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HYDRO POWER, RESERVOIRS AND ENVIRONMENT WITH CLIMATE CHANGE ISSUES IN B&H

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Summary

The world has been dividing onto those that are becoming globally connected, and those becoming globally isolated. In the first part global and European recent trends in energy, climate change, hydro power and environment were summarized. The rest of the paper presents the B&H challenges, existing situation, plans and possible future of these sectors.

Keywords: Hydro power, Energy, Environment, Climate change, B&H Challenges

1. Introduction

Access to energy and water is fundamental to the daily lives of every human being. Citizens are affected by higher prices for drinking water or wastewater services, threats to the security of energy and water supply, and effects of climate changes. Sustainable, competitive and secure energy and water is one of the basic pillars of our daily life, and our economy.

The nations in Central, Eastern and Southern Europe face triple challenges of the ongoing economic and political transition, continuing vulnerability to environmental hazards, and longer term impacts of global climate changes. Bosnia and Herzegovina additionally faces post-war and complex constitutional challenges.

The future of B&H will depend on the speed at which it will find acceptable solution for all its citizens, all three ethnicities and two entities, which will stimulate economic development. Serbia and Kosovo are a large challenge for International Community, since it has been hard to find acceptable solutions that would provide prospects of faster development, and put the war traumas behind. If Croatia wants to become the EU member, and it obviously wants, Croatia will also have to, by rational measures, dampen the emotional charge related to the issues from the war years, and speedily reform and institutionalize the society in accordance with the European norms. The last issue is even more intensively related to Montenegro, and Macedonia, which still has problems with its ethnic divisions [4].

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And while all of the above mentioned countries were, all together and individually, struggling with their own specific problems, the world and the surrounding countries were moving forward increasingly faster and further. Romania and Bulgaria became new EU members in January 2007. The interest of Russia in its neighbors is spreading to the Balkan region as well, as the traditional Russian interest area. China and Africa are concluding contracts on long-term cooperation regarding infrastructure development and utilization of resources, while India and China are preparing a joint entry on the market of Latin America countries. It is completely clear that the Southeast Europe is not devoting enough attention to these wider trends.
The world has been dividing onto those that are becoming globally connected, and those becoming globally isolated. It is certain that global connecting has no reasonable alternative, but the bulk of countries in the region is preoccupied with their own problems, and is therefore not taking part in it; [4].
It is obvious that this region may not expect very high rates of economic growth.

The reasons are the following:

- traditionalism, which does not allow larger liberalization of economy, which is the condition for long-term explosive growth rates of approximately 10%;
- higher labor costs in relation to other undeveloped countries, which does not attract foreign investment and it leads to avoiding of traditional, work intensive industries and mass, market agriculture;
- unfavorable demographic movements of population, on average becoming older, while younger and more skilful people are leaving for developed countries.

Bosnia and Herzegovina is only at the beginning of the new road, when B&H institutions should take full responsibility for future of its inhabitants of all ethnicities. The following goals are indisputable: EU membership, building of democratic and just country, equality of all peoples, poverty reduction, economic development, cooperation with neighboring countries, etc. The problem is how and when to implement all of this. The capacity to implement the goals was the basic problem in the previous period, burdened by war and its consequences. Unfortunately, the synergic solutions that would eliminate the institutional, legislative and organizational problems in building of B&H into a modern and prosperous country, but at the same time respecting all the specific qualities it has, have not been found yet; [4].

2. Global Energy and Climate Change Challenges

2.1. Energy Challenges

Energy is essential to improving the quality of life and opportunities in developed and developing nations. Therefore, ensuring sufficient, reliable and environmentally responsible supplies of energy, at prices reflecting market fundamentals, is a challenge for all countries and for mankind as a whole.
To tackle this overarching goal, political leaders and intellectual elite have to deal with serious and linked challenges such as:

- high and volatile oil prices;
- growing demand for energy (estimated to rise by more than 50% by the year 2030 compared to 2007);
- increasing energy importing dependence in many countries;
- enormous investment requirements along the entire energy chain;
- the need to protect the environment and to tackle climate change;
- the vulnerability of the critical energy infrastructure;
- political instability, natural disasters and other threats.

The global nature of these challenges and the growing interdependence between producing, consuming and transiting countries, require strengthened partnership between all stakeholders to enhance global energy security. But, leading role in this issue is within leading industrialized countries, organized in G8[1] group, so as countries in possession of the majority of World's oil resources, OPEC[2].
G8 leaders agreed in St. Petersburg (July 2006, Joint statement, [10]) that development of transparent, efficient and competitive global energy markets is the best way to achieve objectives on this score. They recognize that governments and relevant international organizations also play an important role in addressing global energy challenges.

[1] The G8 members are: Germany, France, the United Kingdom, Italy, Japan, the United States, Canada (since 1976) and Russia (since 1998). The European Commission is also represented at all the meetings.
[2] The Organization of the Petroleum Exporting Countries (OPEC) is a permanent intergovernmental organization, created 1960, by Iran, Iraq, Kuwait, Saudi Arabia and Venezuela, later joined by other members: Qatar, Indonesia, Socialist Peoples Libyan Arab Jamahiriya, United Arab Emirates, Algeria, Nigeria, Ecuador. OPEC is made up of thirteen developing nations, whose economies rely on oil export revenues. One of OPEC's primary missions is to achieve stable oil prices, which are fair and reasonable for producers and consumers.

Given political will, the international community can effectively address three interrelated issues: energy security, economic growth and environmental protection (the "3 Es"). Applying fair and competitive market-based responses to the global energy challenges will help preclude potentially disruptive actions affecting energy sources, supplies and transit, and create a secure basis for dynamic and sustainable development of our civilization over the long term.

G8 leaders will pursue energy security through a comprehensive and concerted approach consistent with common environmental goals. Previous year (2007), G8 agreed to enhance work under the Plan of Action for Climate Change, Clean Energy and Sustainable Development and resolved to take forward the dialogue on these issues whose results will be reported at the 2008 G8 Summit in Japan.

G8 leaders reaffirm commitment to the United Nations Framework Convention on Climate Change (UNFCCC) and to meet shared multiple objectives of reducing greenhouse gas emissions, improving the global environment, enhancing energy security, and cutting air pollution in conjunction with vigorous efforts to reduce energy poverty. They also agree to work on improving access to energy in developing countries.

They reaffirm commitment to implement and build upon the agreements related to energy reached at previous G8 summits. They will enhance global energy security through actions in the following key areas:

- increasing transparency, predictability and stability of global energy markets;
- improving the investment climate in the energy sector;
- enhancing energy efficiency and energy saving;
- diversifying energy mix;
- ensuring physical security of critical energy infrastructure;
- reducing energy poverty;
- addressing climate change and sustainable development.

A large-scale use of renewable energy will make a significant contribution to long-term energy supply without adverse impact on climate. The renewable solar, wind, hydro, biomass, and geothermal energy resources are becoming increasingly cost competitive with conventional fuels, and a wide variety of current applications are already cost-effective.

Renewable energy sources are accessed to be cost-effective for both heat and electricity generation, as well as the production of bio-fuels.

