Which countries in Central and South Eastern Europe are attractive for Investment in Small Hydro Power Plants?

Detailed comparison of the Markets in
Bosnia and Herzegovina, Bulgaria and the Czech Republic
and a general analysis of the markets in
Croatia, Serbia, Slovakia, Turkey
with a comparing view on
Montenegro, Romania and Slovenia

A Master Thesis submitted for the degree of
"Master of Science"

supervised by
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Vienna, November 2009

Affidavit

I, Mag. Christian Kopecek, hereby declare

1. that I am the sole author of the present Master Thesis,
   "Which countries in Central and South Eastern Europe are attractive for Investment in Small Hydro Power Plants?",
   259 pages, bound, and that I have not used any source or tool other than those referenced or any other illicit aid or tool, and
2. that I have not prior to this date submitted this Master Thesis as an examination paper in any form in Austria or abroad.

Vienna, November 6th 2009

Date Signature

Abstract

The work tries to find attractive markets with future growth for the Small Hydro Power Industry within the CEE/SEE region.

The method chosen was to identify countries to be analysed, assume criteria for investment decisions in the Small Hydro Business, collect data, condens and evaluate it.

The results show, that mainly because of their well-balanced attractiveness countries like Czech Republic, Slovakia and Slovenia might show a strong growth in this industry in the near future.

Markets like Bulgaria, Romania and Turkey could see some substantial growth either because of vast potential or because of investor-friendly environment.

The other countries also have their chances but those might go with considerable project risk thus preventing the investors to enter into long term capital-intensive projects.

The conclusion is to go into more detail at site, apply own weightings in the evaluation and consider a well-balanced portfolio of high-low risk markets.

Executive Summary

The market for Small Hydro Power Plants in Austria does not offer much growth for the near future and for expansion. New attractive sales regions have to be developed.

The Master Thesis tries to identify attractive countries in CEE/SEE for Small Hydro Power Projects for a Company engaged in this industry. The method of approach was to collect, verify and document information available in literature, internet, with government authorities, market players, experts, etc. and to condense and visualize it. The assumption is that markets will develop when certain criteria for investors are fulfilled. Those criteria needed to be identified and compared with the condensed data of each country. A simple rating model was developed and the compliance with the assumed investment criteria was marked with grades for each country.

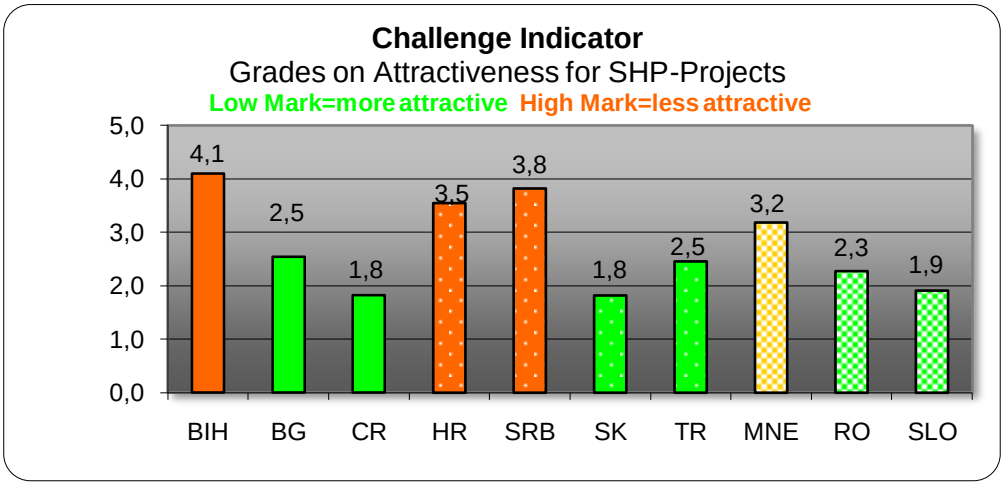

Figure 1: Challenge Indicator- Evaluation of Attractiveness for Small Hydro Power Projects

Source: Kopecek, C. 2009

The result of the analysis shows that within the intensively analysed “Focus 1” countries the Czech Republic seems to be the most attractive market regarding construction and refurbishment of Small Hydro Power Plants. The reasons are the favourable promotion system, the overall fine investment conditions in the country and - for revamping - the outstanding high number of aged plants. Bulgaria comes second in this group, also because of its attractive promotion system and because of a good balance in all other assumed investment decision criteria. Bosnia and Herzegovina has good Small Hydro site potentials and abundant water availability;

but this Balkan country is still struggling with post-war recovery and has severe structural and organisational deficiencies sometimes discouraging the investor's community.

"Focus 2" countries are led by Slovakia with a new advantageous Renewable Energy Law, well performing economy and the risk-free EURO as recently introduced currency. Turkey offers an extraordinary high potential for Small Hydro Projects with a very liberal attitude towards hydropower plants. The country has an unusually dynamic economy but needs urgent reforms. Croatia and Serbia are again former Yugoslavian countries struggling with restructuring and are both not easy to deal with for investors. Croatia is an EU-accession candidate with good incentives. Serbia has large hydropower potential but is missing a clear promotion system.

Slovenia is the favourite of the "Focus 3" countries with rewarding incentives, outstanding water availability and perfect economic performance within the EURO Zone. Romania has large potential and pro-active approach for new plants with a good promotion system but drifts into unsafe political and economical future.

Finally, Montenegro stands out with enormous water availability but presently low developed structures and framework for Renewable Energy Investors.

In the end, engagement in Small Hydro Projects will be a question of risk appetite, view on the future chances, ability to finance and already existing portfolio of investors. A good mix of high-low challenge countries seems advisable for further market development of the Company.

In order to assist the Company to start a subsequent verification process of the underlying data for the rating, which in some countries are extremely contradictory, relating information is given in the work. This refers to existing plants, pending single and multiple "cascade" projects, license holders, developers as well as tender and privatisation lists. The information contained in this work should also give some basis to set first steps for entering the new markets. Further research will be necessary on the reliability and actuality of the data in the concerned countries. The assumption on investment criteria and its weighting need to be tested and adjusted during further research. Permanent monitoring of the markets is required as some important criteria are subject to change. The availability of funding of capital-intensive projects with long payback periods in high-risk countries needs to be assessed as the bankability is a central precondition for projects to materialize.

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Glossary

APS – Alternative Power Station

CCGT – Power Station with Combine Cycle Gas Turbine

CR – Czech Republic

GPS –Geothermal Power Station

HH – High Head

IDA International Development Association of World Bank

IP – Installed Power Capacity

IPP – Independent Power Producer

LH – Low Head

MH – Medium Head

Mtoe - Thousand Tonnes Oil Equivalent

NAP II - National Allocation Plan

NPS – Nuclear Power Station

PS – Power Station

PSPS – Hydro Pumped Storage Power Station

RDC – Regional Distribution Companies

SCGT – Simple Cycle Gas Turbine

SEA - Strategic Environmental Assessment Report

SME – Small Medium Enterprise

TPP- Thermal Power Plant

TPS – Thermal Power Station

UCTE – Union for the Co-ordination of transmission of Electricity

1 Introduction

The Small Hydro Power (SHP) business is a mature technology compared to other Renewable Energy segments. Facing years of slow growth, barriers and limitations the SHP business has not been an easy industry. Even stimulating factors like GHG-emission limits and ambitious EU targets for shares of Renewable Energy Sources (RES) in electricity consumption are not automatically creating a boom in this specific sector as demonstrated in the comparison of electricity generation in EU-27 from 1990-2006:

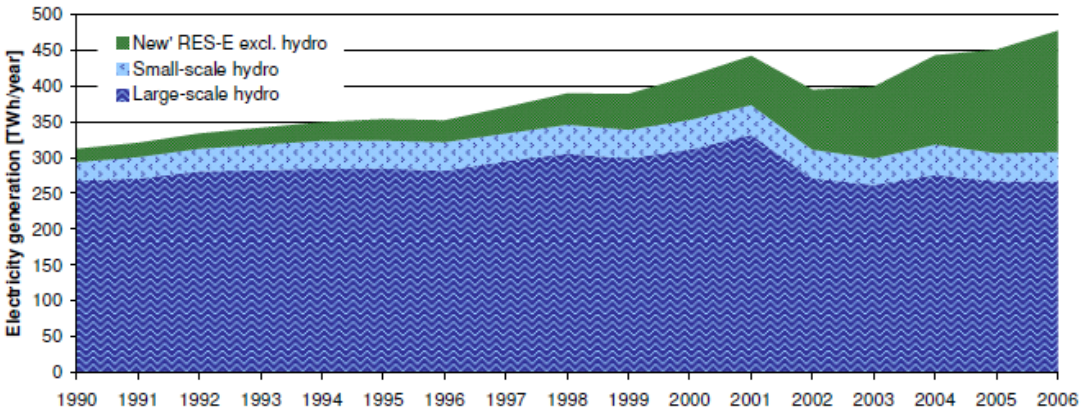

Figure 2: Historical Development of Electricity Generation from RES-E in EU-27 from 1990 to 2006

Source: Progress Study, Final Report, Utrecht 2008

The recent credit crunch turns out to be an obstacle for capital-intensive investments with a long payback period like SHP. The decision, where to concentrate the business development efforts is a difficult and critical one for the success of the international SHP industry.

For a Company in the value chain of the construction and operation of SHP the core questions are “Where are the attractive markets of the future?” and “What are the prerequisites to growth in the SHP market?”

Derived questions are “What are the peculiarities of the individual markets, what information is available for several countries, what is reliable and relevant for forming a first opinion?”

The methodical approach for finding answers with this Master Thesis was:

1. Defining the countries to be analysed
2. Selecting criteria, which are both, relevant for the future attractiveness of a market and available for most countries
3. Collecting information, verifying the contents, classifying, condensing and evaluating it

Ad 1) Define the CEE and SEE countries as core region of strategic interest

- According to frst assumptions of the Company about attractiveness and potential three countries were selected as “Focus 1” markets, four countries as “Focus 2” markets and another three countries as “Focus 3” markets
- In order to get an information base, the market peculiarities of “Focus 1” countries were analysed in detail, Focus 2 and 3 Markets were studied in a more general manner with declining level of detail and scope.

Ad 2) Assumed criteria for a positive SHP-investment decision were set:

- Ranking of the country in the **„Ease of doing business index**” which ranks economies on their ease of doing business, from 1 – 183, with first place being the best. A good ranking means the regulatory environment is conducive to the operation of business**.** [i]
- **Potential**: the existence of technically, economically, environmentally and otherwise feasible SHP sites expressed in installed capacity and annual generation
- **Market Opening:** Liberalisation and Third Party Access are stimulators for new activity especially in markets in need of foreign investors
- **Transparent Promotion System:** taking an investment risk needs investment security i.e. clear rules, comprehensible decisions and transparent processes, e.g. reliable adjustment mechanisms during the whole investment period
- **Legal System:** an adequate legal framework also containing a secondary legislation with comprehensive ruling on all relevant aspects comparable to EU-Standards provides comfort for investors
- **Incentives:** investors not only need safety but also adequate return for their investments. Is the whole package offered allowing the project an attractive economical return over the whole lifetime of the plant?

[i] This index is published by IFC/World Bank and averages the country's percentile rankings on 10 topics, made up of a variety of indicators, giving equal weight to each topic. The rankings are from the Doing Business 2010 report, covering the period June 2008 through May 2009.
http://www.doingbusiness.org/EconomyRankings/

- **Water Availability:** only sufficient precipitation and an adequate network of water flows will allow a sustainable electricity production; also water rights migh be considered for evaluation
- **Economical Aspect:** the status and outlook of the economy of the host country of the investment indicates whether the receipt and repatriation of the returns and incentives over the whole investment period is likely. In case of private off-takers of the produced electricity, the same question applies to its creditworthy.
- **Political Situation:** a political risk, i.e. moratorium, civil wars, nationalisation, etc. could endanger the investment
- **Limiting Factors:** such obstacles could curtail the full exploitation of the potential
- **Barriers:** those obstacles are potentially hindering the execution of a SHP investment

Ad 3) The main sources of information were publications of studies by governments and universities, hydro power associations, industry experts, utilities, commercial banks, financial investors, WORLD BANK, EBRD, ESHA, BALWOIS, TNSHP, US-AID, etc. reports and other information with contacts and further links of the representation offices of the Austrian Foreign Trade Promotion Organisation were very helpful. Interviews and correspondence with experts from the industry in those particular countries were extremely helpful.

Finally, the contents to each criterion of the individual countries were condensed and marked – the lower the grade, the higher the attractiveness. The result is a first level ranking of attractiveness.

Out of scope where aspects like level of competition or evaluation of further incentives like tax privileges or direct subsidies.

This work cannot answer all questions in sufficient detail in order to satisfy the information needs of a market player but it could be a first step for deciding in which markets further investigations would be promising.

Countries under special review

Focus 1: Bosnia & Herzegovina (BIH)
Bulgaria (BG) *)
Czech Republic (CR) *)

Focus 2: Croatia (HR)
Serbia (SRB)
Slovakia (SK) *)
Turkey (TR)

Focus 3: Montenegro (MNE)
Romania (RO) *)
Slovenia (SLO) *)

*) EU member states

The countries in **"Focus 1"** to be investigated in detail have been **Bosnia and Herzegovina, Bulgaria** and the **Czech Republic**. Those three countries are in different phases of development. Whereas CR is a mature industrialised country, BG had a successful economical growth starting from absolute poverty. It has just recently joined EU and is now working on full integration. BIH is still in a recovery phase from war and mismanagement and struggles with the basic elements of organisation and development.

The group of **"Focus 2"** countries has been analysed to a lesser extent, i.e. **Croatia**, which is at the front door of EU, **Serbia** as another Balkan country in recovery, **Slovakia** as mature EU-member country and **Turkey**, which is a booming giant economy.
Finally, the **"Focus 3"** group of countries, **Montenegro, Romania** and **Slovenia** have been looked at in a more general manner.

All of those countries have in common, that they are former communist countries.
Prior to introducing market economy in most of those countries mainly fossil and nuclear energy have been used in the former centrally planned economies. Energy intensive heavy industry dominated the economy at that time. The shift to more service orientated sectors in the first half of the 1990s reduced the need for electricity. Afterwards the demand for electricity was regaining because if improving living standards. The actual financial and economic crisis will again have its impact on the electricity demand in CEE/SEE. Nevertheless, in the midterm this region is in

need of a significant growth of electricity generation when converging to European Standards in the coming years.

Old and often outdated power generation assets will need to be replaced and Renewable Energy will assume its role when filling this gap.

Small Hydro Power has a very important role to play within the renewable energy sources. It is an Alternative Energy Resource, which in several less developed countries still has some potential for further exploitation. The use of SHP for electricity production can help reducing dependency on energy imports and create sustainable jobs. In general, the net impact of SHPP to the environment should be positive due to the reduced greenhouse gas emissions and the added diversity to the main energy resources like coal, oil, gas and nuclear. But it is also necessary to assess and mitigate all potential adverse effects to environment, nature and the objections of other interest groups.

Definition of Small Hydro Power

There is no uniform definition for small hydropower but often the typical upper limits are used as accepted by the European Commission and the European Small Hydro Power Association (ESHA).

Those are set for

Small Hydro Power (SHP):	10 MW
Mini Hydro Power:	1 MW
Micro Hydro Power:	100 kW
Pico Hydro Power:	5 kW

SHPPs normally are “run-of-river” designs, i.e. not using a reservoir storage.
For this work, we will regard all power plant seizes up to 10 MW as Small Hydro Plants but allow for larger size in case of multiple turbines.

The detail of assessment per criteria is presented in Annex I.

2 Bosnia and Herzegovina

Figure 3: Map of Bosnia and Herzegovina

Source: The World Bank, 2004

Total area:	51,129 km² (world ranking 127th)
Population:	4,613,414 - 2009 estimate (world ranking 120th)
GDP (PPP):	USD 30,389 billion - 2008 estimate (world ranking 63rd)
Inflation:	8% - 2008 estimate
Rating:	B+ S&P; B2 Moody's[1]

2.1 General Country Information

Located on the western Balkan Bosnia and Herzegovina (BIH) borders Croatia, Serbia and Montenegro and comprises two entities, the **Federation of Bosnia and Herzegovina** (FBIH), populated with mostly Bosnians and Croats and the **Republika Srpska** (RS) with mainly Bosnian-Serb population. [ii]

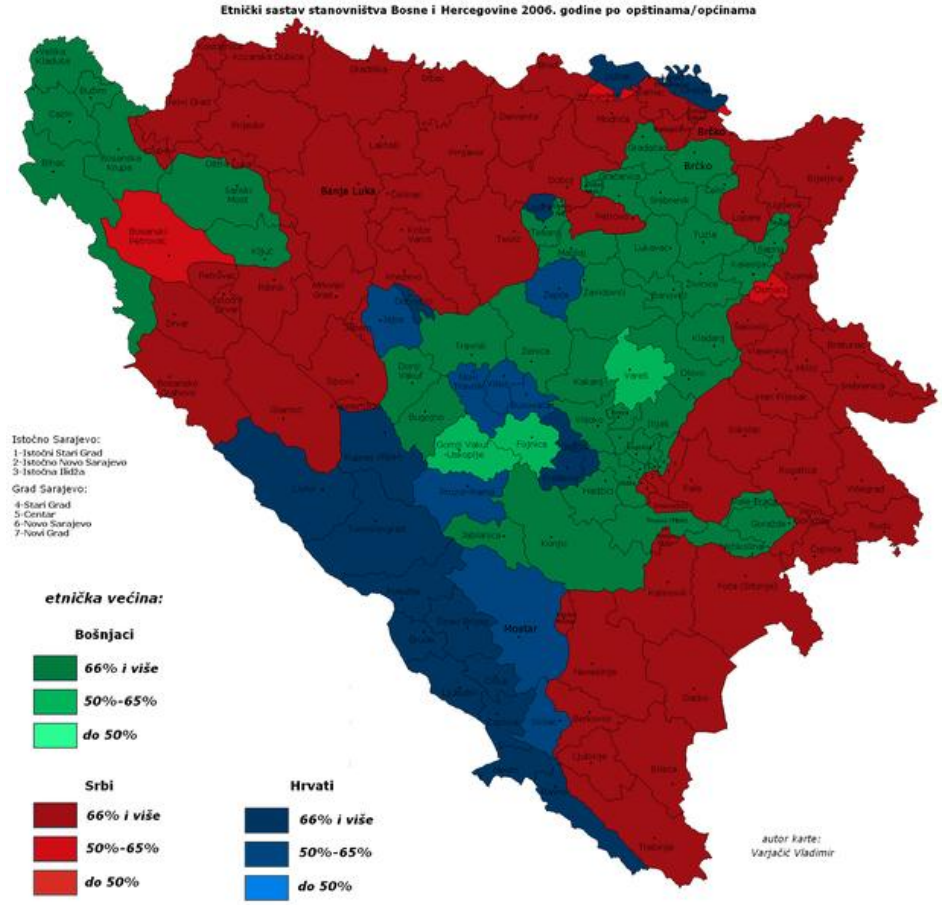

Figure 4: Map with Ethnic Groups in BIH

Source: Wikipedia, 2009

[ii] As a shared entity of FBIH and RS in the north east, the city of Brčko is a self governing district under international supervision. The separation was effected by the Dayton Agreement, which recognized a two-tier government including presidents, parliament, police, etc. The borders within BIH are based on ethnic division and not according to typical geographical borderlines.

Bosniak population has a share of approximate 48%, Serbs 37% and Croatian approximate 14% (as per 2000) and shows a slight growth rate. Muslim religion forms the majority with 40%, second and third are Orthodox (31%) and Roman Catholic (15%).

The most important towns are Sarajevo (400,000), Banja Luka (200,000), Tuzla (150,000), Mostar (87,000) and Bihac (70,000). Total urban population reaches 47% (2008). FBIH is divided into cantons and further on in municipalities. RS is divided only into municipalities.[1]

2.1.1 Political and Economic Situation

With the declaration of sovereignty in 1991 and independence from former Yugoslavia by BIH, Bosnian Serbs responded with armed resistance. What followed was a three years lasting brutal civil war ending in the Dayton Peace Accord at the end of 1995. As outcome, international boundaries remained unchanged and a multi ethnic democratic government was installed with an UN authority, the Office of the High Representative (OHR), being vested with power to monitor the adherence to the agreements. Negative effect of the shared, multi-ethic power is the extraordinary cumbersome bureaucracy.

Since the Dayton Peace Accord, BIH managed a robust economic growth, driven by reconstruction works in the beginning followed by private sector investments. In the years before the economic crisis, GDP has quadrupled and export growth in the past eight years reached 8% in average. Exports are dominated by steel and aluminium, which recently experienced a significant drop in worldwide demand. Year on year inflation stayed moderately below 4% until recently but now increased sharply to 8% in 2008 due to soaring fuel and food prices. Public debt is on a low level (17% of GDP) and the current account deficit was around 20% and as such recognized as a significant external risk. The deficit was reduced to 14.5% in 2008 due to high exports and migrants remittances. The pace of reforms is slowing down from an ambitious start after 1995 and privatization of state owned companies is lacking behind the agenda. Poverty of the population is a sincere and increasing problem and employment growth would be the recipe against it, but this is in contradiction to further privatizations and it is also hard to be achieved given the actual global crisis. [2]

2.1.2 Political and Economic Outlook

Scenarios for the future include Bosnian people to reunite the country into one centralized state eliminating RS whose inhabitants might wish to gain complete independence from FBIH or even joining Serbia. The Bosnian Croats are heading for a third entity within a decentralized governmental structure representing them. Nationalism is the main obstacle for progress. It remains the number one priority for all political parties and held up progress on the EU agenda in the recent years. The OHR sees the actual achievement of stabilising BIH far away from being a sustainable success. The pending problem areas of state organisation, apportionment of state property, completion of the Brčko Final Award, fiscal sustainability and the entrenchment of the rule of law must be solved prior to transition [1, 2]

Reforms necessary to improve competition with other transition economies would include improvements on registration of new businesses, inspection systems and further privatizations. Public expenditure and investment needs to be controlled and focused to areas in urgent need of assistance. This would need an amelioration of the public administration service and capacities as a whole.

BIH until recently was the fastest growing economy in SEE but the historic legacy of this country in transition is still reflected in the poor condition of infrastructure and energy facilities throughout the country. Export and imports dropped at an equal ratio during the beginning of 2009 and the current account deficit is decreasing. Nevertheless, due to reduced fiscal income, financing of this deficit is getting more and more difficult which consequently would endanger the currency board regulation in place, the Bosnian Marka being pegged to the former German Mark. [3]

As a potential candidate country, BIH is supported by various EU programs like the Instrument of Pre-accession Assistance (IPA) covering the period 2007-2012. This program focuses on the challenges of European integration, especially by giving transition assistance, institution building and cross-border co-operations. It will include infrastructure development, trade policy, environment and energy with an overall financial scope of € 530 Mio.

With the ratification of the Stabilization and Association Agreement (SAA) with the EU in June 2008 a milestone for the integration of BIH into Europe was set. The intention to join the WTO is encouraging the business community and the introduction of a modern bankruptcy law offers more legal security to investors and trade partners.

