cases inherited from the former SFRJ, represent a real challenge for the new political establishment in the Region • Climate change will impact precipitation and rainfall regimes in the short- and long-term that may have negative impacts on the output of HPPs

5.2 General notes on electricity markets

The physical electricity markets (i.e. the electricity market that affects both financial and electricity delivery/offtake portfolios - to differentiate it from the financial derivatives markets that affect a financial portfolio only) generally consist of:

- the spot market, open to every market participant to trade energy-only among themselves of their free will, named by their respective specific timeframes: forward (more than 1 day ahead of delivery), day-ahead (12-40 hours ahead), intraday (up to 1 hour ahead of delivery);
- the balancing markets, the energy-only market where a system operator decides whether any deal is to be concluded or not (from the viewpoint of system balancing);
- the market for regulation services that usually includes both capacity reservation and energy delivery when called to.

The conceptual diagram below in Figure 5.1 presents the concept of a well-coordinated spot power market opening times vs. traded energy delivery time. On the day-ahead time-frame (indicated by "DA"), energy that is going to be delivered in the upcoming 12-36 hours is traded, while intra-day (indicated by "ID") facilitates changing scheduled production up to one hour before delivery to the grid. Auctions tend to accumulate liquidity (i.e. the volume of electricity on offer to be bought or sold at particular prices), while continuous trading supports flexibility (the ability of a trading participant to swiftly adjust its market position by an immediate buy or sell of a certain volume of electricity at a particular price). In addition to the accumulation of liquidity, the advantage of auctions over continuous trading is also that the price formation delivers more reliable price indications that may be used as the underlying value for financial derivatives.

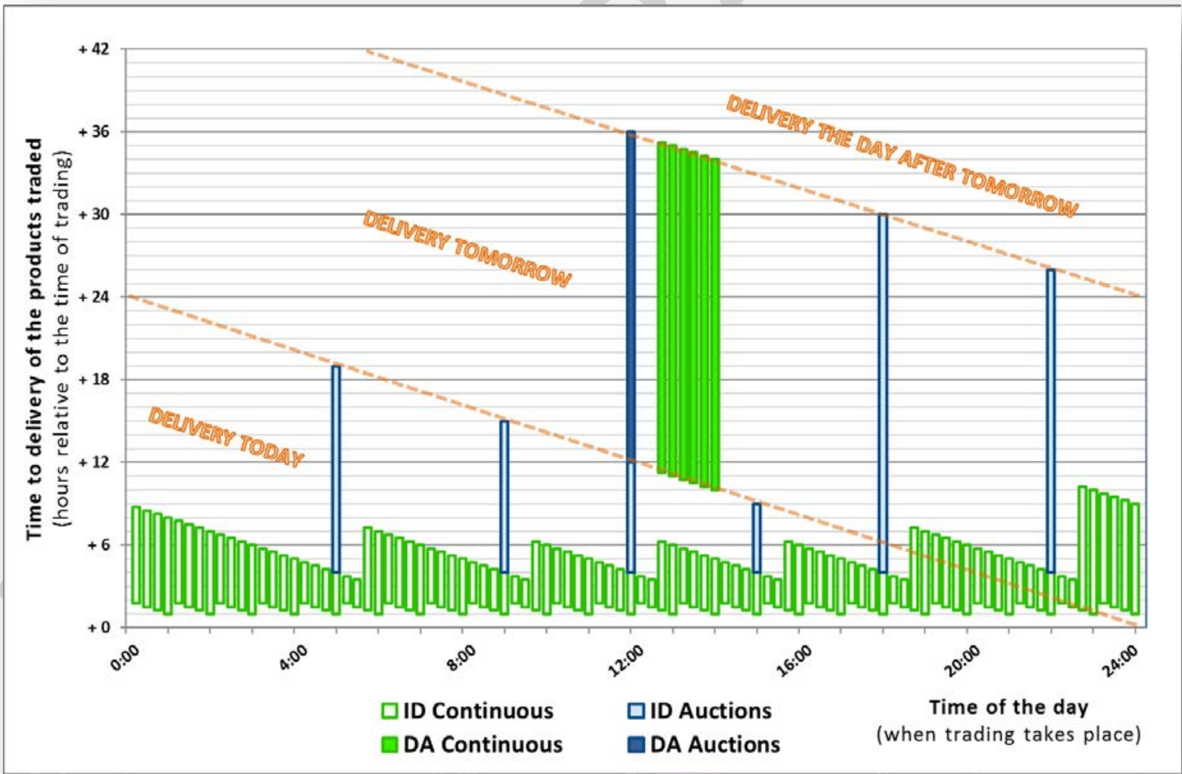


Figure 5.1: Coordinated spot market auctions and continuous trading times concept

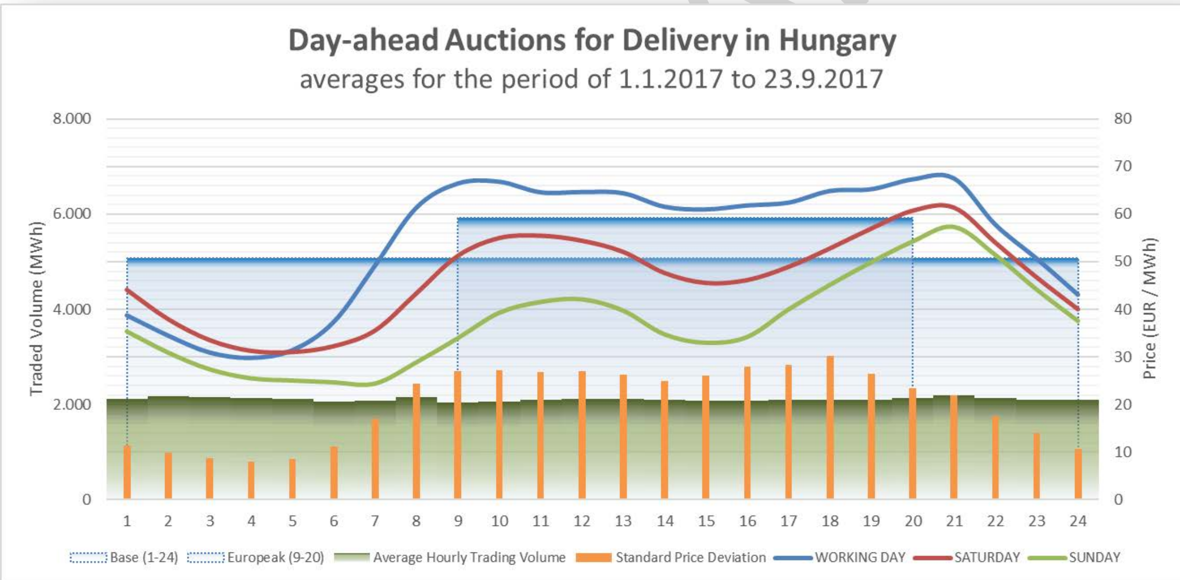
The coordinated market trading times enable the hydropower producer to effectively respond to changing market conditions and forecasts. Should, for example, the results of the DA auction be draining the reservoirs too much for a financial effect lower than the estimated potential of the upcoming hours, the ID market could offer opportunities to buy-back the energy sold for the hours valued the least and retain the water for a production shift to the more lucrative hours. Presently, the markets do not feature such ideal well-coordinated trading times, but

HPP operators should certainly see these exchange-traded markets as one of their most important partners in achieving the best economic results.

5.3 Hydropower on the regional market

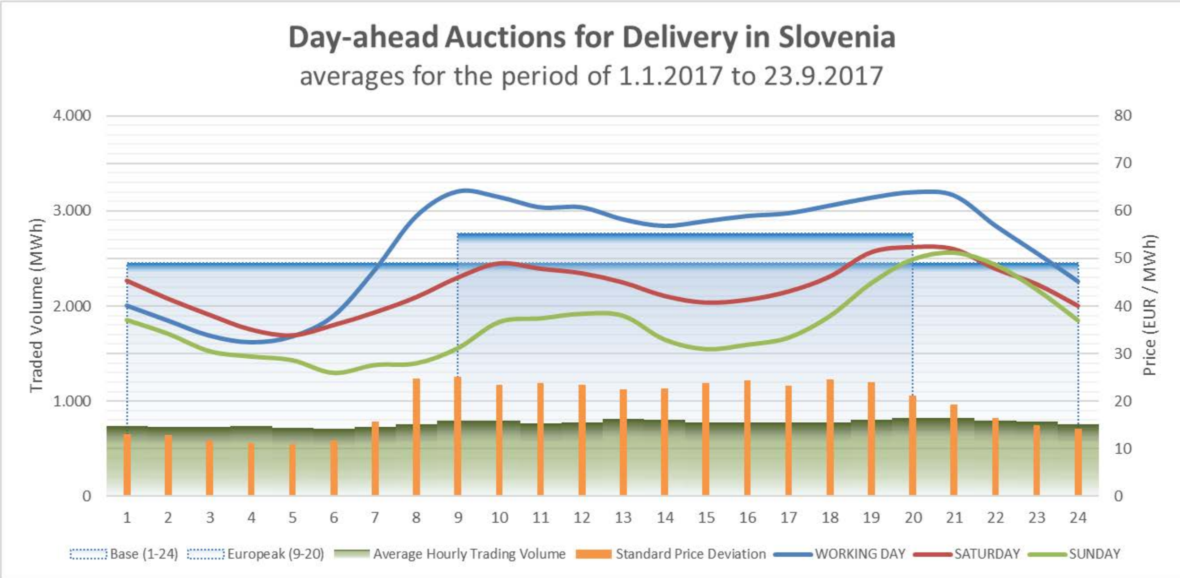
The relatively low prices of electricity in the recent years, mostly caused by the prices established on the German market that the WB6 region follows closely (average prices in German spot markets dropped by roughly 30% between 2012 and 2015, while the most recent trends show slight improvements) presents a challenge to investors in hydropower. Moreover, the previously typical price advantage of peak power from hydropower over the rest of the hours on the day-ahead spot markets has lowered, mostly due to photovoltaics feed-in delivering most of its power right around mid-day. (see the paper by Angelica Gianfreda et al., and Sebastian Braun's presentation) This effect incentivises HPP operators to move to new scheduling and dispatch patterns if they want to safeguard their revenue levels. The present prices of carbon emissions and the markets for guarantees of origin for renewables do not help hydropower generation much, either, and it seems that this is not going to change for some time.

To illustrate the typical recent hourly patterns in the region, examples of three spot markets (Hungarian, Slovenian, Serbian) shown in Figures 5.2-5.4 have been used. They show the average prices for electricity in particular hours of the day, the respective standard price deviations and average traded volumes (this is the most significant difference between the three markets). For clarity, the average prices of base (whole-day average) and peak (average of hours 9-20) are presented.



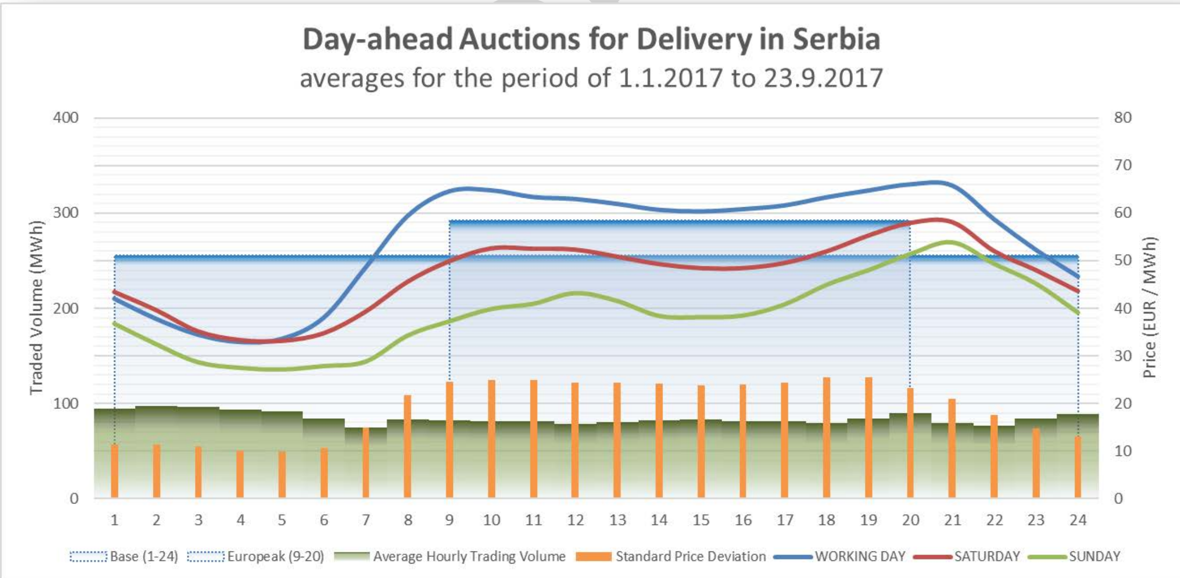
Data source: HUPX

Figure 5.2: Average hourly prices and traded volumes in Hungary (1 January – 23 September 2017)



Data source: BSP SouthPool

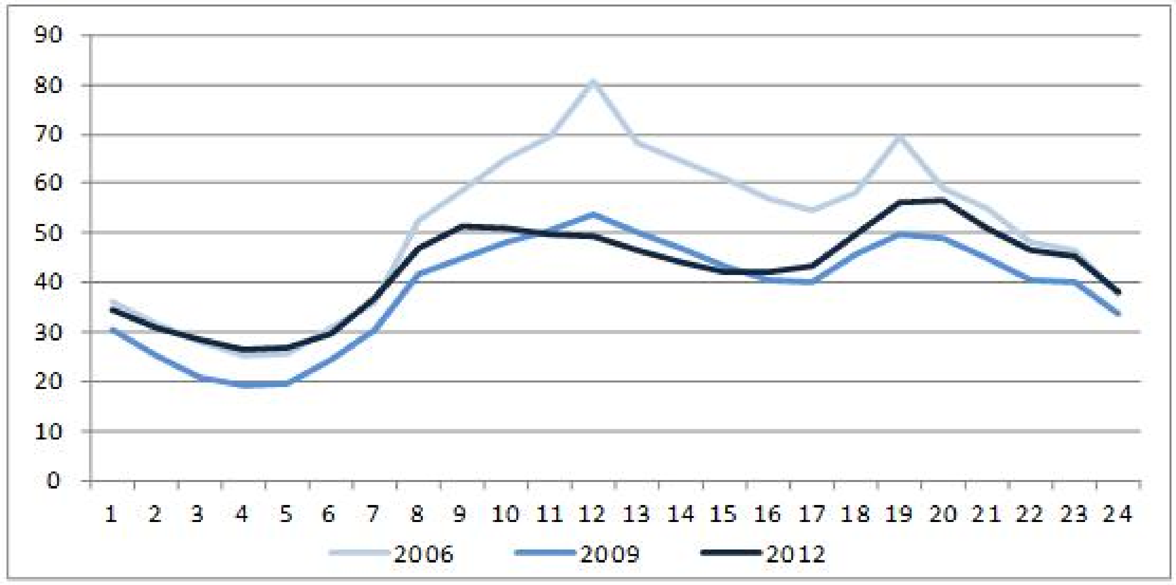
Figure 5.3: Average hourly prices and traded volumes in Slovenia (1 January – 23 September 2017)



Data source: SEEPEX Spot

Figure 5.4: Average hourly prices and traded volumes in Serbia (1 January – 23 September 2017)

The recent absence of the mid-day peak prices compared to the situation in 2006-2012 (Figure 5.5) is evident. In the not-so-distant past, before the effects of high volumes of photovoltaics had taken over production for a large chunk of the mid-day peak consumption in the UCTE interconnected grid (on a sunny day, that is; mostly in the EU, countries are trying to fulfil the 20-20-20 agenda), hydropower used to target its production on consecutive hours around the mid-day peak to obtain the best prices. Now, even though there are two demand peaks, they are nowhere near as lucrative as the mid-day peak used to be.



Source: PowerMarket

Figure 5.5: German EEX spot prices (EUR/MWh) by hour of the day average (2006, 2009 and 2012)

The 2006 peak-hours prices were substantially higher and significantly more volatile (the standard deviation metrics are used to depict it) than the peak-hours prices in 2012. It was not so uncommon to see extreme price spikes during these hours as, for example, has happened for the hour 12 on 25 July 2006, when the price was determined at 2,000.07 EUR/MWh (!). Such occurrences are not likely these days and therefore the opportunities (due to the flexibility of HPPs) for these kinds of windfall profits are not to be relied upon.

Table 5.2: German yearly EEX spot prices (EUR/MWh) by hour of the day average (2006–2012)

	2006	2007	2008	2009	2010	2011	2012
average (EUR/MWh)	50.8	38.0	65.8	38.9	44.5	51.1	42.6
st. deviation (EUR/MWh)	49.4	30.3	28.6	19.4	14.0	13.5	18.7
st. deviation (%)	97.3%	79.9%	43.5%	49.9%	31.4%	26.5%	43.8%

Source: PowerMarket

New opportunities for the marketing of energy from both flexible (fast responding and reliable generation capacity, like hydropower with storage) and intermittent (ability to produce depending entirely on natural circumstances, like with wind and solar power generation) generation alike will increase significantly with the coverage and liquidity of intra-day and balancing markets (both energy-only markets open for trading up to one hour before delivery time, while the balancing market is generally limited for participation to generators and consumers within the delivery-zone). Albeit their uptake appears to be rather slow (it should be noted that a region-wide balancing market project for the SEE, called BETSEE, has been among the first multinational balancing proposals within the UCTE interconnection) they appear to be finally gaining momentum; once they are fully set-up and operational, the challenge of liquidity remains and, due to their inherent flexibility, it is quite reasonable to count on hydropower operators in the WB6 to act as market makers.

The benefits of hydropower participation in the regional **balancing market** leads to greater overall efficiency of both the system and HPPs themselves (see EKC's report) improving both hydropower production volumes and its average financial value. The HPP operators would like to be able to optimise their positions not only on intraday auctions, but also in intra-day continuous markets, as close to dispatch as possible (see Sebastian Braun's presentation).

Another important aspect of hydropower role in the market is their participation within the **balancing groups** in their home markets. The balancing groups serve the purpose of aggregation in terms of summing-up the joint effect an individual group of consumers and producers have on their home regulation zone, enabling the balancing group responsible parties to manage deviations from the scheduled effect (a single hourly value per balance group) jointly for a group, instead of individually for each member (producers and consumers). The HPPs' flexibility is a great asset that can be used to manage the balancing group's deviations in real-time.

Hydropower continues to grow in importance for the purpose of **security of supply**. Beyond delivering mere energy volume and capacity, its opportunities lie in its flexibility to provide a wide range of system regulation services, like secondary regulation via minute reserve and primary regulation, particularly in connection with the increasing participation of intermittent generation, such as wind and solar, in the interconnected grid and challenges presented by the transition to RES-only power generation (see EURELECTRIC's paper). It should be noted that presently, hydropower offers the only large scale (short- and long-term) storage capacity, and, apart from the fairly costly biomass power plants and typically small biogas facilities, hydropower is also the only renewable resource able to guarantee its output.

A summary of the market conditions and opportunities for hydropower:

- Hydropower's flexibility enables an easy move from traditional peak production hours (9h-20h) to more variable operation, improving financial results – e.g. targeting production during 8h-11h and 19h-22h, reversing/pumping during 2h-6h;
- Intraday markets present a great opportunity for hydropower as the prices instantaneously respond to the actual situation in the system - and HPP operators are best positioned to benefit from them due to the flexibility of their dispatch;
- Hydropower is the most flexible RES generation able to deliver various system regulation services at competitive prices.

The importance of new opportunities in the area of system regulation apply to both conventional hydropower and pumped storage plants. Particularly for the latter, technological improvements like variable-speed electronics (enabling multiple operation modes) and hydraulic shortcut design (effectively enabling a pumped-storage plant to operate at any level between -100% and +100%) are of great importance and may substantially contribute to the increased income generation of a plant (their effect on quantification estimates go well beyond 50% increase, according to EPRI's report; a plant's operation may increase to above 8,000 hours per year, according to EURELECTRIC's paper; see also the presentation by Juan I. Pérez-Diaz).

Initial investment into hydropower is fairly high and their ability to generate income sufficient to service the upfront investment cost will make or break the project. Generally, hydropower generated electricity is considered to be on the cheapest side of electricity generation technologies, while it has to be noted that such estimates take into account also its relatively long economic lifetime (the LCOE or "average lifetime levelised cost of electricity generation", see IRENA report). Therefore, the likely circumstances of tightened cash flows (as have been witnessed in the recent years following the financial markets' crisis), in which investment cost can no longer be easily repaid, have to be taken into account, as do the setting of the water fees and concessions (see the paper by Michael Barry et al.) Another investment-hindering issue appears to be the grid connection fees of reversible and pump storage types of hydropower - as they may end up being charged twice, simultaneously for generation and for off-take capacities (see EURELECTRIC's paper).

Conclusions on technology advances and regulatory environment:

- New technologies like variable speed electronics and hydraulic shortcut design provide hydropower with the capabilities for continuous operation by the ability to instantly and precisely respond to market and system conditions;
- Licensing and fees imposed on hydropower producers will have to be adjusted to the new realities and role of hydropower in both the market and the power system.

Hydropower holds an important traditional role in the WB6 region (including the 5 countries that were part of the former SFRJ with Albania), consistently delivering more than a third of electricity produced for more than 25 years. Building on proven hydropower technologies produced in the former SFRJ, regional industrial know-how, the adoption of new technological solutions and creative operational practices fostered by the developing regional markets, has the potential of being an important game changer for hydropower operators and developers.

The new scheduling and dispatch paradigms will be freely vested (by regulation contracts) hydropower resources, leading to their increased efficiency and use (see EKC's report). Benefits of the regional close-to-dispatch markets (i.e. intraday and balancing), identified by simulation on an individual country basis, will undoubtedly spill across borders. The effects of an increased role of regulation in the system and, among other factors, shifting production to peak hours, will allow the less flexible power plants (mostly thermal power plants) to mitigate steep ramping and to generally operate at more efficient levels.

Naturally, the major drivers of these changes will be hydropower with storage and of the cascade type. Should the operators on a single cascade be many (mixed ownership of HPPs), many opportunities for a concerted action arise, also on a regional level, as the example of power swaps from Sweden demonstrate (the Swedish term is "Kraftbyten", see Ulf Brännlund's presentation).

Key facts for hydropower in the region:

- A long tradition in technology production and industrial know-how;
- New scheduling and operation principles will free hydropower capacity presently reserved for regulation purposes which will improve both their own financial results and overall system performance.

(Note the list of references used in this Section 5[9])

[9] List of references used in Section 5:

1. Hydropower – supporting a power system in transition, EURELECTRIC, Brussels, June 2015
2. Trends and challenges in the operation of pumped-storage hydro power plants (PSHP), Juan I. Pérez-Diaz, Trondheim, September 2015
3. The Future of Swiss Hydropower – A Review on Drivers and Uncertainties, Michael Barry et al., Basel, September 2015
4. Final Report of SEE Regional Balancing Integration Study, EKC, Belgrade, December 2014
5. Quantifying the Value of Hydropower in the Electric Grid: Final Report, EPRI, Palo Alto, February 2013
6. Hydropower Storage Optimization Considering Spot and Intraday Auction Market, Sebastian Braun, Trondheim, September 2015
7. Renewable Power Generation Costs in 2014, IRENA, Abu Dhabi, January 2015
8. Power Swaps in Hydro, Ulf Brännlund, Trondheim, September 2015
9. The Impact of RES in the Italian Day–Ahead and Balancing Markets, Angelica Gianfreda et al., Cleveland, January 2016
10. "Are price peaks disappearing from the electricity markets?", PowerMarket, www.powermarket.eu, November 2013.

6 Energy / power sector development policies and strategies and action plans in the region

Albania, Bosnia and Herzegovina, the former Yugoslav Republic of Macedonia, Kosovo, Montenegro and Serbia are all Contracting Parties (CPs) to the Energy Community Treaty (ECT). As such, they have obligations to comply with an *acquis* process, which is like the process of the EU Directives acquis, applicable to EU Member States and candidate and potential candidate countries. However, for CP's the requirements are milder in scope with reduced defined targets and extended deadlines. But all WB6 countries are strategically committed to make significant progress.

A key part of the common energy policy of both the EU and the WB6 countries are RES&EE targets and decarbonisation (i.e. the reduction of greenhouse gases). All countries have adopted their specific targets based upon available resources and envisaged market developments. However, in order to achieve these targets, state support and promotion measures have to be implemented to attract the private sector (investors). In that sense, not all countries have the same approaches and progress; some are still expected to fully transpose and implement relevant EU legislation, develop a positive environment and introduce / implement institutional structures for effective progress in developing RES and EE.

All WB6 countries' energy policies are strongly influenced by the process of transposing and implementing selected items of (currently 10) EU acquis closely related to the energy sector / market development within the framework of the Energy Community. The goal is to create a legal and regulatory framework which is capable of attracting investments for a stable and continuous energy supply. This enables the creation of an integrated energy market and consequently cross-border trade and integration with the EU market.

The main strategic planning documents that each WB6 country is obliged to adopt in order to meet 2020/2030 targets are related to the implementation of Directive 2009/28/EC of 23 April 2009 on the promotion of the use of energy from renewable sources (RES Directive) and Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC EE Directive). Based on the RES Directive, all CPs were obliged to prepare and submit their National Renewable Action Plans (NREAP), and on the EE Directive, rolling 2-year National Energy Efficiency Action Plans (NEEAP).

6.1.1 Energy Strategy

However, the two very important drivers of sustainable energy sector development, notably RES primarily on the supply side and EE particularly but not entirely limited to the demand side, both have to be consistently integrated in the overall energy sector development context - by the development of preferably long-term energy policy concepts and the pertaining energy strategies. Most time-horizons applied in the WB6 region so far are by 2030, with the exception of Albania and Kosovo.

The goal of the Energy Strategy is typically to build a sustainable energy system that makes a balanced contribution to (i) the security of energy supply, (ii) competitiveness and (iii) environmental protection and combat against climate change and which provides security and affordability of energy supply to the citizens and businesses in the future. Despite the gradual development of energy markets, most national strategies count on the self-sufficiency of energy supply from indigenous sources of energy. In such a context, long-term own hydropower generation represents an important element of secured electricity supply, a potential for the integration of other intermittent RES-E sources (wind, solar) and better predictability of electricity prices, which is especially important for the national economy and vulnerable customers. The strategies focus on the principles, strategic guidelines and the main components and mechanisms of the state energy policy implementation. Quantitative parameters of the economy and of energy development are expressed and are subject to verification during the implementation of the measures specified by the Strategy.

The Energy Strategy is necessary to meet national obligations in the framework of the Regional Electricity Market in South East European countries and other international obligations regarding environmental protection and climate change as well as the harmonisation of energy sector development by convergence with the requirements of EU Directives. Each counties' Energy Strategy has a requirement to be accompanied by a proper and transparent SEA, process based on recent and quality data, including analysis of alternatives (e.g. technical characteristics, location, and different alternative sources) with all stakeholders' involvement and a public participation process, in line with the provisions of the SEA directive. The SEA may be completed concurrently with the Energy Strategy development, but in WB6, most counties still should complete these SEA's. The Energy Strategy in the former Yugoslav Republic of Macedonia, completed in 2010, is the only example identified with accompanying SEA.

The CPs to the ECT generally develop an Energy Strategy until 2020 or 2030, wherein they propose targets for renewables, energy efficiency, and greenhouse gas reductions for the period between 2020 and 2030. Table 6.1 shows a list of Energy Strategy documents, their year of adoption and the time horizon covered.

Table 6.1: Energy Strategy documents by country

Country	Document	Year	Time horizon
Albania	The national energy strategy (note: new energy strategy has been drafted in 2016-2017 and presently awaits the formal adoption procedure)	2012	2020
Bosnia and Herzegovina *)	Strategic plan and program of the energy sector development of Federation of B&H	2009	2030
	Energy Strategy of Republika Srpska up to 2030	2012	2030
The former Yugoslav Republic of Macedonia	The strategy for energy development of the Republic of Macedonia until 2030	2010	2030
Kosovo	Energy strategy of the Republic of Kosovo	2009	2018
	Energy strategy of the Republic of Kosovo	2017	2026
Montenegro	Energy development strategy of Montenegro by 2030 – White book	2014	2030
Serbia	Energy Sector Development Strategy of the Republic of Serbia for the period by 2025 with projections by 2030	2016	2030

*Note: *) Bosnia and Herzegovina has still no energy strategy as a state. However, a project has been launched to develop a such strategy in 2017.*

6.1.2 Renewable Energy

In the area of renewables, the main legislative pillar is the Renewable Energy Directive or RED (2009/28/EC) - adopted and adapted for the Energy Community with the Decision 2012/04/EnC-MC of the Ministerial Council on October 18th 2012 - which establishes an overall policy for the production and promotion of energy from renewable sources in order to achieve binding shares of renewable energy in the final energy consumption by 2020.

The CPs to the ECT committed to binding renewable energy targets in the period to 2020 and to implement the RED by January 1st 2014, thus converging with the European climate and energy objectives. Targets are set in the main planning mechanism required by RED, i.e. the National Renewable Action Plans (NREAPs).

The NREAP requires information on sectoral targets (electricity, heating and cooling and transport), measures to support their achievement and the overall implementation of the RED. On the basis of the NREAPs, the CPs are obliged to work towards an indicative trajectory[10] for the achievement of their final mandatory targets. With respect to electricity produced from hydropower sources, there are no specific mandatory targets in NREAPs.

The national targets of the CPs, calculated on the same methodology as for EU Member States, are shown in Table 6.2 and Figure 6.1.

[10] Indicative trajectory is calculated according to the Annex 1 (B) of Directive 2009/28/EC.