Today, renewable energy sources account for 13 % of the world's primary energy demand. Biomass, which is mainly used for heating, is the largest renewable source. The share of renewable energy in electricity generation is

18 %, whilst the contribution of renewables to heat supply is around 26 %. About 80 % of primary energy supply still comes from fossil fuels, and the remaining 7 % from nuclear power; [8].
The real cost of energy production by conventional energy includes expenses absorbed by society, such as health impact and local and regional environmental degradation - from mercury pollution to acid rain - as well as the global negative impacts from climate change. Hidden costs include the waiving of nuclear accident insurance that is too expensive to be covered by the nuclear power plant operators.
Environmental damage should be rectified at source as a priority. Translated into energy generation that would mean that, ideally, production of energy should not pollute and that it is the energy producer's responsibility to prevent it. If they still do pollute, they should pay an amount equal to the damage the production causes to society as a whole, or remediate the full damage. However, the environmental impacts of electricity generation can be difficult to quantify.
An ambitious project, founded by the European Commission - ExternE - has tried to quantify the true costs, including the environmental costs, of electricity generation. It estimates that the cost of producing electricity from coal or oil would double and that from gas would increase by 30 % if external costs, in the form of damage to the environment and health, were taken into account. If those environmental costs were levied on electricity generation according to their impact, many renewable energy sources would not need any support. If, at the same time, direct and indirect subsidies to fossil fuels and nuclear power were removed, the need to support renewable electricity generation would seriously diminish or cease to exist; [8].
G8 welcome the work of interested parties in international mechanisms and programs dealing with renewable energy, including the Renewable Energy and Energy Efficiency Program (REEEP), the Renewable Energy Policy Network for the 21st Century (REN21), the Mediterranean Renewable Energy Partnership (MEDREP), and the establishment of the Global Bio-Energy Partnership (GBEP). G8 will work in partnership with developing countries to foster the use of renewable energy. G8 leaders instructed their experts to work together with other countries, international and regional financial institutions (World Bank, Regional Development Banks, UN agencies, etc.), the private sector and other stakeholders to facilitate technology transfer in the areas of energy efficiency, energy saving, renewable energy and decentralized local sources to reduce energy poverty, thereby improving energy access and enhancing energy efficiency in developing countries.
With the renewable energy, the principal role of public policy is to promote, engage and mobilize action by the private sector [10].

2. 2. Global Challenge of Climate Change

This paragraph builds to a large extent upon the recently published Fourth Assessment Report of the Intergovernmental Panel of Climate Change (IPCC, Valencia, Spain, November 2007), which assesses the latest scientific, technical and socio-economic literature relevant to the understanding of the risk of human-induced climate change, its observed and projected impacts and options for adaptation and mitigation; [19].
Global emissions of greenhouse-gases (GHG)[1] have increased markedly as a result of human activities since pre-industrial times. The increase in emissions has lead to unequivocal global warming, which is evident from observations of increasing air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level.
Emissions projections from future scenarios indicate that without the tightening of current climate change mitigation policies, global GHG emissions will continue to grow at high pace over the next decades. This increase would cause further warming and induce many changes in the global climate system during the 21st century that would be much larger than those observed today. Unmitigated climate change would thus increase the risk of climate-induced impacts for many climate sensitive and vulnerable systems, including food supply, infrastructure, health, water resources, coastal systems, ecosystems, global biogeochemical cycles, ice sheets, and modes of oceanic and atmospheric circulations.
Reducing the risk of irreversible climate impacts requires thus the mitigation of global GHG emissions aiming at the long-term stabilization of atmospheric GHG concentrations. Achieving this goal translates into the need of reducing emissions to virtually zero over long time-frames. The mitigation challenge is best illustrated by the stabilization scenarios for low stabilization levels, which would e.g. be consistent with the 2^0C temperature increases target of the European Union (See Paragraph 3). These scenarios indicate the need for rapid decarbonisation of the energy system, where global emissions would have to be reduced by more than 50 % by 2050, compared to 1990.
Although there are large uncertainties with respect to the deployment of individual future technologies, there is strong evidence that no single mitigation measure alone would be sufficient for achieving the stabilization of GHG concentrations at low levels. A wide portfolio of technologies across all GHG-intensive sectors is needed for cost-effective emissions reductions. The bulk of these emissions reductions would need to come from the energy sector, with

[1] Carbon dioxide (CO_2); Methane (CH_4), Nitrous oxide (N_20); Sulfur hexafluoride (SF_6); Hydro fluorocarbons (HFC); Perfluorocarbons (PFC); Chlorofluorocarbons (CFC); etc.

the forest and agricultural sectors playing an important role for the cost-effectiveness. Energy-related measures range from energy conservation and efficiency improvements to shifts away from carbon-intensive coal to cleaner fuels (such as natural gas, renewables, and nuclear), as well as "add-on" technologies such as carbon capture and storage. Other important measures include changes in agricultural practices to reduce GHG emissions, and enhancement of terrestrial sink activities in the forest sector.
Reducing the risks of climate change significantly, requires fundamental structural changes of the energy system in the long term, combined with accelerated technology diffusion and early investments over the next few decades. In addition, appropriate and effective investment incentives need to be in place for development, acquisition, transfer, and deployment of new technologies. Achieving a trend-reversal of presently declining trends of R&D expenditures in environmentally friendly energy technologies will thus be central for addressing the climate change challenge; [11].

2.3. Climate Change Challenges on Water Resources

As the recent Intergovernmental Panel on Climate Change Report makes clear [19], water is in the eye of the climate management storm. Global warming and related climate changes are predicted to present significant challenges over the century. These challenges are increasingly better understood and there is growing consensus on their likely scale.
To date, much attention has been focused on the dimensions of temperature and sea level rise. Substantial work has also been done on some of the consequences, such as changes in rainfall and the risk of more, and more intense, floods and droughts. However, not nearly enough work has been done to understand how to cope with the potential impact of climate change on the water environment at a regional, national and local level; [7].
As the same IPCC report has also made clear, "irrespective of the scale of mitigation measures, adaptation measures are necessary". This implies an integrated approach to climate changes that embraces both ***mitigation***, which addresses the drivers of climate change, and **adaptation**, which considers the measures necessary to accommodate such changes. In this context, the challenges of water management will become increasingly important because there is general agreement that the supply of and demand for water resources will be substantially affected by climate change.
The first key message is that, if our global energy habits are the focus for mitigation, the way we use and manage our water must become the focus for adaptation; [7].

One reason for this is that it is widely predicted that relatively small temperature changes of a few degrees Centigrade will influence average river flows and water availability increase by 10 - 40 % in some regions, while, in others, they will decrease by 10 - 30 %. A further message is thus that changes in climate will be amplified in the water environment.
If the challenges of climate change for the world's water are not understood and addressed, we run the risk that the water supplies we provide to the communities of a growing, urbanizing world, the infrastructure we build to serve them and the industries and agriculture that supply and feed them, will prove to be unsustainable.
There are also broader dangers. If we fail to understand the interaction between climate change and water, other climate change strategies may actually aggravate the problems and increase the vulnerability of communities to both natural and manmade calamities.
Adaptation efforts must begin immediately, because both the institutions that we establish and the infrastructure that we build today, lock us into patterns of behavior for many years to come. Unless we act now, we will miss opportunities to ensure a more sustainable long term future.
It is thus important for water managers and water users alike to get to grips with the future that is unfolding. An approach to water resources management that can identify and address the challenges - and uncertainties - is needed. But as important as promoting better, more intelligent, water management, we need to ensure that in all sectors of society, the water challenges are addressed in broader climate change and development strategies.
Although it will be some time before the full extent of the impacts of climate change on water resources become evident and are fully understood, it is important that they should be addressed sooner rather than later, to adapt to a future that many believe has already begun to occur. Moreover, the best way for countries to build the capacity to adapt to climate change will be to improve their ability to cope with today's climate variability. Adaptation on seasonal to inter-annual time scales will be critical in adapting to the impacts of longer term climate change as well. So, another overarching message is that improving the way we use and manage our water today will make it possible to address the challenges of tomorrow; [7].
While this brief focuses on the emerging challenge of adaptation, it is important to recognize that aspects of water use contribute to climate change and that different approaches to water management can help to reduce these impacts. Indeed, mitigating global climate change will require addressing a range of thorny water and development problems, such as tapping more of the world's hydroelectric energy potential in ways that are socially and environmentally responsible, balancing the allocation of scarce land and water

resources for bio-fuel production against other key uses, and finding ways to reduce the energy-intensity of desalination and groundwater-based approaches to increasing fresh-water supply.

Hydroelectricity, an important source of renewable energy, depends on reliable water sources. Lower river flows will reduce electricity production and thus supplies too, and power failures will affect the economic and social life of many communities unless new investments are made.

More intense rainfall will increase the cost of flood protection works, as well as that of associated infrastructure such as roads and storm-water drains.

The IPCC does not consider methane generated in reservoirs to be a significant source of greenhouse gases (GHG), noting that "while some GHG emissions from new hydroelectric schemes are expected in the future, especially in tropical settings,..., such schemes are regarded as a lower source of CH_4 emissions, compared to those of other energy sector or agricultural activities". Hydroelectric power is therefore not treated as a separate emission category in the Special Report on Emissions Scenarios. (See IPCC Special Report on Emissions Scenarios, UNEP/WMO 2006); [19].