2.1.3 Work Force

BIH suffered extreme migration and dislocation of the population in wartime. The labour force was close to 1.2 Mio in 2007, unemployment rate is around 30-40%, biased because of grey economy. The formerly centrally planned economy needs to be rebuilt after the war damages. Structural problems are shown in overweight of military industry and inefficient micro scale agricultural sector, which does not allow to covering the countries food consumption. Remittances from Bosnian workers abroad are an important contribution to Bosnian income.

2.2 Energy

BIH has vast brown coal and lignite reserves and hydropower potential, accounting for 62% of primary energy consumption. High costs and staffing levels as well as low productivity and negative environmental impacts characterize the coal industry in BIH. There is no oil and gas production in BIH, so for thermal energy production liquid fuels and natural gas need to be imported. Due to the recent dispute between Russia and Ukraine, the gas supply was cut off for one week last year, so BIH is highly exposed with its current energy supply. Therefore, the creation of a regional energy market has top priority to promote security of supply and this is on the agenda of the Energy Community, where BIH is a member. High-energy intensity and inefficient use of energy are wide spread. Living standards are very low in BIH. Consequentially the per capita energy consumption is approximately one third of the OECD average only. [4]

The supply of primary energy is dominated by coal and pit as shown in the graph below (total 5.39 Mtoe):

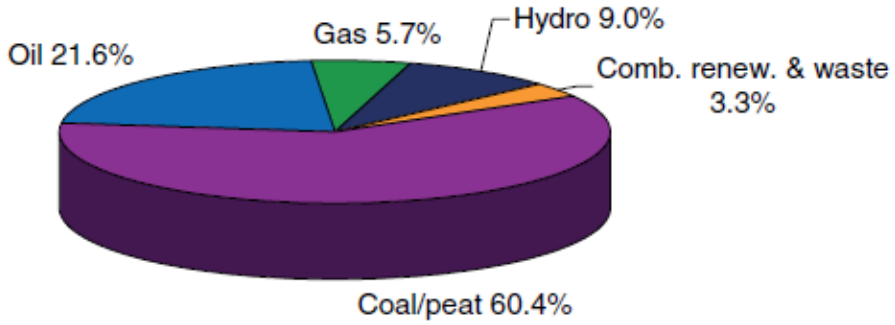

Figure 5: Share of Total Primary Energy Supply BIH
(excluding electricity trade) as per 2006
Source: OECD/IEA 2008

Gross inland energy consumption in BIH climbed from 4.864.000 toe (tons of oil equivalents) in 2000 to 5.504.800 toe in 2005, where final consumption accounts for approx. 66% and the remainder being various energy losses occurring in the transformation process to other energy forms. Final energy consumption grew from 3.214.900 in 2000 to 3.729.200 in 2005. FBIH was responsible for about 2/3 of that consumption, RS added around 32% and the Brčko district contributed 2%. [iii]

Electricity has by far the highest share (42%) of energy forms used in BIH, mostly due to the Aluminium Plant in Mostar. Liquid fuels (22%), coal (16%) and natural gas (15%) are the other important energy sources for industry. [5]

The below table shows the energy consumption by certain zones which were defined by boundaries and according to the distribution sectors of the three electrical companies. The total energy consumption amounted to 121.81 PJ in 2005.

[iii] The share of households exceeded 50% whereas industry and transport consumed 20%, agriculture 6% and services 2% of the final energy consumption in the period between the years 2000-2005.

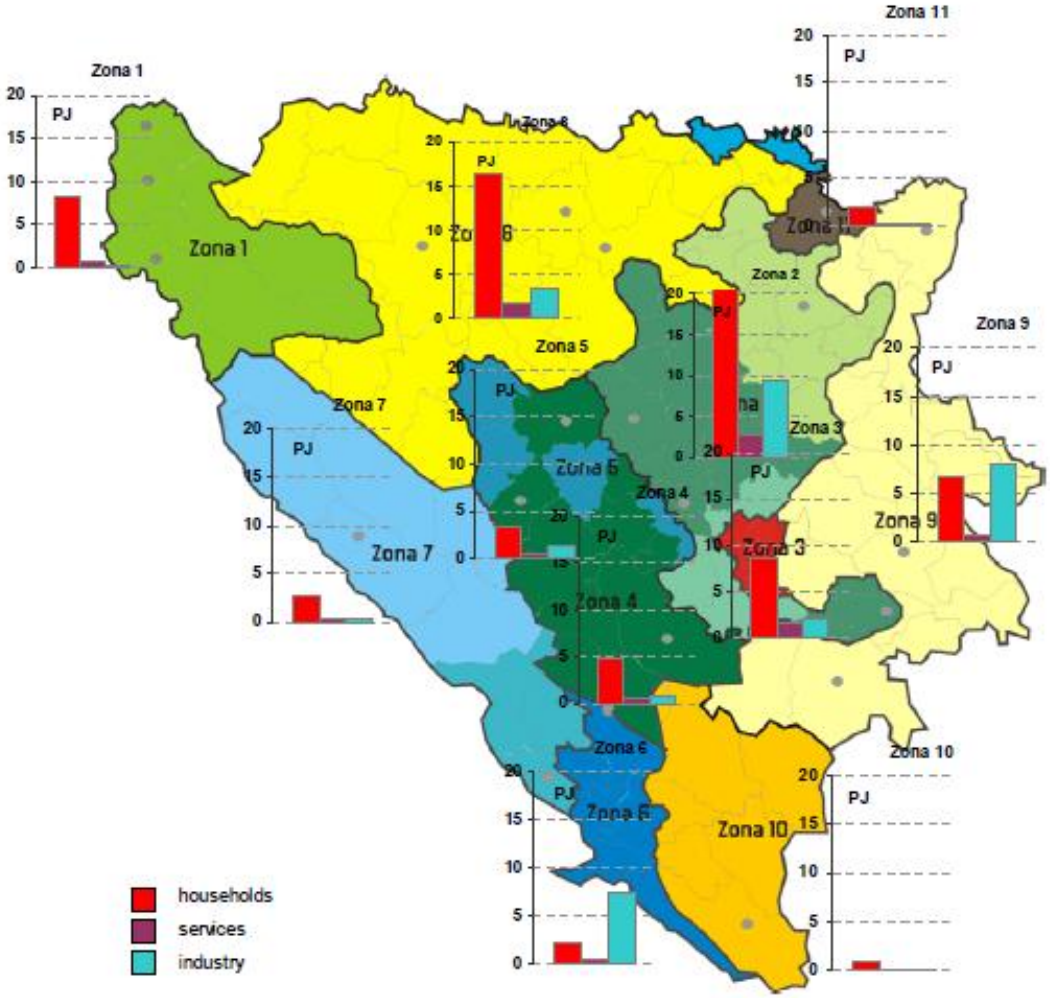

Figure 6: Total Energy Consumption by Sectors BIH

In households, services and industry

Source: Granić Goran et al., ESSBIH, 2008

2.2.1 Overview Electricity Market

The effect of the Yugoslavian war on the electricity generation was dramatic. During the war time (1992-1995) only a small fraction of the power generation capacity was operational as most of the power plants were severely hit.

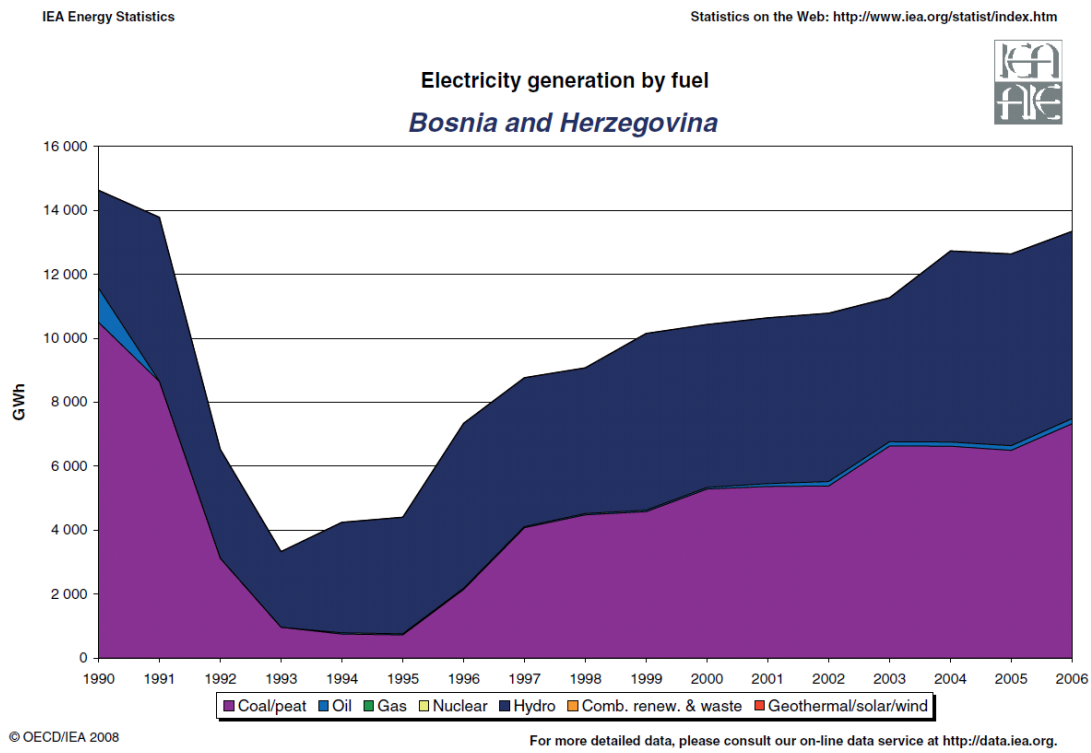

Figure 7: Electricity Generation by Fuel

Source: IEA 2008

Beside the post war reconstruction, unification of the fragmented electricity system and market oriented reforms aim to join regional power markets. In addition, integration with the EU power market is a challenge of the Electricity industry. The Entity's Action Plans for Power Sector Restructuring is dealing with the relating reform processes. First results of its efforts are the primary legislation for the electricity market and the awarding of licenses for certain essential market participants. The secondary legislation, the Grid Code and Market Rules are being worked out. The Tariffs are reflecting individual cost levels, Third Party Access rules and a Book of Rules have been implemented. Two regulatory bodies have been implemented on entity level, one on state level.

Electricity production is back to 90% of the pre-war levels, but it needs further huge investments. The transmission systems have been unified and for assets and authorities two separate joint stock companies, Transco and Independent System Operator (ISO) have been established. Unbundling only took place regarding generation and distribution of the three Elektroprivredas energy companies without

any participation of independent companies. Payment levels are reported to exceed 90% by the power companies. [4]

Total power production reached 13,627 GWh in 2006. Hydropower (HP) and Coal form the main primary energy sources. Only 39% of its hydropower potential is used so far contributing around 46% to the electricity production. 1% is from SHPPs. Coal fired thermal power plants (TPPs) are the main sources of electricity production (54%) and can burn the low-valuable domestic coal which is characterized by low energy efficiency and high negative environmental impacts.

The total electricity consumption reached 11,113 GWh only therefore resulting in a positive power balance close to 2,200 GWh in 2006. [6]

Compared to most other CEE and SEE countries, BIH is behind in the development of energy strategies and building up of the necessary institutions and information database. BIH is a signatory state to the “Energy Community Treaty” which sets the goals for ultimate integration into the EU-Internal Energy Market providing for market liberalisation, higher investment security and tight regulatory control. [7]

As part of the transition efforts European standards for energy production, electricity markets and relating environmental aspects need to be introduced shortly. However, the most urgent task is to rehabilitate and reconstruct power plants and structures damaged during the war and establish new ones.

2.2.2 Electricity Balance

The Electricity Balance from 2000-2005 shows some strong growth periods of production but is interrupted by some years of stagnation. Final consumption grew roughly in line with generation.

SHP-Generation almost doubled in the FBIH area and grew in RS by almost 44% in the period under review.

Table 1: Electricity Balance for FBIH

GWh	2000	2001	2002	2003	2004	2005
Production	**6481,5**	**7233,8**	**7255,1**	**7132,2**	**8353,3**	**8080,5**
- Thermal power plants	3858,3	4030,6	4819,4	4617,2	4968,0	4705,5
- Hydro power plants	2581,3	3139,0	2368,2	2460,4	3312,3	3264,9
- small HPP	40,8	63,2	66,0	53,9	66,4	73,7
- Industrial TPP	1,1	1,0	1,5	0,7	6,6	36,4
Import	2740,2	1788,1	2190,0	2249,1	1712,8	2411,4
Export	2577,9	1993,9	2432,1	1957,8	2876,2	2345,7
Import from FBIH	123,8	103,9	97,0	147,3	693,5	222,1
Export to FBIH	121,1	83,4	78,9	106,2	113,8	174,9
Domestic supply	**6646,5**	**7048,5**	**7031,1**	**7464,6**	**7769,6**	**8193,4**
Own use	**468,9**	**478,3**	**577,2**	**539,4**	**592,5**	**582,9**
- hydro power plants	30,7	36,6	65,1	35,9	38,8	54,0
- thermal power plants	431,1	434,1	504,8	494,6	524,3	477,6
- coal mines	7,1	7,6	7,3	8,9	8,5	9,1
- coke oven coke	0,0	0,0	0,0	0,0	20,9	42,2
Losses	759,9	803,2	765,7	796,0	786,8	789,1
Final consumption	**5417,7**	**5767,0**	**5688,2**	**6129,2**	**6390,2**	**6821,4**
Industry	2551,3	2863,4	2730,6	3051,9	3246,0	3459,6
Transport	10,3	10,9	13,5	17,3	21,7	28,5
Households	2103,1	2124,6	2163,2	2232,6	2286,8	2452,0
Services	753,0	768,1	780,9	827,4	835,7	881,3

Source: EIHP ex ESSBIH Vol I, 2008

Table 2: Electricity Balance for RS

GWh	2000	2001	2002	2003	2004	2005
Production	**4598,1**	**4863,8**	**4258,8**	**4873,5**	**5149,5**	**5411,1**
- Thermal power plants	2361,7	2214,2	2364,0	2710,6	2354,8	2572,1
- Hydro power plants	2188,5	2578,3	1823,7	2108,9	2723,5	2769,9
- small HPP	47,9	71,3	69,6	56,0	71,2	69,1
- Industrial TPP	0,0	0,0	1,5	0,0	0,0	0,0
Import	447,5	461,9	1609,6	502,9	410,9	243,2
Export	1696,3	1905,4	2434,1	1775,0	1294,3	1685,9
Import from FBIH	121,1	83,4	78,9	106,2	113,8	174,9
Export to FBIH	123,8	103,9	97,0	147,3	693,5	222,1
Domestic supply	**3346,6**	**3399,8**	**3416,2**	**3560,3**	**3686,4**	**3921,2**
Own use	**205,3**	**226,8**	**222,9**	**256,6**	**228,4**	**249,9**
- hydro power plants	23,7	24,1	22,9	25,8	24,3	22,8
- thermal power plants	144,2	163,6	159,3	190,7	164,9	187,7
- coal mines	37,4	39,1	40,7	40,1	39,2	39,4
Losses	957,8	907,6	875,5	824,4	778,7	776,3
Final consumption	**2183,5**	**2265,4**	**2317,8**	**2479,3**	**2679,3**	**2895,0**
Industry	460,5	385,7	367,1	419,4	539,2	613,0
Transport	1329,0	1299,8	1348,0	1423,8	1467,1	1533,7
Households	394,0	423,6	437,1	450,7	467,5	495,8
Services		156,3	165,6	185,4	205,5	252,5

Source: EIHB ex ESSBIH Vol I, 2008

2.2.3 Electricity Demand and Production Outlook

The Energy Sector Study BIH (ESSBIH) forecasts the total electricity demand on three scenarios as shown underneath:

Table 3: Scenarios for electricity demands per supply area

Scenario	GWh				%	%/yr
	2005	2010	2015	2020	Total increase 2020/2005	Average annual rate of increase 2020/2005
Electricity System of BIH						
S2-Reference	11343.4	13112.0	15467.9	17878.6	57	3.1
S3-Sustainable	11343.4	13017.7	15098.6	17110.8	50	2.8
S1-Low Growth	11343.4	12970.9	14562.1	16008.6	41	2.3
Federation of BIH						
S2-Reference	7641.7	9050.7	10561.5	12089.1	58	3.1
S3-Sustainable	7641.7	8987.8	10303.6	11548.1	51	2.8
S1-Low Growth	7641.7	9093.0	10010.5	10865.1	42	2.4
Electricity Company EP BIH – Sarajevo						
S2-Reference	4189.7	5274.7	6411.7	7748.0	84	4.2
S3-Sustainable	4189.7	5228.2	6259.6	7407.0	76	3.9
S1-Low Growth	4189.7	5361.1	6014.8	6653.0	58	3.1
Electricity Company EP HZHB – Mostar						
S2-Reference	3452.0	3776.1	4149.8	4341.2	25	1.5
S3-Sustainable	3452.0	3759.7	4044.0	4141.1	20	1.2
S1-Low Growth	3452.0	3731.9	4074.2	4277.5	24	1.4
S2-Reference_ALx2	3452.0	4203.0	6288.5	6482.1	87	4.3
Republic of Srpska						
S2-Reference	3454.4	3813.6	4654.5	5513.1	59	3.2
S3-Sustainable	3454.4	3786.6	4551.4	5299.2	53	2.9
S1-Low Growth	3454.4	3634.5	4229.0	4819.6	39	2.2
Brčko District						
S2-Reference	237.5	238.0	242.1	266.6	12	0.8
S3-Sustainable	237.5	234.0	234.3	253.5	7	0.4
S1-Low Growth	237.5	234.1	236.9	250.4	5.4	0.35
Electricity Company ERS – Trebinje (RS and BD together)						
S2-Reference	3701.6	4061.3	4906.4	5789.5	56	3.0
S3-Sustainable	3701.6	4029.9	4795.0	5562.7	50	2.8
S1-Low Growth	3701.6	3877.9	4475.2	5079.9	37	2.1

Source: Granić Goran et al., ESSBIH, 2008

The figures shown in those scenarios are final demands of customers based on their assumed future consuming behaviour including transmission and distribution losses. A decrease of the omnipresent fraudulent consumption has been assumed.

Scenario S2-Reference_ALx2 in the Mostar area factors in increased electricity demand of the Aluminium plant, which is by far the biggest electricity consumer in BIH and of paramount national importance.

In all three scenarios, a steady yearly growth in demand is forecasted leading to a protection for 2020 of total increases up to a maximum of around 80%.

Regarding electricity production the three independent power companies, Elektroprivreda Bosne i Hercegovine (EPBIH), Sarajevo, Elektroprivreda HZ HB (EPHZHB), Mostar and Elektroprivreda RS (EPRS), Trebinje are responsible for the supply within their respective entities with a gradual opening to additional suppliers due to the commitment to market liberalisation.

EP BIH and ERS are net electricity exporters and they will most likely not need to invest in revitalization of their existing plants before 2017-2020, whereas EP HZHB is short of power, mainly because of the high demand of Aluminji Mostar in its supply area. Therefore, an expansion of the existing capacity of the TPP Kongora by 265 MW is planned in 2013 with a possible phase II in case of increased demand by the aluminium plant. Wind-farms at various prospective locations are an option too.[5] Together with neighbouring countries, plans for construction of hydro plants exist, but data concerning those projects are limited.

The table below shows a comparison of possible construction of new power plants for period 2008-2020 categorized in BIH, entities and electric companies.

Table 4: Construction of new power plants (2008-2020)

Area	New power plants MW			
	HPP	TPP	Wind	Total
BIH	60	1030	0	1090
Federation of BIH	136	906	50	1092
Republic of Srpska	273	389	0	662
Total by entities	409	1295	50	1754
EP BIH	254	641	0	895
EP HZHB	231	265	300	796
ERS	273	380	0	653
Total by companies	758	1286	300	2344

Source: Granić Goran et al., ESSBIH 2008

2.3 Renewable Energy

Apart from the top priority of securing the energy supply through creating a regional energy market and secondly to promote concrete energy related investments in BIH, the third priority is the promotion of Renewable Energy and Energy Efficiency.
Starting this year first steps for the development of Renewable Energy Sources (RES) have been taken and the modalities of the New EU Renewable Directive are analyzed.

The Energy Sector study for BIH (ESSBIH) [5] financed by the World Bank dated 2008 comes to the following conclusion: At present there would still be no elaborated action plan for the promotion of RES within the legal framework, either on state or entities levels, nor a quantified goal of the share of RES-Energy (RES-E) to cover the energy consumption within a stipulated time period. The authors regard this deficiency as the main obstacles to the development of renewable energy sources in BIH.

This lack of achievements in reality may be sometimes caused by BiH's unusual constitutional arrangement. However, initiatives for investments in the area of small hydro power plants have led to the issuing of more than 200 concessions recently, while about 20 SHPP are in operation.

Table 5: RES Potential per Entities

	Hydro	**SHPP**	**Solar**	**Wind**	**Geothermal**	**Agri-Biomass**
	GWh	GWh	mil. GWh/year	MW	MWt	TJ
FBIH	1.727	313			57,08	
RS	5.604	1.500			3,12	
Total BIH	**7.331**	**1.813**	**70,50**	**900-2.000**	**60,20**	**38**

Source: Granić Goran et al., ESSBIH, 2008

Biomass traditionally has considerable importance in the rural locations with its vast forests and forestland areas but there are no actual data available.

Regarding **wind-power**, 27 promising sites have been identified approximately 50 km to the Croatian border. Those sites would allow 900 MW installed capacity of wind-power; neglecting limiting restrictions due to network limitations, environmental limitations, etc. that could count to a possible installed capacity of up to 2.000 MW. With respect to **solar energy**, the study arrives to a considerable potential of 70.5 million GWh of incident energy but with the lack of subsidies, this rather expensive technology cannot really develop in BIH.

Geothermal used for space heating (50 ˚C) shows a potential of 7.15 (2.09) MWt capacity at 28 (16) locations in the FBIH (RS), which would allow 57 (33) MWt used with 20˚ C for recreational use, bathing, etc. Again, the high investment cost implied by test drilling is a main obstacle to the expansion of that energy source.

The total **HP Potential** is estimated to be in excess of 6.000 MW and is actually used only by 40%.[4] This high portion of unused potential allows BIH to become a

leading electricity producer in the region as the neighbouring countries have already used most of their hydropower resources and are forced to import electricity. According to different studies, the technically feasible potential of hydro energy in BiH amounts to approx. 6.800 MW (or 24.000 GWh/year), mostly within Drina, Neretva and Trebisnjica river basins. The economically feasible potential would be 5.600 MW (or 19.000 GWh/year).
However, commissioning of any new plant in BIH is a lengthy process for HP and TPP and realizing a project in BIH in general is an extremely difficult task.

2.4 Small Hydro Power

The available data about SHP varies from source to source and except in the RS there are hardly any documented potentials of SHP, therefore the data presented is not always concise.