Table 6.2: RES targets according to the NREAPs

Country	2020 target	RES-E sub-target	RES-H&C sub-target	RES-T sub-target
Albania	38%	90.7-95.0% *	33.4%	10.0%
Bosnia and Herzegovina	40%	56.9%	52.4%	10.1%
The former Yugoslav Republic of Macedonia	21%	25.6%	24.6%	10.0%
Kosovo*	25%	25.6%	45.6%	10.0%
Montenegro	33%	51.4%	38.2%	10.2%
Serbia	27%	36.6%	30.0%	10.0%

*Note: *) Currently Albania ensures around 95% of the power from the hydropower stations and by 2020, and including other RES, should not go under 90.7%.*

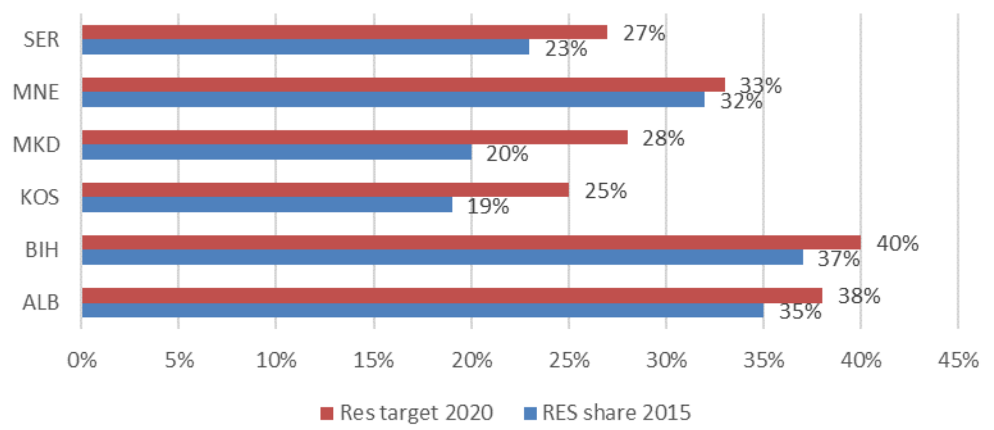


Figure 6.1: National RES targets (2020) and status of 2015-achievements by country, %

All six WB6-countries declared their heavy reliance on the development of new hydro power plants in order to reach the RES share targets which they committed to in their NREAPs.

According to the NREAPs, the total installed hydropower generation capacities amounted to 6,953 MW in the base year of 2009 (all capacity ranges). New HPP capacity additions amounting to 2,717 MW were planned to be implemented by 2020, thus reaching 9,670 MW in 2020. The corresponding additional electrical energy generated would be 6,383 GWh. This represents a 39% increase in terms of capacity and a 25% increase in terms of electricity generation. This development is shown in Figure 6.2.

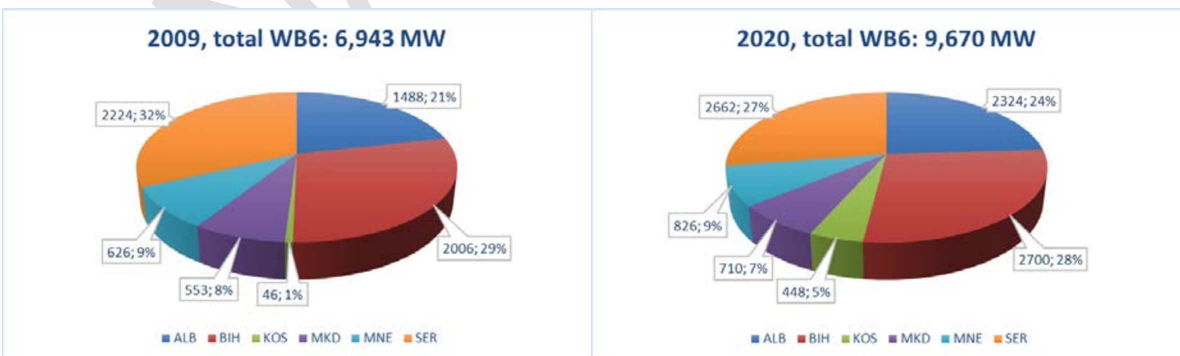


Figure 6.2: Installed hydropower generation capacities in 2009 and binding targets for 2020 (NREAP) by country, MW

Further analysis of this planned increase in installed hydro power capacity by capacity range and country is shown in Figure 6.3.

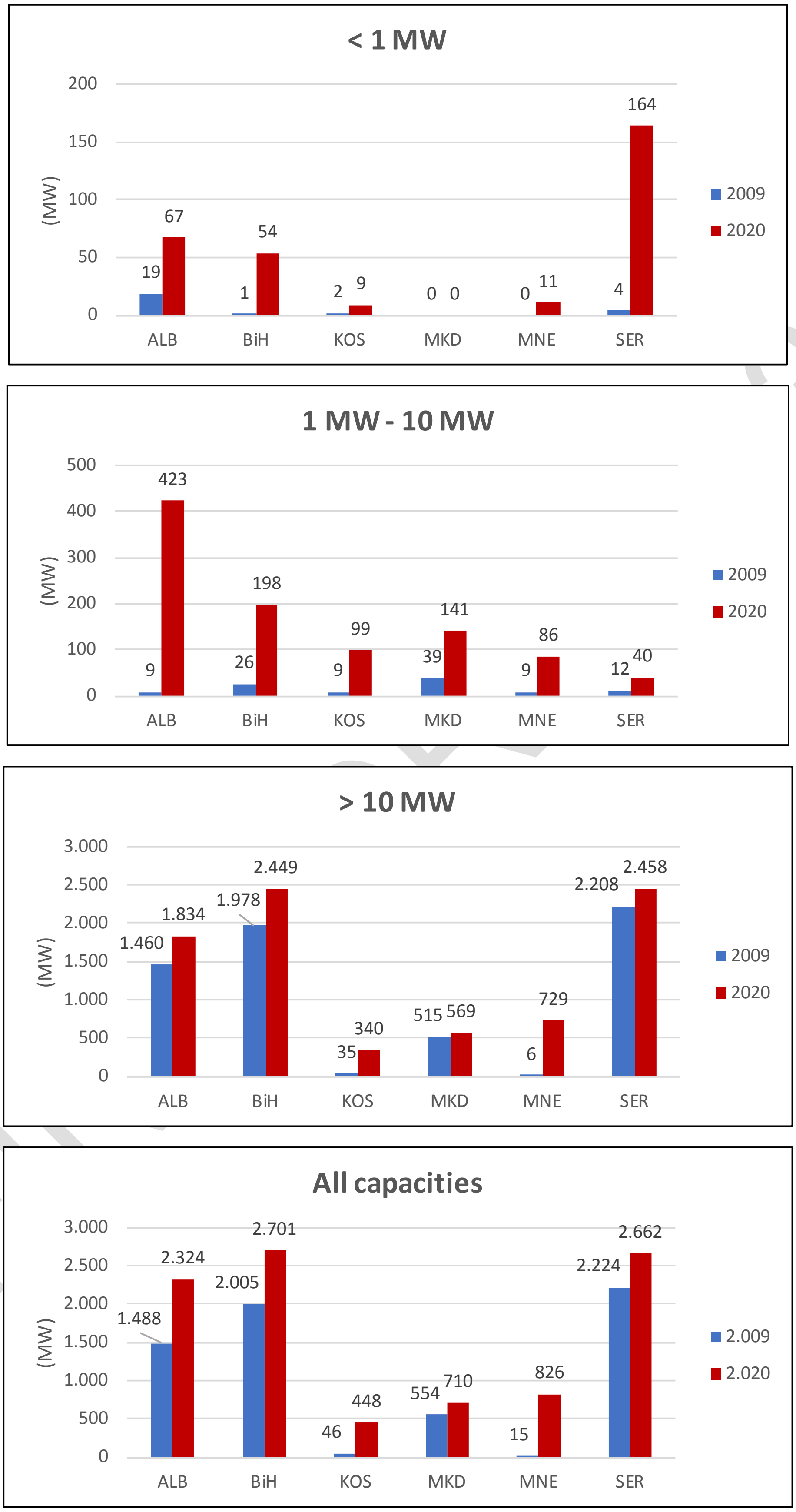


Figure 6.3: Status of installed hydropower generation capacities in 2009 and indicative plans for 2020 (NREAP) by capacity range and country, MW

Regarding the indicative plans to 2020 according to the adopted NREAPs, it can be observed that hydropower capacity additions in HPPs below 1 MW are expected to contribute 10% to the overall hydropower capacity increase, HPPs between 1 MW and 10 MW 33%, and HPPs over 10 MW 57%. In the capacity range below 1 MW, Serbia has highest ambitions, while Albania has relatively highest expectations in the middle capacity range of 1-10 MW. Regarding the higher capacity range of more than 10 MW, the most significant additional capacities are expected in Serbia, Bosnia and Herzegovina and to a lesser extent in Albania. In all capacity ranges, the other countries (Kosovo, the former Yugoslav Republic of Macedonia and Montenegro) have in comparative terms the lowest expectations.

As the achievement of aggregate plans described above depends entirely upon actually implemented projects, these HPPs need to be developed and assessed with respect to their technical, financial, environmental and other attributes governing feasibility. In addition, their implementation readiness needs to be assessed and potential obstacles for their timely development identified. Such analysis can then provide a more realistic feedback on the prospect of the achievement of the goals described in the NREAPs.

6.2 National Renewable Energy Action Plans (2011-2020) – plans vs. expected achievements

The status at the end of April 2016 was that all WB6 countries have their NREAPs adopted by the respective governments. The NREAPs are thus the official policy documents based upon which the WB6 countries intend to reach their binding 2020 RES targets by 2020. The first report of the ECS to the Ministerial Council of the Energy Community (MC-EnC) on “the Progress in the Promotion of Renewable Energy in the Energy Community” (October 2015) could not report on NREAP-related developments in Albania, the former Yugoslav Republic of Macedonia and Bosnia and Herzegovina because their action plans were adopted and submitted only in 2016. BiH has adopted its NREAP by combining the two entities’ (Federation of Bosnia and Herzegovina and Republic of Srpska) plans adopted in 2014 plus making an assumption relating to the Brčko district.

Pursuant to Article 22 of the EU Directive 2009/28/EC, every two years the CPs are obliged to submit a Report on Progress in the Promotion of Renewable Energy to the Energy Community. This Report assesses the CPs’ progress in the promotion and use of renewable energy against the established trajectory towards the 2020 targets set in the NREAPs and also reports upon the sustainability of biofuels and bioliquids consumed in the Energy Community and the impacts of their consumption. All CPs from WB6, except BiH, submitted their progress reports to ECS by March 2017. This section gives an overview of the NREAPs targets in CPs and the progress in their achievement according to the 1st and the 2nd Progress Report.

6.2.1 Albania

Albania is obliged to transpose and to be in compliance with the EU Directive 2009/28/EC. One of the requirements of the law 138/2013 “On Renewable Energy Resources” is the preparation and the approval of the National Action Plan for Renewable Energy (NREAP), which establishes national objectives for renewable energies in the gross final energy consumption (GFEC) as well as the supporting measures to achieve them. The National Action Plan for Renewable Energy Resources in Albania 2015-2020 was adopted in January 2016.

The objectives and goals of the Albanian NREAP are, as follows:

- Consumption of renewable energy resources at the measure of **38%** in total energy consumption in 2020;
- Diversification of domestic renewable resources, not only from water resources i.e. hydropower, but also from wind, solar, biomass and geothermal energy;
- The increase of the contribution of bio-fuels and other combustion materials from renewable resources with 10% of biofuels in the total fuel consumption for the transport sector by 2020.

To achieve its targets in the electricity sector, Albania plans to install an additional 3,276 MW of renewables by 2020: a total of 1,877 MW of new hydropower generating capacity, about 1,367 MW of wind power plants and 32 MW of solar capacity.

Estimation of the RES potential available in Albania for electricity production (RES-E) in the period 2009-2020 in GWh is shown in Table 6.3. The comparison against realised achievements is made according to the Albanian

Progress Report under Renewable Energy Directive 2009/28/EC, as adopted by the Ministerial Council Decision 2012/04/MC-EnC, for the period 2012-2013 and 2014-2015. The results are shown in Table 6.4. and Figure 6.4.

Table 6.3: Estimation of the RES-E potential in Albania, 2009-2020, GWh

Year	sHPP (< 1 MW)	sHPP (1 MW – 10 MW)	HPP (> 10 MW)	PV	Wind-onshore	Solid biomass
2009	53	24	5,900			
2010	69	32	7,743			4
2011	91	100	4,158			8
2012	101	188	4,725			12
2013	122	375	6,586			16
2014	164	755	4,058			20
2015	185	941	4,453			20
2016	195	1,035	4,713			20
2017	213	1,197	4,713	120	8	20
2018	232	1,368	4,713	120	20	20
2019	236	1,402	5,680	120	40	20
2020	259	1,607	5,680	120	60	20

Table 6.4: Estimated and realised share of RES-E utilisation in total electricity consumption in Albania, 2009-2020, %

Year	sHPP ((<1 MW)	sHPP (1 MW – 10 MW)	HPP (> 10 MW)	PV	Wind-onshore	Solid biomass	Total estimated	Total realised
2009	0.7%	0.3%	81.9%	0.0%	0.0%	0.0%	83.0%	
2010	0.9%	0.4%	105.2%	0.0%	0.0%	0.1%	106.6%	
2011	1.2%	1.4%	56.3%	0.0%	0.0%	0.1%	59.0%	
2012	1.3%	2.5%	62.6%	0.0%	0.0%	0.2%	66.5%	79.0%
2013	1.6%	4.9%	85.5%	0.0%	0.0%	0.2%	92.2%	62.2%
2014	2.1%	9.7%	52.1%	0.0%	0.0%	0.3%	64.1%	70.9%
2015	2.3%	11.8%	55.7%	0.0%	0.0%	0.3%	70.0%	79.2%
2016	2.4%	12.6%	57.5%	0.0%	0.0%	0.2%	72.7%	
2017	2.5%	14.3%	56.1%	1.4%	0.1%	0.2%	74.7%	
2018	2.7%	15.9%	54.8%	1.4%	0.2%	0.2%	75.3%	
2019	2.7%	15.9%	64.5%	1.4%	0.5%	0.2%	85.2%	
2020	2.9%	17.9%	63.1%	1.3%	0.7%	0.2%	86.1%	

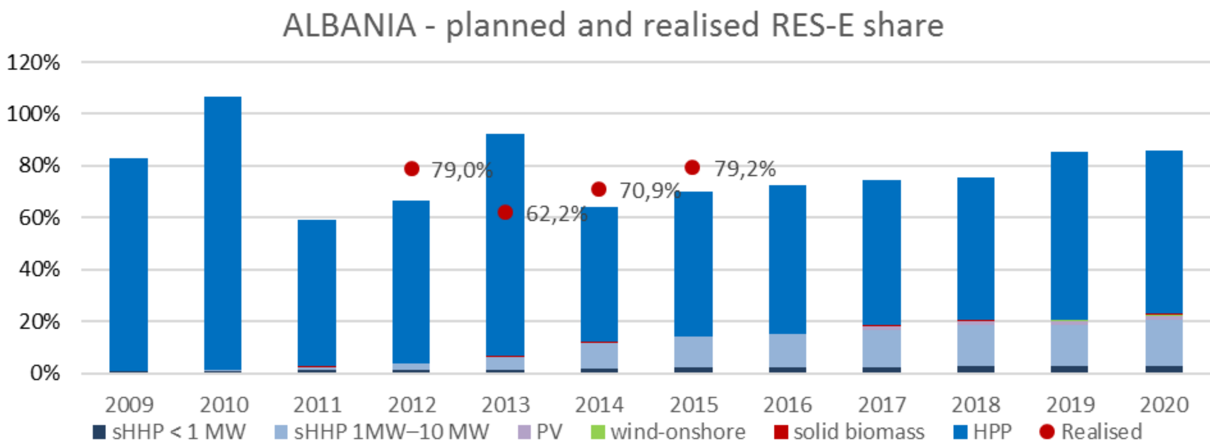


Figure 6.4. Planned and realised RES-E share in Albania

Albania produces most of its electricity in HPPs (95%), so the electricity production in Albania is extremely sensitive to yearly hydrology (note an exceptionally good hydrology in 2010). The data for 2011-2014 in the Albanian NREAP (prepared in late 2015) are historic data, reflective of natural variations in hydrology.

Concessions for the construction of hydro power plants are awarded through an open bidding process; the information and data for a specific concession site are also made available on the official website of Ministry of Energy and Industry of Albania (MEI).

The concession fees for the hydro power plants are the result of a bidding process, where bidders offer a concession fee based on a percentage of the annual output they foresee, which is one of the bid evaluation criteria.

Regarding construction permits, the legislation makes no distinction between renewable energy technologies and other conventional technologies.

Tariffs for the authorisation of new RES plants are published in the Official Journal and in the MEI website together with the relevant government decision, containing the criteria and procedures for reviewing and granting authorisations.

6.2.2 Bosnia and Herzegovina

The Renewable Energy Action Plan of Bosnia and Herzegovina (NREAP BiH) has been harmonised with strategic planning documents of the Federation of Bosnia and Herzegovina, Republika Srpska, the Brčko District and, among other things, presents an overview of RES energy consumption in the reference year of 2009, and for the period 2010 to 2020.

According to the Decision 2012/04/EnC-MC, the overall RES target for Bosnia and Herzegovina in 2020 is set at **40%**.

The planned trajectory for the electricity sector in BiH shows that the electricity production from RES in 2020 will be around 8,846 GWh or 3,082 MW of installed capacities. The dominant share is hydropower generation. Domestic operators have significant experience in constructing hydropower plants, and bearing in mind the unused available hydropower potential, it is the easiest way to achieve 2020 goals while yielding the greatest benefit. According to their plan, BiH should construct small, medium and large hydropower plants with 1,694 MW of installed capacity. Therefore, in 2020, hydropower plants would be generating an estimated 7,699 GWh of electricity per year. Regarding wind energy, the construction of wind farms with an installed capacity of 330 MW is planned, which would deliver an annual electricity production of 775 GWh. Power generation from solar plants represents a smaller share in the overall electricity production plans from RES in BiH. The established trajectory foresees the construction of solar plants for power generation with an installed capacity of 16.2 MW, which would produce around 23 GWh annually. Biomass for the generation of heat and electricity is a strategic goal in BiH bearing in mind the available quantities and possible benefits of biomass use. By 2020, the construction of 35.7 MW of cogeneration biomass power plants is planned, with a total estimated electricity production of 117.4 GWh.

The estimation of the RES potential in BiH for each technology of electricity production, for the period 2009-2020, (GWh) is shown in Table 6.5. Data for planned RES-E shares are taken from NREAP BIH and the data source for realised RES-E consumption is a State Electricity Regulatory Commission report, because no Progress report was published on the implementation of the RES Directive in BiH so far. However, the NREAP does not provide information on large HPP (<10 MW) electricity production. In Table 6.6. and Figure 6.5., the results on achievement by type of RES-E technology are shown.

Table 6.5: Estimation of the RES-E potential in Bosnia and Herzegovina, 2009-2020 (GWh)

Year	sHPP (< 1 MW)	sHPP (1 MW – 10 MW)	PV	Wind-onshore	Solid biomass	Biogas
2009						
2010	0	5	0	0	0	0
2011	2	27	0,3	10	2	0
2012	43	145	3	40	6	3
2013	45	168	3	50	7	4
2014	48	200	9	60	15	4
2015	57	236	12	70	22	5
2016	68	280	15	90	26	7
2017	88	339	20	170	33	8
2018	102	384	22	205	39	9
2019	117	477	24	265	48	11
2020	70	570	28	307	57	13

Table 6.6. Estimated and realised share of RES-E utilisation in total electricity consumption in Bosnia and Herzegovina, 2009-2020, %

Year	sHPP (< 1 MW)	sHPP (1 MW – 10 MW)	HPP (> 10 MW)	PV	Wind-onshore	Solid biomass	Biogas	Total estimated	Total realised

2009	0.3%	1.5%	58.3%	0.0%	0.0%	0.0%	0.0%	60.1%	
2010	0.2%	1.3%	38.7%	0.0%	0.0%	0.0%	0.0%	40.2%	34.4%
2011	0.3%	1.8%	40.3%	0.0%	0.0%	0.0%	0.0%	42.5%	34.4%
2012	0.5%	2.6%	43.5%	0.0%	0.0%	0.1%	0.1%	46.7%	32.9%
2013	0.6%	2.8%	42.3%	0.1%	0.3%	0.1%	0.1%	46.2%	56.7%
2014	0.7%	3.2%	41.4%	0.1%	0.8%	0.2%	0.1%	46.4%	47.7%
2015	0.9%	3.7%	40.3%	0.1%	1.0%	0.3%	0.1%	46.5%	43.0%
2016	1.0%	4.1%	39.5%	0.1%	3.9%	0.3%	0.1%	49.1%	
2017	1.1%	4.3%	41.9%	0.1%	4.4%	0.4%	0.1%	52.4%	
2018	1.3%	5.0%	41.1%	0.1%	4.8%	0.5%	0.2%	53.0%	
2019	1.5%	5.7%	43.6%	0.2%	5.1%	0.6%	0.2%	56.8%	
2020	0.3%	1.5%	58.3%	0.0%	0.0%	0.0%	0.0%	60.1%	

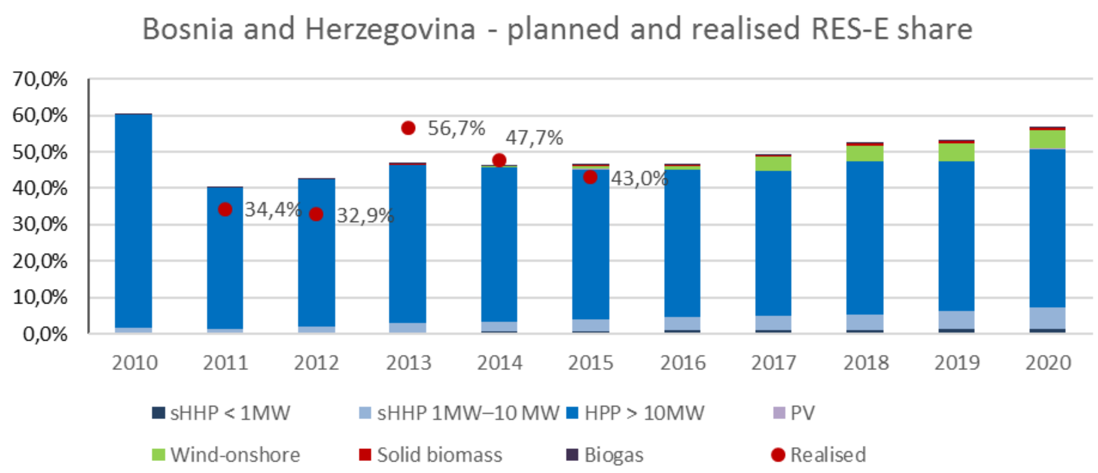


Figure 6.5. Planned and realised RES-E share in BiH

The development and improvement of the Renewable Energy Action Plan of Bosnia and Herzegovina is aligned to entity action plans.

For BiH, the first priority remains the transposition of the Third Package. Certain results in this area have already been achieved, especially where the retail market opening, balancing market implementation and unbundling in the electricity sector are concerned. Numerous important activities are on-going, but there are still a number of reforms to be implemented. The required reforms of the electricity sector are stalled.

6.2.3 The former Yugoslav Republic of Macedonia

In accordance with Article 146 of the Energy Law, the Government of the former Yugoslav Republic of Macedonia, in the session held in November 2015, adopted the Renewable Energy Action Plan of Macedonia until 2025 with a vision until 2030 (NREAP).

In the preparations to transpose and implement the EU legislation on RES into national legislation, the main objective of the NREAP was to provide information on RES potential and the technically and commercially feasible RES exploitation in the country, including the country's strategy to attain their proposed **21%** RES target by 2020. The NREAP provides an overview of options for RES utilisation in the country, a brief description of the power system and its RES absorption capacity, an analysis of RES impact on the electric power system, the structure of feed-in tariffs and financing mechanisms for feed-in tariffs, RES related EU legislation, and the legal and institutional framework for RES in the former Yugoslav Republic of Macedonia.

In order to achieve its targets in the electricity sector, the former Yugoslav Republic of Macedonia plans to install an additional 767 MW of new hydropower generating capacity, about 260 MW of wind power plants, 25 MW of new biomass plant, 68 MW of solar capacity and 10 MW of geothermal energy by 2030.

Table 6.7 provides an estimation of the country's available potential for each RES-E technology in the period 2012-2020 (GWh). According to the 1st and 2nd Progress Reports on the promotion and use of energy from renewable sources, realised achievements in RES consumption were compared with the estimated RES potential (Table 6.8 and Figure 6.6). However, as the NREAP was published later, in November 2015, it does not contain (planned) data for 2012 and 2013.

Table 6.7: Estimation of the RES-E potential in the former Yugoslav Republic of Macedonia, 2009-2020 (GWh)

Year	sHPP (< 10 MW)	HPP (> 10 MW)	PV	Wind-onshore	Solid biomass	Biogas
2014	0	1,522	14	71	0	0
2015	243	1,355	25	96	0	21
2016	293	1,355	27	96	0	42
2017	347	1,355	29	110	0	49
2018	393	1,355	31	110	5	49
2019	439	1,385	33	110	12	49
2020	480	1,355	36	110	25	56

Table 6.8: Estimated and realised share of RES-E utilisation in total electricity consumption in the former Yugoslav Republic of Macedonia, 2009-2020 (%)

Year	sHPP (< 10 MW)	HPP (> 10 MW)	PV	Wind-onshore	Solid biomass	Biogas	Total estimated	Total realised
2012							0.0%	17.0%
2013							0.0%	18.4%
2014	0.0%	18.6%	0.2%	0.9%	0.0%	0.0%	19.6%	19.6%
2015	2.9%	15.9%	0.3%	1.1%	0.0%	0.2%	20.4%	21.9%
2016	3.5%	16.2%	0.3%	1.1%	0.0%	0.5%	21.7%	
2017	4.2%	16.4%	0.4%	1.3%	0.0%	0.6%	22.9%	
2018	4.8%	16.6%	0.4%	1.4%	0.1%	0.6%	23.9%	
2019	5.5%	17.2%	0.4%	1.4%	0.1%	0.6%	25.2%	
2020	5.9%	16.8%	0.4%	1.4%	0.3%	0.7%	25.5%	

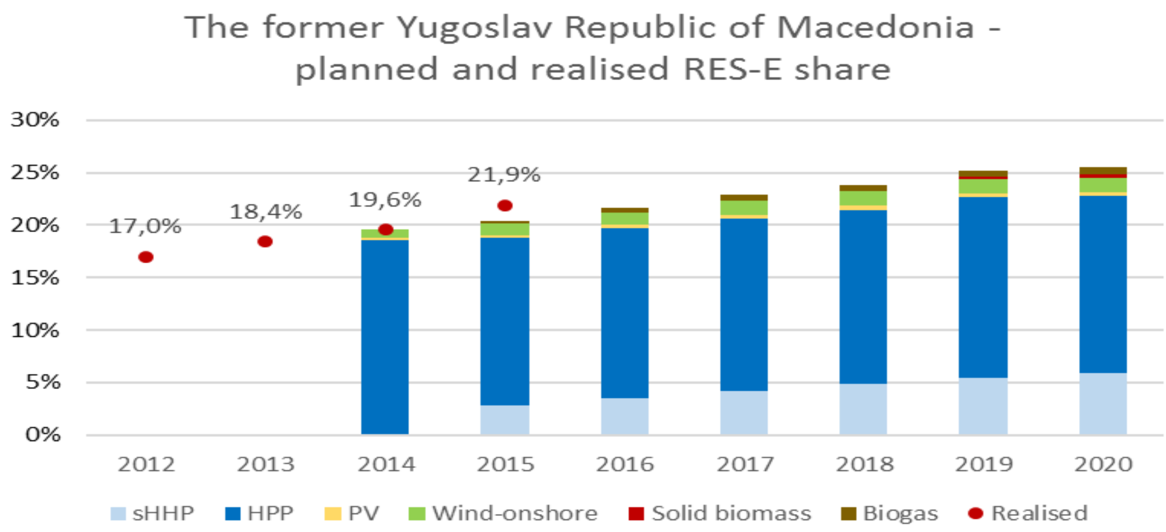


Figure 6.6. Planned and realised RES-E share in the former Yugoslav Republic of Macedonia

6.2.4 Kosovo

The NREAP (2011-2020) for Kosovo was adopted in June 2013. It establishes the targets and measures to be undertaken to achieve them until 2020, and details an extensive Government policy for stimulating RES use in Kosovo.

The national mandatory overall target for RES in 2020 is set at **25%** (Decision 2012/04/EnC-MC). However, Kosovo will aim at a higher target which corresponds to a **29.47%** share of RES in GFEC by 2020.

In the electricity sector, RES generation increases are based on the development of small and large hydro power plants: 240 MW from small hydro power plants; 305 MW from HPP Zhur, 150 MW from wind, 14 MW from biomass and 10 MW from photovoltaic plants.

Since Kosovo plans to reach and surpass its national mandatory target through national measures for the production of energy from renewable sources, there is potential for the transfer of excess amounts above the indicative trajectory by means of the various flexible mechanisms for cooperation, but at the moment this is not planned.

The following Tables 6.9-6.10 provide an estimation of the RES potential in Kosovo for the period 2009-2020 in GWh, under the scenario that Kosovo should follow a higher growth in prospective RES penetration (29.47%) by 2020.