A related issue is the size of extreme water events such as floods and droughts. There are sound reasons to expect that there will be more powerful, intense storms and floods and longer, more intense droughts. One effect of temperature increases that is often forgotten is the increase of aridity - the ratio between rainfall and evaporation. Since evaporation increases with temperature, aridity will increase in many areas.

As important as the size of extreme events is how often they occur, it is predicted that extreme events will occur more often; floods and droughts that previously occurred once in a lifetime, every 50 years, may now occur every 5 or 10 years; [7].

One way to manage the impact of climate's variability on water resources is to capture and control river flows. Dams can retain and store flows in excess of user requirements and release them when low flows are not sufficient; this can also help to maintain aquatic ecosystems. Peak flood flows can be stored and released later, avoiding flood damage by reducing maximum flows. Both functions are important to sustain human settlements and to avert disasters caused by floods and droughts. Dams also store water as a form of potential energy to generate electricity, without which healthy human life is difficult to sustain, particularly as settlements increase in size.

Since the useful life of large water infrastructure is often measured in hundreds of years, investment that are made today will still be operating under the new climate of the 22nd century, and need to be designed for the future as well as for the present.

Building resilience to manage the impact of variable climates on human activity is not new and has been the day to day business of society's water managers for generations. To satisfy an ever increasing water demand, the construction of new dams might remain an option, but the choice of sites is becoming more difficult as the economic, environmental and social costs are increasing again and again. An alternative option to dam building might be to increase the storing capacity of existing dams, since by increasing the size of dam, one can regulate the water output from the reservoir by a more effective use of inter-annual variability; [17].

The design of expensive water-power and water infrastructure and complex management arrangements needs more than technical capacities. It must be guided by sound information about the water resource. Paradoxically, one consequence of the wide uncertainty about the future impact of climate change is that water managers are still using historic climate data to design water infrastructure and guide their management decisions. This has been aggravated by a worldwide decline in the availability of hard water data over the past two decades. In many poorer countries and countries in transition (including B&H), hydrological information systems have been allowed to decay under pressure to allocate scarce resources to more immediate needs. As a result, we have limited information to support the planning, development and management of the water resources, a situation which cannot be reversed overnight. However, unless a start is made to rebuild the basic systems to provide information about water resources, the danger is that new infrastructure will not achieve their predicted yields.

Many poorer countries cannot even manage their current climate variability, not because the strategies needed are unclear, but because the means to implement them are lacking. They may reasonably ask how they should address tomorrow's climate change if they cannot afford to manage today's floods and droughts; [7].

Many of the impacts threatened by climate change are just extreme examples of challenges that are already addressed on a daily basis across the world. Countries which have established effective institutions and infrastructure to deal with today's climate are better placed to deal with the more extreme variability, which we expect tomorrow.

Being rich certainly helps, but being wise is as important. For poor countries, it is arguably more important to develop and apply water wisdom to the challenges of climate change; [7].

2.4. The Clean Development Mechanism (CDM)and Hydro Power

The CDM was established under the Kyoto Protocol of the UN Framework Convention on Climate Changes (UNFCCC) at the 7th Conference of Parties in October 2001. It allows industrialized country Parties to the Protocol to meet their GHG emission reduction targets in part by purchasing "certified emission reduction" credits (CERs) by subsidizing projects in developing country parties.

The mechanism is intended to support the host nation in meeting her sustainable development goals; to transfer new technologies to developing countries; and to lower the cost to developed countries of meeting their emission reduction targets.

Eligibility for participation in the CDM requires the following:

- That a developed country party invests in a project in a developing country in order to reduce GHG emissions from variety of sectoral options,
- To comply with a set of monitoring, verification and validation procedures agreed by the UNFCCC and the CDM board,
- To allow for clear assessment on the "additionality" of a project. "Additional" in that it is an emission reduction activity that would only occur with the extra income obtained by the sale of the CERs.

Annual expected CER generations by project type are:

- Industrial gases 31%,
- Methane capture or combustion 18%,
- Hydro 15%,
- Renewable energy 13%,
- Energy efficiency 12%,
- Fossil fuel switch 8%,
- Land use and other 3%.

Hydro power projects represent approximately one-fifth to one-quarter of all registered CDM projects. Data on CER applications up to September 2007 for hydro projects (updates available on "International rivers" website) show that:

- CERs have been sought for 592 hydro projects for a total installed capacity of 18 GW (this compares to estimates of 1.700 overall planned hydro projects worldwide with more that 135 GW capacity),
- These projects are mainly located in countries with emerging economies: China 371, India 79, Brazil 49;
- The initial buyers of these CERs are from: UK 242, Netherlands 128, Germany 62.

However, the inclusions of hydro power projects in the CDM has been controversial because of the uncertainty over the scale of GHG emitted from reservoirs, and the non-GHG impacts on people and the environment of many hydro projects; [18].

3. EU Energy and Climate Change Policy

Energy landscape of the 21st century is one in which the world's economic regions are dependant on each other for ensuring energy security and stable economic conditions, and for ensuring effective action against climate change.
Europe is the world's second largest energy market, with over 450 million consumers. Acting together, it has the weight to protect and assert its interests. The EU has not just the scale, but also the policy range to tackle the new energy landscape. The EU leads the world in demand management, in promoting new and renewable forms of energy, and in the development of low carbon technologies. If the EU backs up a new common policy with a common voice on energy questions, Europe can lead the global search for energy solutions.
Europe acts urgently, because it takes many years to bring innovation on stream in the energy sector. EU also promotes diversity - of energy type, place of origin (in Europe and outside) and transit. In this way, Europe creates conditions for growth, jobs, greater security and better environment, [1].
At a landmark summit in March 2007, European heads of state agreed to move forward with ambitious objectives to slash greenhouse-gas emissions and boost renewable energies by 2020 in a bid to reduce the EU's dependency on imported fuels and "**set the pace for a new global industrial revolution**"; [5].
Latest & next steps:

- **10 Jan. 2007**: Commission presents "Energy and Climate Change Package" including a Strategic Energy Review focusing on both external and internal aspects of EU energy policy;
- **27 Feb 2007:** Commission issues 3rd high level group report: "Helping Energy Intensive Industries Adapt to the Energy and Climate Change Challenges";
- **8-9 March 2007:** EU leaders endorse key points contained in the package, agreeing on a two-year action plan to launch (in 2009) a Common Energy Policy;
- **19 Sept. 2007**: "Third Liberalisation Package" to ensure completion of internal market for electricity and gas proposed by the Commission;
- **22 Nov. 2007**: Commission proposal on Strategic Energy Technology Plan (SET-Plan);

- **23 Jan. 2008**: Commission presented legislative proposals for carbon trading for the period after 2013, along with revised EU state aid rules and a communication on carbon capture and storage (CCS), as part of a larger package on renewable energies and climate change;
- **March 2008**: Commission hopes for endorsement (and financing commitments) from EU leaders for the SET-Plan;
- **By spring 2008**: Second Strategic European Energy Review;
- **2020**: Target date to achieve the objectives.

European Commission opened a wide-ranging debate on a future European energy policy with the publication of a Green Paper on Security of Energy Supply in March 2006.

The need to act at EU level was prompted by mounting concerns regarding high oil and gas prices and worries about Europe's increasing dependency on a few external suppliers, as well as the global-warming crisis.