After World War II until around 1985 SHPP's have not been in the focus of hydro power development. In order to prevent concentration of large HPP studies have been carried out to analyse the SHP-potential. A possible installed capacity of 215 MW was identified at that time and some limited further analysis of small rivers has been undertaken with weather stations and rain gages as well as mathematical methods. Deeper analysis was done after 1995 regarding SHPP usage in the Federation B&H called the "Study of hydrological usage of water flows".[8]

SHPPS cannot match the generation of large plants but especially in a country like Bosnia with its decentralized structures and lack of funding capacities it could considerably contribute to the future energy production from RES.

According to various sources, the SHPP potential in BIH is around 2.500-2.600 GWh/yr or approximately 700 MW. Plans quoted, ten small hydro plants should be installed every year, with an average capacity of 1.5 MW. In a study by the FBiH further 42 locations in existing weirs with a total capacity of 51 MW are mentioned. WKO Sarajevo reports "293 potential micro locations to be under evaluation and 200 SHPP concessions were awarded in four cantons in FBiH with an installation capacity of approx.180 MW."

In the RS 106 contracts with 47 concessionaires were concluded for SHPP with a total installed power potential of approx 280 MW. [9,10]

The range of **investment cost for a new SHPP** is between 1.300 – 1.600 €/kW with avg. **production cost** of 1.5 €cts/kWh.[11]

2.4.1 SHP Inventory

The information on existing SHPP in BIH varies. A research of the author at various sources produced the inventory below. Local energy engineering company, ENERGOINVEST d.d, confirmed this.
According to this research, around **37 MW are in operation** in BIH generating **186 GWh p.a.** and around 15 MW installed capacity thereof is in RS.

Table 6: Inventory of SHPP in BIH

SHPP Name	Installed Capacity MW	Average Annual Production GWh	Entity	Owner	Info Source
Trešanica	1,40	6,00	FBIH	Amitea Mostar	ENERGOINVEST
Moscani	0,75	3,80	FBIH	Comprex	ENERGOINVEST
Prusac I	0,65	4,50	FBIH	Comprex	ENERGOINVEST
Bila Voda			FBIH	Elgrad Jajce	ENERGOINVEST
Divic	1,40		RS	Eling	ENERGOINVEST
Una Kostela	8,30	56,00	FBIH	EPBIH	Intrade enerija
Osanica	1,20	6,44	FBIH	EPBIH	Intrade enerija
Krušnica	0,46	1,80	FBIH	EPBIH	Intrade enerija
Modrac	1,70	9,50	FBIH	EPBIH	Intrade enerija
Snježnica	0,50	1,55	FBIH	EPBIH	Intrade enerija
Hrid	0,40	0,90	FBIH	EPBIH	Intrade enerija
Bihać	0,16	0,70	FBIH	EPBIH	Intrade enerija
Mesići	3,08	16,00	RS	EPRS	EBRD
Vlasenica	0,90	6,90	RS	EPRS	EBRD

Tišća	2,12	10,00	RS	EPRS	EBRD
Bogatići	7,00	33,00	RS/FBiH	EPRS/EPBiH	Intrade enerija
Mujakovici	1,63	7,60	FBIH	Intrade energija	EBRD
Majdan	2,80	11,40	FBIH	Intrade energija	EBRD
Botun	1,10	4,80	FBIH	Intrade energija	EBRD
Jezernica	1,38	5,10	FBIH	Intrade energija	EBRD
Kara-drvo			FBIH	Kara-drvo Fojnica	ENERGOINVEST
Paloc			FBIH	Paloc	ENERGOINVEST
Torlakovac			FBIH	Vlasic II Donji Vakuf	ENERGOINVEST
TOTAL	**36,93**	**185,99**			

Source: Research by Kopecek, C. with assistance of Dženan Malović, Energoinvest, 2009

The Osanica run-of-river SHP close to the mouth into the Drina has been completed in 1998 has been delivered by Voith-Hydro in a turnkey contract.[12]

Private sector companies including INTRADE ENERGIJA, Sarajevo and ELING from Teslic, RS implemented 4 SHPP with 7,1 MW/29 GWh and 2 SHPP with 3 MW/9GWh respectively between 2004-05.

At present, in the EP BIH there are several small hydro power plants with the overall installed power of 23.7 MW.
In the ERS, the overall hydro energetic potential in the area of power ranging from 0.5 to 10 MW is estimated at 1,500 GWh annually. At the moment, there are several small hydro power plants with the overall installed power of 14 MW. Furthermore, the ERS has allocated concessions for the construction of small hydro power plants of the overall power of 62 MW.[13]

The recent SHERPA survey[11] arrived to the following evolution and forecast figures:

Table 7: Evolution and Forecast 2000-2020 SHP in BIH

	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**FC 2010**	**FC 2015**	**FC 2020**
Total Number of SHPP	9	10	10	10	12	17	19	65	110	175
Capacity MW	11	11	11	11	13	21	22	150	220	380
Generation GWh	74	75	75	75	84	119	125	500	1.100	1.900

Source: SHERPA 2008, compiled by author

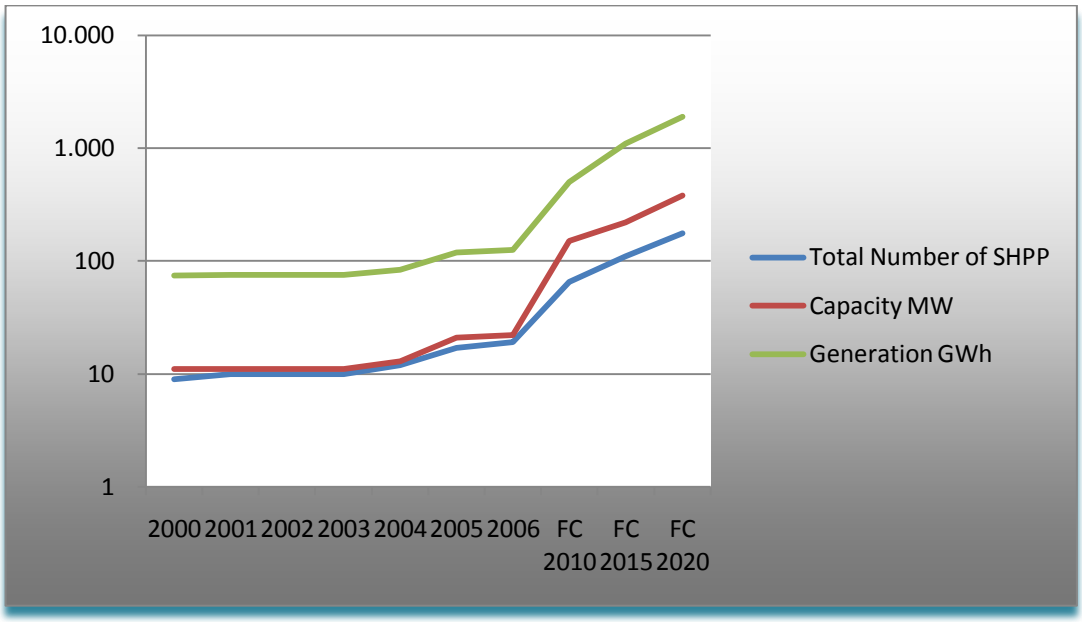

Figure 8: Evolution and Forecast 2000 -2020 SHP in BIH

Source: SHERPA 2008, graph by Kopecek, C.

The **planned installed SHP** is close to 40 MW with a generation of 186 GWh in the EP HZHB supply area. The corresponding values for the EP BIH (ERS) are 34 (212) MW and 127 (650) GWh respectively:

Table 8: Planned SHPP per Entity

supply area	**installed power**	**annual generation**
	MW	GWh
EP HZHB	40	186
EP BIH	34	127
ERS	212	650

Source: Granić Goran et al. ESSBIH, 2008

The recent Energy Sector Study identified about 300 MW of planned small hydro; the potential may be as high as 1.000 MW. [14]

The SHERPA 2008 survey arrives to a **realizable potential for new (retrofit) SHPs** with **425 (7) MW** installed capacity generating possibly **1.330 (30) GWh** per anno.

Table 9: SHP Potential in BIH

Potential	Generation		Capacity
	GWh/yr	%	MW
Gross theoretical	3.500	100	1.100
Technically feasible	2.550	73	825
Economically feasible	1.330	38	425
Economically feasible taking environmental constraints into account (EFEN)	1.330	38	425
EFEN for refurbishing / upgrading estimate	30		7

Source: SHERPA 2008, compiled by author

Some of the identified **potentials for both** entities can be seen in the two tables below.

Based on studies in the **Republika Srpska** in 1985-1991 the technical usable potential has been identified in six rivers:

Table 10: SHPP Potential in RS

River Basin Area	Installed Capacity MW	Possible Annual Production GWh
Drina	162,00	717,00
Vrbas	79,00	300,00
Bosna	79,00	447,00
Sana	7,00	45,00
Trebišnjica	0,50	0,40
Neretva	-	-
Total	**327,50**	**1.509,40**

Source: Avdic and Ajanovic, 2007

From 1999 to 2002 new studies in the **Federation BIH** in several river basins with first water measurements were carried out – but those measurements were only done for two years time. However, as an outcome some overview of possible SHPP projects was achieved and is shown in the following table:

Table 11: Potential SHPP in FBIH according to studies between 1999-2002

SHPP name	Number of SHPP	Installed Capacity MW	Possible Annual Production GWh	Investment in TKM	Investment in € 1€=1,955KM
Bila	20	12,48	64,85	82,50	42,20
Vrbas	19	12,87	62,61	64,00	32,74
Fojnica	9	7,95	43,08	48,00	24,55
Držeanka	12	12,70	49,69	62,50	31,97
Ljuta	14	6,34	36,27	54,50	27,88
Neretvica	17	16,59	75,42	72,00	36,83
Trešanica	5	3,40	16,01	14,50	7,42
Una	3	0,62	3,35	11,50	5,88
Sana	17	16,54	59,68	65,00	33,25
Drina	9	6,34	24,27	89,50	45,78
Bosna	4	2,53	11,87	13,50	6,91
Spreča	11	2,89	12,84	64,50	32,99
Total	**140**	**101,232**	**459,957**	**642,00**	**328,39**

Source: Avdic and Ajanovic, 2007

Table 12: SHPP's tendered in 2004-2006 in FBIH

River basin – River	Number of SHPP	Installed Capacity MW
Šćona	18	14,677
Vrbas	25	15,428
Bila	21	13,104
Lašva	5	3,684
Gostovića	34	16,451
Stupčanica	9	16,267
Drežanka	12	12
Neretva	40	45
Drina	4	2,134
Ustikolina	5	4,199
Prača	5	6,351
Una	3	10,02
Baštra	3	0,456

Glinica	4	1,163
Dobrenica	1	0,275
Bliha	6	5,56
Sanica and Korčanica	5	9,923
Majdanuša	2	0,75
Total	**202**	**177,442**

Source: Avdic and Ajanovic, 2007

According to a strategy paper referring to the hydro power development potential of the Elektroprivreda RS (EPRS) the total technical usable hydropower potential including shared border rivers of RS would be 10.027,5 GWh/yr, of which 7.041,7 GWh/yr of which are still unused. Even if most of this could be used in larger HPP, 1.430 GWh/yr would remain for SHPP according to estimates.

The ESSBIH study found that in the EP HZHB supply area 40 MW SHPP are planned to be installed with an estimated generation of 186 GWh/a, 34 MW (127 GWh/a) are planned in the EP BIH supply area with additional 23,7 MW already in operation and 212 MW (650 GWh/a) are scheduled for the ERS supply area with additional 14 MW already existing.

2.5 Participants on the SHP-Market

2.5.1 Institutions and Authorities

Ministries: Bosnia and Herzegovina does not have a Ministry of Energy at the state level. The responsible Ministries at the entity level are:

- **Ministry of Energy, Mining and Industry of the Federation of Bosnia and Herzegovina**, Sarajevo
- **Ministry of Economy, Energy and Development of Republika Srpska,** Banja Luka
- **Ministry of Foreign Trade and Economic Relations** responsible for policy formulation in the energy sector

Supervision:
The supervision and controlling of electricity (legislation, tariffs, licence etc.) are divided again into a state level and two-entity level companies as well as one independent organisation.

- **State Electricity Regulatory Commission**, Tuzla: regulating generation, distribution & supply
- Regulatory Commission for Electricity in Federation of Bosnia and Herzegovina, Mostar
- Regulatory Commission for Electricity in Republika Srpska, Trebinje
- **Independent System Operator (ISO)** in Bosnia and Herzegovina, Sarajevo: management and control of transmission network, maintenance, grid, generation plan with Transco

Transmission:
Elektroprenos-Elektroprijenos BH (Transco), Banja Luka is in charge for transmission, maintenance and construction the whole BIH territory

2.5.2 Market Players

Public Power Utility Companies

Three public power companies are currently responsible for the electricity production and distribution in BIH:

- **Elektroprivreda Bosne i Hercegovine** (EPBIH), Sarajevo
- **Elektroprivreda HZ HB** (EPHZHB), Mostar
- **Elektroprivreda RS** (EPRS), Trebinje

The Brcko District has its own government controlled Supply and Distribution Company.
The role of the independent power companies is still of marginal importance.

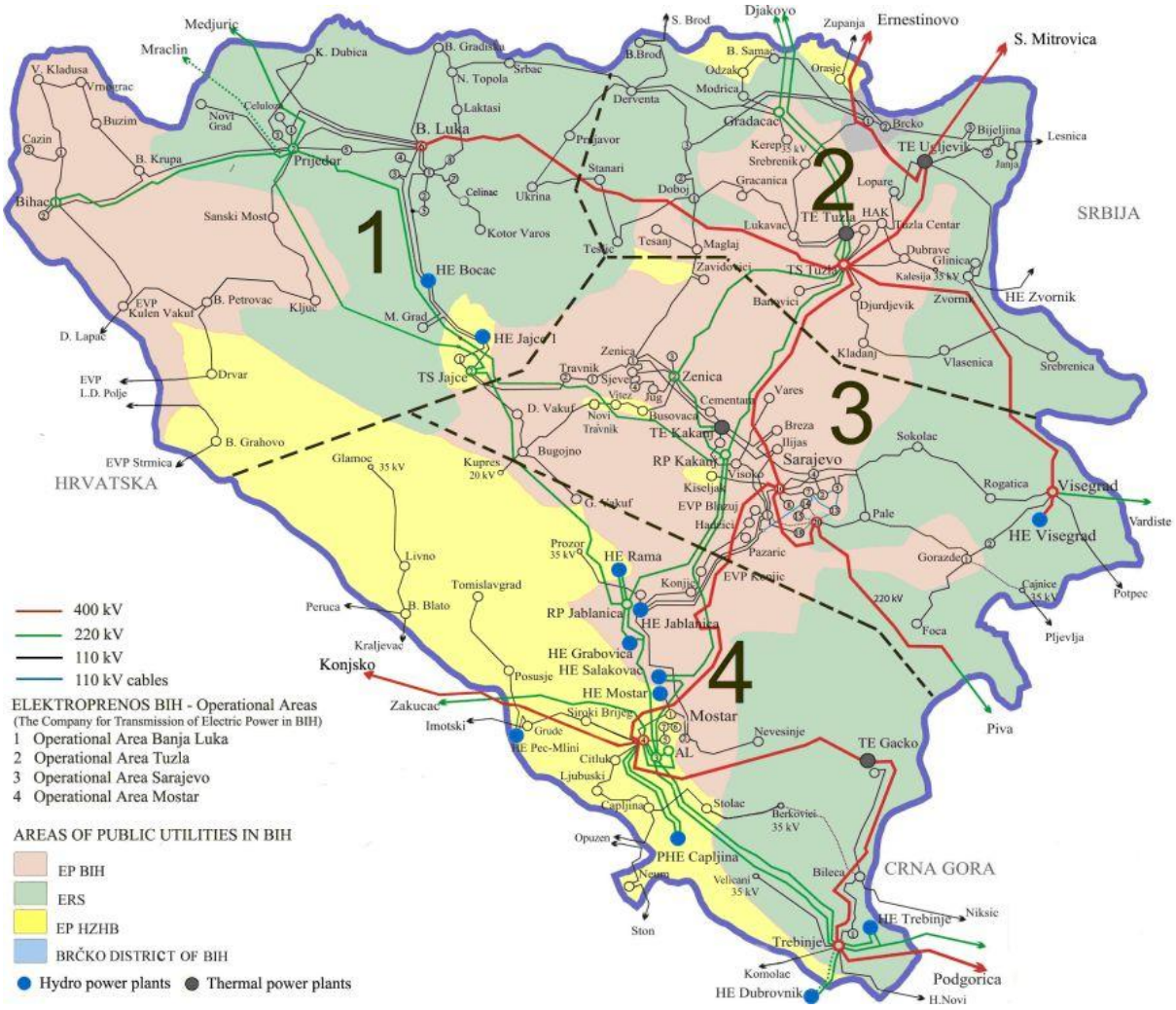

Figure 9: Operational Areas of Public Utilities BIH

December 2008

Source: Derk, 2009 http://www.derk.ba/default.aspx?189

2.6 Legal Framework RES and SHP

A general problem of the former Yugoslavian countries is the struggle between EU and US influence on the adoption of the legal system. US authorities wish to implement the Anglo-American legal system driven by the motivation to create a favourable legal environment for US-investment in the region whereas EU tries to promote their law. In Bosnia, the American system has partly won this issue whereas Serbia and Croatia have adopted EU law system. However, the progress is extremely slow and the project is rather understaffed.[15]

2.6.1 EU and Energy Community

Together with other Western Balkan countries on the one side and the EU on the other side, BIH is a member country of the **Energy Community** and holds presidency this year. It also entertains increasing links with the EU and its bodies such as the EBRD. BIH signed the Stabilisation and Association Agreement with EU in June 2008 and has also ratified the Kyoto protocol.

The central aim of the Energy Community Treaty is to extend the EU Acquis on renewables to all Contracting Parties. i.e. each Contracting Party shall provide to the European Commission within one year of the date of entry into force of the Treaty a plan to implement Directive 2001/77/EC on the promotion of electricity produced from renewable energy sources in the internal electricity market.
BIH's plan was adopted in 6/2007 but practically no progress has been made up to date regarding the implementation of the plan, except the development of necessary secondary legislation.

2.6.2 National

For getting EU compliance, the three ethnic groups needed to compromise on various issues and implemented the relevant legal framework and the corresponding institutions in the years from 2000.

The following acts now determine the legal framework for energy activities:

- Law on transmission, regulator and system operator of electricity in Bosnia and Herzegovina ("Official Gazette of BIH", number 7/02);
- Law on electricity in the Federation BH ("Official Gazette of BH Federation", number 41/02, 24/05 and 38/05);
- Law on electricity in the Republika Srpska ("Official Gazette of RS" number 66/02, 29/03 and 86/03);
- Law on establishment Transmission Company in Bosnia and Herzegovina ("Official Gazette of BH", number 35/2004) (which established BH TRANSCO - the single transmission company in BH - "Elektroprenos BH", with its seat in Banja Luka);
- Law on establishment an Independent System Operator in Bosnia and Herzegovina ("Official Gazette of BH", number 35/2004)

Provisions of the above mentioned laws regulate also the establishment of the Regulatory Commissions at both state and entity levels, new organization of the sector, including establishment of the state companies: ISO BH and TRANSCO.

However, after all those efforts of reform since those 8-9 years, the result is far from satisfying, as the electricity market is not really functioning. New commercial power companies are practically not existing, pricing is not based on market quotes and there is no free choice of suppliers. The former monopolistic structures are still there and all three power companies keep their relating markets closed and protected. Unbundling is still not completed regarding generation and distribution. Procedures for selection of new generation capacity are neither transparent nor efficient and not harmonized with EU directives (Directive 2003/54/EC). As long as the legal framework, setting of prices and tariffs are not finalized and supply security and social questions for the low-income consumers are not solved, the important positive effects of reforms are still missing.[5]
Consequently, the actual implementation of market opening is still hampered by local tariffs that are lower than regional market tariffs.

Commissioning of any new plant in BIH is a lengthy process for HP and TPP and realizing a project in BIH in general is an extremely difficult task.

2.7 Drivers for new Investment in SHP

2.7.1 Promotion for RES-E

Electricity prices in BIH are extremely low compared to rest of Europe and reflect the low purchase power of the population and the limited financial power of the local industry. In the first half of 2008 the price for Electricity was around € 4.5.- /100 kWh, compared to around € 5.7 in Bulgaria, € 7.5 in Croatia, and 11 in Czech Republic[16]. Only in Serbia, prices are lower. Therefore RES do have a hard stance and need considerable promotion in order to become attractive for investors.

As there is still neither an action plan within the legal framework nor some defined goal in whole BIH, either on state or on entities level, RES cannot reach any significance as an energy resource. [5]

There is no specific legal framework other than guidelines by the federal laws dealing with RES. An FBiH Decision dated 2002 only lines out the methodology for the determination of redemption prices from RES up to 5 MW installed capacity (Gazette FBiH 32/2002 und Gazette RS 71/2003).[6]

However, in order to stimulate construction of new capacities and in the absence of an Energy Development Strategy in BIH, the FBIH Government created some initiative by issuing a plan for construction of new generation electric power capacities in 2005 and gave power to the Federal Ministry of Energy to stimulate strategic partnerships in relating power projects (UCTE, 2007). [5]

2.7.2 Feed-in Tariff for RES-E

According to the "Decision about a Methodology for the Determination of Purchase Prices for Electricity from Renewable Sources with Installed Power up to 5 MW" (OG of FBiH, 32/2002), EPBIH and EPHZHB are obliged to buy electricity from RES (produced by plants up to 5 MW). The relevant purchase price is determined by applying corrective coefficients on the current tariff for active energy. Those depend on various factors like season and voltage and RES.

The tariff is set by law and is published by FERK and for SHPP the corrective co-efficient is 0.8[17]:

Purchase price = K x Higher tariff rate, higher season on 10 kV
Purchase price (EPHZHB area) = 0,8 x 13,07 = 10,456 pf/kWh =**5,35 € Cts/kWh**
Purchase price (EPBIH area) =0,8 x 11,45 = 9,16 pf/kWh = **4,68 € Cts/kWh**

2.7.3 International Community Assistance

The Instrument for Pre-accession Assistance (IPA) replaced the CARDS program in 2007 and will run until 2012. With its main programs, like Institution Building, Cross-Border Co-operation, Regional and Rural Development, etc. it wants

to assist BIH with its integration process into EU. This IPA also focuses on small and medium size enterprises (SME) and the energy sector.

The **European Investment Bank** (EIB) which is active in SEE-region since several years is progressively extending its long term lending in the region. BIH is serviced by the Zagreb office and supports e.g. the upgrading of the infrastructure networks and again the energy sector and SME.

The European Bank for Reconstruction and Development (EBRD) is also supporting the SME as well as the creation of operational or regulatory institutions in infrastructures. 22% of the total project value of EUR 1.5 billion up to now went into the energy sector, 6 % into SME financing.
In order to assist BIH in its transition efforts towards market economy, EBRD together with The European Investment Bank and the World Bank and also bilateral donors co-finances projects in the region.