Table 6.9: Estimation of the RES-E potential in Kosovo, 2009-2020, GWh

Year	sHPP (< 1 MW)	sHPP (1 MW – 10 MW)	HPP (> 10 MW)	PV	Wind-onshore	Solid biomass
2009	9	32	88			
2010	9	36	110		0	
2011	9	24	71		0	
2012	15	36	81		3	
2013	14	35	82		3	
2014	15	304	82	6	63	15
2015	14	665	82	8	141	30
2016	15	709	82	12	181	45
2017	35	734	480	14	222	60
2018	56	810	476	13	262	75
2019	58	895	476	19	282	90
2020	87	1,045	476	21	302	105

Table 6.10: Estimated and realised share of RES-E utilisation in total electricity consumption in Kosovo, 2009-2020, %

Year	sHPP (< 1 MW)	sHPP (1 MW – 10 MW)	HPP (> 10 MW)	PV	Wind-onshore	Solid biomass	Total estimated	Total realised
2009	0.2%	0.6%	1.7%	0.0%	0.0%	0.0%	2.4%	
2010	0.2%	0.7%	2.0%	0.0%	0.0%	0.0%	2.8%	
2011	0.1%	0.4%	1.2%	0.0%	0.0%	0.0%	1.7%	
2012	0.2%	0.6%	1.3%	0.0%	0.0%	0.0%	2.2%	1.6%
2013	0.2%	0.6%	1.3%	0.0%	0.0%	0.0%	2.1%	2.3%
2014	0.2%	4.6%	1.2%	0.1%	1.0%	0.2%	7.3%	2.6%
2015	0.2%	9.7%	1.2%	0.1%	2.1%	0.4%	13.8%	2.4%
2016	0.2%	10.2%	1.2%	0.2%	2.6%	0.6%	15.0%	
2017	0.5%	10.3%	6.7%	0.2%	3.1%	0.8%	21.6%	
2018	0.8%	11.1%	6.5%	0.2%	3.6%	1.0%	23.2%	
2019	0.7%	11.5%	6.1%	0.2%	3.6%	1.2%	23.4%	
2020	1.1%	13.2%	6.0%	0.3%	3.8%	1.3%	25.6%	

According to Kosovo's 1st and 2nd Progress Reports, the realised achievements in RES-E were compared to the estimated RES potential that is shown in Figure 6.7.

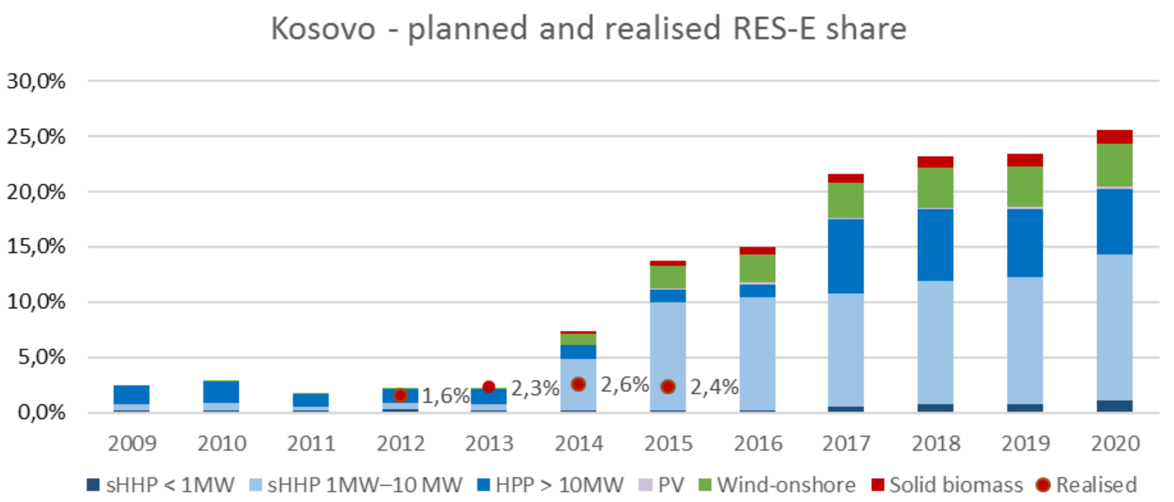


Figure 6.7. Planned and realised RES-E share in Kosovo

According to the 2nd Progress Report from December 2016, the contribution of renewable energy to the final energy consumption has, in absolute terms, grown slightly between the reporting years, largely caused by a growth in fuelwood use by households. Electricity production from renewable sources has fallen between 2014 and 2015 due to hydrological differences. In terms of installed capacity, Kosovo has seen some extra capacity added in its hydropower production during the last reporting year. Furthermore, the first solar PV projects with a total installed capacity of 102.4 kW were brought online (2014) and started delivering power to the national grid of Kosovo, although in modest overall quantities.

A large part of the new solar PV capacity was financially supported through the Ministry of Agriculture (MAFRD), with investment grants in the annual Rural Development Plan, which resulted in 101 farms provided with a total installed capacity of 79 kW of solar PV in 2014, and another 135 farms that received a total installed capacity of 364 kW in 2015 under the same programme. At the end of the reporting period, the first results were visible on the implementation of RES capacity under the Feed-in Tariff scheme, for which the legislative framework was fully approved. The first wind turbines were already in place before the reporting period, supported by a specific Power Purchase Agreement for the project.

6.2.5 Montenegro

The Government-adopted Decision 2012/04/EnC-MC obliges Montenegro to reach the national RES target of **33%** in 2020. The NREAP was adopted in 2014. Two issues were identified as major obstacles: (i) the absence of a basis in the planning documents for the construction of small hydro power plants and (ii) the problems of connecting new, often remote, HPPs to the electricity networks.

The Montenegrin NREAP defines the dynamic of the utilisation of natural resources, as well as the planned use of technologies required to meet the national target. Regarding electricity, an increase in production from RES is based on the construction of small hydro power plants, wind farms, solar power plants and the use of various forms of biomass. By 2020, a total of 90 MW of new hydropower generating capacity should be put into operation. Wind farms are becoming an increasingly important source of RES-E with an increasing share of production. According to the last Energy Development Strategy (2014), about 150 MW of wind power plants, 29 MW of new biomass plant (solid biomass and biogas) capacity and 10 MW of solar capacity is planned to be commissioned by 2020.

The estimation of the Montenegro's RES potential for RES electricity generation for the period 2009-2020 (in GWh) is shown in Table 6.11. The comparison to realised achievements in 2012-2015 is made according to Montenegro's 1st and 2nd Progress Reports.

Table 6.11: Estimation of the RES-E potential in Montenegro, 2009-2020, GWh

Year	sHPP (< 1 MW)	sHPP (1 MW–10 MW)	HPP (> 10 MW)	PV	Wind-onshore	Solid biomass	Biogas
2009	0	19	1,666				
2010	0	19	1,666				
2011	0	19	1,666				
2012	0	19	1,666				
2013	0	19	1,666				0
2014	0	21	1,666	3	106	18	1
2015	14	88	1,679	5	106	16	7
2016	14	96	1,679	10	106	24	8
2017	20	114	1,679	12	271	34	13
2018	35	239	1,725	13	289	42	16
2019	35	252	1,725	15	289	44	20
2020	35	252	1,763	17	348	81	20

Table 6.12: Estimated and realised share of RES-E utilisation in total electricity consumption in Montenegro, 2009-2020, %

Year	sHPP (< 1 MW)	sHPP (1 MW – 10 MW)	HPP (> 10MW)	PV	Wind-onshore	Solid biomass	Biogas	Total estimated	Total realised
2009	0.0%	0.5%	43.6%	0.0%	0.0%	0.0%	0.0%	44.0%	
2010	0.0%	0.4%	39.9%	0.0%	0.0%	0.0%	0.0%	40.4%	
2011	0.0%	0.4%	39.5%	0.0%	0.0%	0.0%	0.0%	39.9%	
2012	0.0%	0.5%	42.4%	0.0%	0.0%	0.0%	0.0%	42.8%	43.1%
2013	0.0%	0.5%	48.1%	0.0%	0.0%	0.0%	0.0%	48.6%	49.0%
2014	0.0%	0.5%	42.1%	0.1%	2.7%	0.5%	0.0%	45.8%	45.2%
2015	0.3%	2.2%	41.2%	0.1%	2.6%	0.4%	0.2%	46.9%	46.3%
2016	0.3%	2.3%	39.7%	0.2%	2.5%	0.6%	0.2%	45.8%	
2017	0.5%	2.6%	38.2%	0.3%	6.2%	0.8%	0.3%	48.8%	
2018	0.8%	5.2%	37.4%	0.3%	6.3%	0.9%	0.4%	51.2%	
2019	0.7%	5.3%	36.4%	0.3%	6.1%	0.9%	0.4%	50.2%	
2020	0.7%	4.9%	34.5%	0.3%	6.8%	1.6%	0.4%	49.2%	

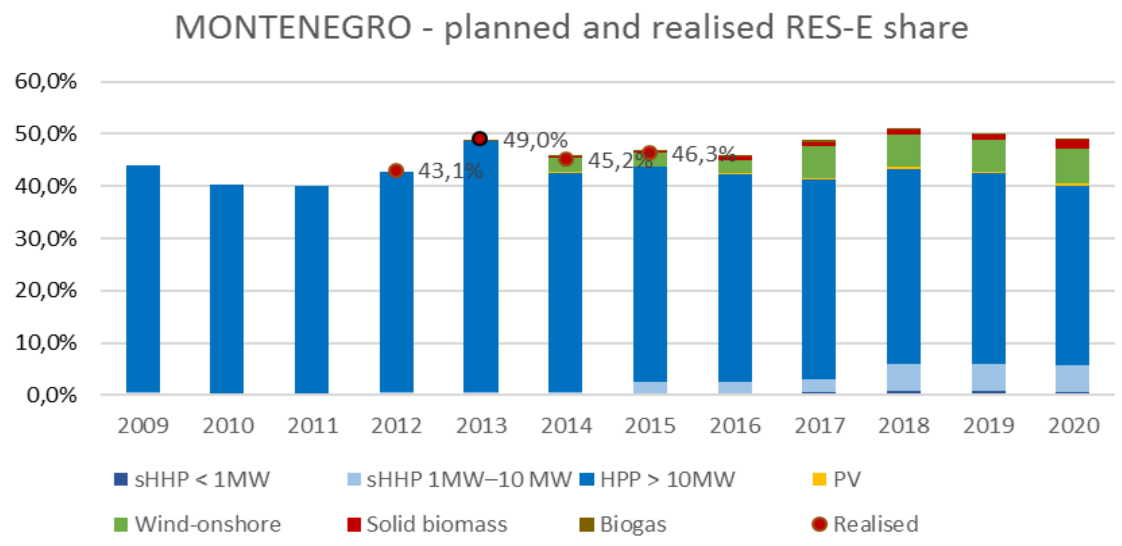


Figure 6.8. Planned and realised RES-E share in Montenegro

The 2nd Progress Report of Montenegro suggests that the pace of RES development is progressing well, but for the overall assessment of Montenegro approach to RES-E targets, it is important to consider a longer timeframe of at least five years in order to level variations to some degree.

6.2.6 Serbia

In line with the Decision 2012/04/EnC-MC, Serbia has to achieve the national RES target of **27%** in 2020. The NREAP was adopted by the Government in June 2013.

In the electricity sector, Serbia plans to achieve an increase of 30% in RES utilisation for electricity generation by 2020, which would denote an increase in RES-E generation of 2.4% (from 9.7% RES-E in 2009 to 12.1% in 2020). To achieve its targets in the electricity sector, Serbia plans to install an additional 1,092 MW of RES until 2020: a total of 438 MW of new hydropower generating capacity, about 500 MW of wind power plants, 100 MW of new biomass plant, 30 MW of biogas plant, 10 MW of solar capacity, 10 MW of landfill gas capacity, 3 MW of energy from waste and 1 MW of geothermal energy.

Estimation of the potential available in Serbia for electricity generation in the period 2009-2020 is shown in Table 6.13. Comparison to the realised achievements is made according to the 1st and 2nd Progress Reports of Serbia for the period 2012-2015. Data shown in the Report were determined based on the amended 2014 Energy Balance of the Republic of Serbia. The results are shown in Table 6.13 and Figure 6.9.

Table 6.13: Estimation of the RES-E potential in Serbia, 2009-2020, GWh

Year	sHPP (< 1 MW)	sHPP (1 MW – 10 MW)	HPP (> 10 MW)	PV	Wind-onshore	Solid biomass	Biogas
2009	11	31	10,234				
2010	20	113	11,752				
2011	16	84	8,559				
2012	28	98	9,311				
2013	27	110	10,919		3		
2014	108	116	10,885		75		
2015	103	110	10,709	7	600		
2016	148	110	10,819	9	585		
2017	208	102	10,966	11	630	66	
2018	224	87	10,886	14	1,000	99	
2019	332	87	10,939	14	1,250	132	135
2020	460	140	10,815	13	1,000	640	305

Table 6.14: Estimated and realised share of RES-E utilisation in total electricity consumption in Serbia, 2009-2020, %

Year	sHPP (< 1 MW)	sHPP (1 MW – 10 MW)	HPP (> 10 MW)	PV	Wind-onshore	Solid biomass	Biogas	Total estimated	Total realised
2009	0.0%	0.1%	28.6%	0.0%	0.0%	0.0%	0.0%	28.7%	
2010	0.1%	0.3%	31.7%	0.0%	0.0%	0.0%	0.0%	32.0%	
2011	0.0%	0.2%	22.7%	0.0%	0.0%	0.0%	0.0%	23.0%	
2012	0.1%	0.3%	24.7%	0.0%	0.0%	0.0%	0.0%	25.1%	38.4%
2013	0.1%	0.3%	28.8%	0.0%	0.0%	0.0%	0.0%	29.2%	37.8%
2014	0.3%	0.3%	28.5%	0.0%	0.2%	0.0%	0.0%	29.3%	38.9%
2015	0.3%	0.3%	27.8%	0.0%	1.6%	0.0%	0.0%	30.0%	40.7%
2016	0.4%	0.3%	27.9%	0.0%	1.5%	0.0%	0.0%	30.1%	
2017	0.5%	0.3%	28.1%	0.0%	1.6%	0.2%	0.0%	30.7%	
2018	0.6%	0.2%	27.7%	0.0%	2.5%	0.3%	0.0%	31.3%	
2019	0.8%	0.2%	27.7%	0.0%	3.2%	0.3%	0.3%	32.6%	
2020	1.2%	0.4%	27.2%	0.0%	2.5%	1.6%	0.8%	33.6%	

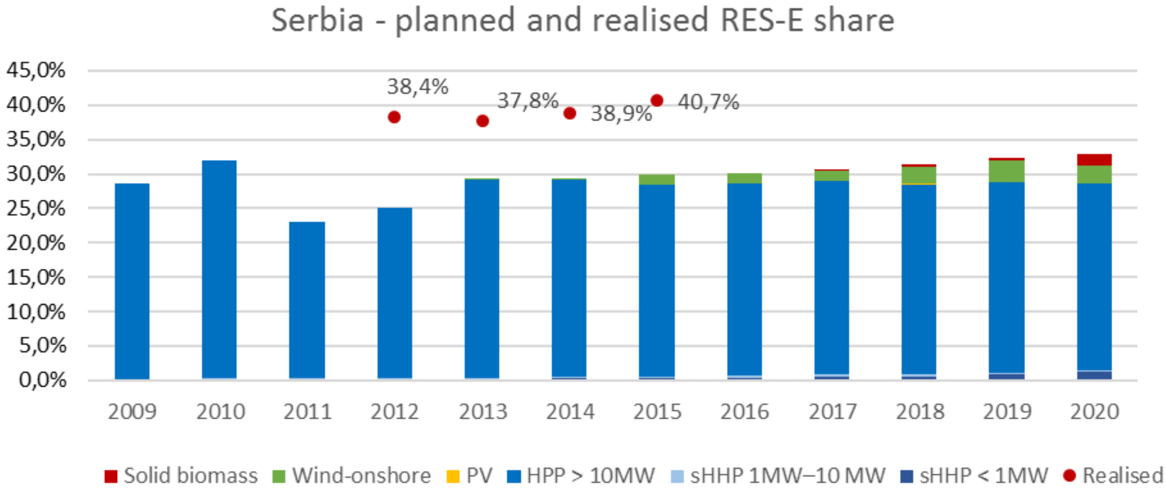


Figure 6.9. Planned and realised RES-E share in Serbia

According to the independent sources based on historic data from IEA, EUROSTAT and Energy Community Statistics, realised shares in 2012 and 2013 are somewhat lower than in the Progress Report (27% in 2012 and 26.9% in 2013). Furthermore, a qualitative assessment of Serbia's progress towards RES targets was given in the SERBIA 2015 REPORT (European Commission, 10/11/2015). According to this source, there has been no significant investment in the renewable energy sector in Serbia. Substantial efforts are urgently needed to achieve Serbia's target of obtaining 27% of GFEC from renewable energy sources by 2020.

According to the 2nd Progress Report from December 2016, since 2009, when the legal framework with incentive measures ("feed-in" tariffs) was established for the first time in the Republic of Serbia, until October 2016, the following new plants with an installed capacity of 80.3 MW were constructed for the production of electricity from RES:

- 61 small hydropower plants with a total installed capacity of around 41 MW (including two old, reconstructed power plants: Ovcar Banja and Medjuvrsje);
- 104 solar power plants with the capacity of 8.8 MW;
- 2 wind power plants with the capacity of 10.5 MW, while 7 wind power plants have gained temporary privileged producer status with a total capacity of 489 MW,
- biogas power plants with a total capacity of around 9 MW.

6.2.7 WB6 region

All WB6 countries' energy policies are strongly influenced by the process of transposing and implementing the EU energy acquis within the framework of the Energy Community. In respect of the EC obligations, all six countries have adopted their NREAPs, in which they have committed themselves to achieving certain goals in terms of RES share in energy consumption. The NREAPs are thus the official policy documents on which the WB6 countries intend to reach their binding 2020 RES targets by 2020. Hydro energy plays an important role in achieving these targets. The development of new small hydro capacity (in general up to 10 MW of installed capacity, up to 30 MW in Serbia and up to 15 MW in Kosovo) is supported mainly with feed-in tariff schemes. However, the development of small and large hydro capacity is hindered by a number of obstacles, primarily the complexity of the procedures and the large number of institutions involved without common coordination, lacking or inadequate by-laws, the legal and regulatory framework being subject to frequent changes and similar.

The first report of the ECS to the Ministerial Council of the Energy Community (MC-EnC) on *"the Progress in the Promotion of Renewable Energy in the Energy Community"* (October 2015) could not report on NREAP-related developments in Albania, the former Yugoslav Republic of Macedonia and Bosnia and Herzegovina because their action plans were adopted and submitted only in 2016. BiH has adopted its NREAP by combining the two entities' (Federation of Bosnia and Herzegovina and Republika Srpska) plans adopted in 2014 plus making some assumptions relating to the Brčko district. Regarding the former Yugoslav Republic of Macedonia, no data exists regarding the estimated RES potential in period 2009-2013, so an expert assessment was made in accordance with the Strategy for Energy Development in the former Yugoslav Republic of Macedonia by 2030.

The second report of the ECS to the Ministerial Council of the Energy Community (MC-EnC) on "the Progress in the Promotion of Renewable Energy in the Energy Community" (February 2017) reported on NREAP-related developments in all countries of the WB6 region, except Bosnia and Herzegovina because their action plans were adopted and submitted only in 2016.

Based on Section 7, the situation for the WB6 region, i.e. if all 6 NREAPs were aggregated, was assessed (Table 6.15).

Table 6.15: Estimation of the RES-E potential in the WB6 region, 2009-2020, GWh

Year	sHPP (< 1 MW)	sHPP (1 MW – 10 MW)	HPP (> 10 MW)	PV	Wind-onshore	Solid biomass	Biogas
2009	73	106	13,353	0	0	0	0
2010	98	205	15,060	14	71	4	0
2011	361	254	11,655	25	131	10	3
2012	480	486	12,418	30	139	18	7
2013	208	707	12,674	4	56	23	2
2014	682	1,396	13,992	51	414	68	9
2015	766	2,040	13,829	63	921	73	11
2016	1,002	1,196	13,940	79	966	177	12
2017	564	1,290	13,130	177	1,301	234	8
2018	1,211	1,521	14,447	98	887	325	17
2019	1,406	1,712	15,171	122	1,185	878	41
2020	1,613	2,009	15,672	209	1,634	953	68

Table 6.16: Estimated and realised share of RES-E utilisation in total electricity consumption in WB6, 2009-2020, %

Year	sHPP (< 1 MW)	sHPP (1 MW – 10 MW)	HPP (> 10 MW)	PV	Wind-onshore	Solid biomass	Biogas	Total estimated	Total realised
2009	0.10%	0.15%	24.94%	0.00%	0.00%	0.00%	0.00%	25.19%	
2010	0.15%	0.31%	32.15%	0.00%	0.00%	0.01%	0.00%	32.61%	
2011	0.17%	0.37%	21.30%	0.00%	0.02%	0.01%	0.00%	21.88%	
2012	0.25%	0.86%	22.52%	0.02%	0.12%	0.02%	0.00%	23.79%	28.92%
2013	0.27%	1.14%	27.00%	0.02%	0.16%	0.03%	0.01%	28.63%	34.33%
2014	0.43%	2.00%	23.15%	0.04%	0.48%	0.09%	0.01%	26.20%	32.58%
2015	0.47%	2.87%	23.00%	0.07%	1.27%	0.11%	0.04%	27.85%	31.55%
2016	0.55%	3.13%	23.16%	0.09%	1.31%	0.14%	0.07%	28.46%	
2017	0.69%	3.47%	23.50%	0.25%	1.73%	0.26%	0.09%	29.98%	
2018	0.78%	3.96%	23.11%	0.26%	2.27%	0.34%	0.09%	30.81%	
2019	0.92%	4.21%	23.95%	0.27%	2.65%	0.41%	0.25%	32.66%	
2020	1.06%	4.77%	23.38%	0.13%	2.48%	1.08%	0.46%	33.36%	

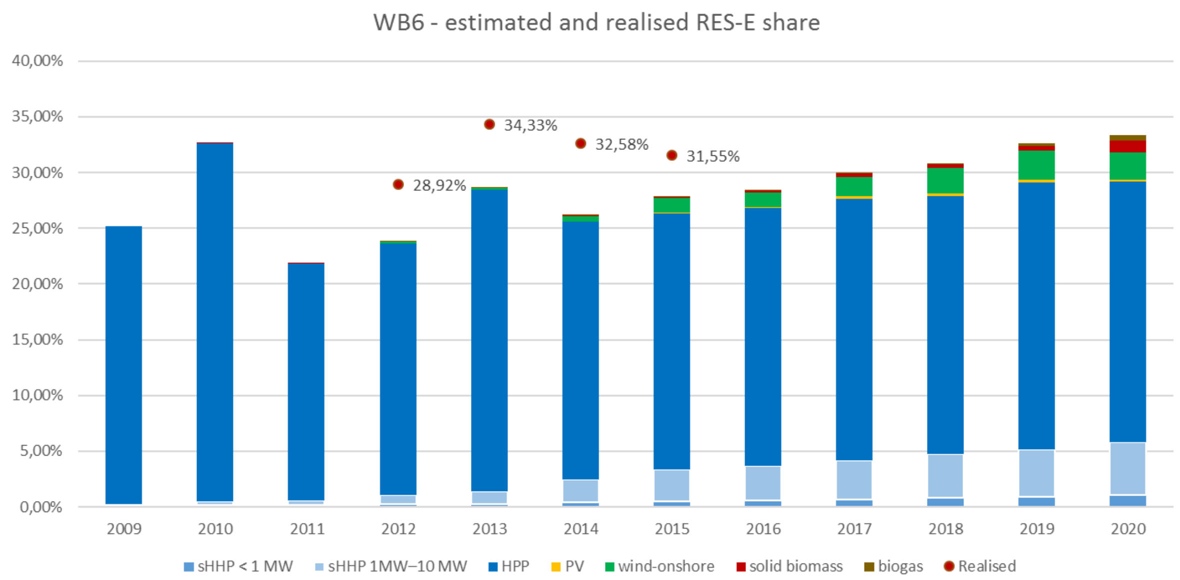


Figure 6.10. Planned and realised RES-E share in WB6

The estimation of the RES potential available in WB6 region for electricity generation in the period 2009-2020 is shown in Table 6.15. The comparison to the realised achievements is made according to the 1st and 2nd Progress Reports of each country. The results are shown in Table 6.16 and Figure 6.10.

With respect to HPPs of more than 10 MW, comparing the goals committed to in the NREAPs and the potential of identified HPP projects in WB6 region identified in the HPP-DB developed in Task 6 of the Study (see also BR-7), it is obvious that the available hydro potential is considerably larger than the aggregated NREAP goals by 2020 for this capacity range – 8,377 MW (see Table 6.17 for comparison of 2020-goals of NREAPs and identified potential in HPPs larger than 10 MW in the HPP-DB – 9,796 MW). Roughly speaking, if the 2020-goals of NREAPs were fully developed, only 50% of the presently estimated total capacity potential in HPPs over 10 MW (16,619 MW) would be developed, leaving 50% (8,242 MW) remaining as undeveloped hydropower potential. The planned capacity additions of 1,554 MW or 23% in this capacity range between 2009 and 2020 should be noted.

Table 6.17. Comparison of the 2020-goals (NREAP) and identified potential in HPPs larger than 10 MW

Country	2020-goals (1) (NREAP) (MW)	Existing in 2009 (2) (NREAP) (MW)	Planned HPPs *) (3) (HPP-DB) (MW)	Total (Existing in 2009 + Planned HPPs) (4=2+3) (NREAP+HPP-DB) (MW)	Difference (Total – 2020-goals) (5=4-1) (MW)
Albania	1,834	1,460	897	2,357	523
Bosnia and Herzegovina	2,448	1,978	3,093	5,071	2,623
Kosovo	340	35	785	820	480
The former Yugoslav Republic of Macedonia	569	515	982	1,497	928
Montenegro	728	627	1644	2,271	1,543
Serbia	2,458	2,208	2,395	4,603	2,145
Total	**8,377** (9,670) **)	**6,823** (6,953) **)	**9,796**	**16,619**	**8,242**

*Note: *) HPP-DB, **) Including small HPPs.*

If the indicative plans for small HPPs of less than 10 MW were added to large HPP capacities in Table 6.17. The total 2020-goal would be 9,670 MW as opposed to 6,953 MW in 2009 (or an increase of 2,717 MW or 39%). The column “Difference” indicates the “excess” capacity in identified projects in HPP-DB compared to the committed 2020-goals in NREAPs.

As a preliminary indication of the financial feasibility of the prospective new HPPs, an analysis has been performed on the capacity factor of the existing HPPs (status in 2009) and a comparison made with the capacity factor of the planned HPPs proposed in the NREAPs to be effective by 2020. The average capacity factor of all HPPs in 2009 was 0.36 (or equivalent to approx. 3,154 operation hours of facilities at maximal installed capacity), while the average capacity factor of newly planned plants is estimated at 0.27 or 2,365 operating hours (see Figure 6.11 for more details). Clearly, the lower capacity factor alone is not sufficient information to judge the financial yields of the project. This would require having reliable data on direct and indirect investment costs and a probable split of the financial burden between the participating partners (investor, state etc.) that can be obtained in a proper feasibility study. However, it is a preliminary indication that the presently planned HPPs will be less financially attractive for investors than the existing ones built in the past. This is not surprising because logically the “best projects” in conditions of limited natural resources have already been developed and commissioned in the past. The law of diminishing returns is thus very obvious in the long-term assessment of hydropower development potential.

Considering the electricity markets in the region today and the relatively low prices of electricity, the financial factors might prove to be a significant challenge for the implementation of a number of HPPs that are not envisaged to be part of the state-support schemes (e.g. FIT) in the future. As there is an obvious trend that RES-E power generation will be gradually totally exposed to the market after 2020, there is likely to be less and less interest of investors for smaller-capacity HPPs that are typically more expensive per unit of capacity and energy output.

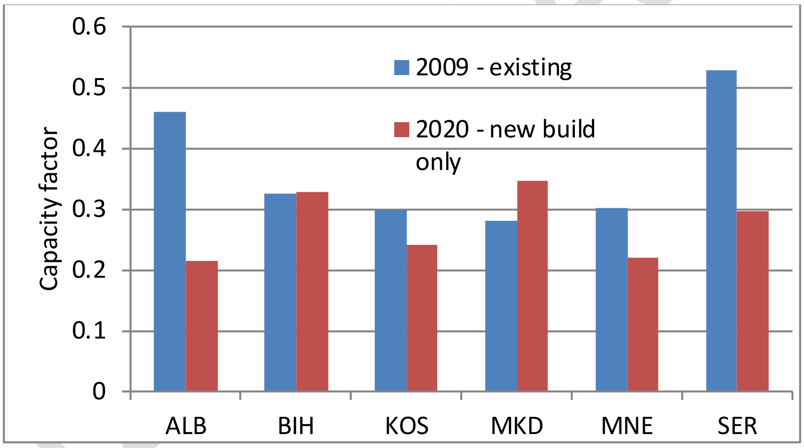


Figure 6.11: Preliminary assessment of the capacity factors of the existing and planned HPPs (based on NREAP)

7 Hydropower in the context of future power sector development beyond 2020 with an outlook to 2050

Strategic planning documents (e.g. strategies, action plans, NREAPs, 10-year Development Plans of TSOs) are prepared in most WB6 countries. These plans address the medium-term time horizon only, in the best case for the next 10-15 years or to 2030, while the economic lifetime of HPPs is typically 40+ years, which is typically extended to several more decades in practice.