Central to the summit of March 2007 agreement is a recognition that energy and climate-change policies should go hand in hand. It stressed the need for "decisive and immediate action" on climate-change and underlined "the vital importance of achieving the **strategic objective of limiting the global average temperature increase to not more than 2°C above pre-industrial levels**". To achieve this aim, EU leaders agreed to:

- a **binding target to slash the EU's greenhouse gas emissions by 20% in 2020** compared with 1990 levels. EU leaders agreed that the objective should be pursued "unilaterally" even if there is no international agreement on reducing greenhouse-gas emissions after 2012, when the Kyoto targets expire;
- a commitment to reduce emissions by 30%, provided that other industrialized nations, including the US, commit themselves to comparable emission reductions and that "advanced developing countries" (i.e.: China and India) contribute as well in the framework of a post-2012 agreement.
- To achieve these objectives, the summit endorsed an action plan to be implemented between 2007 and 2009. The plan's main elements include:
- Completing the internal market for electricity and gas;
- a binding target to raise the EU's share of renewables to **20 % by 2020**;
- an obligation for each member state to have **10% biofuels** in their transport fuel mix **by 2020**;
- boosting **energy efficiency** with a target to save **20 %** of the EU's total primary energy consumption **by 2020**. New initiatives here include proposals for an international agreement on energy-efficiency standards for consumer appliances;

- aiming towards **"a low CO_2 fossil fuel future"** with support for "clean coal" technology, using carbon capture and storage deep underground;
- developing a common **external energy policy** to "actively pursue Europe's interests" on the international scene with major supplier, consumer and transit countries, including Russia;
- developing a **European Strategic Energy Technology Plan** to focus R&D efforts on low carbon technologies, and;
- on **nuclear**, the Commission chose to take an "agnostic" stance, leaving it up to member states to decide; [5].

Developing a European energy policy is a long term challenge. This need a clear but flexible framework: clear in that it represents a common approach endorsed at the highest level, flexible in that it needs periodic updating.
The Strategic EU Energy Review would offer a clear European framework for national decisions on the energy mix. It should analyse all the advantages and drawbacks of different sources of energy, from indigenous renewable energy sources such as wind, biomass and bio-fuels, small hydro and energy efficiency to coal and nuclear, and the knock-on effects of these changes for the EU as a whole.
Coal and lignite, for example, presently account for around one-third of the EU electricity production: climate change means that this is only sustainable if accompanied by commercialized carbon sequestration and clean coal technologies on an EU level.
Effective action to address climate change is urgent and the EU must continue to lead by example and, above all, work towards the widest possible action. Europe needs to be ambitious and must act in a integrated manner that promotes own objectives; [1].
The EU is already at the forefront of approaches to decouple economic growth from increasing energy consumption. Its action has combined robust legislative initiatives and energy efficiency programs with encouragement to competitive and effective renewable energy. However, the EU's commitment to fighting climate change is a long-term one.
Action on renewables and energy efficiency, besides tackling climate change, will contribute to security of energy supply and help limit the EU's growing dependence on imported energy. It could also create many high-quality jobs in Europe and maintain Europe's technological leadership in a rapidly growing global sector; [1].
Moreover, the recent energy supply crises have highlighted Europe's growing dependency on external sources of energy. Energy policy security and climate change security have ceased to be abstract ideas. There are two sides of the some coin; [6].

An effective energy efficiency policy does not mean sacrificing comfort or convenience. Nor does it mean reducing competitiveness. In fact, an effective policy in this area means the opposite: making cost-effective investments in order to reduce the waste of energy, thereby increasing standards of living and saving money, and using price signals that would lead to more responsible, economic and rational use of energy. Market-based instruments can be very efficient tool in this respect. Energy efficiency means making more from less; [1]. In the world of global interdependence, energy policy in B&H, however, necessarily has a European dimension.

4. Hydro Power

Hydro power is a mature technology that has long been used for economic generation of electricity.

Global energy use has risen by 70 % since 1971 and continues to increase at the rate of about 2% per year, demand coming from both developed and developing countries. There are many scenarios for future demand and the energy mix that will be needed to meet this.

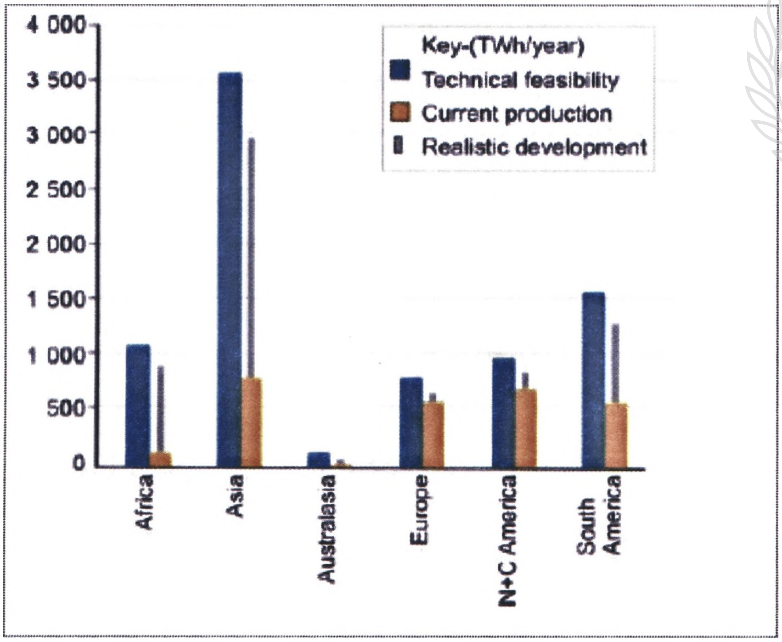

Figure 1 Estimated hydropower development by region
Source: International Hydropower Association

In 2005, renewable energy represented less than one-fifth of total power generation, [16]. Hydro power is the most advanced and flexible of the renewables and represents 87% of this type of energy production. During 2005 alone,

18GW of new hydro capacity was commissioned. Notwithstanding this, the entire renewables portfolio for heat, power and transportation offers an enormous potential. As far as hydro power resources are concerned, the International Hydro power Association estimates that only one-third of the realistic potential in the world has been developed (Fig. 1).
Hydro provides some level of power generation in 160 countries. Five countries make up more than half of the world's hydro power production: Brazil, Canada, China, Russia and the USA. If taking Europe as a benchmark (proportion of production in relation to realistic feasibility), hydro can be expected to see a ten-fold increase in Africa, a three-fold increase in Asia, a doubling in South America, and an increase of about 10% in North America. Just for North America, this would equate to an additional 16 GW of new capacity, of which 11 GW is already identified in Canada. While this expansion will be determined by the needs of the North American market, future development in many less-developed regions will rely more heavily on finding long-term funding mechanisms and appropriate partnerships, thus controlling the rate of progress.
Most of the early hydro power projects were built to provide a primary 'base load' to the power system and this pattern will continue in countries where hydro power occupies a significant share in the power generation mix. As other technologies have been introduced, hydro has tended to evolve into a supporting role - responding to gaps between supply and peak demand.
The challenge is to continuously improve hydro power technology in terms of environmental performance, materials, efficiency, operating range, and costs. From the smallest to the largest, all developments have a footprint, especially evident in the cumulative effect of many small schemes. Smaller-scale hydro plays an important role in remote areas, in community developments, and in maximizing the value of multi-purpose infrastructure - applicable in both developed and developing countries. Large schemes will continue to be the most environmentally benign in supporting grid systems and powering industrial and urban centers; [16].
The least-cost option for producers desiring additional capacity is almost always to modernize existing plants, when this is an option. Equipment with improved performance can be retrofitted, often to accommodate market demands for more flexible, peaking modes of operation. Most of the 807 GW of hydro equipment in operation today will need to be modernized by 2030. There are many recent cases of incremental hydro power, both where current capacity has been added to, and where existing infrastructure has been reworked, resulting in entirely new hydro power facilities.
Development of hydro has a long-term economic advantage. With annual operating costs being a tiny fraction of the initial capital cost, hydro's

autonomy from the fuel price is a distinct advantage. The flexibility of storage hydro (using reservoirs) also makes it a compelling partner to ensure security in mixed power systems. Another driver for hydro development is the increasing need for water management. Multi-purpose hydro reservoirs can bring security of water supply as well as power.

Storage hydro and, in regions where the quantity of water is limited, pumped storage can solve a plethora of system challenges. It can follow load fluctuations, so that fossil-fuel plants can continue to operate at their best efficiency. Wind power produces a variable and intermittent supply and hydro can provide the firming capacity to ensure both security and quality in the system. The characteristics of geothermal plant are well suited to base-load operation; hydro's flexibility can support it by meeting peaks in demand. Similar synergies with solar, bio-generation and marine power will develop as these technologies move into larger-scale deployment. In many regions where there is a diverse mix in the power system, storage hydro and pumped storage ensure total system security and maintain the quality of supply; [16].