2.7.4 Other Supporting Schemes for RES-E

WeBSECLF - Western Balkan Sustainable Energy Credit Line

This is a credit line facility of up to EUR 60 million for financing industrial energy efficiency and small renewable energy projects through Participating Banks with individual loans between EUR 100,000 and EUR 2 million, TC (Technical-Cooperation) assistance and incentive payments

- for investments in Energy from RES (only green field projects up to 10 MW)–e.g. run-of-river hydro power plants
- Sub-loan sizes up to € 2 million (up to € 5 million project size)
- Compliance with national environmental policies and certain EU directives
- Minimum performance in energy savings/reduction of CO2 emissions
- Positive Net Present Value for RES-E

Obligatory involvement of a Consultancy firm for various activities like:
•Identify eligible investments
•Assist in loan applications
•Undertake marketing activities and
•Ensure optimal uptake and utilisation of the facility

WeBSEDFF - Western Balkans Sustainable Energy Direct Financing Facility

This is a direct financing facility operated by the EBRD

- For (small) renewable energy and (industrial) energy efficiency projects
- Up to € 50 million of loan funds + up to € 13 million in TC and incentive payment funds
- Expected number of projects: 15-25
- Senior (secured) loans and project financing arrangements
- From € 1 million 6 million EBRD financing
- Average (expected) maturity 10-12 years for renewable energy projects, with appropriate grace periods and flexible repayment schedules
- Supported by TC funds for project identification and preparations; incentive payments based on the estimated CO2 emission reductions
- Approval procedure with duration 4 –9 months
- Legal costs to be covered by the EBRD
- Market based interest rates according to the type and risk profile of the project, the Sponsor, etc.
- Encouraging local entrepreneurs to develop sustainable projects in a difficult market environment via incentive payments based on the CO2 emissions that each project will avoid, emulating a CDM carbon credits transaction, but without generating actual carbon credits
- The incentive payments will reduce the outstanding loan with cap levels of 15-20% of the loan principal

The **World Bank** also assists in the financing of projects as well as with analysis and advice on important issues such as energy and environmental questions. Since 1996 its IDA Program has provided approximately USD 1.5 billion in BIH for infrastructure, economic development and structural reforms. One of the main projects is the Integrated Eco-system Management in the Neretva and Trebisnjica Basin.

Bilateral Donors

The German KfW Bank started in 1998 with the long tem funding of reconstruction activities in BIH establishing the European Fund for BIH (EFBH) with EU funds.

Austria, Switzerland and The Netherlands also contributed to this financial cooperation.
Investing in the reconstruction of the electricity sector is one of the key areas of those financing activities (KfW, 2005).
The state owned KfW bank administers grants for € 22.5 Mio and favourable loans for € 31 Mio. and allocates it for renewable energy projects such as a Wind-farm, hydro power projects, etc.[18]

Austrian special agreements with BIH

Österreichische Kontrollbank AG is refinancing tied aid credits up to € 25 Mio. with a tenor of 15 years for a period of 2 years for various projects such as infrastructure, water, etc.
The funds provided are to be utilized for the purchase of Austrian goods and services, 30% of which might include capital goods and related services originating outside of Austria. [19]

The Austrian Development Agency (ADA) is responsible for the implementation of bilateral programs and projects in BIH and offers financial support for development related projects and supports co-operation with European companies like B2B partnerships, joint ventures, etc. Improving water supply and using RES are core focus areas.

2.8 The Grid

According to the ESSBIH study, the status of the BIH transmission network does not allow safe operations within the 110 kV system in various parts of the country, especially in the Banka Luka, Sarajevo and Tuzla area. Voltage conditions are also problematic in several areas. Due to the relative low load, sufficient reserves for further load increase and power transmission are available. Several transformer stations need two feeding direction and some “T-connections” in the transmission network are a threat to reliability and safety. Repair of war damages to the 110 kV lines are of high priority.
The approximate investments in the Grid will be € 164 Mio. for the development, € 107 Mio. for the rehabilitation and € 8 Million for the system control by the year 2020. Until that time, 550 km of new 110 kV transmission network shall be

constructed and 1282 km shall be revitalized. The 220 kV and the 400 kV network are of lower importance and consequentially only small investments will be undertaken here. The existing 400 kV lines Possible can manage an increase in exports without additional measures.

Funding of those investments should be received via transmission fees, through cross border transactions and via loans.

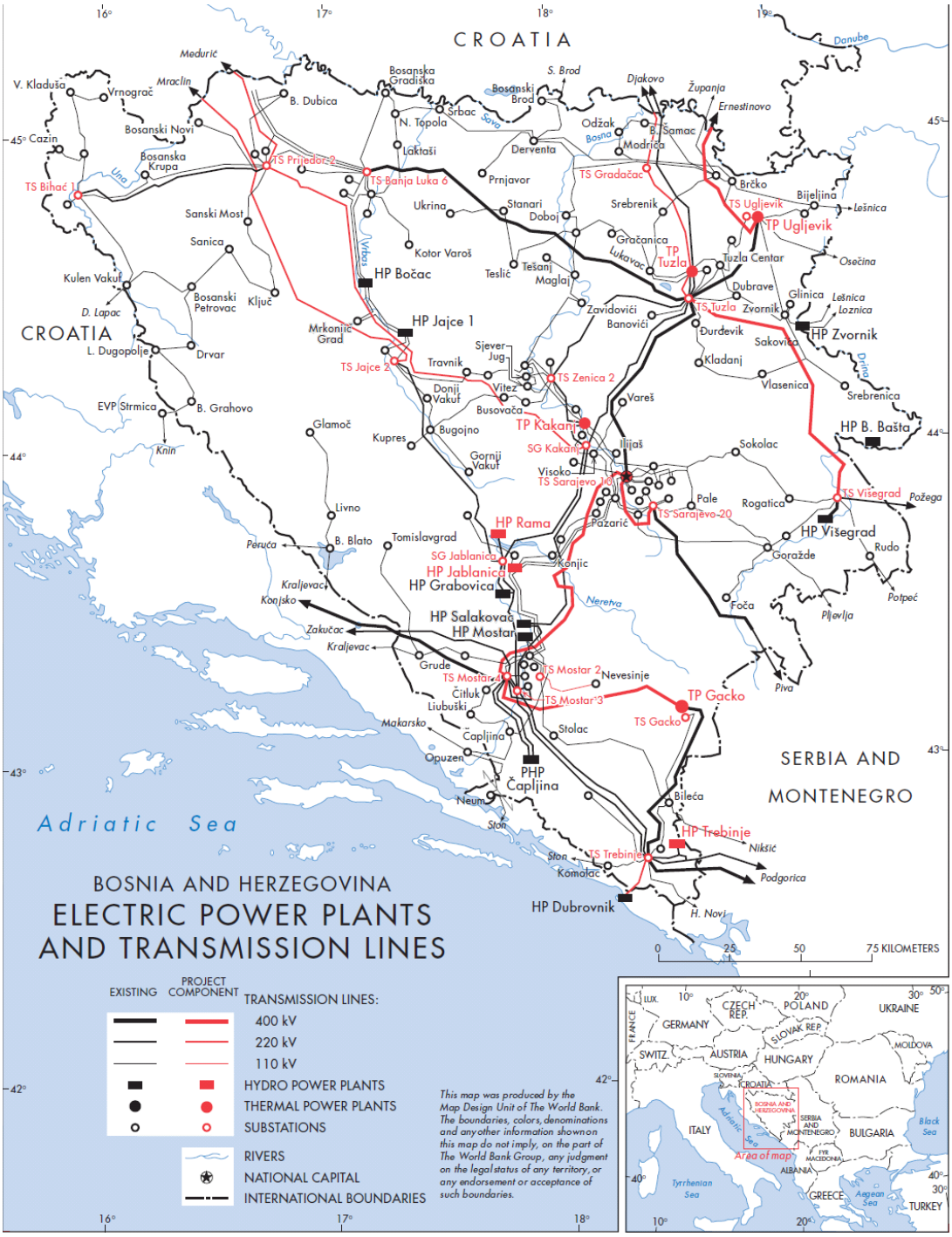

Figure 1: Electric Power Plants and Transmission Lines in BIH

Source: The World Bank, 2004

The low voltage network 10 (20) kV has a length of almost 22.000 km with an unusual high average individual length, stretching to close to 4 (3.7) km in the ERS (EPBIH) network which is much longer than e.g. in the neighbouring country Croatia with 2.6km (1996 data).

Gradually, the 10 kV voltage level shall be replaced by a 20 kV in the rural areas, and the 35 kV shall be abandoned by introducing a direct transformation from 10 kV (cities) / 20 kV (countryside) to 110 kV.

2.9 Natural Conditions for SHP

2.9.1 Topography

The interior of the country is mountainous in the centre and south with the Dinaric Alps dominating, hilly in the northwest, and flat in the northeast and opening to the Pannonian Plain. Roughly, 52% of the land is covered by agricultural land with intensive production and the remainder are forests, pasture and meadows.[20]

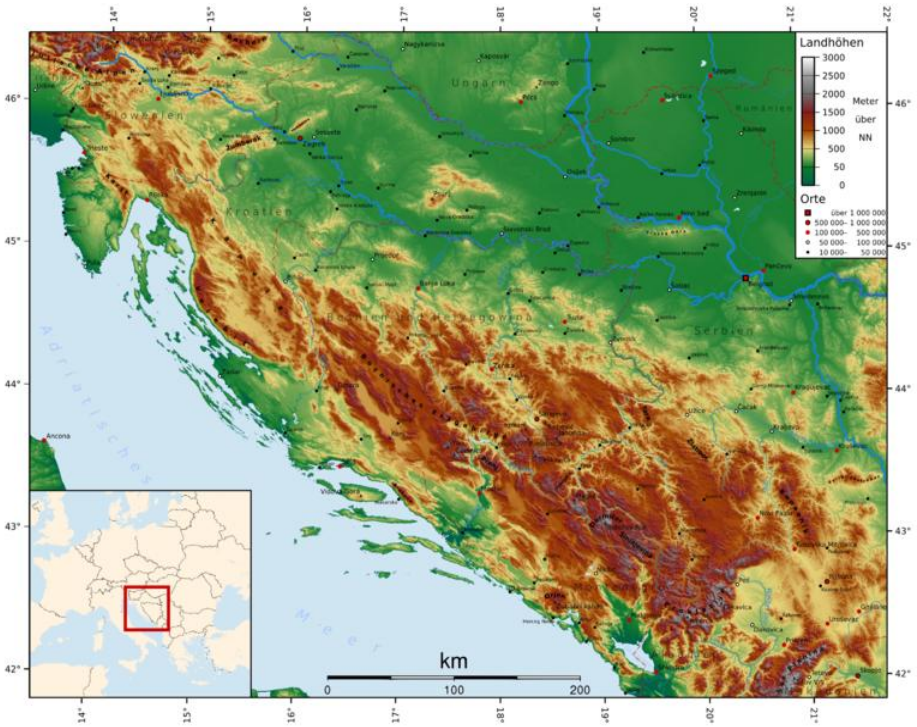

Figure 10: Topographcal Map - Dinarides

Source: Wikipedia

2.9.2 Hydrography

The area of BIH is separated into eight river basins (Sava, Una, Vrbas, Bosna, Drina, Neretva Trebisnjica and Cetina river basin).

Ultimately most of the running waters of BIH are either flowing into the Danube River Basin and into the Black Sea or into the Adriatic Sea. As many borders to neighbour countries are formed by rivers like the Sava in the north, and its tributaries, the Drina partly in the east and the Una a smaller part in the west, many of them are international waterways and hydropower can only be used in co-operation with neighbour countries. The lowest regions in BIH are drained by the Sava, which runs almost 350 km in BIH and finally flows into the Danube. Other important tributaries of the Sava are the Vrbas (235km with an average slope of 6.92‰ with a catchment area of 5'023 km2) and the Bosna (272 km long with a slope of 1.53‰ and a watershed area of 10'457 km²).

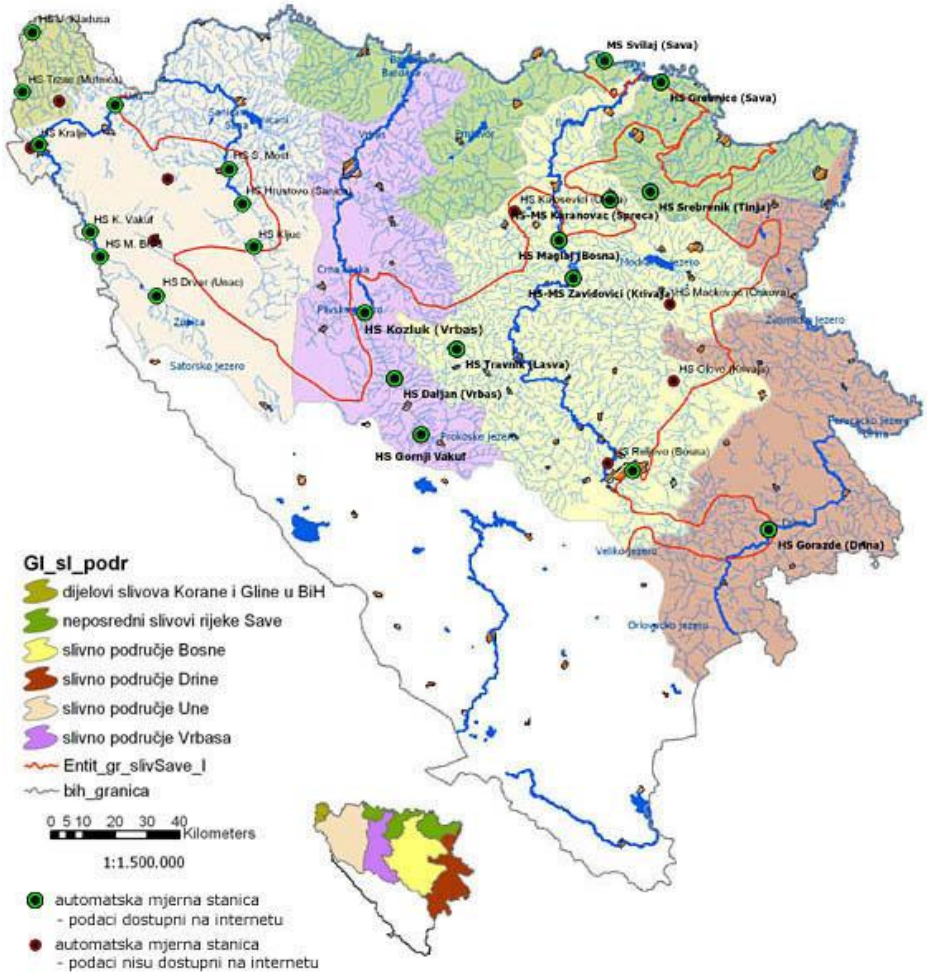

Figure 2: Water Area of Sava River and Black Sea Basins

Source: Avdic and Ajanovic, 2007

The central part of the country is mountainous with peaks above 2000 m. Average rainfall is between 1.000 and 1.200 l/m² and has its peak in November and low in February. The area north of the central part shows precipitation between 800 – 1.100 m². [21]

Figure 3: Precipitation Map of BIH

Source:
http://www.bestcountryreports.com/Precipitation_Map_Bosnia%20&%20Herzegovina.html

The current environmental situation in BIH is sincere as approximately 90% of all wastewater is discharged untreated into the nearest river because most of the sewage treatment plants are out of operations. Consequently, except in the upper sections, the five existing river basins, the Sava, Una-Sana, Vrbas, Bosna and Drina show a very low water quality. In addition, solid waste is dumped into the rivers. Many areas are affected such as the Samac and Sava River. [10]

Figure 4: Map of Rivers of Bosnia and Herzegovina

Source: http://en.wikipedia.org/wiki/File:Bosnia_and_Hercegovina_map_without_streets.png

Retrieved: 12/09/2009 12:33

In general, hydrological data is outdated (updated until 1990) and rare. There is some newer data published by EP RS regarding the Republic Srpska e.g. for the rivers Drina, Sutjeska, Skopotnica, Janjina. Radojna and Vrbnicka Rijjeka.

Some consultant companies like Technor Energy ASA, Norway or SEEC Ltd, Belgrad have data on discharges for the rivers Vrbanja (south of Bosna), Drina (east of Bosna) and Sava (north of Bosna) up to 2005. Alternatively, meteorological data in the watershed area is processed in order to create synthetic discharge data.[22]

2.9.3 Protected Zones

At state level, the Ministry of foreign trade and Economic Relations of BIH is responsible for environmental protection issues and international co-operations with that respect. The Ministry of Environment and Tourism of FBIH and the Ministry of Physical Planning, Civil Engineering and Ecology of RS are responsible on entity level. Both entities have a Law on Nature Protection which also include the EU Habitats directive (92/43/EEC) and Wild Birds Directive (79/409/EEC). BIH ratified various Conventions like CBD (2002), BERN (2008) or RAMASAR (1994).

- the Hutova blato close to the Croatian Border south of Neretva/Brehava Rivers close to BIH's only access to the Adriatic sea
- the Bardaca wetlands, which are a series of 11 lakes situated between the rivers Vrbas and Sava, northeast of Banja Luka near the town of Srbac and
- the wide spread Livno Karst field around the town Livno at the Croatian boarder near Split are proclaimed Ramsar sites

Figure 5: Karst Source of the Bistrica River

next to Livno town

Source: http://www.ramsar.org/cda/ramsar/display/main/main.jsp?zn=ramsar&cp=1-26-45-84%5E18566_4000_0__

The regulation concerning adoption of NATURA 2000 is in passing stage in FBIH, but the scientific expert centre, quality database and register of protected areas do not exist yet. There are some designated protected areas like

- national park UNA
- the nature parks Hutovo Blato and Blidinje
- the nature monuments Skakavac, Vrelo Bosne and Tajan
- the protected landscape Bijambare

In RS the harmonization level with EU Birds directive is quoted at only 3.5% and with the Habitats Directive at 21% respectively as per end of May 2009.
Here in RS the large Sutjeska national park close to Montenegro Border offers 17.250.000 ha of spectacular scenic and historic (Partisan WW II memorials) sites including a 75 m waterfall of Sutjeska river and a famous Perućica forest. The Kozara national park situated north west of Banja Luka is crossed by the river Vrbaska and is again a natural and historic monument.[23, 24]

Figure 6: Location of Sutjeska National Park
Source: http://www.bosniatravel.net

Other projects in BIH include the Sava River basin Management and a cross border project to Croatia, the Neretva and Trebisnija River basin management.

Proposed Natura 2000 sites on Border Rivers are mainly affecting neighbouring Serbia as per now.

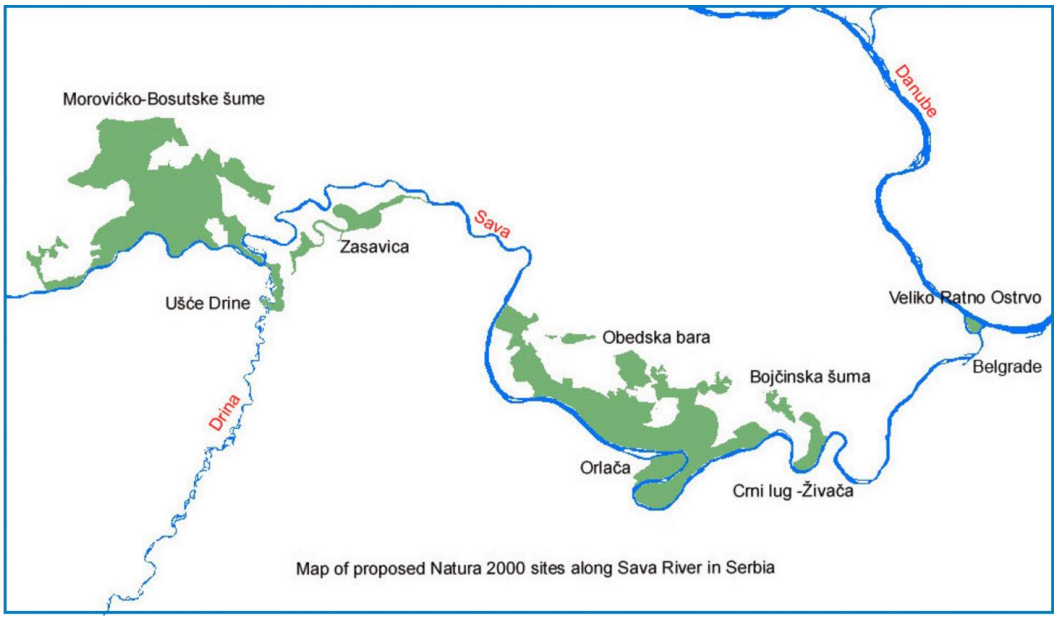

Figure 7: Map of Natura 2000 project along Sava River

Source: Regional Environmental Reconstruction Programme for South Eastern Europe (REReP) funded by the European Commission – CARDS Regional

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2.9.4 Climate

Bosnia is the largest geographic region of BIH with moderate continental climate. The upper and central parts of the Danube River Basin in Bosnia have an Alpine Climate; the lower parts have a tempered continental climate. In the mountainous region of the central part of BIH, severe winters are common, marked by hot summers and cold, snowy winters. Smaller Herzegovina is the southern tip of the country, with Mediterranean topography and climate offering warm summers and mild, rainy winters.[25]

Figure 8: Map of Region Bosnia and Region Hercegovina

Source: http://en.wikipedia.org/wiki/File:Bosna_regija_update.jpg

2.9.5 Small Hydro Power Projects

There is a vague goal to meet 20 per cent of the BIH's electricity demand from waterpower by the year 2020 and it is well recognized, that the cumulative capacity and output of mini-hydropower concession could be quite substantial.
The government has begun a concerted effort to attract foreign investment to develop all the untapped hydro resources and is seeking investors for various projects on the Drina, Lim and Neretva Rivers. [26]

As a general observation, up to recently there were differences in the approach for developing SHP in the two entities: A high concentration of activities in RS is in contrast to a more open distribution of actors in the FBIH. However, this seems to change now in order to open the market also for private concessionaires.

Licenses

In order to receive a license for electricity production, applications have to be filed with the relevant authorities, FERK in the FBIH or RERS in the RS.
The governmental institutions responsible for acquisition of MHPP concessions are divided to the following levels: up to 5 MW [municipality], 5–10 MW [canton] and over 10 MW [entity].[10]

The number of new concessions for Mini Hydro Power Plants (MHPP) with capacity up to five MW is considerable. The cumulative potential capacity of MHPP reaches 230 MW in the RS resulting from 100 MHPP concessions and 30 MW in the FBIH resulting from 29 MHPP concessions applied for only by EPBH from municipalities. EPHZHB has been awarded with 12 MHPP-concessions in three river basins.[4]

Once the application is processed and all requirements are fulfilled, a license is awarded according to the relevant rules stipulated in the laws, e.g. "Official Gazette of Federation Bosnia and Herzegovina," No. 41/02.[27]

2.9.6 Republic Srpska

In the RS most hydropower projects have been identified and developed by EPRS with funding preferably from international finance institutions including the EBRD and the World Bank. In order to attract foreign investment and to increase the number of actors in the energy power market, the responsible Ministry recently granted 47 concessions for 106 contracts regarding the construction of SHPP with a total installed power of roughly 280 MW. The most important projects hereunder are the six SHPP on Bosna River called Doboj and Cijevna. [4]

Vrbas River

The middle and lower section of the Vrbas River together with its tributaries, Pliva, Janj, Ugar, Crna Rijeka and Vrbanja are favourable areas for SHPP-Projects.