In Table 6.17 of Section 6 above, it was stated that if the 2020-goals of NREAPs of the WB6 countries were fully achieved in terms of hydropower development, only 50% of the presently estimated total potential in HPPs over 10 MW (16,619 MW) would be developed, leaving thus 50% (8,242 MW) remaining as undeveloped hydropower potential after 2020.

This estimate is based on the identified remaining potential for (177) HPP projects larger than 10 MW in the HPP database developed by the Study - HPP-DB (BR-7) – 10,005 MW (25,628 GWh). This includes the potential for the construction of Reversible HPPs (3,859 MW, 6,645 GWh). Consequently, the potential for non-reversible HPPs would be 6,146 MW (18,983 GWh), and this potential includes all HPPs finally grouped under: (i) (16) Recommended projects (1,009 MW, 2,863 GWh), (ii) (25) Reasonably good projects (1,028 MW, 4,104 GWh), (iii) (65) Underperforming projects (1,418 MW, 4,588 GWh), and (iv) (64) Tentative projects (2,691 MW, 7,428 GWh) as reported in more detail in Table 7.3 of BR-8.

The term “Sustainability” has a number of different interpretations, even though it is commonly understood to encompass (i) the protection of the environment, (2) social issues and (3) economic sustainability in international norms. The environment, which is strongly regulated by relevant and well-developed EU environmental directives and international agreements and conventions, has the most defined sustainability criteria and procedures e.g. biodiversity assessments. Social issues are the subject of the acceptability of the proposed solutions for the population, which is directly and indirectly potentially impacted by the construction of hydropower plants, while the field of economics depends on the development of the market and the decision of investors, and this is case-specific and can change significantly over time. This means that in hydropower planning, we can identify the probability of developing the hydro-potential in a sustainable manner, rather than quantifying it in absolute terms (such as %, MW, GWh). This is because the factors involved in a comprehensive sustainability assessment are only known in a later stage of project development, such as the Feasibility Study for an HPP or a cascade.

With respect to the role that hydropower could play in the longer-term (2020 – 2050), it is important to note the great uncertainties associated with such development. This will be characterised by HPP protagonists (HPP developers – typically ministries, utilities etc.) exercising pressure for new greenfield projects, possibly without adequate attention being given to the sustainability aspects (environmental, social, economic etc.) In addition, the competitiveness of hydropower against other RES-E options (wind, solar, biomass etc.) and the development of electricity market (i.e. prices), will influence the decision-makers (national authorities and investors). Clearly, the availability of finance will also be a factor because of the up-front investments required for capital-intensive HPP development.

The electricity demand growth in the Region will significantly impact hydropower sector development. Demand development in the long-term future till 2050 can be predicted in a rather speculative manner only, because many aspects will influence its development: GDP growth (the World Bank forecast) and the likely decrease of population in WB6 (according to UN World Population Prospects), intensive energy efficiency measures in all sectors, fuel switching and the expected growing standards of population. To estimate this effect, the Study developed two boundary scenarios. (i) “High demand growth - HDS” by the application of a simulation demand-planning model (MAED[11]) that anticipated an average WB6 regional growth of 1.5% per annum in the period

[11] The bottom-up simulation modelling tool MAED is a standard, internationally-recognised and most frequently used methodology and is the in-house tool of the institution (EIHP, Zagreb), charged with electricity demand assessment in the Study. It is commonly used in several WB6 countries, based upon which national energy

2020-2050, and (ii) “Low demand growth - LDS” based on extrapolation of trends from the 10-year period (2005-2014) which is based on an approximately 1% per annum electricity demand growth from 2014-2050. Both demand scenarios are shown in Figure 7.1 and are discussed below.

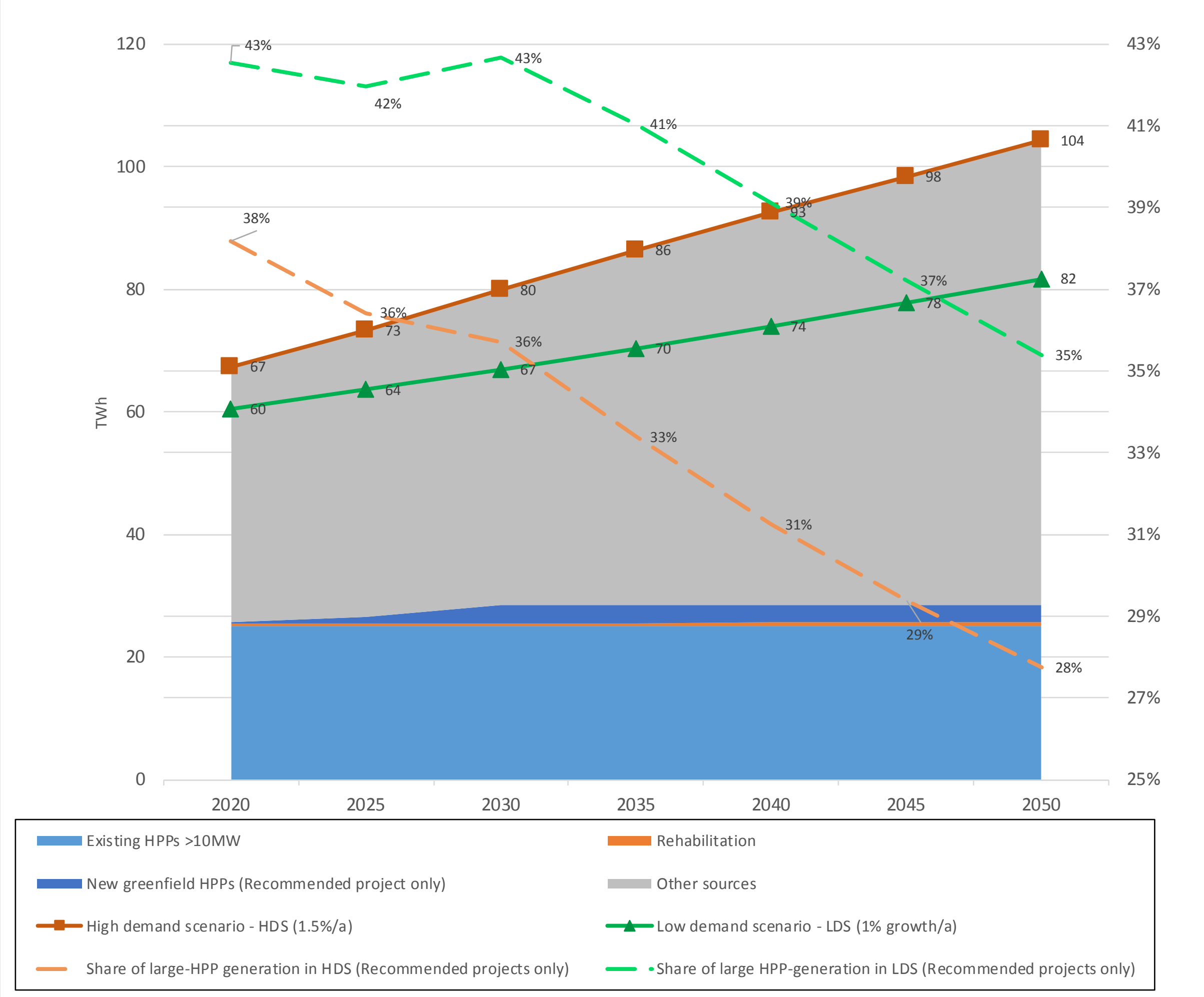


Figure 7.1: Future hydropower generation vs. electricity demand in WB6 until 2050

For illustrative (i.e. indicative purposes), Figure 7.1 shows the Consultant’s assessment of the possible hydropower development for the whole WB6 region in the time horizon up to 2050, based on both the High and Low demand growth scenarios. The electricity supply side comprises of; (i) the existing large HPPs as of end-December 2016, (ii) additional electricity gains from the currently planned rehabilitations of the existing large HPPs, and (iii) production after the commissioning of the greenfield Recommended projects. The considerable remaining gap between large HPP-production and electricity demand amounts to 58-64% in 2030 (for LDS and HDS, respectively), 61-69% in 2040 and 65-73% in 2050. This gap would have to be met by other RES-E sources (wind, solar, biomass, small HPPs), conventional CO2 emitting fossil-fuelled power plants and the rest by power import. This tends to indicate that from a sustainability perspective, when considering new hydropower, countries should take into account the benefits of greenfield hydropower generation together with its associated environmental impacts, and then compare that sustainability of hydropower against the prospective sustainability of other generation / import technologies or modalities, such as thermal or alternative forms of RES-E.

Another very important assumption is that all existing HPPs would be rehabilitated on time, in order to further maintain their present availability and output. Regarding possible additional gains in capacity and output by rehabilitations, the Study concluded (BR-7) that the total reported expected capacity increase of presently planned rehabilitation projects is 105 to 206 MW, or 2.8 – 5.6%, while the generation increase would be 4.0 –

strategies have been prepared in the last 10 years (e.g. Montenegro, Kosovo, BiH…) Its advantage lies in its transparency in operation over other power system optimisation models such as MESSAGE or MARKAL/TIMES.

4.7%. For this exercise, it was assessed that 539 GWh in total, as shown in Tables 4.2 - 4.7 in BR-7, could be achieved from the presently planned rehabilitations by their operators.

It should be noted that this analysis excludes the current contribution of small HPPs (<10 MW, installed capacities: 583 MW, average annual output: approx. 1.8 TWh or 7% of total hydropower capacities and output, status of end-December 2016) as well as their development / contribution in the future.

If only the Recommended projects are considered, for illustrative purposes, by 2030 the situation would be that 43% (2030), 39% (2040) and 35% in 2050 of electricity demand could be met by large HPPs in the LDS and accordingly less (36-28%) in the HDS during the same period. This should be compared to the 40% average for WB6 in the period 2005-2014 (of which 38% is for large and 2% is for small HPPs - IEA Statistics); see the dotted lines in Figure 7.1 for both HDS and LDS, respectively.

If small HPPs were added to Figure 7.1, assuming their 5% share in the overall hydropower production is further maintained (which is considered unlikely because of the anticipated discontinuation of favourable state-support schemes after 2020), then an additional 2% could be added to the production of large HPPs, by which the whole hydropower production would then be encompassed. This means that the contribution of hydropower to the ever-growing electricity demand would remain at approximately the same level till 2030 in the LDS scenario only, but after that would deteriorate afterwards.

This supply-demand analyses on both electricity demand scenarios confirm that hydropower development under the assumption of Recommended projects only is **unlikely to significantly contribute to the fulfilment of the higher RES target by 2030 (at least 27%) and beyond. Hydropower production share is likely to deteriorate**, the gap of which would require to be compensated by other RES-E sources and/or sources outside the power sector (heating / cooling, and transport, the contribution of which to mandatory targets is constrained by the diminishing share of RES-E generation).

As mentioned in Section 4, the total utilised hydropower potential denotes the sum of annual outputs of all HPPs as of end-December 2016, including large and small HPPs, and it is 26,629 GWh – 37.0% of total technical potential (TTP). By the inclusion of the 12 HPPs presently under construction (670 MW, 1,922 GWh), it would increase to 39.7%, and by the currently planned rehabilitations (539 GWh), to 40.4%. By the further inclusion of Recommended projects it would increase to **44.4.0%** or by only **4%**.

Based on the current results of the Study, we regard as the most promising and sustainable, therefore **<u>after the rehabilitation projects, these sustainable greenfield Recommended projects are the second priority for further hydropower planning and development.</u>**

The third priority for further detailed analysis is to possibly prove the sustainability of projects from the group of <u>Reasonably good projects.</u> Finally, some HPPs from the group of Tentative projects may, in time, also become classified as sustainable, provided however that the currently identified transboundary and other issues that hinder their progress are resolved and sustainability criteria are met.

8 Proposals for follow-up actions

The following Table 8.1 summarises proposals for follow-up actions.

8.1 Regional level

Table 8.1: Proposed actions at the regional WB6 level

SN	Brief description of proposed Action	Assumed implementing agent	Anticipated timeframe
1.1	Data and information on the contentious issue of total and remaining hydropower potential should be made available at river basin / sub-river basin or even river / tributary level to allow full implementation of the "bottom-up" approach and application of a "river-basin" rather than "country" approach in hydropower planning. Such a database should be developed / updated by a single authority responsible for multi-purpose use of water resources at the national level. In most countries (except Kosovo), such an inter-ministerial authority (council) still needs to be established.	Inter-ministerial council attached to government directly	ASAP
1.2	Any rehabilitation of an existing HPP project should address the possibility of introducing environmental improvement measures in addition to the typical technical improvements of the facility aiming at improving safety, availability and ensuring prolongation of service lifetime. That shall include determination of Environmentally Acceptable Flow (EAF), feasibility of introducing fishpasses and any other measure that may improve the environment (e.g. sediments, erosion etc.)	Power utilities (public and private) – operators of HPPs, Ministries responsible for energy and Ministries for environment	When rehabilitations are due
1.3	Future energy development strategies in WB6 countries should be developed / updated for a time horizon extending at least for the next 15 years (i.e. to 2030-2035) and with a long-term outlook to 2050. The hydropower sector shall be addressed in terms of possible further development of the entire remaining technical hydropower potential including; (i) additional capacity and output yield of HPP rehabilitations, and (ii) greenfield projects (large and small HPPs). Hydropower development shall be promoted based on clear sustainability criteria and in the context of its competitiveness against other RES-E sources (PV, Wind, biomass) and its technical advantages for the power system. The interdependencies between water and power or water and agriculture shall be taken into account, which will be more important in the future. Therefore, a full analysis incorporating such dependencies will be needed and required when it comes to hydropower. A high-quality SEA has to be done at the earliest stage on energy strategies, during its development and prior to adoption thereof., accompanied by extensive public consultation processes.	Ministries responsible for energy and Ministries for environment	When Strategy updates are due
1.4	Electricity generation from renewable sources (RES-E) should become an indicative target and quantified (GWh, %) in the future NREAPs of all WB6 countries. In addition, the breakdown of RES-E generation by source (hydro: large and small, PV, solar, biomass etc.) shall become a standard approach.	Ministries responsible for energy and Ministries for environment	When new NREAPs for the next decade are due
1.5	Electricity demand development shall be assessed in the context of economic growth, reduction of poverty, improvement of lifestyle of population, the introduction of energy efficiency measures and use of renewable energy sources. Energy demand modelling and	Ministries responsible for energy, National institutes and universities, Energy	ASAP

SN	Brief description of proposed Action	Assumed implementing agent	Anticipated timeframe
	energy demand-supply analysis should become a standard approach in all WB6 countries, to support their preparation of future NREAPS and NEEAPs. Capacity building to responsible institutions in charge of such analysis should be provided to ensure local know-how and skills to undertake such tasks independently from external assistance.	Community Secretariat	
1.6	Further detailed electricity market development studies are required in the WB6 to assess the potential for cost-competitive penetration of electricity generated from RES by the type of RES-E generation (hydro, PV, wind, biomass) and its optimal supply mix in conditions of possible electricity demand development by 2050. Special attention should be given to the effects on electricity prices and electricity bills for final consumers, security of supply and the potential that WB6 could become a net exporter of RES-E to other regional markets including the internal market of EU (e.g. via the new submarine cable between Montenegro and Italy presently under construction).	Ministries responsible for energy, Energy Community Secretariat	ASAP
1.7	Improve information and database on planned rehabilitation projects as opportunities for intensified cooperation between state-owned utilities and IFIs. Timely inspections of the technical status is required to prepare high-quality specifications and to ensure effective tendering procedures and implementation of planned activities / works that typically last 5-10 years.	Power generation utilities – operators of the existing HPPs	ASAP (urgent due to rapidly approaching deadlines)
1.8	Perform a deep analysis of financing needs in the region, taking into account currently available funds on supply side and characteristics of financing needs on the demand side. Start undertaking actions needed to remove barriers to financing, and compensating for currently present fiscal constraints, in order to put much needed project finance mechanics into motion, local governments should commit themselves to: develop a fully-functional legal system with the sponsorship of the EU as a key prerequisite for project finance; improve the business climate to attract credible, risk averse, private investors; determine what financial products are missing (i.e. private equity, mezzanine financing etc.) and work closely with IFIs focusing on the development custom-made solutions which cover the needs; work closely with IFIs to develop much-needed guarantee programmes and schemes to compensate for lack of sovereign guarantees (European Investment Fund and EIB could be one solution) – again custom-made solutions are needed to address true needs, and work closely with, or sponsor the process of, financial institutions in creating specialised insurance products which are base for any project finance scheme and implementation of any complex long-term project such as large HPP development.	WB6 governments/Ministries responsible for energy and environment under guidance and sponsorship of EC/IFIs	ASAP

8.2 WB6 country level

No specific actions are proposed at the WB6 country level. The proposed regional actions in Table 8.1 are valid for all WB6 countries.

9 Summary of main findings, conclusions and final remarks

Hydropower has always been and remains an important source of electricity production in the WB6 region, for many decades as the only RES-E producer while other RES-E technologies (wind, PV, biomass etc.) have not yet been significantly utilised.

Hydropower generation vs. total power generation in WB6 in the last 10-year period (2005-2014) averaged 40% but varied quite considerably, from 35% (2011) to 54% (2005). At the country level, the 10-year average was: Albania (99%), Montenegro (60%), Serbia (51%), Bosnia and Herzegovina (39%), the former Yugoslav Republic of Macedonia (22%), and Kosovo (2%).

Based on IEA Statistics, in 2015, hydro power plants (HPP) represented nearly half (49%) of all installed power generation capacities in WB6. The remaining capacities were coal (44%), gas (4%) and quite minor other RES-E technologies (wind, PV, biomass) – 3%.

Hydropower generation vs. final electricity consumption represented 40% on average for the WB6 region during 2005-2014.

Based on the Study survey, 8,605 MW were installed in HPPs as of end-December 2016. About 90% (7,739 MW) has been commissioned in the former SFRJ before 1990, and only 10% (866 MW) after its disintegration. The average capacity addition achieved during 1955-1990 was 202 MW per annum while in the period 1991-2016 it dropped to a mere 33 MW per annum.

Regarding the structure of existing HPPs, 8,605 MW of total installed capacities included 8,022 MW (93%) in 57 large HPPs of more than 10 MW and 583 MW (7%) in 387 hydro power plants of less than 10 MW of installed capacity. The large HPPs represent 13% in terms of the number of existing HPPs. During 2001-2015, the large HPPs generated 95-97% of all hydropower, while representing approx. 93% in terms of installed capacities. Consequently, the contribution of small HPPs to the security of electricity supply and to meeting the national RES targets was marginal, while being regarded as considerable threat for the environment. In fact, the result of the feed-in tariff and similar mechanisms has led to a large number of SHPPs being developed in the WB6 region, with little useful impact on energy production, and resulting in considerable environmental consequences, impacts and damages in the WB6 countries.

Hydropower generation fluctuated depending on current hydrological conditions as a consequence of changed rainfall regimes which can be attributed also to climate change impacts. For the majority of the large HPPs, nevertheless, the year 2010 represented the absolute maximum in power generation since their commissioning. The second-best year was 2013 and the third-best year was 2005.

Hydropower generation positively contributes to electricity supply security in the WB6 and reduces its dependence on power imports (note: the WB6 was a net importer of electricity during 2005-2014). However, in good hydrological years, certain WB6 countries and the region as a whole may become net exporters of power thus contributing to the evolving WB6 electricity market, integrated electricity markets elsewhere outside the WB6 region including the EU markets.

The benefits of hydropower participation in the regional balancing market leads to greater overall efficiency of both the system and HPPs themselves improving both hydropower production volumes and its average financial value. Another important aspect of hydropower role in the market is their participation within the balancing groups in their home markets. The HPP’s flexibility is a great asset that can be used to manage the balancing group’s deviations in real-time.

The total utilised hydropower potential is denoted by the sum of average annual outputs of all HPPs as of end-December 2016, including large and small HPPs, and it was 26,629 GWh. By adding the remaining hydropower potential, which was assessed in the Study to amount to 45,342 GWh, the total technical potential (TTP) of the WB6 was obtained – 71,971 GWh.

For indicative purposes, because of typically unreliable data on the remaining hydropower potentials in the WB6 countries due to different methodologies and assumptions used, the extent of utilisation of TTP was assessed based on a bottom-up approach applied in the Study. The current level of utilisation (at the end-December 2016) was thus assessed at 37.0%. By adding the planned outputs of 12 HPPs currently under construction in WB6

(670 MW, 1,922 GWh) it would increase to 39,7%, and by adding the additional output of presently planned rehabilitations of HPPs (approx. 539 GWh), it would increase to 40.4%. If Recommended projects of HPPs (1,009 MW, 2,863 GWh) were added, it would increase to **44.4% (by mere 4.0%).**

The Study clearly proposes that the focus in further development should be given to the group of Recommended projects whose probability of being sustainable is highest compared to all other above-mentioned groups. These projects should be also used as test cases for applied implementation procedures based on transposed EU *acquis* on the environment (WFD, Floods, Habitats, Birds, DEA and EIA directives) to WB6 countries and relevant international agreements and conventions (Paris, Aarhus, Berne, Espoo). Climate change considerations also remain an important element for future planning of HPPs.

All WB6 countries' energy policies are strongly influenced by the process of transposing and implementing the EU energy acquis, the implementation of which is supported within the framework of the Energy Community. In respect of the obligations under Energy Community Treaty, all six countries have adopted their NREAPs, in which they have committed themselves to achieving certain goals in terms of RES share in energy consumption. With respect to HPPs of more than 10 MW, comparing the goals committed to in the NREAPs and the potential of identified HPP projects in WB6 region (BR-7), it is obvious that the available hydro potential is considerably larger than the aggregated NREAP goals to 2020 for this capacity range – 8,377 MW. Roughly speaking, if the 2020-goals of NREAPs were fully achieved, only 50% of the presently estimated total capacity potential in candidate HPP projects over 10 MW (16,619 MW) identified in the Study would be developed, leaving the remaining 50% (8,242 MW) as undeveloped hydropower potential.

Due to a very unpredictable long-term future and high uncertainties, a robust approach based on a simplified and pragmatic modelling has been applied to estimate the possible contribution of hydropower generation in meeting electricity demand to 2030/2050. The Study considered two boundary scenarios of possible electricity demand scenarios by 2050: a High demand scenario (the result of a modelling exercise, which anticipated 1.5%/a demand growth in the period 2020-2050) and a Low demand scenario (based on the extrapolation of trends from the past, 2005-2014, 1%/a linear growth to 2050).

The conclusion is that even under the assumption of the Low demand scenario, **the share of large HPP-generation** (comprising of all existing large HPPs, 12 HPPs under construction, and additional output gained after rehabilitation projects – undoubtedly as the first priority) **vs. final electricity demand would decrease over time**, from 43% in 2020/2030 to 35% in 2050 **should only Recommended projects from large HPPs candidates be considered**.

In case of the High demand scenario, and if **only Recommended projects were considered, the situation would be worse as no more than 36% in 2030 and 28% in 2050 of electricity demand could be met by large HPPs.**

The supply-demand analysis on both electricity demand and supply scenarios demonstrates that **hydropower development under sustainable terms is unlikely to be able to contribute to the fulfilment of higher RES target by 2030 (at least 27%) and beyond**. In this case, hydropower production share is likely to deteriorate over time; the gap should be compensated by other RES-E sources and/or outside the power sector (heating / cooling, and transport, the contribution of which to mandatory targets is constrained by the diminishing share of RES-E generation) that in WB6 countries have better long-term prospects for meeting their mandatory targets for the total share of RES and GFEC and in energy consumption in transport.

Despite the high unexploited technical potential in the WB region (approx. 63% on average), the development of new hydropower projects has stalled primarily due to environmental concerns and a lack of financing. Lack of policy credibility, transparency and stability, as well as long procedures to obtain authorisations and permits for projects are still perceived as some of the biggest challenges to the wider implementation of hydropower (and RES in general) projects in WB6 countries.

A balanced approach between energy sector development objectives and broader needs to protect the environment, society and multiple competitive users of water resources as "public good" is required.

Annex 1: Selected data for existing small HPPs in WB6 region

MOTT MACDONALD IPF CONSORTIUM

Table A1.1: Selected data for existing HPPs in WB6

SN1	SN2	Plant	HPP Operator	Owner	River / Tributary	Basin or (Sub)River Basin	Plant type 3)	Total reservoir storage - volume	Number and structure of units	Entered into commercial operation	Capacity	Output	Capacity Factor (Design CF)	Output in 2015
			(-)	(-)	(-)	(-)	(-)	(mill m3)	(nxN MW) 4)	(year)	(MW)	(GWh)	(%)	(GWh)
		Albania (ALB)												
1	1	Curraj-Epshem	not identified	not identified	Curraj	0	0	0,0	0	1969	0,00	0,0	#DIV/0!	0,0
2	2	Dragobia (Dragobi)	not identified	not identified	Valbona	Drin-Bune	0	0,0	0	1969	0,00	0,0	#DIV/0!	0,0
3	3	Kelcyre (Kelcyra)	not identified	not identified	Vjosa	0	0	0,0	0	1978	0,00	0,0	#DIV/0!	0,0
4	4	Lanabregas 1+2	HPP Lanabregas	Ujesjelles-Kanalizime Tirane	0	0	0	0,0	0	0	5,00	0,0	0,00	0,0
5	5	Selita	not identified	not identified	0	0	0	0,0	0	1952	5,00	0,0	0,00	0,0
6	6	Tirana	not identified	not identified	0	0	0	0,0	0	1951	0,00	0,0	#DIV/0!	0,0
7	7	Cerem (Ceremi)	not identified	not identified	0	0	0	0,0	0	1969	0,00	0,0	#DIV/0!	0,0
8	8	Bradazhnice	not identified	not identified	0	0	0	0,0	0	1975	0,00	0,0	#DIV/0!	0,0
9	9	Queparo	not identified	not identified	0	0	0	0,0	0	1960	0,00	0,0	#DIV/0!	0,0
10	10	Theth (Theti)	not identified	not identified	Thethit	Drin-Bune	0	0,0	0	1966	0,00	0,0	#DIV/0!	0,0
11	11	Gjanc	Spahiu Gjanc shpk.	Mr. Dalip Spahiu	Osumi or Leshnje	Shkumbin	0	0,0	0	2010	2,96	0,0	0,00	8,2
12	12	Bistrica I and II cascade / Bistrica 2	Hec Bistrica 1 dhe 2 sha	Kurum International sha (owned by Kurum Holding A.S.)	Bistrica	0	ROR	0,0	0	1967	5,00	36,7	83,79	0,0
13	13	Smokthina (also Smokthine or Lepenice)	Albanian Green Energy shpk	Essegei spa (owned by Alpiah srl holding company (Italy))	Shushica (also Sushice)	0	0	0,0	0	2010	9,20	0,0	0,00	32,1
14	14	Borshi (also Borsh)	Balkan Green Energy shpk (BGE shpk)	Essegei spa	Borsh	0	0	0,0	0	0	0,25	0,0	0,00	0,0
15	15	Bulqize	BGE shpk	Essegei spa	Hutres	Drin-Bune	0	0,0	0	0	0,60	0,0	0,00	0,0
16	16	Funares	BGE shpk	Essegei spa	Lurnikut	Shkumbin	0	0,0	0	0	1,92	0,0	0,00	0,0
17	17	Lunik	BGE shpk	Essegei spa	Lunik	Shkumbin	0	0,0	0	0	0,20	0,0	0,00	0,0
18	18	Nikolica (also Nikolice)	BGE shpk	Essegei spa	Nikolices	Seman	0	0,0	0	0	0,70	0,0	0,00	0,0
19	19	Vithkuq	Favina 1 shpk	not identified	.	0	0	0,0	0	0	0,00	0,0	#DIV/0!	0,0
20	20	Orgjost	BGE shpk	Essegei spa	0	Drin-Bune	0	0,0	0	0	1,20	0,0	0,00	0,0
21	21	Lekbibaj	BGE shpk	Essegei spa	Curraj	Drin-Bune	0	0,0	0	0	1,40	0,0	0,00	0,0
22	22	Velcan	BGE shpk	Essegei spa	Velcanit	Shkumbin	0	0,0	0	0	1,20	0,0	0,00	0,0
23	23	Zerqan	BGE shpk	Essegei spa	Zalli Bulqizes	Drin-Bune	0	0,0	0	0	0,63	0,0	0,00	0,0
24	24	Leshnice (also Leshnica)	BGE shpk	Essegei spa	Leshnice (also Leshnica)	0	0	0,0	0	0	0,38	0,0	0,00	0,0
25	25	Shoshan (Shoshaj)	BGE shpk	Essegei spa	Valbone	0	0	0,0	0	0	0,00	0,0	#DIV/0!	0,0
26	26	Kerpice	BGE shpk	Essegei spa	Kerpice	Shkumbin	0	0,0	0	0	0,42	0,0	0,00	0,0
27	27	Barmash	BGE shpk	Essegei spa	Barmash	0	0	0,0	0	0	0,63	0,0	0,00	0,0