Today, small-scale hydro power plants are generally accepted as renewable and sustainable sources of energy [13]. There are different classifications of small-scale plants (in B&H, it is generally accepted that they are plants up to 5 MW). Both large-scale and small-scale plants may be of different types. These are river plants, especially in cases when dams and reservoirs are primarily constructed for water supply and irrigation purposes. However, on small watercourses, mainly the run-of-river hydro power plants, which use relatively large heads with relatively small discharge, have been built.

Their advantages include: source renewability, lack of any adverse emissions and other types of pollution, "free" raw material and in certain cases the closeness of users. Disadvantages are the following: without dams and reservoirs, the electric power is produced according to the regime that varies, generally inversely proportionate to the size of the watercourse. If a really environmentally friendly small-scale hydro power plant is to be built, then the environmental flow must be satisfied - the guaranteed quantity of water that will always flow through the watercourse between the intake and turbine hall -which causes the additional significant reduction in exploitable flow, especially during dry periods. Run-of-river plants on small watercourses produce, "less valuable", "base" energy, due to impossibility to guarantee the delivery to the system, in accordance with the needs, since the run-of-river plants deliver electric energy depending on the quantity of water available. On the other hand, storage hydro power plants usually cover the "peak" part of their electricity needs, and due to uniquely large speed of putting into operation they are the only efficient way to maintain the voltage and frequency in the network during abrupt consumption changes. The price of generated kWh

from a small-scale hydro power plant may be defined by law. (That is generally the case in B&H as well, due to the political orientation to promote this type of production). Still, the utilization value of such kWh is smaller than for the one from thermal power plant, and that value is even smaller than the value of kWh of the storage or pumped storage hydro power plants, which may store energy for the shortage periods.
Scattering of a larger number of small-scale hydro power plants in relatively inaccessible areas, may be a strategic advantage in crisis situations, but also a major disadvantage in an ordered and regulated electric power system, due to large costs of transmission lines and voltage transformation, as well as access roads.
Due to savings in designing, construction and assemblage, the exploitation coefficients are smaller than with large-scale hydro power plants ("off-shelf" turbines that are close to optimum ones are used, while with large power plants they are optimized for each individual scheme). Shortly, the price per installed kW is still double in comparison to the large-scale hydro power plants, and it ranges from $ 2000 to 5000, and even $ 8000 in the world. It has almost the same disadvantage as the large-scale power plants, and even most of the renewable sources, which is large initial investment, and this means that it is necessary to wait usually about 10 or even more years for the power plant to pay off and become profitable.
In order to replace production of one medium-scale hydro power plant of let's say 100 MW, it would be necessary to build approximately 100 small-scale hydro power plants in the same number of locations, and make transmission lines from all these locations to the electric power system, maintain equipment (200 small power generators) and guard the structures, and change the flow regime at length of approximately 200 km of small watercourses. If we presume that there will be equal production in GWh, large-scale hydro power plants still may have several times larger capacity to fulfill the needs of power system, in terms of daily and seasonal differences in demand.
However, the advantages of small-scale hydro power plants often still prevail over other alternative sources, and their development will continue with large intensity, which will lead to additional decrease in prices per unit of production. The positive role of small-scale hydro power plants in the future is very important and certainly unquestionable, but they cannot replace the conventional hydro power plants with reservoirs; [13].
In terms of climate change, hydro power tends to have a very low greenhouse gas footprint. As water carries carbon in the natural cycle, scientists have investigated the extent to which a new reservoir might accelerate carbon emissions. In some very shallow tropical reservoirs, this may be the case, and the factor would need to be taken into consideration in the life-cycle analysis

of such schemes. In contrast, many reservoirs around the world have been monitored to test their emissions, confirming that hydro power is one of the cleanest methods of power generation; [16].

Today we can also hear the ideas that hydro power which uses water reservoirs is not renewable. It is true that reservoirs have their lifetime and in some cases, this lifetime was overestimated. Filling up of reservoirs does not reduce the natural hydro power potential, but only the flexibility in hydro power plant's operation. The total volume of water is still the same, which can, at the same overall head, produce the same amount of energy; [13].

Population growth in emerging markets is both a driver and a constraint. The demand for land and water resources increases with population growth. However, water management is key to sustainable development. Many future projects will be multi-purpose, climate-mitigation structures, for drought protection and flood mitigation, in addition to power generation. By storing water, freshwater reservoirs increase water security; by maintaining reserve storage capacity, reservoirs can absorb peak flows during flood events; and, by employing hydro power generation in place of fossil-fuel technologies, a significant offset of greenhouse gas emissions can be achieved.

Finding the right balance is fundamental. Sustainability criteria demand that economic decisions incorporate environmental stewardship and social justice.

Sustainability assessment is applicable to both existing schemes and new developments. Europe and North America tend to have the most advanced regulatory frameworks. While comprehensive assessment is necessary, much superfluous bureaucracy is created in the development of new projects and the periodic re-licensing of existing installations. The high administration costs are a significant burden, especially for smaller companies and smaller countries. In Europe, both the Water Framework and Emissions Trading Directives are in need of clarification regarding hydro power. For the transition countries and the developing world, regulations relating to the Kyoto mechanisms need to be better understood. In addition, financial institutions must standardize their policies to avoid unnecessary duplication and inefficiency; [16].

Many economically feasible hydro power projects are financially challenged. High up-front costs are a deterrent for investment. Also, hydro tends to have lengthy lead times for planning, permitting, and construction. When life-cycle costs are examined, however, hydro often has the best performance, with operating costs being low in comparison with the capital investment. The development of more appropriate financing models is a major challenge for the hydro sector, as is finding the optimum roles for the public and private sectors. The main challenges relate to creating investor confidence in hydro power and reducing risk. Green markets and trading in emissions reductions will

undoubtedly provide incentives in some areas. In developing markets, interconnection between countries and the formation of power pools will build investor confidence. Feasibility and impact assessments carried out by the public sector, prior to tenders from the developers, will ensure greater private-sector interest in future projects.
Unfortunately, investment often only materializes when the need becomes urgent - when the lights go out. Unless policymakers are better informed, much of the investment will be targeted at quick-fix solutions. The avoidance of such unsustainable development is a major challenge; [16].

5. Large Dams and Environmental Protection

Worldwide, many countries rely on hydro power for a substantial portion of their electricity. In developing countries, rapid urbanization and continued population growth will ensure increased demand for electric power for decades. Thus, energy planers are likely to continue seeing hydroelectric projects as a promising resource. With large dams continuing to be developed, it is important to find sites that minimize environmental effects.
In the world (but here as well), we are very often witnesses to large media and public campaigns against hydro power plants with reservoirs, which go that far to say that hydro power plants are the enemy no. 1 to environment. It is also interesting to observe that not even closely the same level of attention is given to unheard-of production of plastic bags, bottles and other indestructible throwaway packaging, which, in case of B&H, largely ends up on the banks of rivers and reservoirs.
From an environmental standpoint, all large dams are not alike. The site largely determines the amount of possible environmental damage from a proposed project. While dams at good sites can be environmentally very friendly, those at unfavorable sites often will be problematic, even if all available mitigation measures are properly implemented. Examples of adverse environmental effects that cannot be fully mitigated include:

- Irreversible biodiversity loss, if critical natural habitats not occurring elsewhere are submerged or left dry;
- The pre-dam ecological balance of a river, in terms of species composition or fish migrations, cannot be fully restored with fish ladders facilities; and
- Some cultural property (including sacred sites) cannot be adequately salvaged before reservoir inundation.

Furthermore, ideal mitigation measures may not be carried out due to limited budgets, tight construction schedules, conflicting priorities, and/or weak implementing agencies.

Thus, the single most important environmental mitigation measure for a new hydro project is good site selection, to help ensure the proposed dam will be relatively benign.
Possible adverse environmental and related social effects of large dams and reservoirs are [14], [15]:

- Loss of natural habitats and wildlife;
- Involuntary displacement of people;
- Water quality deterioration;
- Hydrological changes downstream;
- Water-related diseases;
- Damage to fish species and other aquatic life;
- Floating aquatic weed proliferation;
- Loss of cultural property;
- Greenhouse gas emissions;
- Salt water intrusion;
- Effects of complementary works (access roads, transmission lines, quarries and borrow pits);
- Effects of induced development (irrigation, urban, industrial, more dams, if flow regulation from one dam makes others on that river more economical).