Figure 9: Vrbas River upstream Banja Luka

Figure 10: Reservoir area of new planned SHPP on Vrbas River (right)

Figure 11: SHPP locations on Vrbanja River

River Vrbanja is a right tributary to the Vrbas River

Source: Avdic and Ajanovic, 2007

Bosna River

The major part of the Bosna as well as its tributaries Zeljeznica, Miljacka, Krivaja and Usora are belonging to the RS entity and EP RS has identified unused potential of 364 GWh. A Water Management Master Plan from the 60ies exists, but it was never officially approved.[28]

Drina River

The source of the Drina lies at an altitude of 2600 Meter and joins the Sava River after 345 km at an altitude of 74m. Together with an average precipitation of around

700-2000 mm, it offers an unused potential of 3.567 GWh and is the largest reserve in BIH. Its most important tributaries are Bistrica, Drazenica, Govza, Miljevka and Otesa.

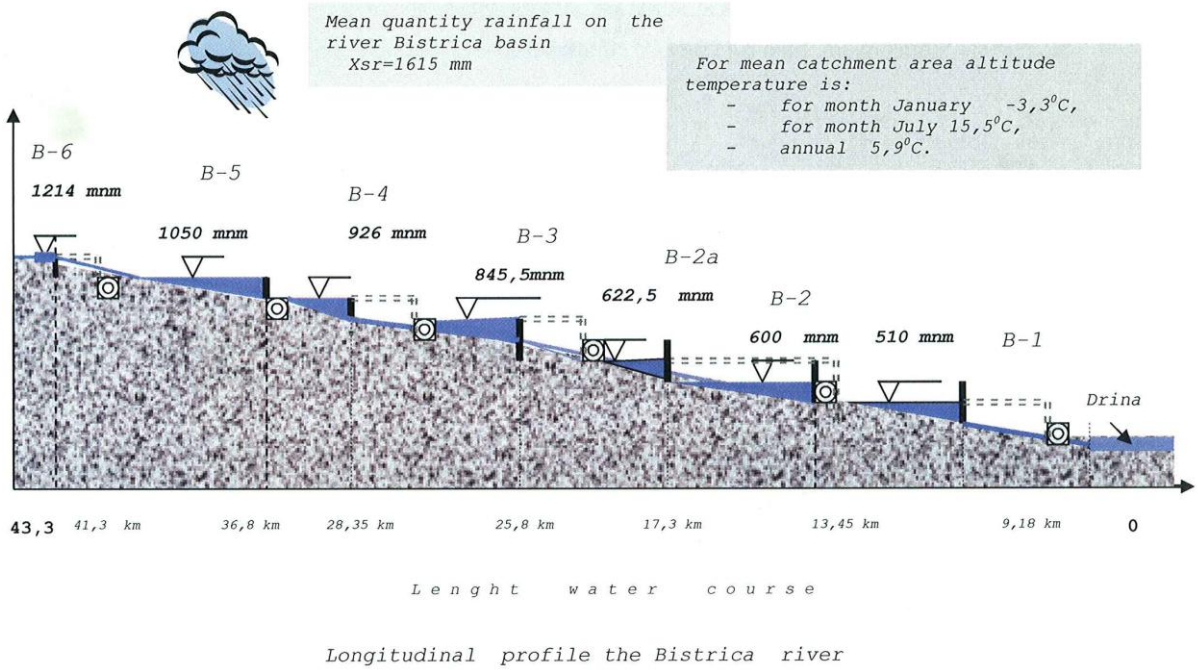

Figure 12: Sketch of SHP-Project Bistrica River

Source: Siemens

Sana River and Una River have an estimated potential of 263 GWh.

The table in ANNEX II shows the SHP projects identified by EP RS in its supply area with a total installed capacity of 426,965 MW and a total Generation of 1,847,546 GWh.

In addition, an SEA of River Basins of the Vrbas and Bosna in Republika Srpska ordered by the Ministry of Energy in Banja Luka and the EBRD shows the following potential projects:

Table 13: List of EBRD-SHPP Projects in EP RS Area

	River	capacity	avg. discharge	dam height	remarks		
		MW	m³/s	m			
HPP Paklenica	Bosna	0,24	0,7	20	will be connected to existing 10KV grid		
HPP Sajinkamen	Bosna	10,00	< 176		shared btw. RS and BIH/landmines		
HPP Doboj	Bosna	8,00	< 176	7	river to be canalized		
HPP Cijevna 1	Bosna	14,10	176		Run of River	river diverted	
HPP Cijevna 2	Bosna	14,20	176		Run of River	river diverted	
HPP Cijevna 3	Bosna	13,90	176		Run of River	river diverted	
HPP Cijevna 4	Bosna	13,90	>176		Run of River	river diverted	
HPP Cijevna 5	Bosna	12,90	>176		Run of River		
HPP Cijevna 6	Bosna	13,20	>176		Run of River		
TOTAL		**100,44**					

Source: Pyöry 2008

The three companies underneath are either in co-operation with Austrian companies or have Austrian origin. Bobar-Taubinger is working on two SHP-Projects on the Bistrica River (3.9 and 2.7 MW) with scheduled Start of Production March 2010.
The Company Bobar (without partner Taubinger) is also reported to be working on the SHP-Project ("Krupac") in BIH on the river Zeljeznica with an estimated capacity of 5 MW and an annual production of 27 GWh. The estimated investment value would be about KM 11 Mio. and the construction has a deadline to be finalized by September 2010.[29]

Table 14: Applications for Licenses

Name of the applicant	Type of the Licence
"Eling MHE" d.o.o. Teslić	Construstion of the SHPP Novakovići
"ERS" Male hidroelektrane d.o.o. Laktaši	Construction SHP Stragčina River Sučeska
"Bobar Taubinger elektrik" d.o.o. Brod na Drini, Foča	Construction of the SHPP Bistrica B5-A

Source: http://www.reers.ba/en/node/286

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Figure 13: SHPP Stragcina River

Stragčina River - Sučeska

Source: http://www.energy-eastern.eu/test/index.php?wahl=projekte&sub=verwalten&landwahl=2&land=en

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2.9.7 Federation BIH

With only 1.24% of the total electricity consumption in the FBIH, the power generation by SHP starts from a very low level. Nevertheless, there is a commitment from the relevant governmental and cantonal authorities to double this figure by the end of this year. Subsequently there are a significantly higher number of construction permit approvals to be seen in FBIH now.

FERC recently issued five licences, the SR HE BUK from Široki Brijeg, determined drafts of initial licenses for GPPD “Vlašić II”, for generation in small hydropower plant Torlakovac on Sokolinska Rijeka in municipality of Donji Vakuf. Those new

actors will increase the SHP community of RES-E generators as shown in the list below.

Table 15: Applicants and License holders in FBIH as per 7/2009

License Holder/Applicant	Project	Location/Address
Amitea		Mostar
Company Peeb d.o.o.	SHP Luke	Mehurići bb, 72270 Travnik
Comprex		Sarajevo
Eco energy		Tuzla
Elgrad		Vinac (Jajce)
ENERGONOVA d.o.o. Sarajevo	SHP Kaljani	Semizovac bb, 71 320 Vogošća
Eskimo S 2 d.o.o. Travnik	SHP Podstinje	Lager bb, 72282 Mehurić-Travnik
Grid BH d.o.o. Sarajevo		Hamze Orlovića 2, 71 000 Sarajevo
Intrade-energija d.o.o. Sarajevo		Zmaja od Bosne 44, 71 000 Sarajevo
Kara drvo		Fojnica
Kara-drvo d.o.o. Fojnica	SHP Grablje	Ostružnica bb, 71270 Ostružnica /Fojnica
KJKP „Rad“		Sarajevo
Mala Hidroelektrana Zagradačka d.o.o. Prozor/Rama	SHP Zagradačka	Dive Grabovčeve bb, 88440 Prozor/Rama
mHE Vitez		Vitez
Paloč		Gornji Vakuf
Rose Wood		Gornji Vakuf
SR HE BUK	SR HE BUK	Široki Brijeg
Vesna-S		Bugojno
Vlašić II d.o.o.Donji Vakuf, Travnik	SHP “Vlašić II”	Torlakovac on Sokolinska Rijeka River

Source: FERK data – compiled by author
http://www.ferk.ba/_en/index.php?option=com_content&view=category&layout=blog&id=62&Itemid=54
and
http://www.ferk.ba/_en/index.php?option=com_content&view=article&id=167%3A160709&catid=89%3Apress-notices&Itemid=175
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Several other concessions to develop SHP projects on the Upper Neretva River Basin had been granted to local private interests.[4]

Table 16: Concessions for SHP developers ex 2006

Small Hydro Plant	Developer	Small Hydro Plant	Developer
"Orahovo"	"25. novembar" Čelinac	"Barski potok"	"Eta" Zvornik
"S-J-3"	"DB CON" Banja Luka	"Ispod Kušleta"	"Eta" Zvornik
"Šibovi"	"DB CON" Banja Luka	"Pliva 1"	"Gomeks" Trn Banja Luka
"Medna Sklop"	"Ekovat" Mrkonjić Grad	"Grabovica"	"Hydro-kop", Banja Luka
"B-G-1-Jeleč"	"Eling-inžinjering" Teslić	"Inter-hem"	"Inter-hem" Banja Luka
"B-G-2-Govza"	"Eling-inžinjering" Teslić	"S-S-2"	"Kaldera" Banja Luka
"B-G-3-Palež"	"Eling-inžinjering" Teslić	"B-K-1"	"Konstruktor" Foča
"Prizren Grad-Sana 2"	"Energetik" Banja Luka	"Vrbanjci" n	"LSB elektrane" Banja Luka
"Medna-Sana 1"	"Energetik" Banja Luka	"Staro selo"	"Reconsult" Laktaši,
"Jurići"	"Energokomerc " Banja Luka	"Šipovo"	"Rojal- prima" Mrkonjić Grad
"Šiprage"	"Energokomerc" Banja Luka	"B-O-2"	"Siming trade" Foča
"Stopan"	"Energokomerc" Banja Luka	"S-J-1A"	"STE SRL" Padova, Italija
"Gradina"	"Energy MBA" Banja Luka	"B-6"	"STE SRL" Padova, Italija
"Rudina"	"Energy MBA" Banja Luka	"S-H-2"	"STE SRL" Padova, Italija
"J-2"	"Energy Zotter Bau", Austrija	"Cijevna II."	"Technorenergy AS" Norveška
"Čajkuša"	"Eta" Zvornik	"Cijevna IV."	"Technorenergy AS" Norveška
"Medaševac"	"Eta" Zvornik		

Source: http://docs.slglasnik.org/pregled-pre.php?lang=lat&j=B&year=2006&broj=14
retrieved 21/09/2009 06:45

The following planned SHP Projects in FBIH were traced at EBRD:

Table 17: Planned SHP in FBIH

SHPP 1	MW	SHPP 2	MW
Crne Rijeka	2,3	Moscanica-2	1,2
Dabar	0,65	Moscanica-3	0,27
Duboki Potoc	0,53	Pavlovac	0,44
Dvanaesti Kilometar	1,5	Pecina	0,6
Gostovic-1	0,64	Pogledala	0,38
Gostovic-3	0,43	Prsljanica	0,24
Grablje	0,35	Tresanica-1	0,29
Hatiraj	1,44	Tresanica-3	0,74
Kljajiei	5,9	Tresanica-4	0,35
Klokun	9	Veliki Duboki Potoc	0,74
Konjic Mini	0,99	**TOTAL 1+2**	**28,95**

http://www.ebrdrenewables.com/sites/renew/Lists/Projects/Public%20View.aspx?View={AA77B830-914E-4553-8403-E7E56FB399F2}&FilterField1=Country%5fx002d%5fRegion&FilterValue1=Bosnia%2FHerzegovina

Figure 14: SHPP Construction

Photo: SHP Gostovič start construction 5/2008

Source: http://www.energy-eastern.eu/test/index.php?wahl=projekte&sub=verwalten&landwahl=1

Retrieved: 20/09/2009 14:06

EP HZHB plans to build five SHPP in the region Tihaljina, Mlade and Trbizat with water flows between 12.5 m³/s in Modro oko and 22.6 m³/s in Stubica. All together, the installed capacity shall be 19.9 MW at an investment of € 43.6 Mio.

Swiss company Geva and the Austrian company Small Hydropower Tirol plan the construction of one and four small hydropower plants respectively in FBIH with a total capacity of 5.4 MW. Both investors have concluded contracts with JP “Elektroprivreda BiH” to feed electricity into grid for a period of 20 years. Small Hydropower Tirol has also entered

into a DBOT (Design-Build-Operate-Transfer) agreement with the canton of Srednjebosanski according to which the ownership of the plants is to pass to the canton after 20 years.[9]

One initial license for construction of a SHPP “Dubrava” with an anticipated annual generation of 8.12 GWh at Kozicka Rijeka in the municipality of Gornji Vakuf/Uskoplje as been awarded to the company Wind Neretva in Konjic. Same company filed a license application for another SHPP named “Lukac T3” on the Tresanica River in Konjic with 8.63 GWh of annual generation, but the procedure was stopped due to revocation of the environmental license.

Again, in Konjic, a company called Amitea from Mostar applied for a license for the “Tresanica 4” SHPP with 7.07 GWh anticipated annual generation. Finally, ECO Energy from Tuzla files an application for a license for the SHPP “Osanica 4” on the river Osanica in Gorazde municipality with an annual generation expected to be 2.583 GWh.[30]

2.9.8 EBRD co-financed Projects

One of the projects where EBRD is actively involved is the development of sustainable energy projects like the Cetina and Trebizat rivers area. A detailed Strategic Environmental Assessment on the implications of the project is a prerequisite of institutions like EBRD in order to assess whether the environmental impacts of the project are in line with its own policies and the relating EU directives (2001/42/EC).

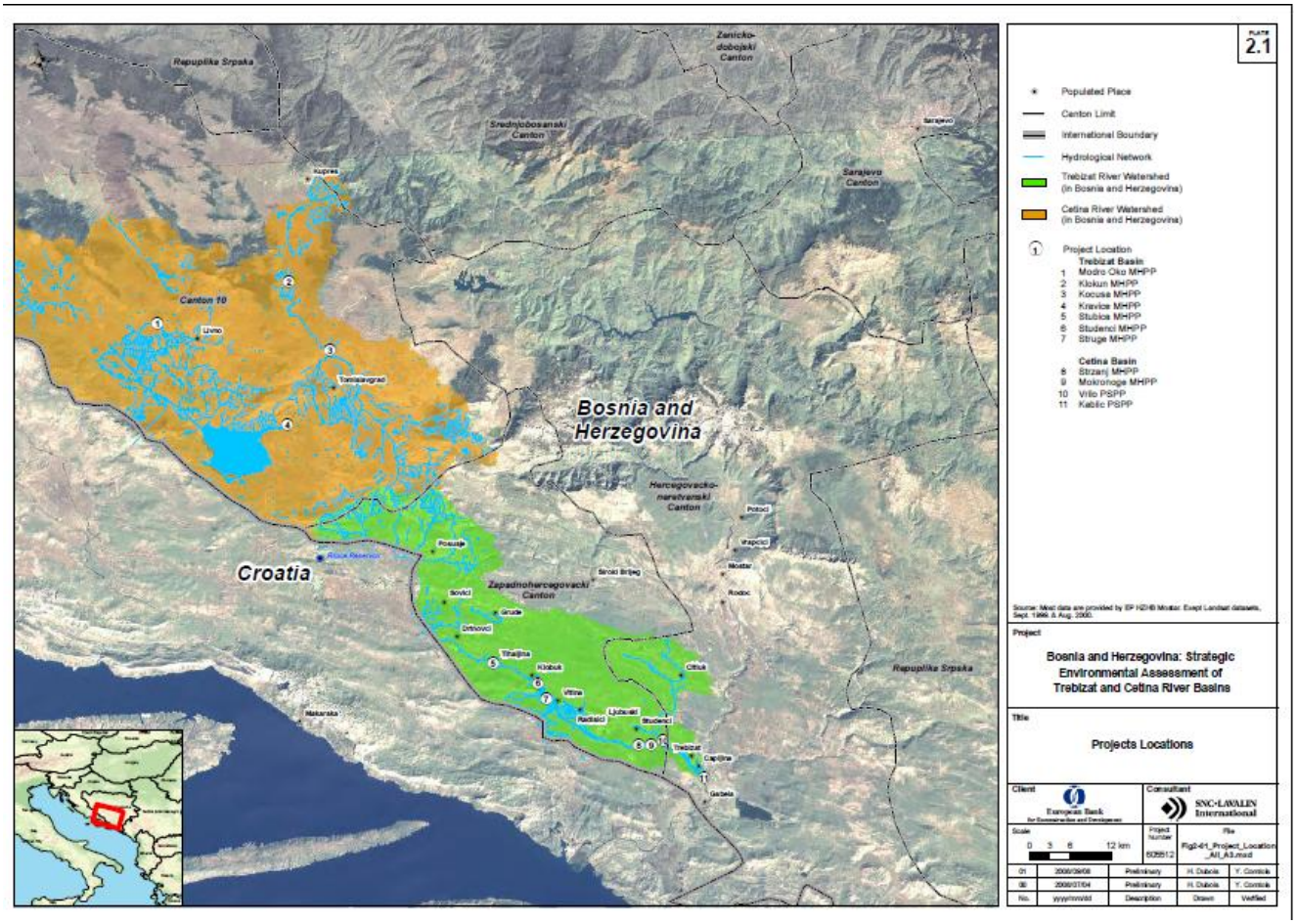

Figure 15: Trebizat and Cetina Basins

Trebizat Basin (south 1-7) and Cetina Basin (north 8-11)

Source: SNC Lavalin, 2009

Besides two larger pump storage power plants, nine SHPPs are planned in the Trebizar/Cetina Basins area as listed underneath:

Table 18: SHP-Project Trebizar and Cetina Basins

SHPP	River	Installed Capacity MW	Anticipated Generation/anno GWh	Useful discharge m³/s	Investment Cost €
Modro oko MHPP	Tihaljina/Trebz.	3,56	12,22	32	
Klokun MHPP	Mlade/Trebz.	3,20	12,00	40	10.733.000
Kocusa MHPP	Trebizat	4,85	18,40	40	9.960.000
Kravice MHPP	Trebizat	5,00	21,80	28	
Stubica MHPP	Trebizat	2,92	12,75	46	
Studenci MHPP	Trebizat	4,00	13,80		
Struge MHPP	Trebizat	5,15	17,80		
Strzanj MHPP	Cetina River	7,38	20,80	5	
Mokronoge MHPP	Suica/Cetina River	3,30	6,60	15	

Source: SNC Lavalin, 2009

The Trebizat River Basin

The climate in the Trebizat River Basin is characterized by drier summers with average monthly rainfalls ranging between 30 mm and 70 mm. Winters are relatively humid, with average monthly rainfall varying between 100 mm and190 mm. July is the driest month with 30 mm, November is the wettest month with over 190 mm of rain. The average yearly rainfall in the basin is 1,500 mm.

The seven projects on the Trebizat River are shown in the profile below:

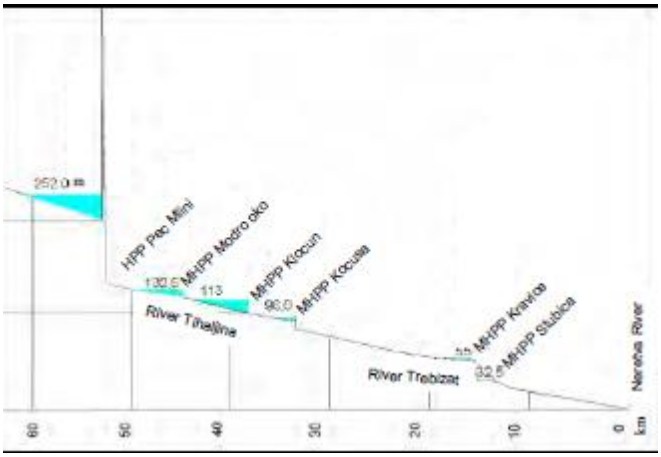

Figure 16: Profile of Trbizat River SHP Projects

Source: EP HZHB Development Sector, 2007 in SNC Lavalin, 2009

Figure 17: Kravice - Natural Sights near SHP Implementation Site

Source: SNC Lavalin 2009

Figure 18: Mokronoge - approximate Implementation Site of the Dam

Photo: Mokronoge – Approximate Implementation site of the dam

Source: SNC Lavalin 2009

The CETINA RIVER BASIN

The table underneath shows the monthly precipitation at four stations in the Cetina projects area. July is the driest month in the project area. The period from October to December (included) is generally the rainiest. The precipitation regime is also affected by snowfalls, which often occur in areas over 500 m above sea level.

Table 19: Mean Monthly and Annual Precipitation in the Cetina Projects Area

Month	Glamoc (1031 m*)	Livno (730 m*)	Tomislavgrad (903 m*)	Bugojno (1190 m*)
January	121	88	106	80
February	124	95	115	85
March	122	103	123	88
April	105	82	94	89
May	110	93	107	105
June	103	87	92	108
July	68	52	56	62
August	77	72	80	87
September	115	90	83	96
October	152	145	150	130
November	148	128	153	110
December	194	134	146	109
Year	1,439	1,169	1,305	1,149

Source: SNC Lavalin 2009

2.9.9 Limiting Factors and Barriers

Investors in BIH have to overcome the complex political administrative system. The main barrier is the constitutional organization of the state with a complicated split of responsibilities. BIH does not have an integrated action plan on state level and there are three regulatory commissions. A lack of reliable database makes new measurements necessary.

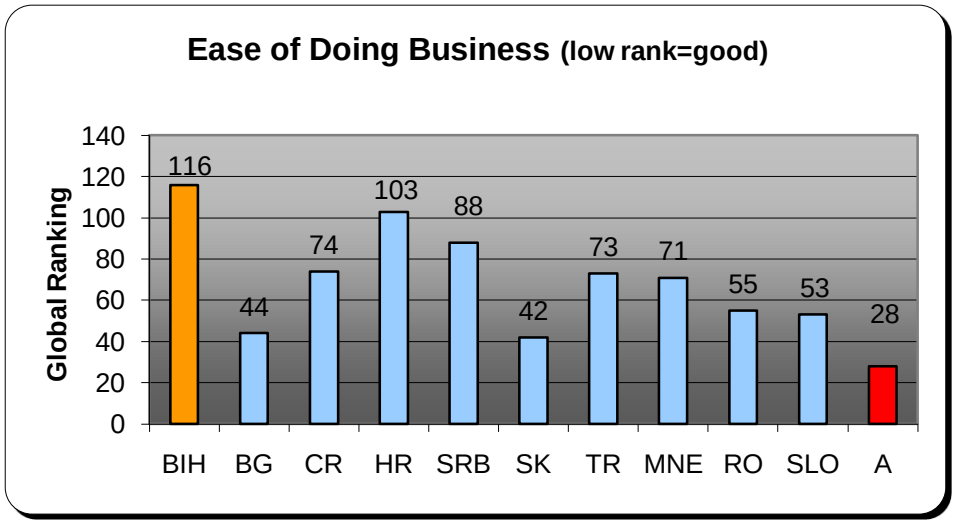

Figure 19: Ease of Doing Business in BIH

Graph created by Kopecek, C.; Source: The World Bank Group, 2009 in http://www.doingbusiness.org/ExploreEconomies/?economyid=13

Doing business in BIH is challenging in several aspects. The World Bank Survey ranks the country number 116 of 183 analysed countries. In categories “Starting a Business” and “Registering Property” it comes last in the Peer Group and obtaining “Construction Permits” also does not seem to be a simple affair. “Enforcing Contracts” and “Paying Taxes” is at close to the worst surveyed Peer Group members as well.