Table A1.1 (Cont. 1): Selected data for existing HPPs in WB6

SN1	SN2	Plant	HPP Operator (-)	Owner (-)	River / Tributary (-)	Basin or (Sub)River Basin (-)	Plant type 3) (-)	Total reservoir storage - volume (mill m3)	Number and structure of units (nxN MW) 4)	Entered into commercial operation (year)	Capacity (MW)	Output (GWh)	Capacity Factor (Design CF) (%)	Output in 2015 (GWh)
		Albania (ALB) (Cont. 1)												
28	28	Homesh	BGE shpk	Essegei spa	Zogjajt	Drin-Bune	0	0,0	0	0	0,33	0,0	0,00	0,0
29	29	Muhur	BGE shpk	Essegei spa	Peshkut	Drin-Bune	0	0,0	0	0	0,25	0,0	0,00	0,0
30	30	Marjan	BGE shpk	Essegei spa	0	0	0	0,0	0	0	0,20	0,0	0,00	0,0
31	31	Arras (also Arres or Arrez)	BGE shpk	Essegei spa	Seta	Drin-Bune	0	0,0	0	0	4,80	0,0	0,00	0,0
32	32	Dukagjin	BGE shpk	Essegei spa	Shale (also Shala)	Drin-Bune	0	0,0	0	0	0,64	0,0	0,00	0,0
33	33	Lure (also Lura)	BGE shpk	Essegei spa	Lure (also Lures)	Drin-Bune	0	0,0	0	0	0,75	0,0	0,00	0,0
34	34	Ujanik	BGE shpk	Essegei spa	0	0	0	0,0	0	0	0,63	0,0	0,00	0,0
35	35	Voskopoje	BGE shpk	Essegei spa	Sules	Seman	0	0,0	0	0	0,00	0,0	#DIV/0!	0,0
36	36	Piqeras (also Piqerras)	BGE shpk	Essegei spa	Piqeras	0	0	0,0	0	0	0,00	0,0	#DIV/0!	0,0
37	37	Rajan	BGE shpk	Essegei spa	Rajan	0	0	0,0	0	0	1,02	0,0	0,00	0,0
38	38	Lozhan	BGE shpk	Essegei spa	Dolanit	Shkumbin	0	0,0	0	0	0,10	0,0	0,00	0,0
39	39	Bene	Marjakaj sh.p.k	Mr. Nike Marjakaj	0	0	0	0,0	0	2010	1,00	0,0	0,00	1,2
40	40	Selce	Selca Energji sh.p.k	Ms. Rudina Gjoni	0	0	0	0,0	0	2010	1,60	0,0	0,00	2,2
41	41	Bogove (Skrapar)	Wonder Power	Mr. Eugen Lici	0	0	0	0,0	0	2010	2,50	0,0	0,00	7,7
42	42	Xhyre (Librazhd)	AMAL	Ms. Luljeta Hysolli	0	0	0	0,0	0	2010	0,25	0,0	0,00	2,0
43	43	Vithkuq (Korce)	FAVINA I	Mr. Viktor Qylafi	0	0	0	0,0	0	2010	2,72	0,0	0,00	10,9
44	44	Orenje (Librazhd)	Juana	Mr. Zija Koci	0	0	0	0,0	0	2010	0,88	0,0	0,00	1,1
45	45	Borje	ENERGJI	Mr. Kujtim Kolgjini	0	0	0	0,0	0	0	1,50	0,0	0,00	0,0
46	46	Oreshke	ENERGJI	Mr. Kujtim Kolgjini	0	0	0	0,0	0	0	5,60	0,0	0,00	0,0
47	47	Carnaleva	ENERGJI	Mr. Kujtim Kolgjini	0	0	0	0,0	0	0	2,95	0,0	0,00	0,0
48	48	Carnaleva1	ENERGJI	Mr. Kujtim Kolgjini	0	0	0	0,0	0	0	3,27	0,0	0,00	0,0
49	49	Bishnica 2	HEC BISHNICA 1,2	Mr. Refat Mustafaraj	0	0	0	0,0	0	2010	2,50	0,0	0,00	11,3
50	50	Dishnica	"Dishnica Energy" shpk	Mr. Zalo Bregu	0	0	0	0,0	0	2010	0,20	0,0	0,00	0,6
51	51	Lubonje	"Elektro Lubonje" shpk	Mr. Agron Hasankolli	0	0	0	0,0	0	2010	0,30	0,0	0,00	0,3
52	52	Labinot–Mal (Elbasan)	shpk	Mr. Saimir Qosja	0	0	0	0,0	0	0	0,25	0,0	0,00	0,0
53	53	Faqekuq 1	"HP OSTROVICA" shpk	Mr. Sali Qeta	0	0	0	0,0	0	0	3,00	0,0	0,00	0,0
54	54	Faqekuq 2	"HP OSTROVICA" shpk	Mr. Sali Qeta	0	0	0	0,0	0	0	3,40	0,0	0,00	0,0
55	55	Stranik	"Hidroinvest 1" shpk	Mr. Bardhyl Hazizaj	0	0	0	0,0	0	0	1,60	0,0	0,00	0,0
56	56	Zall Tore	"Hidroinvest 1" shpk	Mr. Bardhyl Hazizaj	0	0	0	0,0	0	0	2,60	0,0	0,00	0,0
57	57	Gizavesh	"Dosku Energy" shpk	Mr. Emro Doksu	0	0	0	0,0	0	2011	0,50	0,0	0,00	2,5
58	58	Carshove	"ERMA MP" shpk	Mr. Maksim Fejzullahu	0	0	0	0,0	0	2011	1,50	0,0	0,00	3,6

Table A1.1 (Cont. 2): Selected data for existing HPPs in WB6

SN1	SN2	Plant	HPP Operator	Owner	River / Tributary	Basin or (Sub)River Basin	Plant type 3)	Total reservoir storage - volume	Number and structure of units	Entered into commercial operation	Capacity	Output	Capacity Factor (Design CF)	Output in 2015
			(-)	(-)	(-)	(-)	(-)	(mill m3)	(nxN MW) 4)	(year)	(MW)	(GWh)	(%)	(GWh)
		Albania (ALB) (Cont. 2)												
59	59	Sasaj (Sarande)	"Energo – Sas" shpk	Mr. Vasil Gjika	0	0	0	0,0	0	2011	7,00	0,0	0,00	25,0
60	60	Klos (Mirdite)	"Malido-Energji" shpk	Mr. Gjovalin Prenga	0	0	0	0,0	0	2012	1,95	0,0	0,00	2,8
61	61	Peshku (Burrel)	PESHK	Mr. Mehmet Koka	0	0	0	0,0	0	2012	3,43	0,0	0,00	12,2
62	62	Belesova 1 (Lumas Berat)	"Korkis 2009" shpk	Mr. Ramadan Toska	0	0	0	0,0	0	0	0,15	0,0	0,00	0,0
63	63	Belesova 2	"Korkis 2009" shpk	Mr. Ramadan Toska	0	0	0	0,0	0	0	0,28	0,0	0,00	0,0
64	64	Kumbull- Merkurth (Mirdite)	"DN & NAT Energy"shpk	Mr. Dritan Ndrejaj	0	0	0	0,0	0	2012	0,83	0,0	0,00	1,4
65	65	Dardhe	Wenerg shpk	Mr. Zalo Koka	0	0	0	0,0	0	2012	5,80	0,0	0,00	9,3
66	66	Fterra	"Hidro Borshi" shpk	Mr. Vangjel Ngjelo	0	0	0	0,0	0	0	1,08	0,0	0,00	0,0
67	67	Fterra 2	Hidro Borshi shpk	Mr. Vangjel Ngjelo	0	0	0	0,0	0	0	2,00	0,0	0,00	0,0
68	68	Picar 1 (Gjirokaster)	Peshku Picar 1 shpk	Mr. Siri Muho	0	0	0	0,0	0	2013	0,20	0,0	0,00	0,5
69	69	Selishte	Selishte shpk	Mr. Ramazan Biba	0	0	0	0,0	0	2012	2,00	0,0	0,00	5,7
70	70	Lura 1	"Erdat Lura" shpk	Mr. Silvio Allamandi	0	0	0	0,0	0	0	6,54	0,0	0,00	0,0
71	71	Lura 2	"Erdat Lura" shpk	Mr. Silvio Allamandi	0	0	0	0,0	0	0	4,02	0,0	0,00	0,0
72	72	Lura 3	"Erdat Lura" shpk	Mr. Silvio Allamandi	0	0	0	0,0	0	0	5,66	0,0	0,00	0,0
73	73	Verba 1	"Hydro power Plant Of Korca" shpk	Mr. Claudio F Barbano	0	0	0	0,0	0	0	2,00	0,0	0,00	0,0
74	74	Verba 2	"Hydro power Plant Of Korca" shpk	Mr. Claudio F Barbano	0	0	0	0,0	0	0	3,00	0,0	0,00	0,0
75	75	Qafzeze (	ÇAUSHI ENERGJI	Mr. Gramoz Caushi	0	0	0	0,0	0	2013	0,40	0,0	0,00	1,8
76	76	Mollaj	ENERGJI XHAÇI	Mr. Robert Xhaci	0	0	0	0,0	0	2013	0,60	0,0	0,00	1,0
77	77	Kryezi 1	"Bekim Energjitik" shpk	Mr. Muhamet Braha	0	0	0	0,0	0	2013	0,60	0,0	0,00	0,0
78	78	Kryezi i Eperm	"Bekim Energjitik" shpk	Mr. Muhamet Braha	0	0	0	0,0	0	2013	0,20	0,0	0,00	0,0
79	79	Bele 1	"Euron Energy Group" shpk	Mr. Gezim Cela	0	0	0	0,0	0	2013	5,00	0,0	0,00	0,0
80	80	Topojan 2	"Euron Energy Group" shpk	Mr. Gezim Cela	0	0	0	0,0	0	2013	5,80	0,0	0,00	0,0
81	81	Topojan 1	ALB ENERGY	Mr. Pellumb Beta	0	0	0	0,0	0	2015	2,90	0,0	0,00	0,0
82	82	Orgjost I Ri	Energal shpk	Mr. Avni Domi	0	0	0	0,0	0	2015	4,80	0,0	0,00	13,7
83	83	Shkalle	"Energy partners Al" shpk	Mr. Sokol Meqemeja	0	0	0	0,0	0	2013	1,60	0,0	0,00	0,0
84	84	Cerunje 1	"Energy partners Al" shpk	Mr. Sokol Meqemeja	0	0	0	0,0	0	2013	2,30	0,0	0,00	0,0
85	85	Cerunje 2	"Energy partners Al" shpk	Mr. Sokol Meqemeja	0	0	0	0,0	0	2013	2,80	0,0	0,00	0,0
86	86	Klos	"Energy partners Al" shpk	Mr. Sokol Meqemeja	0	0	0	0,0	0	2013	2,30	0,0	0,00	0,0

Table A1.1 (Cont. 3): Selected data for existing HPPs in WB6

SN1	SN2	Plant	HPP Operator	Owner	River / Tributary	Basin or (Sub)River Basin	Plant type 3)	Total reservoir storage - volume	Number and structure of units	Entered into commercial operation	Capacity	Output	Capacity Factor (Design CF)	Output in 2015
			(-)	(-)	(-)	(-)	(-)	(mill m3)	(nxN MW) 4)	(year)	(MW)	(GWh)	(%)	(GWh)
		Albania (ALB) (Cont. 3)												
87	87	Rrype	"Energy partners Al" shpk	Mr. Sokol Meqemeja	0	0	0	0,0	0	2013	3,60	0,0	0,00	0,0
88	88	Shemri	Erald Energy	Mr. Muhamet Braha	0	0	0	0,0	0	2013	1,00	0,0	0,00	0,0
89	89	Mgulle	Erald Energy	Mr. Muhamet Braha	0	0	0	0,0	0	2013	0,80	0,0	0,00	0,0
90	90	Koka1	SNOW ENERGY	Mr. Ismail Meco	0	0	0	0,0	0	2013	3,20	0,0	0,00	5,2
91	91	Tucep	HEC TUCEP	Mr. Qani Bajrami	0	0	0	0,0	0	2013	0,40	0,0	0,00	1,0
92	92	Rapuni 1	"C & S Construction Energy" shpk	Mr. Arjan Cukaj	0	0	0	0,0	0	2013	4,10	0,0	0,00	0,0
93	93	Rapuni 2	"C & S Construction Energy" shpk	Mr. Arjan Cukaj	0	0	0	0,0	0	2013	4,00	0,0	0,00	0,0
94	94	Ostreni i Vogel	"Lu & Co Eco Energy" shpk	Mr. Besmir Muca	0	0	0	0,0	0	2014	0,32	0,0	0,00	0,8
95	95	Qarr	"Hec Qarr & Kaltanj"shpk	Mr. Viktor Qylafi	0	0	0	0,0	0	2014	1,00	0,0	0,00	0,0
96	96	Kaltanj	"Hec Qarr & Kaltanj"shpk	Mr. Viktor Qylafi	0	0	0	0,0	0	2014	0,50	0,0	0,00	0,0
97	97	Langarica 3	"Idro Energia Pulita" shpk	Mr. Defrim Spahiu	0	0	0	0,0	0	2014	2,20	0,0	0,00	0,0
98	98	Gostivisht	"Idro Energia Pulita" shpk	Mr. Defrim Spahiu	0	0	0	0,0	0	2014	1,30	0,0	0,00	0,0
99	99	Ura e Dashit	"Idro Energia Pulita" shpk	Mr. Defrim Spahiu	0	0	0	0,0	0	2014	1,20	0,0	0,00	0,0
100	100	Sotira 1&2	"Hidro Energy Sotire"shpk	Mr. Albert Tafa	0	0	0	0,0	0	2014	2,20	0,0	0,00	5,9
101	101	Murdhar 1	"HydroEnergy "shpk	Mr. Filipo Annoni	0	0	0	0,0	0	2014	2,68	0,0	0,00	0,0
102	102	Murdhar 2	"HydroEnergy "shpk	Mr. Filipo Annoni	0	0	0	0,0	0	2014	1,00	0,0	0,00	0,0
103	103	Kozel	"E.T.H.H. "shpk	Ms. Kostanca Kote	0	0	0	0,0	0	2014	0,50	0,0	0,00	0,0
104	104	Helmes 1	"E.T.H.H. "shpk	Ms. Kostanca Kote	0	0	0	0,0	0	2014	0,80	0,0	0,00	0,0
105	105	Helmes 2	"E.T.H.H. "shpk	Ms. Kostanca Kote	0	0	0	0,0	0	2014	0,50	0,0	0,00	0,0
106	106	Cekrez 1	ZALL HERR ENERGJI 2011	Ms. Natasha Hoxha	0	0	0	0,0	0	2014	0,43	0,0	0,00	0,0
107	107	Cekrez 2	ZALL HERR ENERGJI 2012	Ms. Natasha Hoxha	0	0	0	0,0	0	2014	0,23	0,0	0,00	0,0
108	108	Trebisht	SA-GLE KOMPANI	Mr. Luan Perllaku	0	0	0	0,0	0	2014	1,78	0,0	0,00	1,3
109	109	Perrollaj	FATLUM	Mr. Isa Ukperaj	0	0	0	0,0	0	2015	0,50	0,0	0,00	0,2
110	110	Truen	TRUEN	Mr. Zalo Koka	0	0	0	0,0	0	2015	2,50	0,0	0,00	2,9
111	111	Stravaj	STRAVAJ ENERGY	Mr. Ymer Dashi	0	0	0	0,0	0	2015	3,60	0,0	0,00	7,6
112	112	Kacni	KISI BIO ENERGJI	Mr. Imer Memetaj	0	0	0	0,0	0	2015	3,87	0,0	0,00	1,7
113	113	Shutine	SHUTINA ENERGJI	Mr.Simon Lala	0	0	0	0,0	0	2015	2,40	0,0	0,00	0,8

Table A1.1 (Cont. 4): Selected data for existing HPPs in WB6

SN1	SN2	Plant	HPP Operator	Owner	River / Tributary	Basin or (Sub)River Basin	Plant type 3)	Total reservoir storage - volume	Number and structure of units	Entered into commercial operation	Capacity	Output	Capacity Factor (Design CF)	Output in 2015
			(-)	(-)	(-)	(-)	(-)	(mill m3)	(nxN MW) 4)	(year)	(MW)	(GWh)	(%)	(GWh)
		Albania (ALB) (Cont. 4)												
114	114	Radove	MTC ENERGY	Mr. Leonidas Maniatakis	0	0	0	0,0	0	2014	2,50	0,0	0,00	7,6
115	115	Gurshpate 1	GURSHPAT ENERGY	Mr. Rexhep Tarba, Ms. Katina Xhaolli	0	0	0	0,0	0	2015	0,84	0,0	0,00	0,0
116	116	Gurshpate 2	GURSHPAT ENERGY	Mr. Rexhep Tarba, Ms. Katina Xhaolli	0	0	0	0,0	0	2015	0,83	0,0	0,00	0,0
117	117	Hurdhas 1	KOMP ENERGJI	Mr. Muchal Morcienec, Mr. Fili Lala	0	0	0	0,0	0	2015	1,71	0,0	0,00	0,0
118	118	Hurdhas 2	KOMP ENERGJI	Mr. Muchal Morcienec, Mr. Fili Lala	0	0	0	0,0	0	2015	1,30	0,0	0,00	0,0
119	119	Hurdhas 3	KOMP ENERGJI	Mr. Muchal Morcienec, Mr. Fili Lala	0	0	0	0,0	0	2015	1,20	0,0	0,00	0,0
120	120	Treska 2	"Hec-Treske"shpk	Ms. Enkeleida Shamo	0	0	0	0,0	0	2015	0,62	0,0	0,00	0,0
121	121	Treska 3	"Hec-Treske"shpk	Ms. Enkeleida Shamo	0	0	0	0,0	0	2015	0,40	0,0	0,00	0,0
122	122	Treska 4	"Hec-Treske"shpk	Ms. Enkeleida Shamo	0	0	0	0,0	0	2015	3,60	0,0	0,00	0,0
123	123	Borove	DITEKO shpk	Mr. Shkelqim Golli	0	0	0	0,0	0	2015	1,92	0,0	0,00	0,0
124	124	Zabzun	DITEKO shpk	Mr. Shkelqim Golli	0	0	0	0,0	0	2015	0,30	0,0	0,00	0,0
125	125	Sebishte	DITEKO shpk	Mr. Shkelqim Golli	0	0	0	0,0	0	2015	2,84	0,0	0,00	0,0
126	126	Prodan 1	DITEKO shpk	Mr. Shkelqim Golli	0	0	0	0,0	0	2015	0,38	0,0	0,00	0,0
127	127	Prodan 2	DITEKO shpk	Mr. Shkelqim Golli	0	0	0	0,0	0	2015	0,80	0,0	0,00	0,0
128	128	Okshtun Ekologjik	DITEKO shpk	Mr. Shkelqim Golli	0	0	0	0,0	0	2015	0,45	0,0	0,00	0,0
129	129	Ternove	DITEKO shpk	Mr. Shkelqim Golli	0	0	0	0,0	0	2015	0,92	0,0	0,00	0,0
130	130	Lubalesh 1	DITEKO shpk	Mr. Shkelqim Golli	0	0	0	0,0	0	2015	4,60	0,0	0,00	0,0
131	131	Lubalesh 2	DITEKO shpk	Mr. Shkelqim Golli	0	0	0	0,0	0	2015	5,10	0,0	0,00	0,0
132	132	Gjorice	DITEKO shpk	Mr. Shkelqim Golli	0	0	0	0,0	0	2015	4,18	0,0	0,00	0,0
133	133	Lengarica	“Lengarica & Energy” sh.p.k	Ms. Aida Nani	0	0	0	0,0	0	2015	8,94	0,0	0,00	1,4
134	134	Driza	MESOPOTAM ENERGY	Mr. Koco Gjilo	0	0	0	0,0	0	2015	3,41	0,0	0,00	0,3
135	135		“Projeksion Energji” sh.a.	0	0	0	0	0,0	0	0	0,13	0,0	0,00	0,0
136	136	Çarshove	“Projeksion Energji” sh.a.	0	0	0	0	0,0	0	0	0,07	0,0	0,00	0,0
137	137	Rehove	“Projeksion Energji” sh.a.	0	0	0	0	0,0	0	0	0,10	0,0	0,00	0,0
		Total ALB									**252,49**	**36,7**	**1,66**	**194,2**

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Table A1.1 (Cont. 5): Selected data for existing HPPs in WB6

SN1	SN2	Plant	HPP Operator	Owner	River / Tributary	Basin or (Sub)River Basin	Plant type 3)	Total reservoir storage - volume	Number and structure of units	Entered into commercial operation	Capacity	Output	Capacity Factor (Design CF)	Output in 2015
			(-)	(-)	(-)	(-)	(-)	(mill m3)	(nxN MW) 4)	(year)	(MW)	(GWh)	(%)	(GWh)
		Bosna and Herzegovina (BiH)												
138	1	Trebinje 2	ERS / HE na Trebišnjici	ERS / HE na Trebišnjici	Trebišnjica	Adriatic	RES	15,7	1x8	1981	8,00	4,0	5,71	7,8
139	2	Osanica 1	EP BiH	EP BiH	Osanica	Drina	ROR	0,0	2x0.54	1999	1,00	3,0	34,25	1,9
140	3	Modrac	EP BiH/Spreča	EP BiH/Spreča	Spreća	Bosna	RES	88,0	1x2	1999	1,90	7,8	46,86	0,8
141	4	Botun	Intrade d.o.o	Intrade d.o.o	Kozica	Bosna	ROR	0,0	1x1.043	2005	1,00	3,8	43,38	0,0
142	5	Jezernica 1	Intrade d.o.o	Intrade d.o.o	Jezernica	Bosna	ROR	0,0	1x1.294	2005	1,20	4,0	38,05	0,0
143	6	Majdan	Intrade d.o.o	Intrade d.o.o	Kozica	Bosna	ROR	0,0	1x2.635	2005	2,60	11,1	48,82	0,0
144	7	Mujakovići	Intrade d.o.o	Intrade d.o.o	Jezernica	Bosna	ROR	0,0	1x1.5	2005	1,50	8,2	62,25	0,0
145	8	Snježnica	EP BiH	EP BiH	Rastošnica	Drina	RES	20,6	1x0.25; 1x0.15	2007	0,40	1,6	45,66	1,6
146	9	Tisca	ERS / ED Bijeljina	ERS / ED Bijeljina	Tisca	Drina	ROR	0,0	0	1989	2,00	8,2	47,00	4,3
147	10	Vlasenica	ERS / ED Bijeljina	ERS / ED Bijeljina	Jadar	Drina	ROR	0,0	0	1950	0,90	3,7	47,00	4,5
148	11	Krušnica	EP BiH	EP BiH	Krušnica	Una	ROR	0,0	2x0.23	1932	0,46	1,6	39,71	1,4
149	12	Mesići	ERS / ED Pale	ERS / ED Pale	Prača	Drina	ROR	0,0	0	1950	4,90	23,9	55,68	13,4
150	13	Štrpci	MHE Strpci	MHE Strpci	za FAP	-	0	0,0	0	1998	0,08	0,3	47,00	0,2
151	14	Divič	Eling MHE doo Teslić	Eling MHE doo Teslić	Vrbanja	Vrbas	ROR	0,0	0	2005	2,83	11,6	47,00	4,2
152	15	Sućeska 1 i 2	hidroelektrane Banjaluka	hidroelektrane Banjaluka	Sućeska	Drina	ROR	0,0	2x0.92 + 1x1.0	2009	3,37	11,6	39,29	5,5
153	16	Bistrica B5a	Bobar - Taubinger electric doo Foča	Bobar - Taubinger electric doo Foča	Bistrica	Drina	ROR	0,0	0	2010	5,00	20,6	47,00	3,6
154	17	Žiraja	Megaelektrik Banjaluka	Megaelektrik Banjaluka	Žiraja	Bosna	ROR	0,0	0	2012	0,30	1,2	47,00	1,6
155	18	Novakovići	EHE doo Banjaluka	EHE doo Banjaluka	Ugar	Vrbas	ROR	0,0	0	2012	5,77	23,8	47,00	15,3
156	19	Paklenica	ERS - Elektro Doboj	ERS - Elektro Doboj	Paklenica	Bosna	ROR	0,0	1x0.228	2013	0,22	0,9	47,00	0,5
157	20	Oteša BO2	Foča	doo Foča	Oteša	Drina	ROR	0,0	1x0.992	2014	1,00	4,3	49,09	3,7
158	21	Grabovička rijeka	E-promet doo Kotor Varoš	E-promet doo Kotor Varoš	Grabovička rijeka	Vrbas	0	0,0	0	2014	0,79	3,3	47,00	1,7
159	22	Velika Jasenica	Megaelektrik Banjaluka	Megaelektrik Banjaluka	Jasenica	Vrbas	0	0,0	0	2014	0,65	2,7	47,00	1,6
160	23	Ilomska	Eling MHE doo Teslić	Eling MHE doo Teslić	Ilomska	Vrbas	0	0,0	0	2014	4,82	19,8	47,00	9,2
161	24	Žeželja	Megaelektrik Banjaluka	Megaelektrik Banjaluka	Žeželja	Bosna	0	0,0	0	2014	0,32	1,3	47,00	0,6
162	25	Zapeće	EHE doo Banjaluka	EHE doo Banjaluka	Ugar	Vrbas	0	0,0	0	2015	4,10	16,9	47,00	2,2
163	26	Ustiprača	Hidroinvest doo Rogatica	Hidroinvest doo Rogatica	Prača	Drina	ROR	0,0	0	2015	6,70	27,6	47,00	0,5
164	27	Otoke 1	MHE Otoke 1 Šipovo	MHE Otoke 1 Šipovo	Janj	Vrbas	0	0,0	0	2015	0,03	0,1	47,00	0,0
165	28	Čardak	EBH doo Sarajevo	EBH doo Sarajevo	Gostović	Bosna	ROR	0,0	3x0.4	2014	1,20	3,6	34,25	0,0
166	29	Rujevica	EBH doo Sarajevo	EBH doo Sarajevo	Gostović	Bosna	ROR	0,0	2x0.36	2015	0,70	2,6	42,40	0,0
167	30	Botašnica	EBH doo Sarajevo	EBH doo Sarajevo	Gostović	Bosna	ROR	0,0	2x0.5	2016	1,00	2,6	29,68	0,0

Table A1.1 (Cont. 6): Selected data for existing HPPs in WB6

SN1	SN2	Plant	HPP Operator	Owner	River / Tributary	Basin or (Sub)River Basin	Plant type 3)	Total reservoir storage - volume	Number and structure of units	Entered into commercial operation	Capacity	Output	Capacity Factor (Design CF)	Output in 2015
			(-)	(-)	(-)	(-)	(-)	(mill m3)	(nxN MW) 4)	(year)	(MW)	(GWh)	(%)	(GWh)
		Bosna and Herzegovina (BiH) (Cont. 1)												
168	31	Bistričak	Adria produkt doo Zenica	Adria produkt doo Zenica	Bistričak	Bosna	ROR	0,0	2x0.5	2011	1,00	4,2	47,95	0,0
169	32	Čajdraš	JP ViK Zenica	JP ViK Zenica	Krušćica	Bosna	ROR	0,0	1x0.5	2012	0,50	3,6	82,19	0,0
170	33	Ružnovac	Inter-Energo doo G.Vakuf	Inter-Energo doo G.Vakuf	Vrbas	Sava	ROR	0,0	2x0.5	2012	1,00	3,6	41,10	0,0
171	34	Derala	Inter-Energo doo G.Vakuf	Inter-Energo doo G.Vakuf	Deralski potok	Vrbas	ROR	0,0	1x0.24	2012	0,24	1,0	47,56	0,0
172	35	Jelići	Inter-Energo doo G.Vakuf	Inter-Energo doo G.Vakuf	Vrbas	Sava	ROR	0,0	1x0.45; 1x0.9	2006	1,50	6,3	47,95	0,0
173	36	Duščica	ING-EKO doo Prozor-Rama	ING-EKO doo Prozor-Rama	Duščica	Rama	ROR	0,0	2x0.25	2012	0,50	2,1	47,95	0,0
174	37	Duboki Potok	DF Gradnja doo Konjic	DF Gradnja doo Konjic	Duboki potok - Trešanica	Neretva	ROR	0,0	1x0.92	2015	1,00	3,0	34,25	0,0
175	38	Veliki Duboki Potok	DF Gradnja doo Konjic	DF Gradnja doo Konjic	Duboki potok - Trešanica	Neretva	ROR	0,0	1x0.4	2016	0,40	1,8	51,37	0,0
176	39	Crima	Rama	Rama	Crima	Rama	ROR	0,0	2x0.66	2010	1,30	5,0	43,91	0,0
177	40	Pogledala	Karadrvo doo Fojnica	Karadrvo doo Fojnica	Borovnica	Bosna	ROR	0,0	1x0.290	2006	0,60	2,3	43,38	0,0
178	41	Gradlje	Karadrvo doo Fojnica	Karadrvo doo Fojnica	Borovnica	Bosna	ROR	0,0	1x0.48	2010	0,50	2,1	48,86	0,0
179	42	Torlakovac	Vlašić gradnja doo Travnik	Vlašić gradnja doo Travnik	Sokolinski potok	Vrbas	ROR	0,0	1x0.460	2008	0,50	2,2	50,00	0,0
180	43	Čemernica	ENERGONOVA doo Sarajevo	ENERGONOVA doo Sarajevo	Čemernica	Drina	ROR	0,0	1x0.5	2009	0,50	2,1	47,95	0,0
181	44	Kaljani	ENERGONOVA doo Sarajevo	ENERGONOVA doo Sarajevo	Prača	Drina	ROR	0,0	2x0.6	2011	1,20	4,9	46,14	0,0
182	45	Sastavci	IEP energy doo Gornji Vakuf-Uskoplje	IEP energy doo Gornji Vakuf-Uskoplje	Vrbas	Sava	ROR	0,0	1x0.8	2006	0,80	3,2	44,95	0,0
183	46	Duboki potok	IEP energy doo Gornji Vakuf-Uskoplje	IEP energy doo Gornji Vakuf-Uskoplje	Desna	Vrbas	ROR	0,0	2x0.43	2006	0,90	4,0	50,74	0,0
184	47	Mošćani	COMPREX doo Sarajevo	COMPREX doo Sarajevo	Kozica	Bosna	ROR	0,0	1x0.75	2006	0,75	3,2	48,71	0,0
185	48	Prusac 1	COMPREX doo Sarajevo	COMPREX doo Sarajevo	rijeka	Vrbas	ROR	0,0	1x0.69	2006	0,69	3,7	61,21	0,0
186	49	Kordići	PRO-EL doo Bugojno	PRO-EL doo Bugojno	Bunta	Vrbas	ROR	0,0	2x0.24	2016	0,50	2,2	50,23	0,0
187	50	Hum	Eskimo S2 doo Travnik	Eskimo S2 doo Travnik	Jesenica	Bosna	ROR	0,0	1x0.648	2012	0,65	2,8	49,17	0,0
188	51	Podstinje	Eskimo S2 doo Travnik	Eskimo S2 doo Travnik	Bila	Bosna	ROR	0,0	1x0.420	2010	0,40	1,6	45,66	0,0
189	52	Vileška	Eskimo S2 doo Travnik	Eskimo S2 doo Travnik	Vileška rijeka	Vrbas	ROR	0,0	1x0.349	2011	0,35	1,6	52,19	0,0
190	53	Pršljanica 1	Vesna S doo Bugojno	Vesna S doo Bugojno	Pršljanica	Vrbas	ROR	0,0	2x0.100	2008	0,20	0,8	45,66	0,0
191	54	Pršljanica 2	Vesna S doo Bugojno	Vesna S doo Bugojno	Pršljanica	Vrbas	ROR	0,0	1x0.350	2010	0,35	1,5	48,92	0,0
192	55	Bihać	JP EPBiH	JP EPBiH	Una	Sava	ROR	0,0	1x0.16	1912	0,16	0,8	57,08	0,9