While some effects occur only during construction, the most important effects usually are due to the long-term existence and operation of the dam and reservoir.
Worldwide, the proportion of sites available for hydroelectric generation that have been developed is roughly 15 %. This means that many developing countries have numerous, and varied, choices for hydro project sites; [15].
Large hydroelectric projects typically are connected to a national or regional power grid. Thus, government or private sector planers have the opportunity to identify those sites that would be the least damaging from an environmental standpoint, especially in relation to the amount of electric power or other economic benefits generated.

6. B&H Challenges

6.1. Environmental aspects of hydro power in B&H

The most common argument given by those who strongly oppose the construction of (new) hydro power plants is that the developed "West" has realized how much the hydro power plants are "bad" and that is why today it is impossible to build even one hydro power plant there. For most of the highly developed countries it is true that there will be no new hydro power schemes. Why? Primarily since all hydro power plants that could be built have already been built a long time ago. We can look at the Table 1 which presents an overview of hydro power potential in selected countries and how much this potential has been used (the most developed European countries have been selected, which have either significant or large share of hydro power in power system, as well as several countries outside of Europe, or those to which hydro power is the most important source in the power system); [13].

	Gross potential (TWh/year)	Technically usable (TWh/year)	Economically usable (TWh/year)	Installed (TWh/year)	Degree of potential utilization (%)	Share of hydro power in the power system (%)
Germany	120	25	20	24.8	124.0	4.0
Latvia	7.2	4	3.9	4.3	110.3	75.3
France	200	72	71.5	72	100.7	15.0
Switzerland	144	41	35.5	34.5	97.2	56.0
Belgium	0.6	0.45	0.4	0.385	96.3	0.5
Italy	150	69	54	51.6	95.6	19.5
Ukraine	45	23.5	19	15.9	83,7	9.2
Japan	717.6	135.5	114.3	95.6	83.6	9.0
Albania	40	15	6.4	5.3	82.8	98
USA	4485	528	376	309	82.2	9.0
Slovakia	10	6.6	6	4.75	79.2	17.5
Ireland	1.4	1.18	0.95	0.725	76.3	5.0
Sweden	200	130	90	68.3	75,9	47.7
Paraguay	111	85	68	51.3	75.4	99.5
Austria	150	54	53.7	37.5	69.8	65.0
Canada	1332	981	536	350	65,3	61.3
Norway	560	200	180	116.5	64.7	99.4
Finland	46.5	20	19.7	12.2	61.9	19.0
Slovenia	12.5	8.8	6.1	3.7	60.7	29.6
Croatia	20	12	10.5	6.1	58.1	46
Serbia and Montenegro	?	27	27	12	44.4	32.0
B&H	68.6	24	22	8.9	40.5	48
Europe	3220	1225	775	567	73.2	

Table 1 Share of hydro power in selected countries

It is interesting to see that France, Germany, Italy and Switzerland are at the top of the table (Latvia and Belgium are less interesting in this sense, due to small number of water resources). Germany and France have built the plants

by which they use almost entire technically usable potential, exceeding the amount that was assessed as cost-efficient.
If we analyze other developed countries as well, we will see the correlation between the level of economic development (standards) and utilization of hydro potential. B&H is at the bottom of the European list with utilization of only 55% of the average potential utilized in other European countries. It is even slightly behind all other neighboring countries, although it has significantly larger potential.
It is interesting that one such a large country like Brazil, can satisfy over 95% of its electricity needs from hydro power plants. Norway practically produces all its energy in hydro power plants. The orientation of these countries is obviously to rely primarily on hydro energy in the future as well. One more interesting thing is that the Alpine, record-large dams are a type of tourist attraction in Switzerland, and that the Swiss people are very proud of them. Economically speaking, in countries with appropriate natural resources, hydro power plants had a decisive development role [13].
Today however, the approach to planning, construction and management of reservoirs must be drastically changed, as it indeed has started to change, but somewhat too slow. Namely, today we are aware of many environmental disadvantages of large hydro power plants, about which we learned from numerous examples in the past. Large dam is not an end in itself, but it represents a way to achieve optimum use of water resources (flood control, creation of water reservoirs for dry periods, water supply, irrigation, navigation, fish-farming, recreation and, of course, electricity production). Reservoirs are one of the basic tools for solving of water management problems in every basin. In this matter, it is important that they can be used for all of the above mentioned purposes, which are applicable under the conditions given.
Approximately 45,000 large dams have been registered in the world today. Most of these dams have been successfully implemented, but some problems have also occurred that may be put into categories from “environmental problems” to “failures” (loss of function) and even “disasters”. 142 “failure” cases have been registered [13], including one of our local dams - Idbar, downstream from Konjic, which has not been torn down, but it has also never started to operate due to instability of its right wing (since the adequate bottom outlet has not been foreseen, during the reservoir testing, water from the reservoir had to be released through the opening made by explosive).
When talking about failures, the most frequent concern is related to tearing down of dams. The largest enemy of dams is water, and the most common reason why dams are torn down is inadequate sizing of overflows and operational problems with them (34 %), problems with foundation engineering and stability of slopes (30 %) and inadequate infiltration regime through the

foundations (20 %). One of these three reasons is responsible for 84% of damages, while the remaining 16 % is caused by other problems; [13]. It is interesting that the significant problems caused by seismicity, or earthquakes, have been registered only with two dams in the world, but one of them did not suffer any significant damage. Still, the most common concern of the public, when dams are in question, is related to the danger of earthquakes.

The significant reason for "animosity" of the public toward the hydro power plants may also be the feeling that they are somebody else's property, and that the others (minority) benefit from, while the majority (at least of local population) is damaged by them, what unfortunately often has been truth. Absolutely nothing has been done in B&H on raising of public awareness and promotion. The access to these structures was (and still is) forbidden, as well as taking of photos, therefore the people see them as imposed and undesirable foreign body. In all EU states, the practice is exactly the opposite. Hydro power plants are open for the public, local and foreign tourists etc. Large boards have been placed, which present all more important data and interesting facts about the plant, the brochures and souvenirs may be bought, and all tourists may take as many photos as they want. In addition, by presentation of important facts, the awareness of the people is raised, and they realize that the electricity without hydro power plants would be more expensive, and cuts in electricity supply more frequent. In this way, people no longer have fear of the unknown, and they understand that they personally benefit from these plants, and they start to see them as "their own"; [13].

One of the more important arguments of those who are against construction of new hydro energy schemes, is that B&H has a "surplus" of energy, since it "exports" electricity, and new hydro power plants are therefore not necessary. It should be right away emphasized that B&H has a "shortage" of energy, since it imports oil and gas, which must be paid by something, and the electricity "surplus" largely exists because of heavy losses inflicted on industrial production. Such situation may not last for long and the electricity needs in B&H will certainly grow. In addition, we should bear in mind that B&H has deficits in foreign trade in almost all fields, and that „surplus" in one field (electricity in this case) can certainly not be considered as unnecessary! In the trade-economy equation, there must be a "surplus" somewhere, which can cover the numerous "shortages".

As it has already been mentioned earlier, the main problem in acceptance of hydro power plants are large dams and reservoirs that they make. From the aspect of environmental protection, the most important fact is that, no matter for how long they last, the dams are not everlasting, and hence there is the issue of sustainability. In the eyes of the public, the largest problems are the loss of quality of water in the reservoirs so as loss of natural water sources, loss of land and landscapes. If all main negative impacts of reservoirs are simplified, they come down to the size of artificial lakes, in other words the area and storage capacity taken by them.