3 Bulgaria

Figure 20: Map of Bulgaria

Source: http://biega.com/maps/bulgaria.jpg

Total area:	110,910 km² (104th)
Population:	7,606,551 - 2009 estimate (95th)
GDP (PPP):	USD 93,569 billion - 2008 estimate (63rd)
Inflation:	5% - 2009 estimate
Rating:	BBB S&P; Baa3 Moody's[31]

3.1 General Country Information

Located in south-eastern Europe, Bulgaria (BG) is bordering the Black Sea and lies strategically important between Turkey, Greece, Romania, Serbia and Macedonia. Its 28 provinces (oblasti) are subdivided into 264 municipalities. The urban portion of the population is 71% (2008) with the biggest towns in Sofia, Plovdiv and Varna. The population is decreasing with a rate of minus 0.79% (2009 EST.). [32] [iv] Income from agriculture contributed 8%, from industry 26.1% and from services 65.9% to the GDP (2006). BG is relatively rich of mineral resources. Lignite, coal and anthracite as well as copper, lead, zinc uranium and gold play an important role. The country is heading the Balkans in terms of steel production per capita.[31]

3.1.1 Political and Economic Situation

Having fought on the losing side in both World Wars, BG fell within the Soviet sphere of influence and became a People's Republic in 1946. Communist domination ended in 1990, when BG held its first multiparty election since World War II and began the continuous process of moving toward political democracy and a market economy while combating inflation, unemployment, corruption, and crime. Since 1997 it is following a consistent reform policy and through today BG has been a source of stability in the Balkan region. The country joined NATO in 2004 and the EU in 2007. BG is the poorest country in the EU.[32]

BG has a parliamentary democracy. The elections in July 2009 brought a landslide victory of a conservative party beating the previously ruling socialists.
The new force in the country is the mid-right wing GERB party with the major of Sofia, Mr. Bojko Borissow as its populist leader.

BG is now in the waiting room of the EURO zone. This next step of joining the European Monetary System will most probably take another 3 to 5 years due to the difficulties reaching the convergence criteria. However, the Bulgarian LEW is pegged to the EURO (1.95583/€) via the Currency Board which gives more comfort to €-based investors but takes away the

[iv] The main ethnic groups are Bulgarian (83.9%), Turk (9.4%) and Roma (4.7%). The Religions are Bulgaria Orthodox 82.6%, Muslim 12.2% and other Christian 1.2% (2001 census). ,[iv]

ability to devalue the currency for economic rescue actions.[v] However, the high current account deficit has been a problem in the past. Inefficient administration and judicial system, corruption, crime, the weak infrastructure and environmental protection are remaining obstacles to BG closing the gap to EU economic standards. [33]

The impact of the financial crisis on BG is severe. BG is the poorest country in the EU. Capital flows to the region have dropped dramatically, Western banks are no longer providing funding to their local representations and the virtual stop of private sector credit has slowed demand. [vi]
Due to various misuses, EU has cancelled supporting funds in the region of approx. € 800 Mio last year.

The Bulgarian economy is expected to contract this year (-3.5%) and next year (-1.0%) and local companies will face difficulties serving their debt, but Bulgarian banks are reported to still have strong buffers in place as a result of prudent policies during the boom years. [34]
The trade balance reached a record high 25.3% of the GDP in 2008, which could be offset against direct foreign investments, at least until last year.
BG will need a Multi-Billion rescue package helping the meanwhile exploded external debt (107% of GDP in 2008).[35]

3.1.2 Work Force

Due to high emigration and the difficult economic situation, BG faces a demographic crisis with a decline of the population of about 1.5 million people during the last 2 decades.
The total work force is 4.806 million (2008 est.) thereof in agriculture 11%, industry 32.7%, services 32% (3rd qtr. 2004 EST.).[36] The unemployment rate went down from 20% in 2001 to 5.6% in 2008 but is estimated to climb to 7.5% in the current year. The education quality is relatively high, although a bit worse than in the communist era due to lower funding.[37]

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[v] With its stringent fiscal and debt policy together with currency board regulation financial stability a surplus budget since 2003 was achieved. Bulgaria has seen several years of strong economic growth buoyed by private consumption and EU-funding.

[vi] Up to mid of the year, thanks to the prudent policies and the larger cushions BG has been shielded from the extreme problems associated with the Financial Crisis. Banks did retain their previous year's profits increasing their capital and thus remained relatively stable. Sharp exchange rate depreciations experienced by other countries were absent in BG and public finances have been in surplus so far. However, further deterioration of the balance of payments shows that BG is also facing a severe shock. [vi]

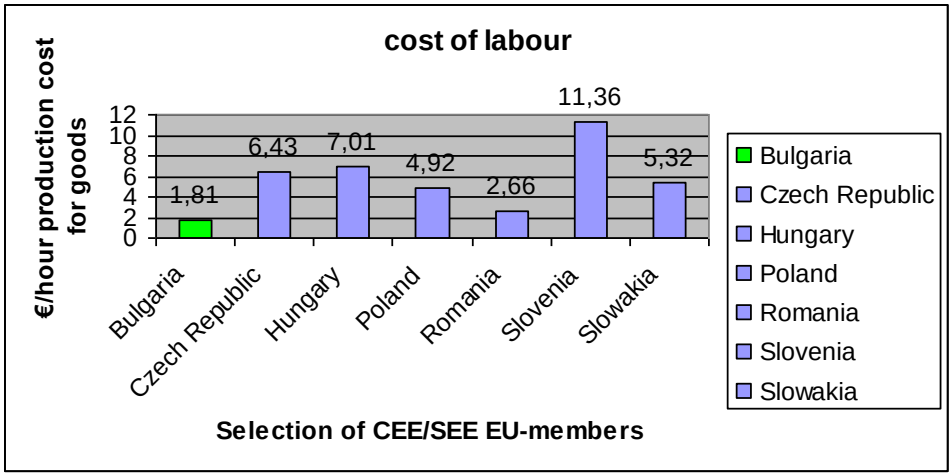

Figure 21: Cost of Labour Comparison selected CEE/SEE countries

Source: data from Die Presse May 27th 2009; graph by author

The wages are by far the lowest of the EU-countries and much lower than the wages in other ex eastern bloc EU countries.

3.2 Energy

BN needs to import 70% of its energy supplies. Oil and Gas reserves are not material and the significant coal and lignite deposits are not easily to be recovered lying under densely populated areas.

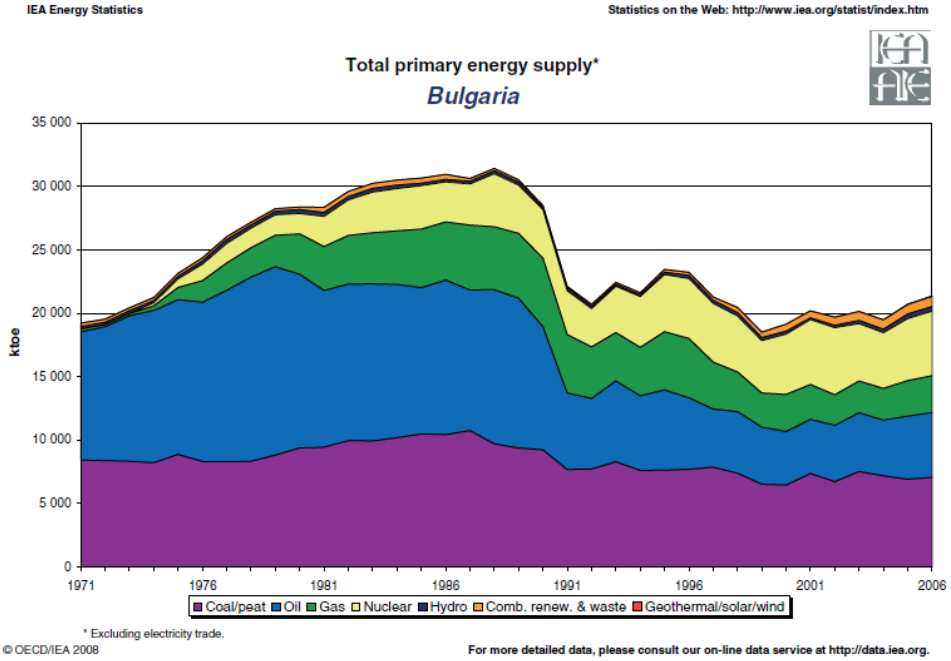

Figure 22: Total Primary Energy Supply in BG

Source: OECD/IEA

Almost 12.7 GW of installed capacity use thermal, nuclear and hydro resources. Until next year, a big portion of the generation capacity, mostly outdated nuclear power plants will be retired and replaced by new smelters, thermal and hydro power plants.

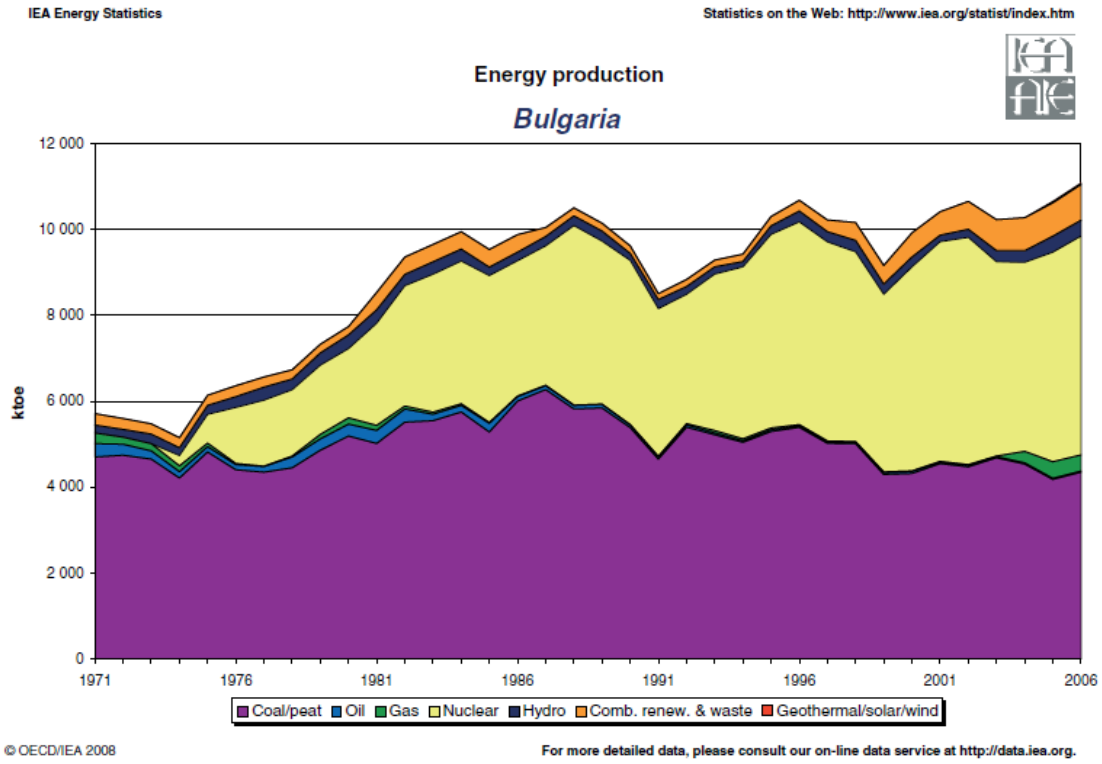

Figure 23: Energy Production in BG

Source: OECD/IEA

NEK, the National Electricity Company, bases its demand forecasts on the assumption, that there will be a significant reduction in the electricity intensity in the long term. Until 2015 the Tsankov Karnak hydro power project, the Belene nuclear power plant but also an substantial growth of wind energy will provide new capacities. After 2015 new hydro capacities like the SHPP at the Gorna Arda Cascade and the Danube River based Nikopol – Turnu Magurele HPP and Silistra – Calarasi HPP will be commissioned (Scenario I). In another scenario, Gorna Arda would only be built after 2024.[38]

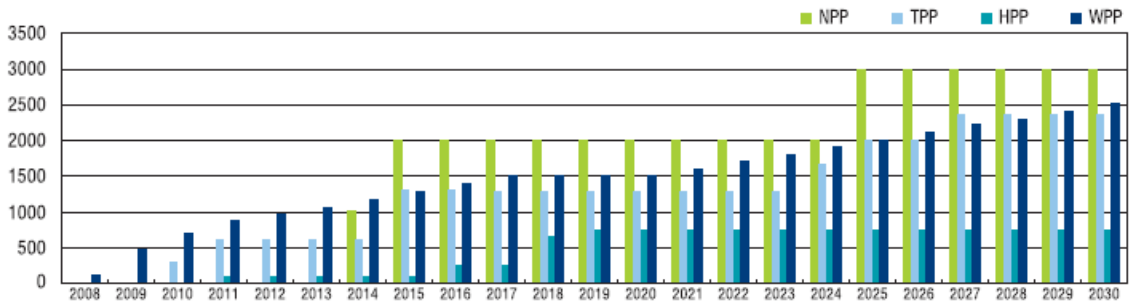

Figure 24: Forecast of New Energy Generating Capacities in BG

Commissioning of new capacities by stages under scenario I in MW

Source: NEK Annual report 2008

NPP=nuclear power plant, TPP =thermal power plant, HPP=hydro power plant, WPP =wind power plant

3.2.1 Overview Electricity Market

Electricity production reached almost 42.5 TWh in 2007 (41.5 TWh in 2006), thereof 48% of fossil fuel sources, 44% nuclear and 8.1% hydro energy. BG is a net exporter of electricity (almost 8 TWh 2007 estimate) due to its vast power plant capacities but it is depending on imports of primary energy such as oil, natural gas coal and uranium for its nuclear plants. [39]

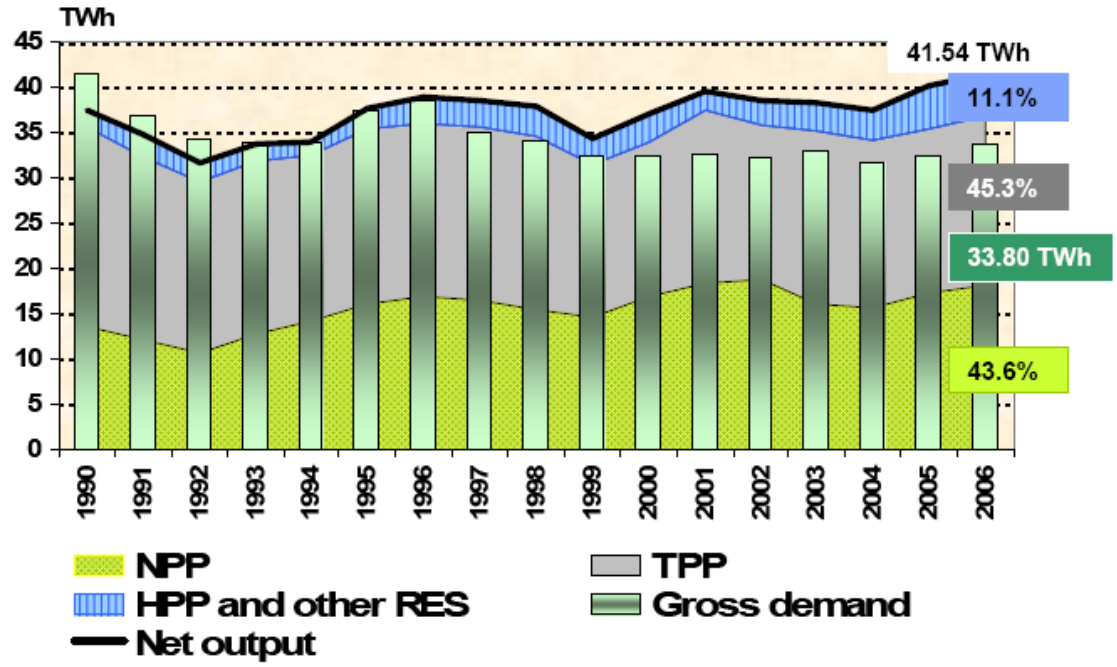

Figure 25: Development of Net Power Generation in BG (1990-2006)

NPP=nuclear power plant, TPP =thermal power plant, HPP =hydro power plant RES =renewable energy sources

Source: Papazyan, M.: Electric Power Infrastructure in BG and Prospects for its Development

Bulgarian industrial sector accounts for 37% of electricity consumption, the economy has the highest energy intensity in the EU.

The former ruling party around Sergej Stanischev was often blamed for its pro Russian Energy policy. Oil- and Gas pipelines as well as a nuclear plant are to be built under the lead of Russia. On the other side, EU is willing to pay € 300 Million of compensation for the decommissioning of ¾ of the reactor blocks of the Kosloduj plant.

3.3 Renewable Energy – Actual and Potential

BG fulfilled already its 2010 renewable electricity target of 11% of its electricity consumption out of Renewable Energy Sources (RES) by achieving 11.2% already in 2006. But it is far away from reaching the 16% target of the share of RES in final energy consumption by 2020; although BG is expected only to provide the lowest increase in RES to the reference year 2005 (+6.6%) compared to the other member states.

Renewable Electricity generation is dominated by the hydropower sector. Total installed Hydropower generation capacity was 2,707 MW of which were 388 MW contributed by SHPP in 2006.

Energy generated from RES in 2005 was 1,000 Mtoe and is mostly produced by HPPs (24%), energy from biomass (70%) and geothermal energy and others (6%).

BG has a significant unused potential of renewable energy sources. According to the "National Long Term Programme to Promote the Use of Renewable Energy Sources 2005-2015", the available potential of different RES is estimated at about 6,000 Mtoe per year, which includes hydro, wind, solar, geothermal energy and biomass. [40]

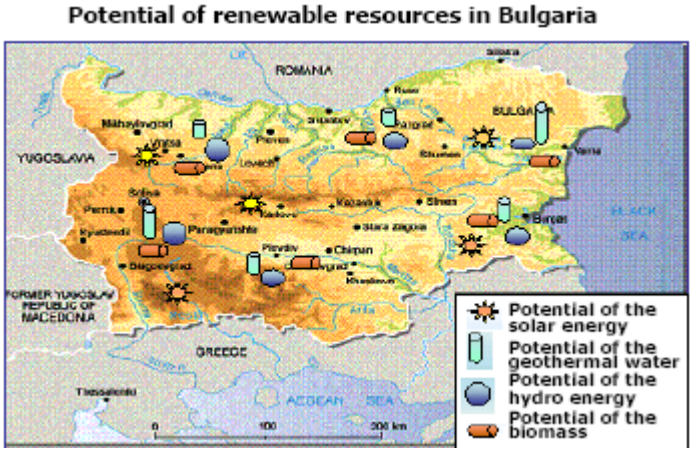

Figure 26: Map with potential RES-Sites in BG

Source: G&A Consultants – Bulgarian Energy Market Overview

Common assumption of all energy development scenarios of NEK is the considerable increase of renewable energy. The table below shows the forecasted increase based only on wind- and hydropower:

Table 20: Outlook on Wind- and other RES-Energy until 2020 in BG

	Renewables Output		
Timeline	**GWh**	**Relative share of total output in %**	**Installed wind energy capacity in MW**
2010	3400	8.2-8.4	240
2015	5100-5800	10.6-13.0	1000-1350
2020	6100-7000	11.1-14.1	1500-2000

Source: NEK Annual Report 2008

The production forecasted by the Ministry of Economy and Energy sees a high portion of Biomass and less wind. [41]

Table 21: RES-E Production Forecast up to 2015 (in GWh) in BG

	Biomass	Biogas	Hydro PP	Wind PP	Geothermal PP
2010	5,894	57.84	2,813	0.612	408
2015	8,014	1,764	3,248	373	3,145

Source: Ministry for Economy and Energy

The potential of RES for electricity production was quantified by the National Project/Programme on Renewable Energy Sources as follows:

Table 22: RES Potential for Electricity in BG

RES POTENTIAL for Electricity	Envisaged Investment Cost in USD mio	Total Power Capacity in MW
Photovoltaic	49,7	12,43
Wind	162,19	62,22
SHPP	151,77	101,18
Biogas and Natural Gas	251,96	244,26*
TOTAL	**615,62**	**175,83**

*investments include 126 MW heat

Source: "National Project/Programme on Renewable Energy Sources (NPPRES) in Republic of Bulgaria 2004 – 2014" Energy Efficiency Agency. MEER in http://www.agreenet.info/documents/studie_bg.pdf

The newer developments in the RES sector show, that **wind-energy** is getting overweight but also **photovoltaic** is in the focus of the investors.

In recent years a real run for projects in the RES sector has started.
Most of the projects are wind power plants situated in the Kavarna region, to a lesser extent photovoltaic plants. The applications received by NEK by the end of 2008 showed PV plants with 440 MW capacity compared to 7.690 MW applications for wind-farm.

But the booming Renewable Energy Industry, which is facilitated by attractive climatic and topographic preconditions and the incentive scheme is already facing growing resistance by concerned parties. NEK and the state energy and water commission call for restrictions of renewable energy projects. NEK reports investment projects in the size of 10.500 MW, thereof 8.826 MW for Wind Energy Plants. Even if only part of those projects materialize, the feeding in of the green electricity in the partly antiquated grid would trigger investments of around € 180 Million.
But now, due to the actual financial crisis, the foreign investments into BG have considerably dropped. The renewable energy will most likely remain a chance for BG to attract foreign investment and it will be the task of the new government, which was elected on July 5th to draft a comprehensive new energy policy. [42]

3.4 Small Hydro Power – Actual and Potential

All together, the water resources are scarce (2,380m³ per capita p.a.) but due to the high elevation of the mountain regions the total hydro-energy potential (LHP and SHP) is estimated to be 24.6 GWh in average. The technical potential has been calculated to be 15 GWh according to feasibility studies for potential HPP in BG. The existing roughly 100 HP plants use 30% of the technical potential.[43]

The share of the SHPP is approximately 0.8% of the total electricity mix and 16.5% of the Renewable Energy in BG. The respective share of Hydropower is roughly 3.6% (83.5% respectively).

According to the ATLANTIS[44] study BG has a total (average) installed capacity of 235 MW (2.1 MW). NEK owns 107 MW (2 MW), with an average age of close to 60 years.[vii] A list with the inventory of the SHPP in BG is presented in ANNEX III.

In the so-called Strategic Study by SHERPA **102 SHPPs** were counted in BG with an **installed capacity of 196 MW** and **electricity generation of 627 GWh/year** as per 2006.