Table A1.1 (Cont. 7): Selected data for existing HPPs in WB6

SN1	SN2	Plant	HPP Operator	Owner	River / Tributary	Basin or (Sub)River Basin	Plant type 3)	Total reservoir storage - volume	Number and structure of units	Entered into commercial operation	Capacity	Output	Capacity Factor (Design CF)	Output in 2015
			(-)	(-)	(-)	(-)	(-)	(mill m3)	(nxN MW) 4)	(year)	(MW)	(GWh)	(%)	(GWh)
		Bosna and Herzegovina (BiH) (Cont. 2)												
193	56	Osanica 4	ECO ENERGY doo Tuzla	Tuzla	Osanica	Drina	ROR	0,0	1x0.63	2008	0,60	2,5	47,56	0,0
194	57	Mujada+B24	GRID BH doo Sarajevo	GRID BH doo Sarajevo	rijeka	Vrbas	ROR	0,0	1x1.281	2009	1,28	7,5	66,84	0,0
195	58	Zagradačka	MHE Zagradačka doo Prozor-Rama	MHE Zagradačka doo Prozor-Rama	Zagradačka rijeka	Neretva	ROR	0,0	1x0.8	2010	0,80	3,1	44,66	0,0
196	59	Vitez 1	MHE V 1 doo Vitez	MHE V 1 doo Vitez	Lašva	Bosna	ROR	0,0	1x1.2	2008	1,20	6,0	57,08	0,0
197	60	Kraljuštica 1	Amitea II doo Mostar	Amitea II doo Mostar	Kraljuštica	Neretva	ROR	0,0	1x3.3	2015	3,30	12,5	43,24	0,0
198	61	Kraljuštica 2	Amitea II doo Mostar	Amitea II doo Mostar	Kraljuštica	Naretva	ROR	0,0	1x4.995	2015	5,00	18,9	43,15	0,0
199	62	Trešanica 4	Amitea II doo Mostar	Amitea II doo Mostar	Trešanica	Neretva	ROR	0,0	1x1.2	2008	1,20	6,0	57,08	0,0
200	63	Buk	HE Buk doo Široki Brijeg	HE Buk doo Široki Brijeg	Lištica	Neretva	ROR	0,0	2x0.180	1992	0,35	1,2	39,14	0,0
201	64	Lukač	Wind-Neretva doo Konjic	Wind-Neretva doo Konjic	Trešanica	Neretva	ROR	0,0	1x2.9	2015	2,90	12,0	47,24	0,0
202	65	Dubrava	Wind-Neretva doo Konjic	Wind-Neretva doo Konjic	Kozička rijaka	Vrbas	ROR	0,0	1x3.13	2015	3,13	13,7	49,97	0,0
203	66	Vareš	EKO ENERGY doo Tešanj	EKO ENERGY doo Tešanj	Stavnja	Bosna	ROR	0,0	1x0.475; 1x0.810	2016	1,30	3,9	33,81	0,0
		Total BiH									**102,28**	**392,5**	**43,81**	**86,9**
		The former Yugoslav Republic of Macedonia (MKD)												
204	1	Matka (New)	EVN Macedonia Elektrani DOOEL	EVN AG	Treska	Vardar	RES	3,7	2x4,8 MW	2007	9,60	30,0	35,67	37,4
205	2	Pena	EVN Macedonia Elektrani DOOEL	EVN AG	Pena	Vardar	ROR	0,0	1x1,28 MW + 1x2MW	1927	3,30	11,0	38,05	12,7
206	3	Zrnovci	EVN Macedonia Elektrani DOOEL	EVN AG	Zrnovska	Bregalnica	ROR	0,0	2x0,8 MW	1950	1,60	4,8	34,25	7,5
207	4	Pesočani	EVN Macedonia Elektrani DOOEL	EVN AG	Pesocanska	Lake Ohrid, Crn Drim	ROR	0,0	2x1,76 MW	1951	2,88	10,5	41,62	12,4
208	5	Sapunčica	EVN Macedonia Elektrani DOOEL	EVN AG	Sapunčica	Dragor, Crna Reka	ROR	0,0	2x1,76 MW	1952	2,90	11,0	43,30	13,7
209	6	Dosnica	EVN Macedonia Elektrani DOOEL	EVN AG	Dosnica	Vardar	ROR	0,0	3x1,7 MW	1953	5,10	18,5	41,41	28,9
210	7	Popova Šapka cascade	EVN Macedonia Elektrani DOOEL	EVN AG	N/A	N/A	ROR	0,0	4x1,2 MW	1993	4,80	20,0	47,56	22,3
211	8	Turija	EVN Macedonia Elektrani DOOEL	EVN AG	Turija	Strumesnica ,	RES	48,0	2x1 MW	1985	2,00	1,5	8,56	0,7
212	9	Babuna	EVN Macedonia Elektrani DOOEL	EVN AG	Babuna	Vardar	ROR	0,0	2x0,32 MW	1994	0,64	0,8	14,27	1,7
213	10	Belica 1 cascade	EVN Macedonia Elektrani DOOEL	EVN AG	Belica	Reka, Treska	ROR	0,0	1x0,25 MW	1989	0,25	0,6	27,40	0,6
214	11	Belica 2 cascade	VODAVAT	VODAVAT	0	0	0	0,0	0	0	1,00	2,2	25,00	0,0
215	12	Lukar Kavadarci	SOL SEE, JP Komunalac	SOL spa	Old River	0	ROR	0,0	0	2003	1,30	2,8	25,00	0,0

Table A1.1 (Cont. 8): Selected data for existing HPPs in WB6

SN1	SN2	Plant	HPP Operator	Owner	River / Tributary	Basin or (Sub)River Basin	Plant type 3)	Total reservoir storage - volume	Number and structure of units	Entered into commercial operation	Capacity	Output	Capacity Factor (Design CF)	Output in 2015
			(-)	(-)	(-)	(-)	(-)	(mill m3)	(nxN MW) 4)	(year)	(MW)	(GWh)	(%)	(GWh)
		The former Yugoslav Republic of Macedonia (Cont. 2)												
216	13	Filternica	not identified	not identified	0	0	0	0,0	0	1997	0,38	0,8	25,00	0,0
217	14	Streževo 1	JP Strezevo	HS Strezevo - Bitola	Semnica	0	RES	0,0	3x0.8 MW	1992	2,40	5,3	25,00	0,0
218	15	Biološki	JP Strezevo	HS Strezevo - Bitola	Semnica	0	RES	0,0	0	1994	0,13	0,3	25,00	0,0
219	16	Dovlednjik	JP Strezevo	HS Strezevo - Bitola	Semnica	0	derivation	0,0	0	1997	0,46	1,0	25,00	0,0
220	17	Filternica	JP Strezevo	HS Strezevo - Bitola	Semnica	0	derivation	0,0	0	1997	0,38	0,8	25,00	0,0
221	18	MHE Letnick izvori Skopje (Ohrid 1)	MHE Letnick izvori DOO Skopje	MHE Letnick izvori DOO Skopje	Vodovod Ohrid	0	ROR	0,0	1X0,117	2010	0,12	0,1	8,24	0,2
222	19	MHE Letnick izvori Skopje (Ohrid 2)	MHE Letnick izvori DOO Skopje	MHE Letnick izvori DOO Skopje	Vodovod Ohrid	0	ROR	0,0	1x0,320	2010	0,32	1,0	36,99	1,3
223	20	MHE Letnick izvori Skopje (Ohrid 3)	MHE Letnick izvori DOO Skopje	MHE Letnick izvori DOO Skopje	Vodovod Ohrid	0	ROR	0,0	1x0,229	2010	0,23	0,6	28,65	0,8
224	21	MHE Gorno Belicki izvori (Belica 1)	MHE Gorno Belicki izvori DOO Skopje	MHE Gorno Belicki izvori DOO Skopje	Vodovod Ohrid	0	ROR	0,0	1X0,995	2010	1,00	3,1	35,29	3,3
225	22	MHE Gorno Belicki izvori (Belica 2)	MHE Gorno Belicki izvori DOO Skopje	MHE Gorno Belicki izvori DOO Skopje	Vodovod Ohrid	0	ROR	0,0	1X0,996	2010	1,00	2,9	32,75	3,0
226	23	DIKOM	DIKOM DOOEL Kavadarci	DIKOM DOOEL Kavadarci	NA	0	ROR	0,0	1x0,032	2010	0,03	0,1	18,30	0,1
227	24	HIDROENERGO PROJEKT VODOVOD BITOLA	HIDROENERGO DOOEL BITOLA	HIDROENERGO DOOEL BITOLA	Glaz	0	ROR	0,0	1x0,4	2010	0,40	1,7	48,77	1,9
228	25	Studencica	Studencica Mali hidro DOO Skopje	Studencica Mali hidro DOO Skopje	Hidro sistem Studencica	0	ROR	0,0	1x0,6	2011	0,60	2,7	50,97	3,0
229	26	Krkljanska reka	Mali hidro elektrani DOO Skopje	Mali hidro elektrani DOO Skopje	Krkljanaska river	river/Pcinja/ Vardar	ROR	0,0	1x0,384	2012	0,38	1,0	28,94	1,3
230	27	Slatino	Fero invest DOO Skopje	Fero invest DOO Skopje	Slatinska reka	reka/Ohrid Lake/Crn	ROR	0,0	1x0,560	2012	0,56	1,4	28,01	1,7
231	28	Brbushnica	Mali hidro elektrani DOO Skopje	Mali hidro elektrani DOO Skopje	Brbushnica	Bregalnica/ Vardar	ROR	0,0	1x0,576	2012	0,58	1,5	29,04	1,9
232	29	Kranska reka	Mali hidro elektrani DOO Skopje	Mali hidro elektrani DOO Skopje	Kranska reka	Lake/Crn Drim	ROR	0,0	1x0,584	2012	0,58	1,7	34,10	2,0
233	30	Kriva reka 2	Mali hidro elektrani DOO Skopje	Mali hidro elektrani DOO Skopje	Kriva reka	Pcinja/Vard ar	ROR	0,0	1x0,584	2012	0,58	1,7	32,52	2,0
234	31	Brajcino 1	Mali hidro elektrani DOO Skopje	Mali hidro elektrani DOO Skopje	Brajcinska(Sta ra) reka	Lake/Crn Drim	ROR	0,0	1x0,704	2013	0,70	2,3	36,52	2,4
235	32	Kamenicka reka	Mali hidro elektrani DOO Skopje	Mali hidro elektrani DOO Skopje	Kamenicka reka	Bregalnica/ Vardar	ROR	0,0	1x1,2	2013	1,20	4,4	41,98	5,9
236	33	Ljubanska	EMK Mali hidroelektrani DOOEL Skopje	EMK Mali hidroelektrani DOOEL Skopje	Ljubanska reka	Serava/Vard ar	ROR	0,0	1x0,234	2013	0,23	0,7	32,50	0,9
237	34	Pesocan 393	Hidro Energy Group DOO Skopje	Hidro Energy Group DOO Skopje	Pesocanska reka	reka/Ohrid lake	ROR	0,0	1x0,990	2013	0,99	2,7	31,01	3,1

Table A1.1 (Cont. 9): Selected data for existing HPPs in WB6

SN1	SN2	Plant	HPP Operator (-)	Owner (-)	River / Tributary (-)	Basin or (Sub)River Basin (-)	Plant type 3) (-)	Total reservoir storage - volume (mill m3)	Number and structure of units (nxN MW) 4)	Entered into commercial operation (year)	Capacity (MW)	Output (GWh)	Capacity Factor (Design CF) (%)	Output in 2015 (GWh)
		The former Yugoslav Republic of Macedonia (Cont. 3)												
238	35	Selecka reka, s. Burinec	Mali hidro elektrani DOO Skopje	Mali hidro elektrani DOO Skopje	Selecka reka	reka/Radika/ Crn Drim	ROR	0,0	1x1,720	2013	1,72	3,5	23,27	4,6
239	36	Zelengrad	Hidro eko inzinering DOO Skopje	Hidro eko inzinering DOO Skopje	Zelengradska reka	reka/Bregalnica/Vardar	ROR	0,0	1x0,130	2013	0,13	0,4	31,33	0,6
240	37	Brestjanska reka	EMK Mali hidroelektrani DOOEL Skopje	EMK Mali hidroelektrani DOOEL Skopje	Brestjanska reka	Lake/Pcinja/ Vardar	ROR	0,0	1x0,666	2013	0,67	1,8	30,33	2,3
241	38	Ratevo	DDS Solar DOO Skopje	DDS Solar DOO Skopje	Ratevska reka	Bregalnica/ Vardar	ROR	0,0	1x0,400	2013	0,40	1,0	27,40	1,5
242	39	Mini Turija	Ezoterna DOOEL	Ezoterna DOOEL	Turija dam	dam/Strumica	ROR	0,0	1x0,160	2013	0,16	0,8	59,89	1,1
243	40	Gradecka	PCC HIDRO DOOEL Skopje	PCC HIDRO DOOEL Skopje	Gradecka reka	Bregalnica/ Vardar	ROR	0,0	1x0,920	2013	0,92	2,4	29,65	3,5
244	41	Tresonce	Hidro Energy Group DOO Skopje	Hidro Energy Group DOO Skopje	Tresonecka reka	Radika/Crn Drim	ROR	0,0	1x1,98	2013	1,98	3,0	17,51	4,5
245	42	Pesocan 392	Hidro Energy Group DOO Skopje	Hidro Energy Group DOO Skopje	Pesocanska reka	reka/Ohrid lake/Crn	ROR	0,0	1x1,125	2013	1,13	2,4	24,38	3,0
246	43	Golemaca 259	EMK Mali hidroelektrani DOOEL Skopje	EMK Mali hidroelektrani DOOEL Skopje	Golemaca	Crna Reka/Vardar	ROR	0,0	1x0,423	2013	0,42	1,1	28,85	1,8
247	44	Mala reka	EMK Mali hidroelektrani DOOEL Skopje	EMK Mali hidroelektrani DOOEL Skopje	Mala reka	Crna Reka/Vardar	ROR	0,0	1x0,270	2013	0,27	0,5	21,94	0,9
248	45	Dobrenoec	Studencica Kicevo	Studencica Kicevo	Hidro sistem Studencica	Treska/Vardar	ROR	0,0	1x0,480	2014	0,48	2,8	67,35	3,6
249	46	Bistrica 97	SOL HIDROPAUER DOOEL Skopje	SOL HIDROPAUER DOOEL Skopje	Bistrica, Tearce	Vardar	ROR	0,0	1x2,64	2014	2,64	4,5	19,44	5,8
250	47	Bistrica 98	SOL HIDROPAUER DOOEL Skopje	SOL HIDROPAUER DOOEL Skopje	Bistrica, Tearce	Vardar	ROR	0,0	1x3,2	2014	3,20	5,4	19,41	6,5
251	48	Brajcino 2	PCC HIDRO DOOEL Skopje	PCC HIDRO DOOEL Skopje	Brajcinska(Stara) reka	Lake/Crn Drim	ROR	0,0	1x1,4725	2014	1,47	2,4	18,52	3,9
252	49	Galicka reka 3	PCC HIDRO DOOEL Skopje	PCC HIDRO DOOEL Skopje	Galicka reka	Radika/Crn Drim	ROR	0,0	1x1,2825	2014	1,28	1,2	10,72	2,1
253	50	Esterec 372	EL TE HIDRO DOOEL Skopje	EL TE HIDRO DOOEL Skopje	Esterec	reka/Bregalnica/Vardar	ROR	0,0	1x0,376	2014	0,38	0,7	20,07	1,3
254	51	Bistrica 99	SOL HIDROPAUER DOOEL Skopje	SOL HIDROPAUER DOOEL Skopje	Bistrica, Tearce	Vardar	ROR	0,0	1x3,28	2014	3,28	6,7	23,49	6,7
255	52	Eksploatacionen minimum	PC Strezevo	PC Strezevo	Hydro System Strezevo	System Strezevo	ROR	0,0	1x0,320	2014	0,32	1,5	54,59	1,5
256	53	Brza voda 3 95	BNB ENERGI DOO Skopje	BNB ENERGI DOO Skopje	Brza Voda	System Strezevo/Cr	ROR	0,0	1x0,720	2015	0,72	1,2	19,20	1,2
257	54	Toplec	Ezoterna DOOEL Strumica	Ezoterna DOOEL Strumica	Hydro sysstem	Dojransko Ezero	ROR	0,0	1x0,332	2015	0,33	0,3	11,46	0,3

Table A1.1 (Cont. 10): Selected data for existing HPPs in WB6

SN1	SN2	Plant	HPP Operator	Owner	River / Tributary	Basin or (Sub)River Basin	Plant type 3)	Total reservoir storage - volume	Number and structure of units	Entered into commercial operation	Capacity	Output	Capacity Factor (Design CF)	Output in 2015
			(-)	(-)	(-)	(-)	(-)	(mill m3)	(nxN MW) 4)	(year)	(MW)	(GWh)	(%)	(GWh)
		The former Yugoslav Republic of Macedonia (Cont. 4)												
258	55	Brza voda 2 94	BNB ENERGI DOO Skopje	BNB ENERGI DOO Skopje	Brza Voda	Vardar	ROR	0,0	1x0,960	2015	0,96	1,0	12,48	1,0
259	56	Brza voda 1 96	BNB ENERGI DOO Skopje	BNB ENERGI DOO Skopje	Brza Voda	Vardar	ROR	0,0	1x0,960	2015	0,96	0,5	6,40	0,5
260	57	Patiska reka 146	PCC HIDRO DOOEL Skopje	PCC HIDRO DOOEL Skopje	Patiska reka	Vardar	ROR	0,0	1x0,7125	2015	0,71	1,6	25,21	1,6
261	58	Golemo Ilino 257	BNB ENERGI DOO Skopje	BNB ENERGI DOO Skopje	Goelmo Ilinska reka	Crna reka/Vardar	ROR	0,0	1x0,464	2015	0,46	0,8	19,41	0,8
262	59	Baciska reka 2 28	Albnor Kompani	Albnor Kompani	Baciska reka	Treska/Vardar	ROR	0,0	1x1,170	2015	1,17	1,6	16,01	1,6
263	60	Kusnica 256	Elektrolab DOO Skopje	Elektrolab DOO Skopje	(Maloilinska reka)	Crna reka/Vardar	ROR	0,0	1x0,2475	2015	0,25	0,3	14,22	0,3
264	61	Kamena reka 125	SOL HIDROPAUER DOOEL Skopje	SOL HIDROPAUER DOOEL Skopje	Kamena reka	Lipkovsko Lake	ROR	0,0	1x2,4	2015	2,40	1,1	5,27	1,1
265	62	Konjarka 236	EL TE HIDRO DOOEL Skopje	EL TE HIDRO DOOEL Skopje	Konjarka	Lake/Pcinja/Vardar	ROR	0,0	1x1	2015	1,00	1,0	11,46	1,0
266	63	Kriva reka 1 179 -1	EMK Mali hidroelektrani DOOEL Skopje	EMK Mali hidroelektrani DOOEL Skopje	river/Pcinja/Vardar	river/Pcinja/Vardar	ROR	0,0	1x0,540	2015	0,54	0,6	11,69	0,6
267	64	Kriva reka 2 179 -2	EMK Mali hidroelektrani DOOEL Skopje	EMK Mali hidroelektrani DOOEL Skopje	river/Pcinja/Vardar	river/Pcinja/Vardar	ROR	0,0	1x0,990	2015	0,99	1,2	13,74	1,2
268	65	Kalin Kamen 1	Hidro Osogovo DOO Skopje	Hidro Osogovo DOO Skopje	river/Pcinja/Vardar	river/Pcinja/Vardar	ROR	0,0	1x0,248	2015	0,25	1,8	81,30	1,8
269	66	Kalin Kamen 2	Hidro Osogovo DOO Skopje	Hidro Osogovo DOO Skopje	river/Pcinja/Vardar	river/Pcinja/Vardar	ROR	0,0	1x0,320	2015	0,32	1,7	60,45	1,7
270	67	Bosava 1	Hidro Bosava DOO Kavadarci	Hidro Bosava DOO Kavadarci	Bosava	Vardar	ROR	0,0	1x2,880	2015	2,88	1,1	4,32	1,1
271	68	Bosava 2	Hidro Bosava DOO Kavadarci	Hidro Bosava DOO Kavadarci	Bosava	Vardar	ROR	0,0	1x2,880	2015	2,88	1,2	4,56	1,2
272	69	Bosava 3	Hidro Bosava DOO Kavadarci	Hidro Bosava DOO Kavadarci	Bosava	Vardar	ROR	0,0	1x1,920	2015	1,92	0,6	3,63	0,6
273	70	Bosava 4	Hidro Bosava DOO Kavadarci	Hidro Bosava DOO Kavadarci	Bosava	Vardar	ROR	0,0	1x1,920	2015	1,92	0,3	1,67	0,3
274	71	Bosava 5	Hidro Bosava DOO Kavadarci	Hidro Bosava DOO Kavadarci	Bosava	Vardar	ROR	0,0	1x1,440	2015	1,44	0,1	0,76	0,1
275	72	Stanecka reka	Hidro Osogovo DOO Skopje	Hidro Osogovo DOO Skopje	river/Pcinja/Vardar	river/Pcinja/Vardar	ROR	0,0	1x0,136	2015	0,14	0,2	16,35	0,2
276	73	Kazani 208	BNB ENERGI DOO Skopje	BNB ENERGI DOO Skopje	Semnica	Crna reka/Vardar	ROR	0,0	1x1,064	2015	1,06	0,3	3,68	0,3
277	74	Vejacka reka 93	AK - INVEST ДООЕЛ Tetovo	AK - INVEST ДООЕЛ Tetovo	Vejacka reka	Vardar	ROR	0,0	1x1,3064	2015	1,31	0,0	0,14	0,0
278	75	Jablanica 399	MHE Jablanica DOO Skopje	MHE Jablanica DOO Skopje	Jablanicka reka	Crn Drim	ROR	0,0	1x3,28	2015	3,28	0,0	0,02	0,0
		Total MKD									**97,36**	**212,0**	**24,85**	**246,4**

Table A1.1 (Cont. 11): Selected data for existing HPPs in WB6

SN1	SN2	Plant	HPP Operator	Owner	River / Tributary	Basin or (Sub)River Basin	Plant type 3)	Total reservoir storage - volume	Number and structure of units	Entered into commercial operation	Capacity	Output	Capacity Factor (Design CF)	Output in 2015
			(-)	(-)	(-)	(-)	(-)	(mill m3)	(nxN MW) 4)	(year)	(MW)	(GWh)	(%)	(GWh)
		Kosovo (KOS)												
279	1	Kaskada e Lumbardhit - Lumbardhi 1	KelKos Energy sh.p.k	Kelag International	Lumebardhi i Decanit	Drini Bardhe	ROR	0,0	1x4,04	2005	8,08	22,0	31,08	18,9
280	2	Kaskada e Lumbardhit - EGU Belaja	KelKos Energy sh.p.k	Kelag International	Decanit	Drini Bardhe	ROR	0,0	1x5.29 + 1x2.79	2016	8,08	23,4	33,00	0,0
281	3	Kaskada e Lumbardhit - EGU Decani	KelKos Energy sh.p.k	Kelag International	Decanit	Drini Bardhe	ROR	0,0	1x6.66 + 1x3.15	2016	9,81	28,4	33,00	0,0
282	4	Dikance (also Dikanc)	Frigo FoodsEnergy Invest shpk or Energy Development Group	Frigo FoodsEnergy Invest shpk	Brodi	Drini Bardhe	ROR	0,0	2x0.5 MW 1x2.34 MW	2010	3,34	9,7	33,00	8,1
283	5	Burimit (also Burimi and Burim and Istogu 1 and Istok)	Triangle General Contractors Inc	not identified	Lumi I Istogut	Drini Bardhe	ROR	0,0	2x0.427 MW	2011	0,86	2,5	33,00	1,8
284	6	Radaci (also Radac)	Triangle General Contractors Inc	not identified	Drini Bardhe	Drini Bardhe	ROR	0,0	2x0.45 MW	2007	0,90	2,6	33,00	3,5
285	7	Brod 2 Lumi Rastelic Dragash	"Eurokos J.H" sh.p.k	"Eurokos J.H" sh.p.k	Restelica	Drini Bardhe	ROR	0,0	[illegible]	2015	4,80	7,0	16,58	1,0
286	8	Albaniku III - Shala Bajgores	Albaniku III	"Hydro-line" sh.p.k.	Bistrica	Drini Bardhe	ROR	0,0	1x1.068 MW	2016	4,27	20,4	54,44	0,0
		Total KOS									**40,14**	**115,8**	**32,93**	**33,3**
		Montenegro (MNE)												
287	1	Glava Zete	"Zeta Energy" doo Danilovgrad	EPCG and NTE	Zeta	Morača	ROR	0,0	2x2.68	1954	5,36	12,0	25,56	15,0
288	2	Slap Zete	"Zeta Energy" doo Danilovgrad	EPCG and NTE	Zeta	Morača	ROR	0,0	2x0.60	1952	1,20	3,5	33,30	0,0
289	3	Rijeka Mušovića	EPCG	EPCG	Levaja	Tara	ROR	0,0	3x0.42	1950	1,20	3,5	33,30	5,0
290	4	Rijeka Crnojevića	EPCG	EPCG	Rijeka Crnojevića	Skadar Lake	ROR	0,0	1x0.555	1948	0,56	0,7	14,40	0,0
291	5	Lijeva Rijeka	EPCG	EPCG	Grbi dol	Morača	ROR	0,0	1x0.055	1987	0,65	0,6	10,54	0,0
292	6	Šavnik	EPCG	EPCG	Šavnički potok	Drina	ROR	0,0	2x0.100	1957	0,00	0,0	0,00	0,0
293	7	Podgor	EPCG	EPCG	Oraoštica	Skadar Lake	ROR	0,0	1x0.395	1937	0,00	0,0	0,00	0,0
294	8	Jezerštica	Hidroenergija Montenegro Berane	Hidroenergija Montenegro Berane	Lim	Drina	ROR	0,0	1x0.844	2014	0,84	3,0	40,58	1,2
295	9	Bistrica	Hidroenergija Montenegro Berane	Hidroenergija Montenegro Berane	Lim	Drina	ROR	0,0	2x1.8	2015	5,60	17,6	35,82	8,1
296	10	Orah	Hidroenergija Montenegro Berane	Hidroenergija Montenegro Berane	Lim	Drina	ROR	0,0	1x0.954	2015	0,95	4,1	49,44	0,0
297	11	Rmuš	Hidroenergija Montenegro Berane	Hidroenergija Montenegro Berane	Lim	Drina	ROR	0,0	1x474	2015	0,47	1,9	45,18	0,0
298	12	Spaljevići 1	Hidroenergija Montenegro Berane	Hidroenergija Montenegro Berane	Lim	Drina	ROR	0,0	1x0.65	2015	0,65	2,6	44,96	0,0
299	13	Šekular	Hidroenergija Montenegro Berane	Hidroenergija Montenegro Berane	Lim	Drina	ROR	0,0	2x0.83	2016	1,67	4,9	33,57	0,0
300	14	Vrelo	Synergy, Podgorica	Synergy, Podgorica	Lim	Drina	ROR	0,0	1x0.615	2015	0,62	2,8	51,23	0,8
301	15	Bradavec	Igma Energy, Andrijevica	Igma Energy, Andrijevica	Lim	Drina	ROR	0,0	1x0.954	2015	0,95	3,8	45,71	0,3
302	16	Jara	Kronor, Podgorica	Kronor, Podgorica	Lim	Drina	ROR	0,0	2x2.284	2016	4,57	14,5	36,35	0,0
		Total MNE									**25,29**	**75,5**	**34,06**	**30,5**

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Table A1.1 (Cont. 12): Selected data for existing HPPs in WB6