No.	Name	Watercourse	Basin	Storage capacity 10^6 m^3	Area (ha)	Purpose
Black Sea Basin (Sava River Basin)						
1.	Jajce II	Vrbas	Vrbas	3.5	47	E
2.	Bočac	Vrbas	Vrbas	52.7	233	E
3.	Modrac	Spreča	Bosna	88	1675	WS,C,O
4.	Snježnica	Rastošnica	Bosna	20.6	103	WS
5.	Bajina Bašta	Drina	Drina	355	1030	E,C,WS,O
6.	Zvornik	Drina	Drina	89	1380	E
7.	Višegrad	Drina	Drina	161	890	E
8.	Hazna	Hazna	Adjoining the Sava Basin	0.7	12	C,R
9.	Vidara	Vidara	Adjoining the Sava Basin	2.9	46	C,WS
10.	Drenova	Vijaka	Adjoining the Sava Basin	9.5	132	C,WS,O
Sava Basin				762.90	5548	
Adriatic Sea Basin						
1.	Jablanica	Neretva	Neretva	318.0	1440	E,C,I,O
2.	Grabovica	Neretva	Neretva	21.1	134	E
3.	Salakovac	Neretva	Neretva	68.1	370	E
4.	Mostar	Neretva	Neretva	10.9	161	E
5.	Rama	Rama	Neretva	487	1550	E,C,I,O
6.	Svitava	Krupa	Trebišnjica	44	1000	E,C
7.	Tribistovo	Ružički stream	Trebišnjica	5.0	70	WS
8.	Klinje	Mušnica	Trebišnjica	1.7	26	I,WS
9.	Alagovac	Alagovac	Neretva	3.6	70	WS
10.	Vrba	Vrba	Trebišnjica	14.6	77	WS
11.	Bileća	Trebišnjica	Trebišnjica	1280	2764	E,C,I,O
12.	Gorica	Trebišnjica	Trebišnjica	15.0	171	E
13.	Popovo polje	Trebišnjica	Trebišnjica	5.4	86	E,WS,I
14.	Mandak	Mandak	Cetina	1.8	35	K,WS,I
15.	Lipa	Brda-Lipa	Cetina	2.3	230	E,WS,I
16.	Buško Blato	Ričina	Cetina	800	5670	E,WS,I
Adriatic Sea Basin				3078.5	13854	
TOTAL (both basins)				3841.4	19402	

Index: C - Flood control; I - Irrigation; O - rising the level of low water
E - Energy; WS- Water supply; R - Recreation

Table 2. Overview of artificial lakes in B&H

In addition to the above mentioned existing reservoirs, different water management plans have foreseen 35 additional reservoirs with the storage capacity of 3.473 x 10^6 m^3 and area of 14.340 ha. These include 24 artificial lakes/reservoirs in the Black Sea Basin (ΣV= 2.352 x 10^6 m^3, ΣP = 10.070 ha), and 11 in the Adriatic Sea Basin (ΣV= 1.120 x 10^6 m^3, ΣP = 4.267 ha); [14].

Most of these planned reservoirs will be used, among other things, for electricity production. In certain cases, some land areas and parts of watercourses with special residential, agricultural, landscape, ecological and other values would be covered by water. Almost all planning documentation based on which these reservoirs have been defined, is more than 20 years old. In the meantime, many criteria and conceptions have significantly changed, and it would therefore be for the best to first make new water management plans (better to say River Basin Management Plans, in compliance with the EU Water Framework Directive), new studies regarding the usability of parts of watercourses that have not been used yet, new spatial plans, and the like, in order for the most favorable sustainable solution to be defined, taking into account all available data, standards and criteria, as well as the facts known today; [13].
As it is no longer acceptable to build too large reservoirs, it is also hardly acceptable to cover entire watercourses with water and turn them into lake steps. Although other human or tourist activities, such as rafting for example, cannot in economic terms be competitive to electricity production at the same river reach, this does not mean that the entire river should be covered with water, and in that way the possibility to practice rafting eliminated. On the other hand, this should not mean that nothing can be built, since, as we saw, there will be the shortage in electricity, and alternatives to hydro power plants are mainly more expensive, dirtier and less flexible.
Through development of new planning documentation, taking into account all interests (not to build anything may not be anybody's serious interest), the solutions acceptable for all could be found. If realization of projects for a long period of time would continue to prolong, it might come to the point that there will be no one on the B&H side to implement them, nor will there be anyone to implement them for.
In both B&H entities, the environmental laws have been passed, which are harmonized with the EU standards, and which prescribe the obligation to develop the Environmental Impact Study, for hydro power plants as well (including the existing ones). Such studies must identify the problems, establish the environmental management measures and monitoring, as well as measures for mitigation and compensation.
For example, expropriation compensations would have to be acceptable for inhabitants that have to move. This does not mean only financially acceptable, but also socially acceptable, through compensation of lost land, employment and the like. In addition, the common "minimum flow" (the quantity of water that must be released in order to supply other users, including environment as one of the key users, previously usually neglected), will have to be redefined as "environmental flow", which will certainly be larger than the one from pre-

vious practice, whose release causes the decrease in production of electricity. Aiming at preservation of acceptable water quality, we will have to implement adequate measures. Further on, structures such as artificial spawning sites, fish ladders, selective intakes, discharges of turbid currents, compensation tanks etc. will become the common structures within new hydro power plants.
All this implies additional costs and reduction of profit, with aim to preserve existing (pre-dam) environmental conditions, what was largely neglected in the past; [14]. As a result, aiming at environmental sustainability, costs of construction will be larger, and the impact on cost-efficiency of such schemes might cause delay in the realization of some of these schemes for the time when, after other energy sources become more expensive, they will again be acceptable.
The activities of non-governmental organizations in B&H, which are on average against building of new reservoirs, sometimes have such unpleasant formulations like "there is no common sense in that", they are "monstrous, or half-crazy, or crime plans, crumbs of projects worth millions" and those who support the construction are called "yes-men of energy lobby" etc. However, in one serious brochure [9], recently promoted in the Academy of Arts and Sciences of B&H, the "Greens" say: "It is very important for the movement against construction of dams not to become so radical to develop into a movement which is against construction of any dam. It is in the first place necessary to request the transparency of the project, involvement of all interested parties during the entire process, from the planning to designing phase, and possibility to directly give recommendations for improvement and correction of designs, where that is possible. In cases when the project may cause maximum negative impacts on people and environment, project abandonment should be requested".
The developed countries have constructed their hydro power plants during the period when they did not have to fulfill even much less strict environmental management conditions. Countries in development will construct their plants in future, under much stricter conditions.
Unused natural resources cannot pull us out of poverty. Only through improved, rational and sustainable management, natural resources in B&H can gain value, which is B&H' only chance toward sustainable development.

6.2. Hydro Power Situation in B&H

Use of hydro energy potential in B&H started in 1895, when first hydro power plant was constructed on the Pliva River, with installed capacity of 7 MW, which was at the time the largest in Europe. Until 1917, several hydro power plants were built: "Plava voda" (Blue Water) /Travnik, "Kanal-Una" (Una

Channel)/Bihać, "Krušnica"/Bosanska Krupa and "Hrid"/Sarajevo, which, together with smaller thermal power plants, satisfied the electricity needs at that time. In the period between two world wars, until 1939, small-scale hydro power plants "Fojnica", "Ljuta", "Bugojno" and others were built, 16 small-scale hydro power plants in total, with total installed capacity of 10.7 MW and production of 48 GWh. More intensive construction started after the World War II. The dynamics was different, depending on the possibilities and consumption growth.

Hydro power situation in B&H today is shown in Table 3; [4].

Federation of B&H - existing hydro power plants		
Elektroprivreda B&H [1]		
Name	HPP Power House output	Expected annual production
	(MW)	(GWh)
Jablanica	175	771
Grabovica	114	334
Salakovac	207	410
Small scale HPP B&H	13	65
Total EP B&H	509	1580
Elektroprivreda HZHB		
Čapljina	400	200
Rama	159.4	650
Mostar	71.6	247
Jajce I	58	233
Jajce II	28	157
Peć Mlini	30	82
Total EP HZHB	747	1569
Total F BiH	1256	3149
Elektroprivreda RS - existing hydro power plants		
Višegrad	315	1038
Bočac	110	307.5
Trebinje I	180	535.4
Trebinje II	7.6	12.5
Dubrovnik I (50%)	108	695.6
Small-scale and industrial hydro power plants	14.1	72
Total EP RS	734.7	2660.9
Total B&H	1990.7	5809.9

Table 3 Overview of the existing hydro power plants (HPP) in B&H

[1] Currently in B&H power sector there are three major producers and distributors of electricity, public utilities - Elektroprivredas (EPs): Elektroprivreda B&H (EP B&H), Elektroprivreda HZHB (EP HZHB) and Elektroprivreda RS (EP RS). Each EP has its own generation and distribution facilities and is in charge of generation, distribution and supply on its territory.