Table 23: SHP Evolution and Forecast in BG 2000-2020

	2000	2001	2002	2003	2004	2005	2006	FC 2010	FC 2015	FC 2020
Total Number of SHPP	77	79	83	84	89	95	102	128	250	305
Capacity MW	149	150	156	166	175	184	196	255	310	330
Generation GWh				523	560	588	627	810	990	1.050

Source: SHERPA 2008

[vii] The first SHPP "Simeonovo" was built in 1927 is partly fitted with SIEMENS equipment and still working satisfactorily.

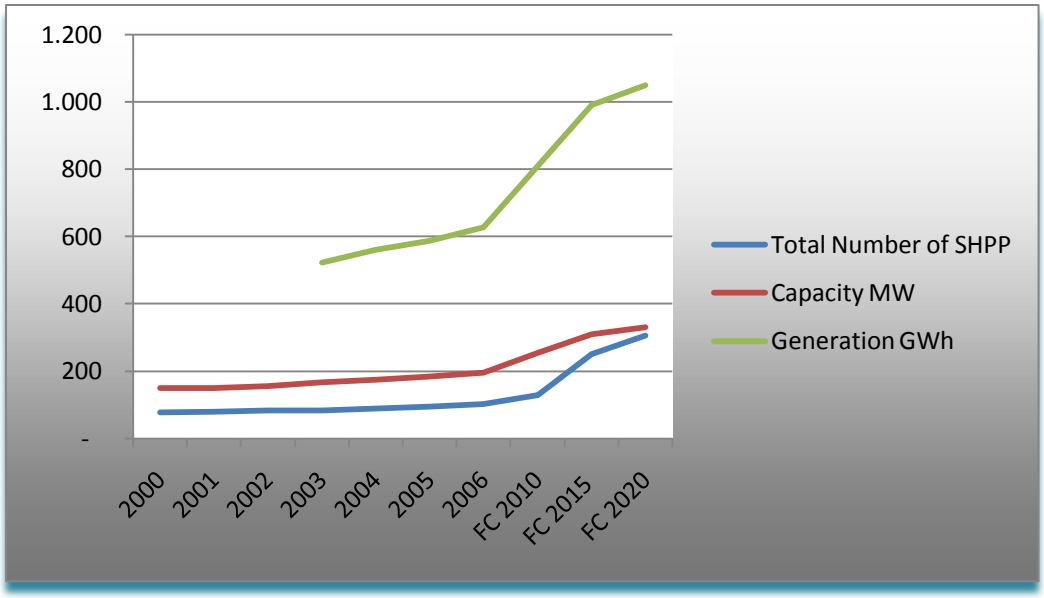

Figure 36: SHP Evolution and Forecast in BG 2000-2020

Source: SHERPA 2008, Graph by Kopeck, C.

The **net realizable potential for new SHPP (retrofit SHP)** is quoted with **290 (56) MW and 1.000 (158) GWh/year** in an estimate by SHERPA. [11]

Table 24: SHP Potential in BG

Potential	**Generation**		**Capacity**
	GWh/yr	**%**	**MW**
Gross theoretical	1.527	100	477
Technically feasible	n/a	n/a	n/a
Economically feasible	1.070	70	300
Economically feasible taking environmental constraints into account (EFEN) estimate	1.000	66	290
EFEN for refurbishing / upgrading estimate	158		56

Source: SHERPA 2008

Like most other countries located in Southern Europe BG has a big share of high head SHPP. Those plants are older than in most other countries of the region under review. The average age is around 54 years, with 65% of the plants being older than 40 years and about 25% under 20 years. Most (84%) are privately owned.

Table 25: Age Structure of SHPP in BG

Age in years	0-19	20-39	40-59	>60	**Total**
Number	22	7	29	25	**83**

Source: TNSHP 2004

The range of **investment cost for a new SHPP** is between 1.000 – 1.500 €/kW with **production cost** of 0.4-0.8 €cts/kWh.[11]

The contribution to the gross electricity generation is 0.8%. Resistance against erection of SHPP has not been reported in the 2004 TNSHP survey.

Compared to other peer group countries BG is not in the top league like Turkey and Romania concerning the SHPP but TNHP study of 2004 around 44% of the economically feasible sites would have been already exploited, the remaining corresponding potential was quoted with only 393 GWh/year. [45]
The NPPRESS estimates the **potentia**l of approximately **100 MW** (see above table RES Potential for Electricity).

3.5 Participants on the SHP-Market

3.5.1 Institutions and Authorities

The Ministry of Economy and Energy (MEE) conducts the energy policy and takes the functions as owner of the state controlled energy companies.
The Council of Ministers defines state policy in the energy sector and the Minister is the responsible administrative body for carrying out the defined policy.[46]

The State Energy and Water Regulatory Commission (SEWRC) is an independent state body responsible for the regulation of the activities concerning energy and water supply and sewage. Regarding electricity, it monitors markets, prices and licensing for generation, transmission and distribution.[47]

The Energy Efficiency Agency (EEA) is a legal entity with executive status to the Minister of Energy and Energy Resources which is in charge of developing programs and projects for enhancing energy efficiency and use of RES and providing funds for their co-financing and implementation.[48]

Bulgarian Energy Holding EAD (BEH EAD) was established on September 18th 2008 with the subject of activity acquisition, management and sale of shares in state owned companies that carry out business activity in the areas of production, output, transport, transit, storage, management, distribution, sell and/or buy of natural gas, coal, electricity, etc.

National Electricity Company (NEK EAD) is 100% owned by BEH EAD. The main functions are the electricity generation, transmission, trading and supply to customers connected to the transmission; also the construction and maintenance of power generation facilities.[49]

The Privatization Agency (PA) was originally established in 1992 in fulfilment of the Law on Privatization and Restructuring of the State- and Municipal owned large enterprises. In 2002 the law was adopted and since then the divestment of all state owned interests is in the responsibility of the PA.[50]

3.5.2 Market Players

As defined by the Law the participants in the Bulgarian electricity market are the

- power producers
- public supplier (NEK)
- public providers (the companies controlled by EVN, ČEZ and E.ON.)
- transmission company (NEK)
- distribution companies (the companies controlled by EVN, ČEZ and E.ON.)
- traders of electric power
- transmission system operator (ESO)
- end suppliers
- consumers

3.6 Legal Framework for RES and SHP

The main drivers for developing renewable energy generation in BG are the various national and also the relevant EU renewable energy policies, whose goals provide the framework for BG.

3.6.1 EU

The Directive 2001/77/EC on the promotion of electricity produced from renewable energy sets a 21% indicative share of electricity produced from renewable energy sources in total Community electricity consumption by 2010.

It defines national indicative targets for each Member State, which is around 11% for BG of RES on electricity consumption by 2010, encourages the use of national support schemes, the elimination of administrative barriers and grid system integration. As per 2020 BG 16% of the gross final energy consumption in 2020 should be covered by Renewable Energy.

The EU-Commission herewith is setting reduced national targets for countries like BG, which GDP level per capita is lower than the average EU level. Thus, BG is only obliged to increase the RES share by 6.6%, which is the lowest in the EU. However, BG is still far away from reaching even this low target.

Reducing energy intensity is one of the main priorities of BG's energy policy, together with ensuring the security of supply and the sustainable development of the energy sector.

The Draft of the Bulgarian Energy Strategy states, that through setting up proper promotion systems for biomass, SHP and wind-power, the targets will be met. Photovoltaic according to this paper would have the biggest technical potential but it is regarded as most costly option with only limited economic potential. [51]

3.6.2 National

Since 2007 the EC Directives have been widely implemented and the energy market is fully liberalised now.[viii]

Some other provisions like public service obligation or unbundling provisions have yet to be implemented.

The main legal framework for energy activities is the Law with the following main Acts:

- Energy Act SG No. 43/29.04.2008
- Renewable and Alternative Energy Sources and Bio fuels Act Promulgated, State Gazette No. 49/19.06.2007
- Water Act SG No. 70/8.08.2008
- Environmental Protection Act SG No. 52/6.06.2008
- Investment Promotion Act SG No. 37/2004
- Spatial Development Act SG No. 69/5.08.2008

The provisions of the Law are further developed in several ordinances, rules, decrees, decisions, instructions, etc.:

- Ordinance on the operation and maintenance of electric power plants and networks

[viii] All consumers, including households, are considered "eligible consumers" who can freely exercise the right to change their suppliers.

The provisions regarding the market opening, 3rd party access, generation, technical rules, and monitoring of security of supply have been fully transposed into the local legislation.

- Ordinance on the conditions and way of dams and their facilities operation and maintenance
- Ordinance on the technical provisions and norms for design, construction and operation of sites and facilities for heat energy generation, transformation, transmission and distribution
- Rules on Bulgarian Grid Code [52]

The national laws concerning renewable energy were introduced in 2006 in fulfilment of EU requirements with later amendments.

Those laws extend privileges to Renewable Energy Producers like obligatory access and feed in rights at guaranteed preferential prices and a maximum response time for applications for grid connection. The transmission and distribution companies are obliged to allocate a certain portion of their annual investment and repair programme to the development of grids which relate to RES promotion.

The State Energy and Water Regulation Commission issues certificates of origin to RES-generated electricity. Public providers and end suppliers have then to purchase all that electricity (except the portion used in the balancing market of for own use). Up to an installed capacity of 10 MW, a preferential price which is determined by an ordinance of the SEWRC on an annual basis until 2022.

Activities in the field of electricity are subject to a prior licensing regime. The Law provides an exception from the license regime for the generation of electricity by a plant with total installed capacity of up to 5MW. The issuance, amendment and withdrawal of energy licences are within the competence of the SEWRC.

When meeting certain requirements, those licenses are issued to legal persons for a term of up to 35 years with an option to prolong for the same period. Within 3 month of application with a complete set of documents, SEWRC has to issue or refuse a licence.

“By 31 March of each year, SEWRC sets preferential prices for the sale of electricity generated from RES excluding energy generated from hydroelectric power plants of installed capacity of more than 10 MW. The preferential price is set at 80% of the average selling price for the previous calendar year of the public provider and end suppliers, plus a mark-up depending on the type of the primary energy source. The mark-up for the next calendar year may not be less than 95% of the mark-up for the previous calendar year.” [53]

3.7 Drivers for new Investment in SHP

3.7.1 Promotion for RES

BG uses neither the common feed-in tariff system, which is widely spread in Europe for promoting RES nor has it introduced the system of Green Certificates, although the implementation of latter incentive system has been stipulated in Renewable and Alternative Energy Sources and Bio fuels Act / State Gazette No. 49/19.06.2007.

For the time being, BG has a system that regulates the electricity prices in its own way.
The State Energy and Water Regulation Commission, SEWRC, has increased feed-in prices for electricity generated on the basis of all forms of renewable energy, with effect from April 2009.
The biggest **price increase** applies to **small hydropower plants (8.2%)**.[54]

For the period 1 April 2009 - 1 April 2010 SEWRC the new price consists of two components:

- The first component is the equivalent of 80% of the average selling price of public/end suppliers for the previous year. For 2009/10 this component was set at BGN 64.40 (approx. EUR 32.93). Although the average selling price is calculated on the basis of legally set formulae, the calculation is not subject to an open review. The calculation of the average selling price is only used for price formation of energy produced by RES and is not published or otherwise distributed, outside the yearly decision of SEWRC for adoption of the feed-in tariff.

- The second component is an add-on “bonus” at an amount no less than 95% of the add-on “bonus” for the previous year. For 2009/10 this is calculated as 95% of the add-ons for the previous year. It should be noted, that the limit of the add-on is set with respect of the minimum percentage, but does not set a maximum.

In general, the buy-out prices of energy produced by all types of renewable energy sources as compared to the prices for the previous year are increased. The preferential prices applicable for SHPP as per 2009/10 were set by SEWRC as shown below:

Table 26: Calculation of Preferential Price 2009/2010

	Limit	**Unit**	**2008/09 Preferential Price**	**80% of average Sales Price (80,50)**	**Surcharge**	**2009/10 Preferential Price**
SHPP	up to 10 MW	BGN/MWh	97	64,40	40,60	**105**

Source: SEWRC

Power companies are obliged to buy RES-E and the duration of such contracts for SHP is 15 years. However, private power companies are not always prepared to conclude those contracts due to high cost and low revenue.

3.7.2 Other Supporting Schemes for RES-E

The European Bank for Reconstruction and Development (EBRD) is one of the most important supporters for achieving their EU energy targets offering BG an “Energy Efficiency and Renewable Energy” credit line. The EBRD has committed EUR100 million to a credit line to Bulgarian banks specifically earmarked for investments into renewable energy and energy efficiency projects.

The credit line had funded 17 wind projects, 16 small hydro projects, 8 biomass and 5 geothermal projects as of June 2007. The credit line is supplemented by grant funds from the Kozloduy International Decommissioning Fund providing technical assistance to support project appraisal and incentive payments to completed projects. [55]

The “Bulgarian Energy Efficiency and Renewable Energy Credit Line” (BEERECL) is a product of a co-operation of EBRD, EU and the Bulgarian government. It offers financing packages for small RES-projects where only 80% of the loans granted up to a maximum of € 2.5 Mio need to be repaid. Under this facility, loans are extended to participating banks including Raiffeisen BG and UniCredit Bulbank, for on-lending to private borrower investing in RE and Energy Efficiency projects in BG. Specialised consultant assists the project developers in the application procedures, preparing business plans and implementation. Eligible are investments in new SHPP only, rehabilitation of existing sites or investment in second hand SHPP is excluded. Further criteria are fulfilment of certain environmental, safety, natural protection, recreational and cultural requirements.

For SHP-Projects under the BEERECL program, there is a so-called Hydro Environmental Procedure which includes the assistant of specialised consultants under the Rational Energy Utilisation and Financing Plan.

3.8 General Investment Incentives

Bulgaria offers various incentives for investor like:

- Profit Tax: 10%
- Dividend Tax: 5%
- Lowest price of agricultural land in EU
- EU-and NATO membership
- Currency Board fixes BGN to €

3.9 The Grid

The Electricity System Operator - ESO EAD has been established on January 04, 2007 as a subsidiary of the Bulgarian National Electrical Company - Natsionalna Elektricheska Kompania - NEK EAD and it is wholly-owned by the State and managed by the Bulgarian Minister of Economy and Energy. The National Dispatching Centre of the Electricity System Operator performs the general operational planning, coordination and control of the electrical power system of the Republic of BG, as well as its common operation with the electrical power systems of other countries.

Figure: 37 Electricity Grid of BG

Source: http://www.tso.bg/Uploads/Image/BGMAP.jpe

The grid is relatively well maintained. According to the Austrian Trade Representative in Sofia, media reports that between 100 and 300 Mio. BGN (around € 50 to € 150 Mio.) are spent for maintenance and refurbishment of the transmission system.

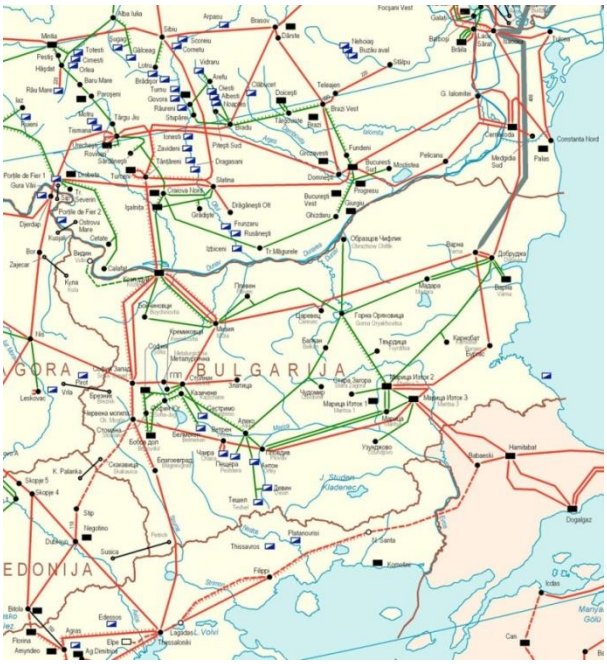

Figure 38: Interconnection Lines of the EPS in BG

Source: http://www.tso.bg/Uploads/Image/InterconnnetUCTE_bg.jpe

For Grid access the provisions of the Grid Code need to be adhered to.[56] Whilst the transmission net is owned and operated by state owned NEK, the seven former distribution companies have been bundled and majority stakes were sold to CEZ, E.ON and EVN to supply the West- , North-East- and South-East Region. Only one minor distributor serves a tiny area in the East close to Burgas.

	Region	Ownership
Gorna Oryahovitsa	North-East	E.ON
Varna	North-East	E.ON
Sofia District	West	CEZ
Pleven	West	CEZ
Sofia Capital City	West	CEZ
Stara Zagora	South-East	EVN
Plovdiv	South-East	EVN
Slanchev Briag	South-East	Slanchev Briag AD

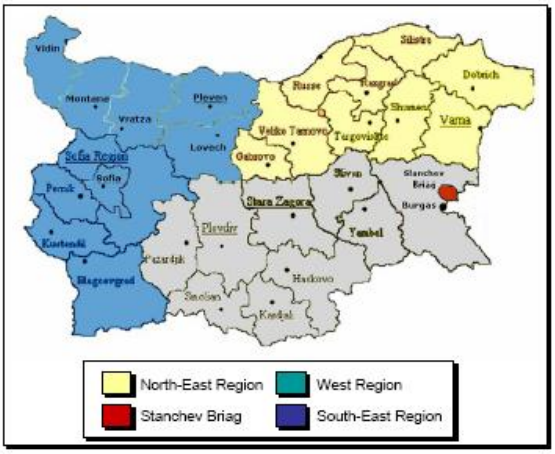

Figure 27: Energy Distribution Companies in BG

Source: G&A Consultants – Bulgarian Energy Market Overview

3.10 Natural Conditions for SHP

3.10.1 Topography

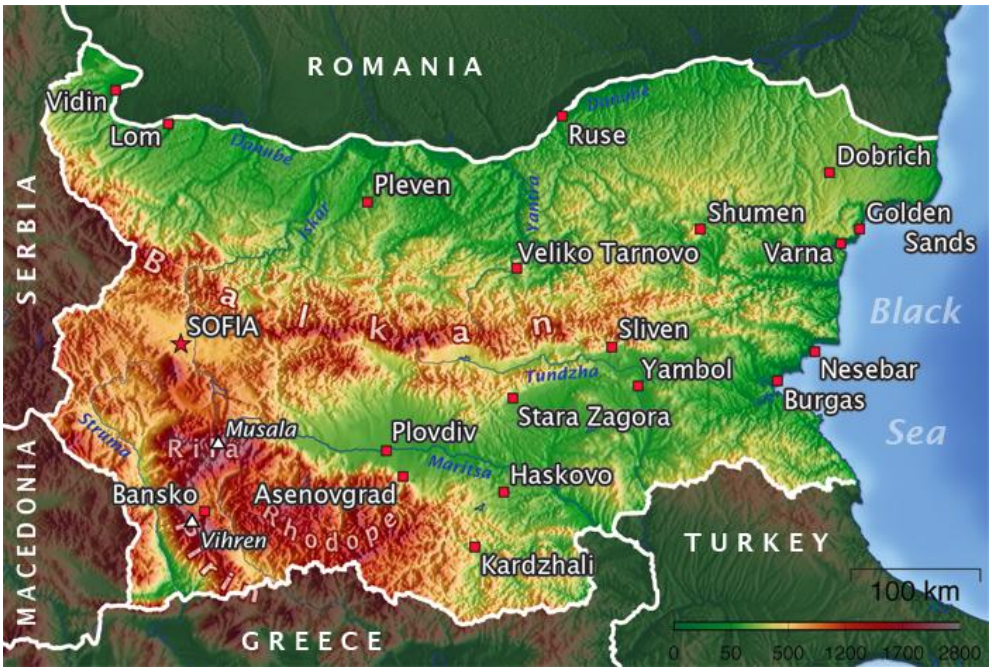

Figure 28: Topographical Map of BG

http://en.wikipedia.org/wiki/File:Bulgarien_EN.png retrieved 7/2/2009 2:43 PM

The country offers a great variety of low and high mountains, plains, valleys and deep gorges. The Danubian Plain, the Tara Planina, the Transitional Region and the Rilo-Rhodope Massif form the characteristic alternating bands of high and low terrain, which extends east to west across the country.

Table 27: Height Zones in BG

Height zones	Height (m)	Area (km^2)	Area (%)
Lowlands	0-200	34,858	31,42
Hills	200-600	45,516	41,00
Low mountains	600-1000	16,918	15,24
Medium-high mountains	1000-1600	10,904	9,82
High mountains	1600-2925	2,798	2,52

Source: http://en.wikipedia.org/wiki/Geography_of_Bulgaria, retrieved: 02/07/2009 15:17

BG is frequently affected by severe earthquakes, which is problematic to large damming. The North Bulgarian Swell in the north-central region and the West Rhodopes Vault are especially sensible to temblors.

3.10.2 Hydrography

BG's dense river network has about 540 mostly short streams with low water-levels. Most rivers flow through mountainous areas. The two catchment basins, separated by the Balkan Mountains, are the Black Sea (57% of the territory and 42% of the rivers) and the Aegean Sea (43% of the territory and 58% of the rivers) basins. The longest river located solely in Bulgarian territory, the Iskar, has a length of 368 km and takes its source like the Maritsa and the Mesta River from the Rila Mountains. The Struma River in the south leading to Greece has a catchment area of 10,800 km² and originates from the Vitosha Mountain.[57]

Main rivers are Danube, Maritsa, Mesta, Strouma, Iskar, Yantra;[58]

Figure 29: Map of Main Rivers in BG

Source: http://www.mapsofworld.com/bulgaria/bulgaria-river-map.html

3.10.3 Protected Zones

Natura 2000

As an EU member state BG is also obliged to adhere to the Natura 2000 regulations where it keeps natural sites for protection of certain species and habitats. It was intended to cover approximately 34% of Bulgarians territory with protection zones thus facing resistance of various parties mainly developers of tourism resorts but also of energy generation plants. [59]

Whether those regulations can withstand the monetary interest of various investors remains to be seen in the future. Projects in Natura 2000 sites may not be eligible for BEERECL funding.