SN1	SN2	Plant	HPP Operator	Owner	River / Tributary	Basin or (Sub)River Basin	Plant type 3)	Total reservoir storage - volume	Number and structure of units	Entered into commercial operation	Capacity	Output	Capacity Factor (Design CF)	Output in 2015
			(-)	(-)	(-)	(-)	(-)	(mill m3)	(nxN MW) 4)	(year)	(MW)	(GWh)	(%)	(GWh)
		Serbia (SER)												
303	1	Pod gradom	EPS	EPS	Djetinja	Ibar	DER	0,3	0	1900	0,40	0,0	0,00	0,0
304	2	Turica	EPS	EPS	Djetinja	Ibar	DER	0,1	0	1929	0,00	0,0	0,00	0,0
305	3	Radaljska banja	EPS	EPS	reka	Drina	DER	0,1	0	0	0,20	0,0	0,00	0,0
306	4	Vrelo	EPS	EPS	Vrelo	Drina	DER	0,0	1x0.09	1927	0,09	0,3	0,00	0,0
307	5	Vrutci	DV Technologies d.o.o.	EPS	Djetinja	Ibar	0	54,0	0	2009	0,40	5,0	142,69	0,0
308	6	Vučje	EPS	EPS	Vučjanka	Vučjanki	DER	0,0	0	1903	1,00	0,0	0,00	0,0
309	7	Gamzigrad	EPS	EPS	Crni Timok	Crni Timok	DER	0,0	0	1909	0,30	0,0	0,00	0,0
310	8	Raš	EPS	EPS	Raška	Ibar	DER	1,5	0	1953	5,60	0,0	0,00	0,0
311	9	Seljašnica	EPS	EPS	Velevačka; Bucjanska	Lim	DER	0,0	0	1955	1,30	0,0	0,00	0,0
312	10	Sokolovica	EPS	EPS	0	Timok	ROR	0,4	0	0	0,10	0,0	0,00	0,0
313	11	Sićevo	EPS	EPS	Nišava	Morava	DER	0,0	0	1931	1,30	0,0	0,00	0,0
314	12	Sveta Petka	EPS	EPS	Nišava	Nišava	DER	0,0	0	1908	1,10	0,0	0,00	0,0
315	13	Temac	EPS	EPS	Temstica	Nisava	DER	0,0	0	1940	0,00	0,0	0,00	0,0
316	14	Jelašnica	EPS	EPS	Jelasnica	Morava	DER	0,0	0	1928	0,00	0,0	0,00	0,0
317	15	Moravica	EPS	EPS	Moravica	Morava	ROR	0,0	0	1911	0,00	0,0	0,00	0,0
318	16	Prvonek	EPS	EPS	0	0	DER	20,0	0	2014	0,87	0,0	0,00	0,0
319	17	Ovčar Banja	EPS	EPS	Zapadna Morava	Danube	ROR	3,0	1x(3,2 + 5)	1954 / Rev 2010	8,20	27,0	37,59	69,5
320	18	Međuvršje	EPS	EPS	Zapadna Morava	Danube	ROR	18,0	1x(3,4 + 5,6)	1957 / Rev 2010	9,00	31,3	39,70	0,0
321	19	Kratovska Reka	EPS	EPS	reka	Kutska	DER	0,0	0	1989	1,50	0,0	0,00	0,0
322	20	Skačak Pleš	Green Power doo Brus	0	Rasina	Zapadana Morava	0	0,0	1	2015	0,38	1,8	0,00	0,1
323	21	Đorđić	Đorđić MVM doo	0	Ljubovića	Drina	0	0,0	0	0	0,01	0,0	0,00	0,0
324	22	Vodenice	MHE Vodenice Tutin	0	Smalućka reka (Raška)	Zapadana Morava	0	0,0	1	2014	0,15	0,8	0,00	0,5
325	23	Izberovići	MM Hidro Energi	0	Crna Reka (Ibar)	Zapadana Morava	0	0,0	1	2016	0,29	0,8	0,00	0,0
326	24	Radošićska reka	SZR MHC Radošićksa Reka-Raška	0	Radošićska reka (Ibar)	Zapadana Morava	0	0,0	0	0	0,04	0,0	0,00	0,1
327	25	Radošiće	Hidroenergija doo Raška	0	Radošićska reka (Ibar)	Zapadana Morava	0	0,0	1	2014	0,16	0,7	0,00	0,7
328	26	Velež	Univers doo	0	Jošanica (Raška)	Zapadana Morava	0	0,0	1	2013	0,52	2,4	0,00	2,1

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Table A1.1 (Cont. 13): Selected data for existing HPPs in WB6

SN1	SN2	Plant	HPP Operator (-)	Owner (-)	River / Tributary (-)	Basin or (Sub)River Basin (-)	Plant type 3) (-)	Total reservoir storage - volume (mill m3)	Number and structure of units (nxN MW) 4)	Entered into commercial operation (year)	Capacity (MW)	Output (GWh)	Capacity Factor (Design CF) (%)	Output in 2015 (GWh)
		Serbia (SER) (Cont. 1)												
329	27	Klupci	SZR Mečkari - Crna Glava	0	Gobeljska reka (Ibar)	Zapadana Morava	0	0,0	1	0	0,04	0,0	0,00	0,1
330	28	Belci	Energo Ras doo Kraljevo	0	Jošanica (Raška)	Zapadana Morava	0	0,0	1	2014	1,22	4,7	0,00	5,5
331	29	Studenica	Srpski pravoslavni manastir Studenica	0	Studenica (Ibar)	Zapadana Morava	0	0,0	0	0	0,09	0,0	0,00	0,7
332	30	Devići	MHE Patnovići Ivanjica	0	Brusinačka reka (Ibar)	Zapadana Morava	0	17,3	0	2013	0,01	0,0	0,00	0,2
333	31	Kaludra	Studenicaelektro doo Kraljevo	0	Savošnica (Studenica)	Zapadana Morava	0	0,0	1	2013	0,68	2,7	0,00	4,1
334	32	Samokovo	Doo Magal Elektrik	0	Gobeljska reka (Ibar)	Zapadana Morava	0	0,0	1	2015	0,32	0,8	0,00	0,4
335	33	Županj	PD za proizvodnju električne energije Županj	0	Jošanica (Raška)	Zapadana Morava	0	0,0	2	2015	1,00	3,6	0,00	1,2
336	34	Kneževići	Energorama doo Beograd	0	Rasina	Zapadana Morava	0	0,0	1	0	0,58	1,5	0,00	0,2
337	35	Vladići 1 Nova	MHE Vladići 1 Nova doo	0	Raška	Zapadana Morava	0	0,0	1	2015	0,95	3,9	0,00	0,5
338	36	Šutanovina	Univers doo Raška	0	Jošanica (Raška)	Zapadana Morava	0	0,0	0	2016	0,41	2,0	0,00	0,0
339	37	Manastir Rača	Srpski pravoslavni manastir Rača	0	Rača	Drina	0	0,0	1	0	0,06	0,4	0,00	0,3
340	38	Mokra Gora	Lotika doo Užice	0	Beli Rzav	Drina	0	0,0	0	0	0,10	0,0	0,00	0,4
341	39	Crkvina	W&W Energy doo Kragujevac	0	Bistrica (Lim)	Drina	0	0,0	2	2013	0,96	4,3	0,00	3,8
342	40	Rečica	W&W Energy doo Kragujevac	0	Bistrica (Lim)	Drina	0	0,0	2	2014	1,40	4,1	0,00	5,3
343	41	Seoce	15 Avgust doo Beograd	0	Gračanica (Lim)	Drina	0	0,0	2	2016	0,48	1,7	0,00	0,0
344	42	Beli Kamen	Zlatiborske elektrane	0	Crni Rzav i Ribnica	Drina	0	0,0	2	2016	1,68	6,5	0,00	0,0
345	43	Bovan	DV Tehnologies	0	Moravica	Južna Morava	0	0,0	1	2012	0,25	0,2	0,00	1,2
346	44	Tegošnica	ECO Energo Group	0	Vlasina	Južna Morava	0	0,0	0	0	0,64	0,0	0,00	0,8
347	45	Elektro Slavica	Slavica Ćirić PR - Elektro Slavica	0	Trgoviški Timok	Timok	0	0,0	0	0	0,05	0,0	0,00	0,2

Table A1.1 (Cont. 14): Selected data for existing HPPs in WB6

SN1	SN2	Plant	HPP Operator	Owner	River / Tributary	Basin or (Sub)River Basin	Plant type 3)	Total reservoir storage - volume	Number and structure of units	Entered into commercial operation	Capacity	Output	Capacity Factor (Design CF)	Output in 2015
			(-)	(-)	(-)	(-)	(-)	(mill m3)	(nxN MW) 4)	(year)	(MW)	(GWh)	(%)	(GWh)
		Serbia (SER) (Cont. 2)												
348	46	Grčki mlin	ZR Elektro Đorđević Prokuplje	0	Toplica	Južna Morava	0	0,0	0	0	0,08	0,0	0,00	0,4
349	47	Munja	SPR Munja	0	Vrla	Južna Morava	0	0,0	0	0	0,03	0,0	0,00	0,0
350	48	Poštica	Hidrowat doo Beograd	0	Vlasina	Južna Morava	0	0,0	0	0	0,70	0,8	0,00	1,9
351	49	Livađe	ECO Energo Group	0	Darkovačka reka	Južna Morava	0	0,0	0	0	0,45	0,0	0,00	2,3
352	50	Prohor Pčinjski	Hidsotel doo Klanike (Manastir Prohor Pčinjski)	0	Pčinja	Vardar	0	0,0	0	0	0,25	0,0	0,00	0,1
353	51	Jevtić	Proizv. Hidroele. En. HE Jevtić, Miroljub Jevtić PR.	0	Crni Timok	Timok	0	0,0	0	0	0,10	0,0	0,00	0,2
354	52	Gornje Gare 1	ECO Energo Group	0	Vlasina	Južna Morava	0	0,0	0	0	0,99	0,0	0,00	3,3
355	53	Gornje Gare 2	ECO Energo Group	0	Vlasina	Južna Morava	0	0,0	0	0	0,99	0,0	0,00	2,3
356	54	Donje Gare I	ECO Energo Group	0	Vlasina	Južna Morava	0	0,0	0	0	0,99	0,0	0,00	3,5
357	55	Donje Gare II	ECO Energo Group	0	Vlasina	Južna Morava	0	0,0	0	0	0,99	0,0	0,00	0,7
358	56	Debela stena	Brane Veljković PR	0	Aldinska reka	Južna Morava	0	0,0	1	0	0,03	0,0	0,00	0,1
359	57	Pročovci 1	Best Energy-jedan 2010 doo	0	Tripušnica (Pčinja)	Vardar	0	0,2	2	0	0,82	1,0	0,00	3,7
360	58	Donje Gare 3	ECO Energo Group	0	Vlasina	Južna Morava	0	0,0	1	2013	0,50	1,8	0,00	2,6
361	59	Gramada	Pioner Energy	0	Crnovrška reka (Trgoviški Timok)	Timok	DER	0,0	1	2012	0,47	1,9	0,00	1,7
362	60	Pročovci II	Best Energy 2	0	Tripušnica (Pčinja)	Vardar	0	0,2	2	2013	0,50	3,7	0,00	3,2
363	61	Bare	MHE Bare doo Vlasotince	0	Vlasina	Južna Morava	0	0,0	2	2014	1,16	5,8	0,00	3,9
364	62	PD MHE Krstići doo	MHE Krstici	0	Vlasina	Južna Morava	0	0,0	1	2013	0,70	4,9	0,00	1,0
365	63	Bane Bovan	Drvoprerada-elektroproizvodnja Bane	0	Moravica	Morava	0	0,0	1	2012	0,03	0,2	0,00	0,1
366	64	Jabukovik	Jabukovik	0	Vlasina	Južna Morava	DER	0,0	2	2013	1,52	4,6	0,00	3,6
367	65	Prisoje	GHP-Green Hydro Power-Jedan 2010 doo	0	Tripušnica (Pčinja)	Vardar	0	0,0	2	2013	0,91	4,5	0,00	4,3
368	66	Ljuti Do	National Electric Power Company doo Surdulica	0	Božička reka (Dragovištica)	Struma	0	0,0	2	2013	0,63	2,4	0,00	1,5

Table A1.1 (Cont. 15): Selected data for existing HPPs in WB6

SN1	SN2	Plant	HPP Operator	Owner	River / Tributary	Basin or (Sub)River Basin	Plant type 3)	Total reservoir storage - volume	Number and structure of units	Entered into commercial operation	Capacity	Output	Capacity Factor (Design CF)	Output in 2015
			(-)	(-)	(-)	(-)	(-)	(mill m3)	(nxN MW) 4)	(year)	(MW)	(GWh)	(%)	(GWh)
		Serbia (SER) (Cont. 3)												
369	67	Gradište	Pure Energy 2012 doo Bosilegrad	0	Brankovačka reka (Dragovištica)	Struma	0	0,0	2	2014	0,70	2,6	0,00	2,5
370	68	Džep	National Electric Power Company doo Surdulica	0	Džepska reka	Južna Morava	0	1,0	2	2014	0,89	0,5	0,00	2,7
371	69	Darkovce	Pd Građevina-visokogradnja i proizvodnja električne energije doo Darkovce	0	Darkvoačka reka (Vlasina)	Južna Morava	0	0,0	1	2015	0,19	0,6	0,00	0,8
372	70	Porečje	Power-B.N.M doo Kumarevo	0	Korzaraka, Rupska	Južna Morava	0	0,0	2	2014	1,26	5,6	0,00	5,2
373	71	Kuršumlija	Hidroenergija doo Raška	0	Toplica	Južna Morava	0	0,0	2	0	0,35	1,5	0,00	0,3
374	72	Padina	Best Energy -Tri 2010 Trgovište	0	Crna Reka	Vardar	0	0,0	1	2015	0,34	1,4	0,00	0,2
375	73	Šaince	Best Energy-Četiri 2010 Trgovište	0	Trgovište (Pčinja)	Vardar	0	0,0	1	2015	0,25	1,0	0,00	0,1
376	74	Viča	Can Electro	0	Toplica	Južna Morava	0	0,0	2	0	0,16	1,0	0,00	0,0
377	75	Bistar	Springe Enegry jedna Bistar doo	0	Jarešnička (Dragovštica)	Struma	0	0,0	1	2015	0,32	1,8	0,00	0,0
378	76	Dubak	Fantastic Energy Two doo Trgovište	0	Lesnička r. (Pčinja)	Vardar	0	0,0	2	2016	0,61	3,0	0,00	0,0
379	77	Jelimirovci	Moja stara vodenica doo	0	Vrla	Južna Morava	0	0,0	2	0	0,23	1,4	0,00	0,0
380	78	Pržinci	Green Energy	0	Korbevačka reka	Južna Morava	0	0,0	2	2016	0,35	2,0	0,00	0,0
381	79	Zvonce	Mala hidroelektrana Zvonce doo	0	Rakitrska r (Jerma)	Nišava	0	0,0	2	2016	0,36	1,7	0,00	0,0
382	80	Rakita	Mala hidroelektrana Rakita doo	0	Rakitrska r (Jerma)	Nišava	0	0,0	2	2016	0,32	1,4	0,00	0,0
383	81	Varoška reka	Energozlatar doo	0	Varoška Reka (Bistrica)	Drina	0	0,0	0	2016	0,05	0,0	0,00	0,0
384	82	Prodanča	Vlasina Eco Energy doo	0	Bistrička reka (Vlasina)	Južna Morava	0	0,0	0	2016	0,18	0,0	0,00	0,0
385	83	Đorđina	Vlasina Eco Energy doo	0	Bistrička reka (Vlasina)	Južna Morava	0	0,0	1	0	0,32	1,4	0,00	0,0
386	84	Samokovska reka 1	Samuk doo	0	Samokovska reka (Raška)	Ibar	0	0,0	0	0	2,00	0,0	0,00	0,0
387	85	Sušara	MBNM Invest doo	0	Orovička reka	Drina	0	0,0	1	2016	0,09	0,3	0,00	0,0
		Total SER									**65,62**	**165,0**	**0,00**	**150,2**
		Total WB6									**583,18**	**997,4**		**741,6**

Annex 2: Financing options for large hydropower project implementation in the Western Balkans

Contents

List of abbreviations and symbols

Abbr. & Symbols	Description / Meaning
EBRD	European Bank for Reconstruction and Development
EC	European Commission
ECS	Energy Community Secretariat
EIB	European Investment Bank
EnC	Energy Community
EU	European Union
FIT	Feed-in tariff
HPP	Hydro power plant / project
IEA	International Energy Agency
IFI	International Financing Institution
IHA	International Hydro Association
KfW	Kreditanstalt fuer Wiederaufbau
PPA	Power purchase agreement
RES	Renewable energy sources
TA	Technical Assistance
WB(g)	World Bank (Group)
WBIF	Western Balkans Investment Framework
WB6	Western Balkans consisting of 6 countries: Albania, Bosnia and Herzegovina, Kosovo, the former Yugoslav Republic of Macedonia, Montenegro and Serbia

1. Introduction – Background and Objectives

Hydropower projects, especially large HPP projects, by their definition are highly capital intense projects. They are complex projects, which take years to be developed, involve large upfront investment and are often regarded as high-risk prospects compared to thermal power projects.

As the International Energy Agency (IEA) reports, the construction and financing of power-generation projects have traditionally been the domain of the public sector. However, generally, private investment in, and ownership of, power generation utilities have increased continuously in recent years. This is a consequence of a general liberalisation of the power market in many countries. Another factor in this development has been that funding from government and international agencies has become steadily more difficult to secure, making loans and equity capital from the private sector increasingly important in the financing of both thermal and hydroelectric power projects.

According to International Hydropower Association (IHA), and the independent findings determined in this Study, despite the high unexploited hydropower potential in the Balkan region, the development of new hydropower projects has stalled since the 1990's. This is mainly due to environmental concerns and a lack of financing, among other factors.

The objective of this Annex to the Background Report No. 1 is to address main financing issues, challenges and prospects for large HPP projects in the WB6 countries through:

1. Providing a brief overview of possible financing mechanisms available for financing HPP projects by summarising publicly available reports from World Bank Group, IEA and IHA,
2. Providing a brief overview of current situation with financing of hydropower projects in Western Balkans by summarising main findings of the report *Financing for hydropower in protected areas in Southeast Europe* prepared by CEE Bankwatch Network as most the comprehensive available report on the subject,
3. Addressing key challenges specific to the Western Balkans region with regard to the financing of HPP projects in terms of: the role of governments, the role of IFIs and third-party financial aid and the role and expectations of private investors, and
4. Give an introduction to new and innovative financing opportunities – Green Bonds in particular.

2. Financial mechanisms for financing HPP projects

Financing can be a major problem in many hydropower projects. In many cases, the developer does not have sufficient funds for self-financing, nor sufficient assets to provide security for a bank loan. In this situation, the developer can try to finance the project by securing loans against the anticipated cash flows of the project. However, this will require a series of complex contractual arrangements that are expensive to set up.

2.1 Use of in-house (own) funds

The developer's accumulated reserves may be used to finance a project. This may involve company in-house funds or personal reserves. As hydropower projects involve relatively large up-front investments, the use of in-house funds as the sole source of finance is usually only possible for small hydropower projects and is rarely used.

2.2 Ordinary bank loans (on balance sheet financing)

A bank loan supplies the majority of the required capital (60 – 80 %). Loans are secured against assets or property owned by the developer. Bank loans are relatively simple to arrange if the developer can provide sufficient security for the bank. As the lender's interests are well secured, the need for a tight network of contracts to control risk can be relaxed, making the financing structure more flexible. This reduces the time and cost involved in arranging the loan. In addition, good security for the lender will normally result in lower annual borrowing costs. However, this route is normally closed to a developer with limited financial resources.

Developers of the majority of the large HPP projects in WB6 countries are the incumbent national power utilities with considerable, but on the other hand limited leverage potential. Namely, existing assets operated by these incumbents are usually old and require considerable capital expenditure for their maintenance and necessary refurbishment programmes, thus lowering potential loan amounts available for new investments, since usually bank loans are used for financing the regular refurbishment of their existing assets. Since these utilities are state-owned, there is a high political influence present in their financial management including prioritisation of capital investments and treatment of profits. Moreover, the electricity price setting mechanism (through which social policies, in terms of subsidising different consumer groups, are often implemented) are often politically influenced, limiting the revenue generating possibilities of utilities and consequently lowering their credit ratings.

This indicates that major developers in the WB region, despite being among the highest-earning companies in their countries, have limited credit potential for new investment projects which, especially in case of large HPPs, require large sums of long-term debt funds.

2.3 Co-development with a financially strong partner

A hydropower development project can be developed as a joint venture with a financially strong partner. A strong partner may provide equity capital and offer security for bank loans (assets/property). In addition to their risk-sharing potential, the partners may also be selected based on their ability to provide expertise important for the project (engineering, finance, and power market).

Joint ventures with established EU power companies is one of the plausible options for the implementation of the large HPP projects in the WB6 countries. There are two main drivers for this. Firstly, WB6 countries need new investments but have limited financing potential. At the same time, in terms of legislation and regulation of the energy markets, through their EU (pre)accession processes and Energy Community membership, these countries transpose EU regulations to their national legislations, thus being more appealing to potential EU (strategic) partners. Secondly, EU power companies face many long-term challenges to their business models. With their large fleets of fossil-fuelled generation capacity, many are grappling with the issues of the finiteness of natural resources and CO_2 emissions penalties. The significant influx of renewable energy on the grid, and, more specifically, the privileges renewables enjoy in terms of priority grid access, is also decreasing the competitiveness of traditional fossil-fuelled generation by exerting downwards pressure on wholesale power prices. This forces these well-established EU companies to look for new investment opportunities in new and growing markets. Since it is reasonable to expect that WB6 countries are on their way to becoming part of the integrated EU market in the foreseeable future, these markets are becoming more appealing to EU companies in terms of investment opportunities in the RES generation.

2.4 Limited recourse project financing – Project Financing

The principal difference between on balance sheet financing and limited-recourse project financing is the way in which the bank loans are secured. In limited-recourse project financing the future cash flows from the project are the lenders' main security. There are two important reasons for using limited-recourse project financing. The developer may not have sufficient assets to secure a bank loan, or the developer may not wish to bear all the project risk involved in the development. As the lenders cannot rely on the liquidation value of the project (or project developers) as a means of securing repayment, they will "take security". This involves exercising tight control over most aspects of the project development:

- Charge over the physical assets
- Assignment of the project contracts
- Contract undertakings
- Shareholder undertakings
- Insurance

All aspects of the project will be arranged to control the risk for the lenders, who will wish to see evidence of the project's economic viability. They will require an independent technical report by a credible consultant. They will scrutinise important agreements such as the power purchase agreement, the operating agreement, shareholders' agreement, etc. The lenders will wish contractors, suppliers and operators that have a strong record of accomplishment in their field. Whenever possible, the risk is transferred to third parties. A contractor working on a turnkey fixed-price basis can be used to minimise the completion risk. A long-term Power Purchase Agreement mitigates the market risk. The lenders will even ensure that they have the right to step in and operate the project in the case that it is not paying its debts. Limited-recourse project financing involves a series of complex contractual agreements. The initial arrangement costs are relatively high.

For large HPP projects, a project finance scheme will be a must to a certain degree. Usually this will be required by long- term debt financiers (commercial banks of IFIs), as well as strategic partners in the case of JV arrangements, since projects finance is perceived as risk sharing mechanism. The fact is that project finance is rather new concept and a rarely used technique in WB6 countries therefore lack of experience and knowledge is present with both governments (as project sponsors) and developers (usually large utilities). This opens a space for manipulation and extra profits for financiers, potential strategic partners and/or third-party agents not acting in good faith and trying to exploit lucrative arbitrage opportunities arising from an imperfect information situation. This fact calls for stronger transparent promotion and capacity building on project finance mechanics within WB6 countries.

2.5 Build Own Operate (BOO) and Build Own Transfer (BOT) schemes

One of the main ideas behind the BOO/BOT approach is to bring private capital into construction of infrastructure, like hydropower plant. The foreign company or the operating company runs the scheme for a stipulated period and then, at some point in the future potentially transfers the assets to the public sector of the host nation. These can appear in several forms:

- BOT (Build-Operate-Transfer), where the facility is transferred to the host government after a certain period;
- BOO (Build-Operate-Own), where the facility is owned by the consortium;
- BOOM (Build-Operate-Own and Maintain), where the maintenance function and responsibility is added;
- BOTT (Build-Operate-Transfer-Training), where a training function and responsibility is added;
- ROT (Rehabilitate-Operate-Transfer), where an existing facility is refurbished, operated for a period and subsequently transferred,
- ROL (Rehabilitate-Operate-Leasing) in this case, an existing facility is refurbished, operated and leased from the consortium for the cooperation period for operation and maintenance.

In a BOO project, the owner of the water rights grants the development rights to an independent developer. The developer controls the design, construction, and operation of the plant. In return, he pays a fee to the rights owner. In many cases, there is an agreement that the project will be transferred back to the owner after a period of time – Build Own Operate Transfer (BOOT). BOO/BOOT projects do not necessarily involve a new route of financing. The developer may use one of the financing alternatives described above.

Since BOO/BOT schemes, while highly desirable and praised, are in fact (legally) complex and challenging financing mechanisms, they assume well-designed and well-implemented concession rights system is in place. Experience shows that in the majority of WB6 countries advanced concession regulations are not in place, governments and agencies are lacking crucial know-how and experience in dealing with complex legal schemes and support/oversight mechanisms are insufficient. Again, this calls for stronger transparent promotion and capacity building if these schemes are to be put in place. Without that, it is not reasonable to believe that BOO/BOT schemes can prove to be functional within the region, at least not on larger scale and not with large and complex HPP projects.

2.6 Suppliers' credit

Suppliers are often willing to provide financing for their equipment. The purchase price is often closely linked with the financing terms. The conditions are subject to negotiation, and a competitive situation can significantly improve the terms available.

This mechanism has, to certain extent, been exercised in some WB6 countries with large projects (mainly TPP) and are being promoted recently in some HPP projects by Chinese plant equipment suppliers. This will be further elaborated in following sections of this Annex.

2.7 Factors which affect the financing strategy

Securing financing may be a major obstacle in developing a hydropower project, and the efforts involved should not be underestimated. The principal question for the developer is: should the project be financed by the use of in-house funds, by co-development with a financially strong partner, by ordinary bank loans secured against the developer's other assets or property, or by limited recourse project financing? The financing strategy will affect the developer in several ways. Risk, revenue, and control over the project are all closely related to the financial arrangements. The developer's financial resources are the first things to consider. A financially strong developer can use in-house funds or ordinary bank loans. This gives a large degree of control over the project, which may be an important consideration, particularly if the project is a part of the developer's core activity. However, it also means tying up financial resources for a long time. With fewer financial resources, the developer must look for other routes of financing. The size of the debt component is important when considering limited-recourse project financing of hydropower projects. The high arrangement costs make relatively smaller projects unattractive to project lenders.

Co-development with a financially strong partner may be the only option for financing a hydro project. At an early stage, the developer should consider possible partners for co-development. It may be worth approaching companies that are already involved in the operation of hydropower (e.g. Statkraft, who are already present in some WB6 countries - Albania). Such companies are well qualified to judge the feasibility of the project and will already possess much of the expertise necessary for developing the project in-house. Management of the project risks is another important consideration. In general, a high level of debt means a high cash-flow risk. Debt service has the first claim on project earnings. The developer will receive revenue only if there is a surplus after interest and repayments.

The size of the financial obligations is important if the project is a failure. If the project fails, the developer in the case of in-house funding or ordinary bank loans, carries all the losses. Using the same methods as in limited-recourse project financing can mitigate much of the risk. However, the developer should consider the consequences if the project is a failure. In project finance, the cash flow risks are higher, but the involvement is limited. In a nonrecourse project the involvement is limited to the equity. In a limited-recourse project the developer has accepted additional undertakings, but the involvement is still limited. The developer will have to pay a price for reducing that risk. The arrangement costs are high and third parties accepting a risk will require a premium. The developer's desire to control the project is also affected by the financial arrangements. With a high degree of equity control of the project will remain with the developer. With much unsecured debt, the financiers will control the project until it has been repaid. If control over the project development is important to the developer, he must also accept a larger financial involvement.

3. Current situation with financing of HPP projects in Western Balkans

Despite the high presence of Multilateral Development Banks (MDBs, also referred as International Financial Institutions - IFIs) and different EU-sponsored programmes which (among others) target financing HPP projects (usually as part of wider set of RES financing initiatives), there is limited data available on the scale and the extent of the financing of HPP projects.

The most comprehensive report available was prepared by an NGO – CEE Bankwatch Network in December 2015. Their report, titled: *Financing for hydropower in protected areas in Southeast Europe* (hereafter referred as the Report or Report) focuses primarily on projects in protected areas and focuses on a wider SEE region (WB6 + Bulgaria, Croatia, Greece and Slovenia). It provides clear overview of the activities of financiers and the availability of the funds in the Region.

For all details we refer to the original Report[12], and hereafter we reflect on main findings and the conclusion with the aim of creating a sort of snapshot of current situation in the region with regards to financing of HPP projects.

3.1 Multilateral Development Banks

According to the Report, the majority of greenfield projects in SEE (including WB6) have been financed by MDBs through different financing schemes, programmes and mechanisms. Most active MDBs include:

[12] http://bankwatch.org/sites/default/files/SEE-hydropower-financing.pdf

- European Bank for Reconstruction and Development
- World Bank Group (including IFC and MIGA)
- European Investment Bank

Apart from above stated (although technically not an MDB but rather qualified as other public source financier but essentially with the same business plan and approach as MDBs), another very active participant in the region (especially with projects of HPP refurbishment) is certainly Germany's Kreditanstalt für Wiederaufbau (KfW) who supported several greenfield projects and provided funds for technical assistance and capacity building facilities.

Smaller scale projects were usually financed through some sort of one-size-fits-all facility (e.g. EBRD's Sustainable Energy Financing Facilities or the GGF loan programmes for RES), which were implemented through commercial banks. Large projects were evaluated and financed on a project-by-project basis and in terms of financial mechanics they usually included some sort of club or syndicated long-term financing which limited the exposure of the MDBs.