Name	HPP Power House output (MW)	Expected production (GWh/year)	Specific investment EUR/kW	Construction duration (year)	Earliest year of commissioning
Federation of B&H					
Elektroprivreda B&H					
Small-scale HPP EP B&H	34.2	126.6	1493	2	2009
Unac	71	250	963	3	2012
Ustikolina	59	255	1396	4	2013
Vranduk	22	103.2	2111	4	2013
Glavatičevo	171.8	295	1048	5	2014
Bjelimići	100	306.4	1660	5	2016
Vrhpolje	68	157.4	1562	4	2016
Čaplje	7.7	56.8	2845	4	2016
Konjic	121	290	1074	5	2016
Total EP B&H	654.7	1840.4			
Elektroprivreda HZ HB					
Mostarsko Blato*	60	167	1200	4	2010
PHPP Vrilo	52	92	1149	5	2011
PHPP Kablić	52	73	1437	5	2012
Han Skela	8.5	36	1500	5	2015
Vrletna Kosa	25	63	1500	5	2013
Jajce II -extensión of HPP Ugar Mouth	15	60	1500	5	2014
Small-scale HPP HZ HB Basin T-M-T	19.9	127.7	1881	2	2010
Lištica Basin	7	27.7	1832	2	2011
Gornja Cetina Basin	12.7	30.7	1650	2	2015
Total EP HZ HB	252.1	677.1			
Total F BiH	906.8	2517.5			
Elektroprivreda RS					
Small-scale HPP on the territory of RS	212	650	1750	2	2009
Buk Bijela	132	450	2121	4.5	2013
Foča	56	199	1512	4	2012
Dabar	160	271	1049	4.5	2013
Bileća	36	117	1417	3.5	2013
Dubrovnik II	152	159	1153	4	2015
Nevesinje	60	101	2027	5	2013
Krupa	49	140	1528	5	2015
Banja Luka low	37	187	2316	5	2019
Novoselija	16	70	1559	2.5	2019
Ključ	49	2011	2998	4	2019
Total EP RS	958	2555			
TOTAL B&H	1865	5072			

* under construction

Table 4 Hydro power plant candidates in B&H

Average annual precipitation on the territory of B&H is 64 km³, of which 59% runs down the watercourses, or 38 km^3. Behind 26 dams (5 rock- and earth-fil-

led dams, 20 concrete dams and one constructed from blocks), are reservoirs with total storage capacity of 3,85 km^3, or approximately 10% of total runoff volume.
With its hydro energy potential, B&H is at eleventh position in Europe (without the European part of Russia, behind Norway, Sweden, France, Italy, Austria, Island, Spain, Switzerland, Serbia and Montenegro), and in front of Germany, Portugal, Finland and Ukraine, which have similar potential. A large part of other European countries has much smaller potential than B&H.
The annual electricity consumption in B&H has decreased from 13.8 TWh (1991) to approximately 11 TWh in 2000. The share of production from hydro and thermal sources is approximately equal today, while in the period before the war the share of hydro energy varied from 25 to 40%. Approximately 10% of produced electricity is exported to neighbouring countries, whose needs for import are approximately 4 times larger than that.
The total capacity of pump-reversible plants is 660 MW. The total capacity of hydro power plants in B&H, if entire potential would be used, could be between 5600 and 6800 MW. Usable hydro potential is estimated to 22 TWh per year, and the potential used today is approximately 40%.
The Table 4 shows hydro power plant candidates in B&H, according to the existing plans of Power Companies (Elektroprivredas) in B&H [4].
Unused potential for small-scale hydro power plants is approximately 2.500 GWh per year. Studies from the period 2000-2002, identified approximately 140 small-scale plants from 1 to 5 MW. By the Law from 2002, the state guarantees the price of kWh from small-scale hydro power plants (with capacity up to 5 MW) in the amount of 7.74 pfenings, which creates conditions for implementation of plans on construction of approximately 10 new small-scale hydro power plants every year.
In addition to public Power Companies (Elektroprivredas), new projects will be managed by several other, private companies from both entities, as well as foreign concessionaires. For some reason, the larger part of them is not willing to give even basic data about plants in operation, therefore, during a short research period it was not possible to get the updated picture of current situation. It would be useful to see what is the situation like for the entire B&H, and there is not obvious reason why this data should be (treated like) a secret. Such practice reminds of the common (unnecessary) secrecy associated with large projects before the war, which partially lead to an aversion of a large part of the general public toward hydro power plants. If such practice continues with small-scale hydro power plants, can soon be expected similar reaction of the public towards them, since, as it can be seen, they are not completely friendly to environment. Naturally, issues will be raised that, if the data is kept a secret, something must be wrong with it!

6.3. Accents from Medium Term Development Strategy 2004-2007 for Energy Sector

The major goals of the energy sector reform are:
1. Stimulate national and international investment;
2. Ensure a more reliable supply of energy, at lowest prices;
3. Join the international market through a single market of electric power and gas in B&H;
4. Enhance cost-effectiveness and rational use of energy sources and improve energy efficiency;
5. Implement liberalization and introduce competition and transparency;
6. Ensure protection of environment in accordance with national and international standards;
7. Protect interest of the system users;
8. Increase the use of renewable energy sources;
9. Meet the conditions of the European Energy Charter Agreement, as well as other international contracts and agreements.

(Just to remember)

7. Conclusion and Recommendations

7.1. Conclusions

- Energy needs in the world, and in the region, including B&H, will grow during the forthcoming 50 years;
- In the foreseeable future, it is realistic to expect constant rising of prices, and then final exhaustion of fossil fuel resources, which are largest environmental polluters;
- Alternative energy sources, toward which we aspire, will not be able to replace the conventional sources during the forthcoming 50 years;
- Small-scale hydro power plants, as generally accepted as sustainable and renewable energy sources, will play a very important role in the power system, especially in the distanced areas, close to isolated users. Nonetheless, it is not realistic to expect, even with full use of their potential, that they could supersede or replace their large "cousins";
- The developed countries, whose standard is considered to be a model toward which all other countries aspire (e.g. USA, Japan, Switzerland, Austria, Italy, Germany, France, Norway, or Sweden) have entirely, or almost entirely used their available hydro potentials;
- The utilization of hydro potential in B&H is at the bottom of the European list, including the neighbouring countries, which, due to deficits in the

available resources, present potential market for possible surplus in electricity production in B&H. Production of electricity is one of rare economic fields in which B&H will still be able, for certain period of time, to produce "surplus";

- Hydro energy, although not being ideal as it was considered 20-30 years ago, will remain one of the most important sources for electricity production and not as much because of quantity as because of the quality that lies in the simple flexibility during satisfaction of peak needs;
- New hydro power plants will have to be built in environmentally friendly manner, for which there is the know-how, as well as legislation. The existing hydro power plants will also gradually have to satisfy the newly set environmental criteria;
- There is a clear correlation between the development of a certain country, and level of utilization of its hydro potential and management of other natural resources. Accordingly, B&H can be pulled out of poverty through improvements in management of water and other natural resources.

7.2. Recommendations

- Promotion of importance of hydro power plants, their opening for the public, and fair dissemination of information about positive as well as negative aspects of their operation, is not only desirable but indispensable for development of new hydro power schemes. Without this development, we would all loose an important component of modern life - we would have to get used to frequent power shortages, and even more frequent power cuts, due to breakdowns in parts of the network;
- It is especially necessary to conduct an environmentally concerned review of conceptual designs for hydro power utilization of parts of basins, in cases where there is a large opposition of the public (e.g. „Gornja Neretva" (Upper Neretva), „Gornji horizonti" (Upper Horizons) Trebišnjice, gornja Drina (Upper Drina), Banja Luka and others). This would imply development of new studies in accordance with the environmentally sustainable principles, paying special attention to all stakeholders and providing public consultations. In this way, it would be possible to find solutions that could, although they do not have optimum level of energy usability, satisfy all stakeholders, which would put an end to the stalemate, and create preconditions for real environmentally sustainable development.

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