The Report shows that in terms of the number of supported projects, EBRD has been most active while EIB has provided the largest amount of direct financing by volume. The World Bank's International Finance Corporation (IFC) has also supported a considerable number of greenfield hydropower projects either directly or through financial intermediaries, including equity financing, most of which were focused in Albania.

In addition to individual MDB financing, the Green for Growth Fund (GGF), set up by the EIB and KfW has been involved in financing greenfield projects majority of which were smaller scale projects and executed through financial intermediaries (commercial banks).

Apart from providing long-term financing, the activities of the MDBs in the region has had much broader focus. Namely, MDBs have provided different types of technical assistance vehicles which included:

- Providing much need funds for the improvement of regulatory and legislative systems (as necessary prerequisites for the investments to take place), aligning them with EU regulations aiming to ensure that standards are raised in the target countries,
- Providing funds or finding donors for technical assistance grants for preparing projects, which has proved to be one of main challenges in the region in past decades,
- Providing (limited) equity funds (primarily EBRD and IFC), and
- Setting up financial intermediation schemes aiming at channelizing funds through commercial banks and/or special funds.

Despite the high activity and high visibility of MDBs in the region, experience in the past few years indicates several challenges or areas of potential improvement for the future, with regard to financing HPP projects. These include:

- Often competing programmes within same countries. Namely, it is not a rare case that MDBs (e.g. EBRD and EIB) offer very similar financial products or try to implement very similar programmes (especially in their financial intermediation products),
- A One-size-fits-all approach, in which basically the same financial products are being offered in different countries without fully respecting country specifics and needs (primarily at the relative level development of legislative frameworks and standards in WB6 countries),
- Lack of equity and mezzanine financing products which has proved to be one of the greatest challenges for private investors,
- Inability to attract much needed and vastly larger amounts (available on the international financial market) of private funds,
- Adopting a risk-transfer rather than risk-sharing approach,
- High costs of lending – the majority of pricing terms of MDBs come down to be just a bit below commercial terms,
- High transaction costs imposed by lengthy procedures and additional terms set by MDBs which lower their competitiveness, and
- Lengthy, inflexible and often confusing procedures which at the same time have proved, in a considerable number of cases, to be insufficiently stringent and meticulous especially with regard to highly sensitive environmental protection elements and standards of the projects. The procedures

followed could, at the end of the day, (after years of project documentation preparation and development) be rightly and with ease challenged by NGOs, local communities or host governments.

3.2 Commercial Banks

According to the Report, only a relatively small percentage of the total funds provided for financing greenfield projects, have been secured by commercial banks in the region. Also, it is important to stress the fact that it is almost impossible to get exact data on the funds provided by commercial banks (due to their sensitivity and confidentiality) and to determine the precise source of this funds - differentiating between a commercial bank's own sources and funds being provided through financial intermediation and which can be traced to source in the MDBs.

Nevertheless, it can be pointed out that a greater engagement of commercial banks is still noticeably lacking through the region. With exceptions of the local branches of some Austrian, Italian and French banks present in the region, involvement of commercial banks is lagging (This reluctance to finance comes down to individual cases of internal organisation, practices and the capacity of foreign commercial banks together with their experience and willingness to finance RES in general). Some of the reasons for this could be pinned down to:

- The high cost of borrowing of commercial banks generated by the high-risk profile of the countries in the region (and consequently high credit default swaps and other associated costs of lending) which transfer into a high price of borrowing for final consumer,
- Disparities between the maturities of borrowing sources (usually commercial banks in the region can borrow on the financial market the larger sums needed for capital intense projects only up to 10 years) and the lifetime of the investment (HPP projects have long economic lifetimes and short maturity of loans ruins their financial performance), meaning that commercial banks cannot provide funds for long economic lifetime projects,
- A general lack of experience with, and interest in, RES projects,
- A lack of experience with advanced financing techniques (specifically, project finance) in combination with the limited leverage of potential borrowers on corporate finance basis,
- The perception of HPP projects and RES projects in general, as a high-risk investment primarily due to a perceived high legislative risk and regulatory uncertainty, and
- Un(der)developed guarantee and insurance market, innovative products of which are expressly needed in any highly complex and capital intense transaction.

3.3 Private and institutional investors

One of the key financial products/sources of financing lacking at the moment in the region is private equity and subordinated financing such as mezzanine finance. This poses a special challenge for projects being developed by private developers (especially domestic ones), who can hardly secure the needed 15 – 35% of equity capital. In general, the private equity market is still highly underdeveloped throughout the region. A specialised private equity fund which would invest in RES does not yet operate in the region. A few cases of private equity financing of RES projects in the region targeted smaller projects secured with FiT (with usually a longer time horizon than the equity fund's exit strategy, thus minimising the risks).

International private equity funds, including ones specialised in RES investments, as well as major institutional investors, still perceive the region as high-risk market in general, and the RES market even riskier due to high perceived legislative and political risks. At the moment, there are no major indications of change in this trend and no major initiatives of establishing specialised, region-oriented RES private equity/mezzanine debt funds. HPP projects, in their financial essence, as projects of moderate but (over the longer period) predictable and stable average returns should and could be an appropriate investment opportunity for institutional investors of IFI-supported private equity funds. Stronger initiative and commitment is thus required from local governments, MDBs, international organisations and the EU as key sponsor in finding a way to attract private investor's money into the region to support development of sustainable HPP portfolios and/or setting up fund raising for a financial vehicle with the same goals.

3.4 Third – party financial assistance

In recent years, partially due to slow development of major infrastructure projects which are of critical importance for the overall development of the WB6 countries and one of prerequisites for meeting EU standards, a lot of attention and expectations by local governments is paid to third party financial assistance – in particular to the one coming from China. Intensification of Chinese investment in the region speaks to an increasingly growing interest and a pressing need for investments. The best manifestation of this is the "16+1"[13] initiative which started in 2012 and which seeks to improve economic relations between China and 16 European countries. The fifth 16+1 summit, which took place in the Chinese town of Suzhou in November 2015, confirmed investments of up to US$ 10 billion. In economic terms, EU accession for these countries represents a prospect for Chinese companies to gain better access to the main EU markets, as well as to the markets of the Western Balkans countries, where spending power will likely increase once they have joined the EU. In political terms, this is a wise investment into what one day may be one-fifth of the enlarged EU in terms of number of members. Based on these long-term economic and geopolitical objectives, China seeks to present itself in SEE as a politically neutral force and a reliable business partner, which, among other things, addresses some concerns in the region triggered by the recent deterioration in relations between Russia and the West. US$ 10 billion would be made available in the coming years for various projects, some of which are already under way. There is also continuing institutionalisation of the cooperation in the 16+1 format, highlighted by plans for the establishment of a permanent Business Council and the signing of a number of high-profile MoUs between state-sector entities and governments on both sides.

According to the EBRD, EU integration is the firm long-term choice of all SEE countries, supported by a wide cross-party consensus. However, when it comes to funding, some of them, particularly those in the Western Balkans, perceive Chinese finance as practically the only available way to overcome the following dilemma: access to large EU structural funds for candidate countries is not possible until they join the EU, but in order to make progress towards accession, countries need to improve infrastructure and transport links both within their borders and with neighbours. The second, and from an environmental protection and sustainability point of view even more worrying, dilemma which WB6 countries face: to finance their projects using relatively cheap funds with very few to almost no major requirements with regards to compliance with procedures, standards and regulation of environmental protection, or to go through lengthy and complex procedures of IFIs and EU-sponsored programmes with high ESIA requirements eventually ending up with access to limited funds at higher price.

Western Balkans countries will continue to seek EU and IFI funding for major, capex-intensive infrastructure projects of European importance. Regional leaders seem to have understood the importance of improved coordination and better prioritisation of regional projects. However, given the remaining financing gap, which the resources available through EU and IFIs funding alone currently cannot fill (even with the help of the Western Balkans Investment Framework, today the most effective tool for pooling these resources), the relatively slow process of project preparation, and other institutional obstacles, China is often able to present an attractive alternative with its offer of streamlined approval processes, state-backed financing, and speedy implementation.

China's economic links with SEE come in three broad forms. The highest-profile involvement is through direct lending to governments for infrastructure – roads, railways, ports, power plants, etc. The second way is through trade links: Chinese exports to, and imports from, the SEE region have grown dramatically in the past decade, with the potential for further strong growth in the coming years. Lastly, Chinese companies are showing an increasing interest in direct equity investments in SEE.

Regional integration through transport projects has become a key priority for SEE countries, while development of energy resources is also crucial for the region's future. Chinese funding in SEE is highly visible in these two sectors. The upgrade and modernisation of the region's infrastructure are not only crucial for economic development in the Balkans, but would also considerably shorten existing trade routes between China and Western Europe and therefore reduce the costs of trade between these two major trading blocks. Financing is usually offered on favourable financial terms relative to most alternatives. Typically, funding comes as a loan from the state-owned Exim Bank of China covering about 85 per cent of the needed capital, with the rest financed by

[13] The 16 countries are: Albania, Bosnia and Herzegovina, Bulgaria, Croatia, Czech Republic, Estonia, the former Yugoslav Republic of Macedonia, Hungary, Latvia, Lithuania, Montenegro, Poland, Romania, Serbia, Slovak Republic, and Slovenia.

the home (i.e., recipient) country. The loans normally have a long maturity (of ca. 20 years) and low interest rates (at ca. 2 per cent). However, while these conditions may seem attractive, the spillovers (i.e. impacts) on the rest of the economy are sometimes limited as Chinese companies often bring their own workers and supplies, and rely only to a limited extent on local resources. A further concern is that loans are usually contracted in US dollars which, given the recent strengthening of the dollar, is an added burden for SEE countries with currencies tied to, or closely shadowing, the euro. This foreign exchange risk for SEE will grow as the cumulative size of Chinese-supported investments made on dollar terms increases.

China's interests in the energy sector are spread widely. They range from coal-based thermal power plants to nuclear energy and renewables. Serbian and Chinese officials have signed a loan agreement for the construction of a new 350MW unit at the Kostolac thermal power plant complex, the first such investment in Serbia in 25 years, while Exim Bank is already financing a private investment in the Stanari thermal power plant in Bosnia and Herzegovina and will be financing a 450MW unit at the Tuzla thermal power plant. Chinese presence is notable in the energy sector of Romania, where Chinese companies have been chosen as investors in four major energy projects in the country: modernisation of two thermal power plants (Rovinari and Mintia), expansion of the hydro-power plant Tarnita, and the construction of units 3 and 4 in the Cernavoda nuclear power plant.

However, fact is that difference between the IFIs and Chinese banks certainly is in their business policies. EBRD is particularly devoted to encouraging energy efficiency and the efficiency of use of resources, the reduction in waste generation, redevelopment of abandoned industrial locations, renewable resources and re-use of resources, recycling, implementation of cleaner production and alignment with high environmental and sustainability standards.

Also, access to what seems cheaper and easily accessible funds does not come without a price. Based on the value of currently implemented projects which are financed by Chinese banks, these make up between 7 and 27% of some of WB6 countries GDP.

With regards to all the issues elaborated above, a key challenge that EU faces with ever-growing presence of Chinese financiers is how to ensure that HPPs are not implemented under standards that do not fit with EU standards and requirements. An answer to this challenge should come through coordinated action regarding more rapid implementation of EU standards and the transposition, implementation and enforcement of the legislation through the existing mechanisms of the Energy Community and bilateral pre-accession processes while ensuring additional improved (in terms of accessibility, reliability, price and type of) financial funds which are currently lacking.

4. Overcoming perceived risks – the role of Governments

Lack of policy credibility, transparency and stability, as well as long procedures to obtain authorisations and permits for projects are still perceived as one of the biggest challenges to the wider implementation of hydropower (and RES in general) projects in WB6 countries. These often go hand in hand with conceptual misinterpretation of the role of government within the market and the process of sponsoring projects. A straightforward view on the role of governments is that they should be setting transparent strategies, market rules, a positive overall business climate, sound and efficient regulatory and legal frameworks and meeting the needs of their societies while preserving national and environmental interests of the countries.

One of the greatest challenges all countries in the WB6 region face is to create transparent policy making process and more importantly fully functional, independent legal system. At the moment, common practices in all WB6 countries include:

- rapid and often unexplained policy shifts (usually coming with the change of political parties in power),
- non-transparent and non-inclusive policy making processes,
- (slow) transposition of provisions of EU legislation and regulations (especially important in segments regulating common/internal market) which are rarely applied in practice,
- creation of strategic documents without any, or with very limited, commitment to for implementing them,
- ignoring advise from international organisations and/or not applying solutions and recommendations developed through donor funded initiatives,
- ignoring needs and suggestions for improvement coming from private investor initiatives,

- developing very complex and often redundant environmental protection standards and procedures which lag behind EU standards, are not enforced but almost impossible to go through,
- constantly creating additional administrative barriers instead of removing them.

All of these practices (and the list presents just an excerpt) distort the overall business climate in WB6 countries, discouraging private investors and making RES projects (which are already perceived as risky) even riskier. Very slow progress (if development of WBG's Doing Business index) with improvement of overall business climate has been made in recent years in most of WB6 countries. Without dramatic and fast improvement of business and investment climate, improved transparency and social dialogue in policy making process two very troublesome effects will (continue) to occur: 1) international trustworthy (private) investors will be still uninterested in making investments in the region despite all the efforts made by the EU, IFIs and other international sponsors, and 2) in desperate need for investments, governments will lower their criteria and standards trying to attract at least "vulture" investors ready to take high risks seeking high returns. This will make investments, if actually financed, happen at higher overall (social) costs and implemented at lower level of standards applied.

Action has to be taken quickly and boldly, with the EU at the flagship, by making pressures on governments to formally and in practice improve all issues perceived, remove exiting barriers and to speed up the process of transposition, implementation and enforcement of EU legislation and standards into legal practice. Surely, additional funds should be secured to assist local governments and close supervision (sponsorship) of the process should be in place. Tailor-made solutions to country specific challenges and issues should be found and these should be implemented stepwise with monitoring of progress.

If the prerequisites in terms of a fully functional legal system, transparent policy-making process and enforcement of committed obligations, liberalisation and integration of energy markets with clear market rules are not in place very soon, no major step will be made in meeting the need for private money and attracting credible private investors into the region. For international private and institutional investors, WB6 will remain an area of high risk investment environment, making development and implementation of large HPP projects questionable, at least, and highly dependent on limited international donors' funds.

This is of utmost importance taking into account the crucial financial barrier for large HPP projects to be financed from governments point of view – fiscal constraints. Namely, traditionally, governments in WB6 countries, but MDBs also, were used to finance large infrastructure projects using government-backed guarantees. In fact, some MDBs have a restriction such that they can't finance loans other than sovereign ones. The usual modus operandi for financing large power projects was: the state-owned incumbent wants to finance a project, the IFI approves the loan to the government which then issues a guarantee backing the loan and then the government provides the funds to the power utility. The issue is that these guarantees pose is sovereign debt. Most of the governments in the WB6 region are already overleveraged with very low credit ratings (which constantly increases the price of debt) and have now reached, or nearly so, the limit of the sovereign debt that they can guarantee. This puts an end to this type of finance as an option calling for one of two things: 1) a rapid move to new, innovative, market-based and flexible mechanisms rooted in project finance schemes or 2) an even wider turn of governments to third party finance assistance and their financial products. The key question is at what total (social) price.

If fiscal constraints are to be compensated, if not fully mitigated, project finance mechanics should be put in motion, and in order to do so following has to be done:

- develop a fully-functional legal system with the sponsorship of the EU as a key prerequisite for project finance,
- improve the business climate to attract credible, risk averse, private investors,
- determine what financial products are missing (i.e. private equity, mezzanine financing etc.) and work closely with IFIs focusing on the development custom-made solutions which cover the needs,
- work closely with IFIs to develop much-needed guarantee programmes and schemes to compensate for lack of sovereign guarantees (European Investment Fund and EIB could be one solution) – again custom-made solutions are needed to address true needs, and
- work closely with, or sponsor the process of, financial institutions in creating specialised insurance products which are base for any project finance scheme and implementation of any complex long-term project such as large HPP development.

5. New and innovative financing opportunities for HPP projects – Green Bonds

A green bond is a fixed income instrument that allows the issuer to tap into debt capital markets and use the proceeds to invest in projects that have environmental benefits. Repayment of the bond's principal amount and the agreed rate of interest is then the issuer's obligation in the case of a green 'use of proceeds' bond, which is the simplest and more commonly used form. Repayment can also depend in other green bond structures on the issuer's revenues, the project's balance sheet, or assets against which the bond could be collateralised (See Section 2.2). Green bonds are thus similar to conventional bonds in almost all aspects, except in that in the use of their proceeds they are earmarked by their issuer for investments in green projects, an intention that is commonly specified in the bond's legal terms. This includes similarity to financial features of bonds from the same issuer, such as credit rating and price.

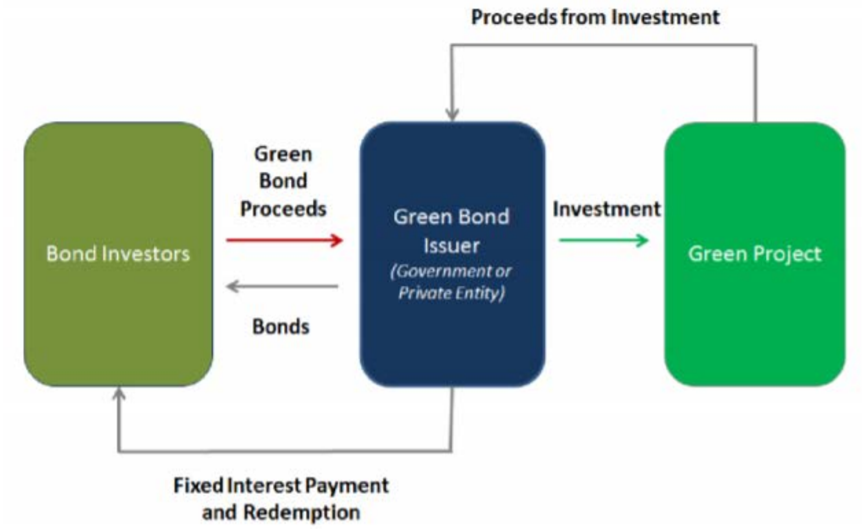

Figure A2.1: Green Use of Proceeds Bond Structure, *Source: Climate Bonds Initiative*

Green bonds take different forms, the most common of which is the green use of proceeds bond, which can be issued by a private sector entity (corporate green bond), a public-sector entity (national government, local government such as a municipality, or a state entity), or a supranational entity (World Bank, IFC, EIB). The funds raised from the bonds are earmarked for a green project or projects, and repayment is tied to the issuer. A similarly structured bond, the green use of proceeds revenue bond is earmarked for green projects, but repayment is tied to the issuer's revenues that act as collateral to the bond in case of default. In comparison, a green project bond is tied to the underlying project or projects, whereby recourse is to the project's assets and balance sheet rather than the issuer, meaning that the investor would have a stake in the success of the project. Green bonds support climate financing and the implementation of national climate policies, and open up room for investors to diversify their fixed income portfolios. In their accreditation mechanism, green bonds promote transparency of information relating to the underlying assets allowing investors to better implement their green investment strategies, to observe their green investment mandates when applicable and to better assess their risk return portfolios in cases of green use of proceeds revenue bonds and green project bonds. From an issuer perspective, Green bonds open up access to a growing pool of investors looking to subscribe in environmental, social, and governance (ESG) performance investments, and allow the issuer to communicate its sustainability goals and improve its credibility in the commitment to sustainable investments. This can be better achieved when the issuer subscribed to the voluntary oversight mechanism of independent parties. With a growing pool of ESG investors, cases in which green bonds have attracted a higher demand than an issuer's regular bonds are becoming commonplace, such as in the case of the US State of Massachusetts, whereby a green bond issuance was 30 percent oversubscribed, compared to its regular bond that was undersubscribed (Climate Bonds Initiative, 2014, Page 3) The growth spurt in green bond investments since between 2007 to date is proof that the market still holds substantial potential, with expectations of issuances to exceed USD 100 billion in 2017. Finally, with additional transparency and the project financing developmental aspect of bonds, issuers are more likely to benefit from the support of national entities and / or of supranational organisations through guarantees for cost reductions or credit rating enhancement purposes.

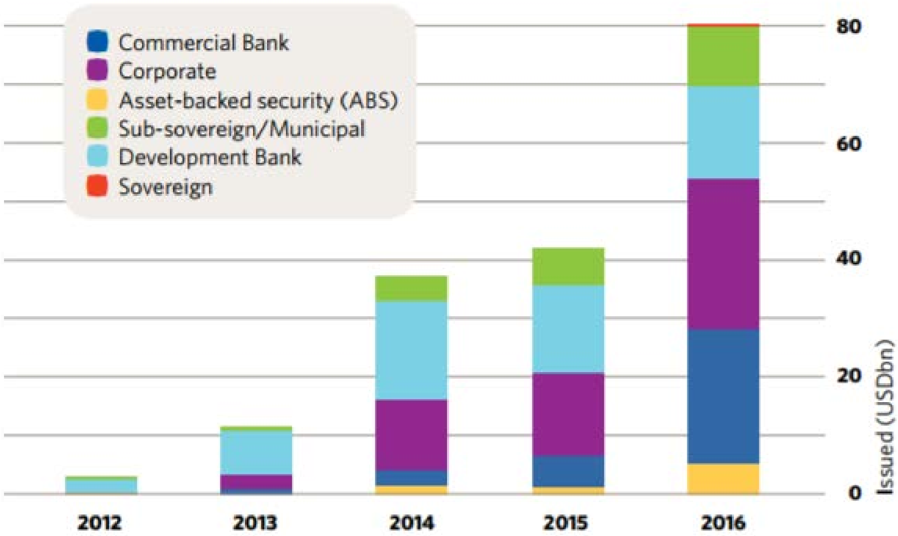

Figure A2.2: The green bond market 2012-2016, *Source: Climate Bonds Initiative*

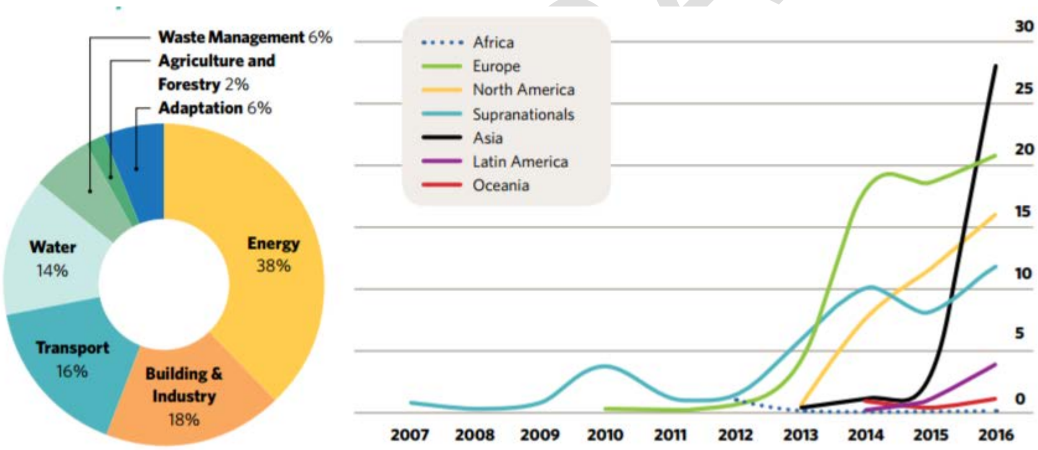

Figure A2.3: The green bond issuance by region and range of use of proceeds, *Source: Climate Bonds Initiative*

The top three energy-related bond offerings and the World Bank bonds include hydropower. The EDF, GDF SUEZ and Iberdrola bonds are among the largest and most successful issued to date and all refer to hydropower.

At the moment, HPP-specific green bond guidance is being further developed indicating that green bonds could become, in the foreseeable future, common, well developed, attractive and a standardised financial product used for financing HPP projects, especially large HPPs.

As part of the Public Consultation process that took place after the First Workshop on Regional Hydropower Development in Western Balkans (held in Podgorica, Montenegro, 30 – 31 March 2017) useful comments to the draft report have been received. Among them, EDF shared their experience in the Western Balkans as well as details on EDF Green Bonds issuance. Next paragraph gives shortened overview of EDF's Green Bond activity as provided by EDF in their useful comments.

Since November 2013, EDF has issued the equivalent of around €4.5bn in Green Bonds to support its development in renewable energy sources. Following the first two issuances that aimed to finance the construction of new wind and solar projects by EDF Energies Nouvelles, the Group extended its Green Bond

Framework to financing of investments to renovate and modernize hydropower assets in mainland France. This new framework was first implemented for the October 2016 issuance.

EDF mainland France hydro eligible projects cover investment in existing facilities in the following areas:

- Renovation and upgrade of hydropower generation facilities
- Modernisation and automation of existing hydropower facilities maintenance and operation
- Hydropower development projects

The financing must focus to:

- Improve hydropower generation efficiency and safety
- Improve resilience to climate change
- Increase generation flexibility and ability to manage growth in intermittent renewables
- Net increase of hydropower output and/or storage capacity (for pumped storage)

EDF Hydro Project E1S criteria for Green Bond eligibility cover five E&S aspects

- Development of sustainable human resources practices and processes,
- Management of environmental impacts,
- Protection of employees and contractors' workers' health and safety,
- Promotion of responsible contractors' relationship, and
- Dialogue with local partners.

Green Bonds are fully integrated to the Group's financing policy, making EDF a frequent Green issuer participation in the development and liquidity of the Green Bond market.

Addendum – View and the experience of (potential) investor: Case of EDF

As already mentioned, as part of the Public Consultation process that took place after the First Workshop on Regional Hydropower Development in Western Balkans (held in Podgorica, Montenegro, 30 – 31 March 2017) useful comments to the draft report have been received. Among them, EDF shared their experience in the Western Balkans which authors of the report find to be fully in line with the findings presented in this Annex but also very insightful and thus want two share it in this Report. Next text box gives and overview of EDF's experience, views and thoughts on hydropower development (but also and energy sector in general) in the Western Balkans as provided in EDF's comments to the Draft Report presented at above mentioned Workshop.

The demand for electricity in the Western Balkan region will still increase steadily until 2050. The carbon intensity in the region is high due to its heavy dependence and use of coal/lignite in power generation. The majority of thermal power plants were built in the 1960s and 1970s with old technology, and their maintenance is often inadequate. The average weighted operation life is more than 30 years, having passed the designed technical life, but they still operate. The implementation of the Large Combustion Plant (LCP) Directive (2001/80/EC) is an obligation for the Contracting Parties of the EC thus forcing power plants that are not in compliance to be rehabilitated or closed down.

Despite the high unexploited potential in the Balkan region, the development of new hydropower projects has stalled primarily due to environmental concerns and a lack of financing. While there are many potential projects in the planning stage, it is expected that the majority will not come to fruition.

Many of the developments in the region are small (less than 10 MW in capacity). Typically feed-in tariffs (FIT) are given up to 10/15 MW of installed capacity. In Serbia, the FITs can be up to 30 MW or include the modernization of existing infrastructure to increase life-span with less attention to efficiency of operational plants and to minimize ecological impacts.

Nowadays, Joint Ventures (JV) with local power utilities are rare in SEE region, foreign companies are no longer major shareholders in development projects but just turnkey contractors, mainly Chinese.

Which are the policy measures to be adopted in the region to induce a wave of transformation? Are PPPs (and IPPs) contributing to the development of the energy sector in WB? Which are the key (lack of) success factors? Can PPPs play a stronger role in the future of the development of the regional energy sector?

IPPs/PPPs have been invoked to address financial lack of funding by local utilities and contribution to potential market liberalization (also in order to comply with the EU directive). Few hydro and thermal power projects have been realized in the western Balkans since 1990, of which some as capital investments by the incumbent utilities, very few under IPP schemes, none under PPP schemes. Various reasons have been indicated such as political instability and financial distress of utilities. In addition, the best sites for hydro projects have already been developed and there are several transboundary issues, since a significant number of hydro projects are shared between several WB6 countries.

Remarkably, one key element has often been overlooked: the electricity price level. Since statistics have been available, prices have systematically and substantial been lower than the LCOE of any plant (HPP and TPP.) IPPs are not grant, they are profit –seeking entities and require remunerative price perspectives. Involving international utilities increases the minimum acceptable financial return level, as international companies will price in the risk of operating in a foreign country and the “one egg in one basket” risk. The outcome is either an unfavourable business case, or the request for Page 12price-certain PPAs at levels which have often (always) been judged unacceptable by the counterparts (often/always the incumbent utilities).

In recent years, funding has been abundantly available, due to accommodating monetary policies, thus supporting an alternative approach which is competitive in the eyes of local utilities: supplier credit. Several projects (not only hydro) have been indeed developed according to this scheme. This appears logical when analysed from the local utility’s point of view and even more in a low electricity prices landscape, as a traditional IPP approach will require PPAs, which again de facto anchor the market risk on the local utilities, with no substantial financial advantage of the IPP scheme vs. the state/corporate backed supplier’s credit.

Are IPPs a lost case? We believe no, but all stakeholders need to consider other factors like transfer of competencies, contribution to market opening, etc. In addition, in case of massive modernization plans, participation of international investors in large projects may give more comfort to the external financial lenders, as local utilities generally do not assess profitability of a preventive maintenance approach against a curative approach, fail to carefully optimize operation and safety and environmental aspects.

Higher cost of electricity from new HPP (and in some cases even rehab) may be considered acceptable in the light of external condition such as ancillary non–energy products, offset of fossil fuel energy, important water management function, etc.

We believe that a deep analysis of the recent past should be performed in order to identify the key success factors or the lack thereof. Most Eastern European countries, and especially the WB6, have suffered in the recent past and are still suffering from remarkable lack of investments in energy infrastructures. This has had a significant negative impact on both development and environmental impact mitigation.

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