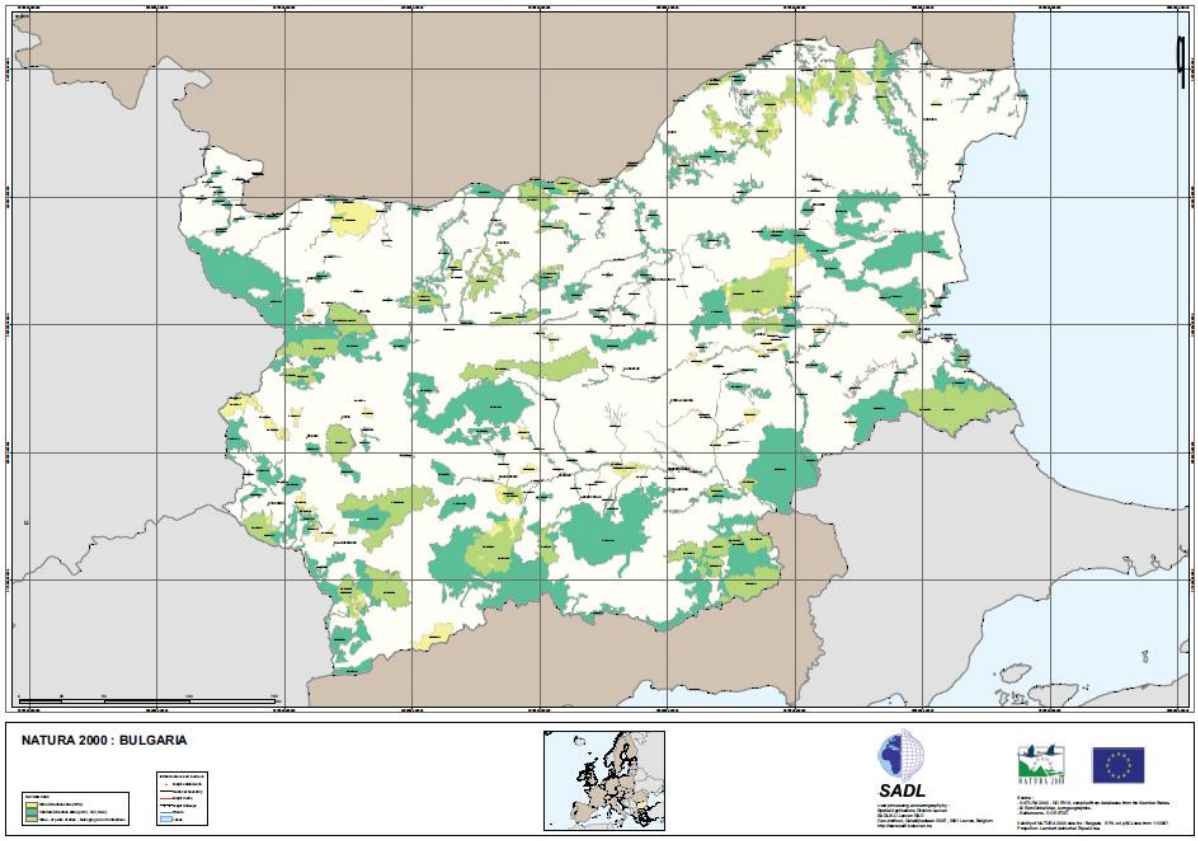

Figure 30: Map of Natura 2000 Sites in BG

Source: http://ec.europa.eu/environment/nature/natura2000/db_gis/pdf/BGn2k_0802.pdf

Retrieved: 02/07/2009 16:13

Strict natural reserves are the **Sreburna Reserve** and the **Pirin National Reserve**.

Sreburna Reserve Is a biosphere reserve in the valley of the Danube, including the Sreburna Lake and its surroundings. It has been established for the preservation of rare plant and animal species. It is 16 km west of the town of Silistra.

Pirin National Park is part of the scenic Pirin Mountain. Located in the high parts of the Northern Mount Pirin, it is characterized by a specific relief and an inimitable plant and animal world. It also incorporates the Bayuvi Doupki-Dzhindzhiritsa Biosphere Reserve and the Yulen Reserve.

Vrachanski Balkan Nature Park stretches over an area of 28,844 hectares, most of which is covered with karstified limestone, creating an abundance of caves and chasms. It is home to rare species of plants and endangered species of birds. The Middle Iskar River forms the southern boundary of the park but is not regarded as part of the protection area due to the river being considerably degraded and contaminated; also due to a lack of importance for the protection of the rare species. **T**wo tributaries of the Iskar which enter the Iskar in or near the Project area, have been identified as potential Natura sites (see Figure below), and are recognised as essential for river life, which will enable the re-population of the Iskar River as water quality improves over time.

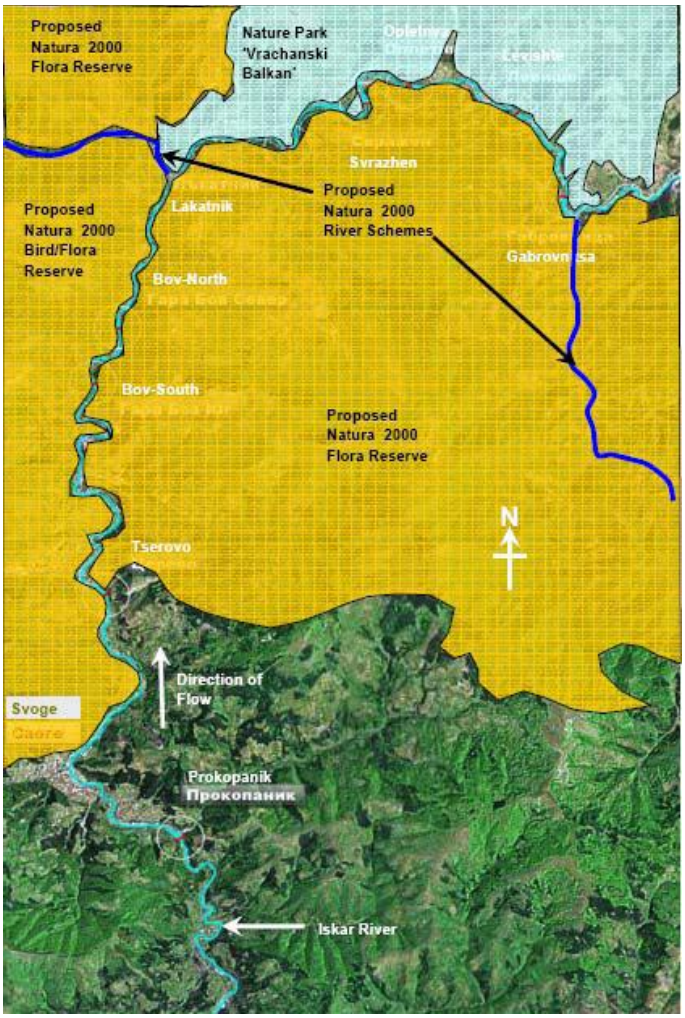

Figure 31: Location of Vrachanski Balkan Nature Park and Proposed Natura 2000 Sites

Source: http://www.ebrd.com/projects/eias/36032e.pdf; retrieved 30/07/2009 15:21

3.10.4 Climate

The temperate climate in BG can feature heavy snowfall in the cold winters and hot summers, which become dry after a rainy first half. The Balkan Mountains act as a barrier and bring colder climate to the north of BG together with more rain than in the southern lowlands.

Figure 32: Precipitation Map of BG

Source: http://www.bestcountryreports.com/Precipitation_Map_Bulgaria.html

The **precipitation** reaches 630 Millimetres in the average in BG with annually 500-800 mm in the lowlands and 1,000-1,400 mm in the mountains. The elevated regions of Rila, Pirin, Rhodope Mountains and the Stara Planina, the Osogovska and Vitosha Mountains offer the highest precipitation.[60]

A research of the climatologically parameters of the Rila Mountain done by the National Institue of Meteorology and Hydrogy in Sofia showed a tendency to warm and dry winters.[58]

A study undertaken during the years 2004 and 2007 in the mountainous watersheds in the Petrohan region in the Western Balkan mountain with continental climate showed that during the month August to October the precipitation is lower which affects the runoff. This precipitation regime is observed in most of the countries on the Balkan.[61]

3.11 Small Hydro Power Projects

BG has considerable technical and economical potential for SHP, especially in the mountain regions. The development of its hydropower is done via public tender process by the ministry of economy and energy/licensing and marketing department.

3.11.1 Iskar River

Figure 33: Iskar River Basin

Source: Joint Implementation Supervisory Committee

http://ji.unfccc.int/UserManagement/FileStorage/OYOP9WRHMDGKEHMA4KO2APXOHXE05R retrieved 12/07/2009 09:21

The Sreden Iskar valley would allow forty SHPP with a total capacity of 93 MW and an annual electricity production of about 520 GWh. The annual utilization is estimated to be roughly 5.600 hours.

Table 28: Sreden Iskar Cascades

	SHPP	Level	Inrush m	Q constr. M^3/sec	W caught. $M^3 \cdot 10^6$	Capacity kW	Electricity GWh
1	Rebrovo	480	9	30	615	2250	11,84
2	Tompsan	475	4	30	638	1050	5,93
3	Prokopanik	465	9	30	650	2250	13,60
4	Svoge-south	450	14	30	664	3450	21,62
5	Svoge-north	435	14	30	693	3450	21,56
6	Tzerovo- south	425	9	30	693	2250	14,05
7	Tzerovo- north	417	7	30	693	1800	11,28
8	Bov-north I	398	9	30	693	2250	14,50
9	Bov-north II	390	7	30	694	1800	11,03
10	sp. Balkan-south	380	9	30	694	2250	14,05
11	sp. Balkan-north	375	4	30	695	1050	6,46
12	Lakatnik-south	367	7	30	707	1800	11,51
13	Lakatnik-east	348	10	30	713	2550	16,58
14	Svrajen	336	11	30	718	2700	18,37
15	Svrajen-north	331	4	30	722	1050	6,07
16	Oplethia-east	320	8	40	821	2800	15,27
17	sp. Prolet	315	4	40	824	1400	7,66
18	Gabrovnitza	308	4	40	838	1400	7,08
19	Eliseina	301	6	40	844	2000	11,77
20	s. Eliseina	296	4	40	847	1400	7,09
21	Eliseina-east	283	4	40	851	1400	7,09
22	Zverino-west	275	4	50	931	3000	15,16
23	Zverino-east	260	7	50	944	1650	8,78
24	Zverino-north	255	4	50	945	1650	8,80
25	Cherepish	238	6	50	945	2500	13,19
26	Cherepish-south	246	7	50	945	3000	15,38
27	Lutibrod	230	7	50	945	3000	15,38
28	Lutibrod-east	219	6	50	948	2500	13,23
29	s.Oslen	177	7	50	945	3000	15,38
30	Sinio bardo	170	5	50	957	2250	11,13
31	Strupetz	152	9	50	959	3750	20,07
32	Roman-mill	145	4	50	953	1750	8,86
33	s. Roman	137	6,5	50	1077	3000	16,28
34	Radovanovo	130	5,3	60	1162	2700	14,32

35	Kunino	125	4	60	1171	2100	10,89
36	Karlukovo I	118	5	60	1179	2700	13,71
37	Karlukovo II	111,5	5	60	1183	2700	13,76
38	Reseletz-south	105	5	60	1186	2700	13,76
39	Reseletz	98	6	60	1186	3000	16,55
40	Cherven briag	90	6,5	60	1197	3600	18,09
	TOTAL	279,4	266,3				517,13

Source: Report on options for designing a green investment scheme for Bulgaria - Annexes[43]

The lower Iskar is being regarded as precious landscape due to its ecology and scenery. The EU-commission has therefore concerns regarding further plant constructions. Also due to different efficiency, the chances of all plants being built are unclear, but there are at least 14 cascade stages as shown in below table defined for reservoirs to be prioritized. In the map below the nine projects are marked, which are being co-financed by EBRD.

Figure 34: Location of the nine River Iskar MHPP

Source: http://www.ebrd.com/projects/eias/36032e.pdf

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Table 29: Sreden Iskar Cascades – 14 top prioritized SHPP Projects

	SHPP	EL. Capacity MW	Annual EL-Production GWh	Capital Investment in USD million	Annual cost in TUSD	Specific Capital Investment USD/kW
1	Prokopanik	4,60	23,00	4,00	174	870
2	Tzerovo-south	2,40	13,00	3,68	164	1.533
3	Bov-north	3,84	21,50	4,13	177	1.076
4	Balkan-south	2,65	14,00	4,12	178	1.555
5	Balkan-north	3,10	17,50	4,08	176	1.316
6	Lakatnik	3,10	17,50	3,96	173	1.277
7	Svrajen-south	3,10	18,31	3,88	173	1.252
8	Svrajen-north	4,40	26,00	4,10	175	932
9	Opletnia I	2,65	15,00	3,89	174	1.468
10	Opletnia II	2,25	12,75	3,58	161	1.591
11	Opletnia III	2,65	15,12	4,04	177	1.525
12	Cherepish I	3,48	19,00	4,05	181	1.164
13	Cherepish II	3,48	19,20	4,39	147	1.261
14	Lutibrod	1,86	10,50	4,27	189	2.296
	TOTAL	43,56	242,38	56,17	2.419	1.289

Source: Report on options for designing a green investment scheme for Bulgaria - Annexes[43]

3.11.2 Arda River

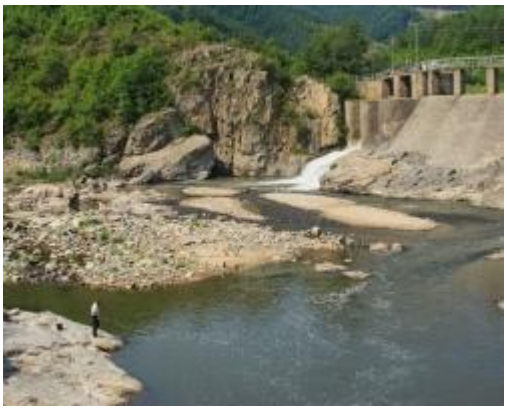


Figure 35: Arda River SHPP Dam

The Arda river is the third largest river after Maritza and Struma rivers with respect to high water but it is top regarding constant outflow. In addition to the three existing steps further plants could add 174 MW of capacity and 487 GWh of electricity production to the grid.
Three SHPP are mentioned in the literature Annex F[43], namely the Srednogortzi, the Malka Arda and the Pesnopoi in the Annex F with the following technical specifications:

Table 30: Gorna Arda Cascades – existing SHPP

SHPP	net Inrush m	Water Q. M^3/sec	W caught. $M^3 \cdot 10^6$	Capacity MW	EL GWh/yr	Units	Annual cost in USD	Specific Capital Investment USD/kW
Srednogortzi	26	30	372	6,6	22,00	3	1.260.000	13.730.000
Malka Arda	137	2,8	39	3,2	12,00	2	460.000	5.030.000
Pesnopoi	114	7	81	6,8	21,00	2	410.000	4.450.000
TOTAL	277	39,8	492	16,6	55,00	7	2.130.000	23.210.000

Source: Report on options for designing a green investment scheme for Bulgaria – Annexes43

3.11.3 Other Projects - Micro Hydro Power

The Micro Hydro Power Plants (MHPP) with 2 MW max. with lesser requirements on automation and safety issues seem to have a huge potential. A study carried out in the eighties showed a technical capacity with winter flow above 100/sec in suitable locations for construction of almost around 730 power plants under 2 MW with a total capacity of 210 MW and 795 million kWh electricity generation. 49 MHPP existing were counted with a total capacity of above 25 MW and an electricity generation of 121.4 kW/h. After more than 50 years since construction 41 MHPP are still in operation. They are located in the Western Highlands with low water pressure and small water quantities.
The actual electricity production reaches only 60-65% of the planned one due to lower efficiency of the old plants.

The potential identified for new MHPP is in the region of 200 plants, 60 of which (36 MW capacity and 128 million kWh) could be built in the next 10-15 years according to an average optimistic program.

Table 31: Projected Micro-HPP

period	number MHPP	MW	E-GWh	Investment USD Million
until 2007	12	16	58	15
2008-12	20	11	38	12
2013-2015	28	9,5	32	13
Total	60	36	128	40

Source: Report on options for designing a green investment scheme for Bulgaria – Annexes

Table 32: Prioritized MHPP recommended to be built in 2007:

Micro HPP	Region	River	Power kW	EL GWh	Investment USD	USD/ kW	USD/GW/h
Kamchia	Vama	Luda Kamchia	900	4,50	600.000	667	133.333
Sandanski II	Sofia	Sand. Bistritza	1.000	6,70	900.000	900	134.328
St. Ribaritza II	Lovech	Ribaritza	1.630	5,85	1.360.000	834	232.479
Krastavichka	Montana	Lom	1.500	4,58	1.130.000	753	246.725
Lobach	Sofia	Struma	1.300	4,60	1.200.000	923	260.870
Bansei II	Sofia	Damianitza	2.000	8,00	2.100.000	1.050	262.500
Osinovlak VII	Sofia	Gabrovitza	1.360	3,80	1.000.000	735	263.158
Lopuha	Plovdiv	Chepelarska	87	0,49	130.000	1.494	265.306
Bansei I	Sofia	Damianitza	2.000	8,00	2.320.000	1.160	290.000
Chiroka laka	Plovdiv	Chiroka laka	372	1,50	450.000	1.210	300.000
Vlahina	Sofia	Vlahina	2.000	6,20	2.140.000	1.070	345.161
Rositza	Lovech	Rositza	1.900	3,70	1.850.000	974	500.000
Total			**16.049**	**57,92**	**15.180.000**		

Source: Report on options for designing a green investment scheme for Bulgaria – Annexes[43]

Table 33: Recommended Micro-HPP for 2008-2012

Micro HPP	Region	River	Power kW	EL GWh	Investment USD	USD/ kW	USD/GW/h
Goliama reka III	Montana	Ogosta	640	2,73	630.000	984	230.769
Eipilovtzi IV	Montana	Ogosta	355	1,22	300.000	845	245.902
Borov dol III	Burgas	Cham dere	240	0,8	200.000	833	250.000
Pilatovetz VI	Montana	Ogosta	760	2,71	680.000	895	250.923
Bogaevtzi	Sofia	Elechnitza	190	0,83	210.000	1.105	253.012
Pilatovetz V	Montana	Ogosta	120	2,92	760.000	6.333	260.274
Berkovitza III	Montana	Ogosta	260	1,03	280.000	1.077	271.845
Oriahovo II	Plovdiv	Orechitza	130	0,69	190.000	1.462	275.362
Pilatovetz IV	Montana	Ogosta	1050	3,2	890.000	848	278.125
Leva reka IV	Montana	Lom	360	1,28	370.000	1.028	289.063
Bansko I	Sofia	Damianitza	2000	8	2.320.000	1.160	290.000
Kotel I	Burgas	Kotelska	420	1,32	420.000	1.000	318.182
Churkovo	Plovdiv	Churetzka	95	0,47	150.000	1.579	319.149
Borov dol I	Burgas	Cham dere	130	0,5	160.000	1.231	320.000
Oriahovo I	Plovdiv	Orechitza	150	0,81	260.000	1.733	320.988
Vodni pad	Plovdiv	Belmetzki dol	70	0,38	130.000	1.857	342.105
Goliama reka V	Montana	Lom	225	0,95	340.000	1.511	357.895
Borov dol IV	Burgas	Cham dere	100	0,33	130.000	1.300	393.939
Ravna	Haskovo	Taja	2000	7,25	3.560.000	1.780	491.034
Borov dol II	Burgas	Cham dere	170	0,35	180.000	1.059	514.286
Total amount 2008-12			9465	37,77	12.160.000		

Source: Report on options for designing a green investment scheme for Bulgaria – Annexes[43]

Table 34: **Recommended micro-HPP for 2013-2015**

Micro HPP	Region	River	Power kW	EL GWh	Investment USD	USD/ kW	USD/GW/h
Tzaparevo VI	Sofia	Tzaparevska	800	2,51	820.000	1.025	326.693
Binkos	Burgas	Belenska	90	0,35	120.000	1.333	342.857
Martinovo II	Montana	Ogosta	700	2,10	740.000	1.057	352.381
Bunovo	Sofia	Bukovska	160	0,68	240.000	1.500	352.941
Vintina	Plovdiv	Alhovska	135	0,64	230.000	1.704	359.375
Tzaparevo V	Sofia	Tzaparevska	90	0,41	150.000	1.667	365.854
Kozarevo IV	Burgas	Kozarevska	200	0,68	250.000	1.250	367.647
Isiovtzi	Plovdiv	Cherechovska	255	1,22	450.000	1.765	368.852
Maraganevo I	Montana	Ogosta	580	1,74	650.000	1.121	373.563
Iabalkovo IV	Burgas	Selska	140	0,55	210.000	1.500	381.818
Cherechnitza	Plovdiv	Cherechovska	160	0,78	300.000	1.875	384.615
Elenin vrah	Sofia	Elechnitza	460	1,44	560.000	1.217	388.889
Tzaparevo III	Sofia	Tzaparevska	210	0,97	380.000	1.810	391.753
Votrachka	Sofia	Votrachka	380	1,17	460.000	1.211	393.162
Borov dol IV	Burgas	Cham dere	100	0,33	130.000	1.300	393.939
Paden	Sofia	Stara reka	540	1,72	680.000	1.259	395.349
Chuprene VIII	Montana	Lom	405	1,44	570.000	1.407	395.833
Kustendil III	Sofia	Novoselska	430	1,26	510.000	1.186	404.762
Elechnitza II	Sofia	Elechnitza	480	2,14	870.000	1.813	406.542
Chepelare	Plovdiv	Chepelarska	80	0,44	180.000	2.250	409.091
Zla reka II	Lovech	Zla reka	520	1,77	770.000	1.481	435.028
Ostretz I	Lovech	Ostrechka	530	1,82	800.000	1.509	439.560
Kustendil IV	Sofia	Novoselska	480	1,38	610.000	1.271	442.029
Kalofer Plovdiv	Taja	Taja	198	0,81	360.000	1.818	444.444
Tzaparevo III	Sofia	Tzaparevska	330	1,10	520.000	1.576	472.727
Osenovlak V	Sofia	Gabrovnitza	480	1,38	700.000	1.458	507.246
Sasa dere	Burgas	Belenska	80	0,30	160.000	2.000	533.333
Osenovlak IV	Sofia	Gabrovnitza	440	1,23	670.000	1.523	544.715
Total amount 2013-15			9.453	32	13.090.000		

Source: Report on options for designing a green investment scheme for Bulgaria – Annexes[43]

3.11.4 EBRD – Projects

With USD 155 Mio credit line extended to Bulgarian Banks for investments in the RES-sector the EBRD has already supported the development of small hydro plants.

USD 54 Mio are committed as a direct loan from EBRD for renewable energy development in BG and a great portion will be provided by international bank syndication for the Vez Svoghe project. UK and Italian government authorities are funding the relating environmental and technical due diligence. Knowledge transfer is one of the main aims of the venture and the EBRD hopes to encourage such public-private partnerships (PPP) in East and Central Europe.[62]

This particular partnership is also one of five projects in BG's carbon trading programme for the Netherlands Carbon Fund which are to be developed under a joint EBRD-EIB fund called the Multilateral Carbon Credit Fund (MCCF). This new instrument will facilitate the purchase of carbon credits from projects across the high energy intensity countries such as BG and also focus on SHP.[63]

The Vez Svoghe project is administered and co-financed by EBRD (€ 34 million loan signed in 2007, total investment € 80 million) and is scheduled to be in operation by 2012. It envisages the establishment of nine small-scale hydro power plants with a combined installed power of 26 MW, about 40 km north of Sofia stretching over 33km along the river Iskar. The hydro power plants are being built, owned and operated by Vez Svoghe, a company 90 percent owned by a subsidiary of Petrolvilla & Bortolotti, an Italian provider of energy and energy-related services, and 10 percent by the municipality of Svoge.

The proceeds from the sale of the carbon credits enhance the performance of the project, assist BG in diversifying its energy sources and support the Netherlands in meeting its Kyoto targets as the first two hydro projects under construction will be bought by the EBRD's Netherlands Emissions Reduction Co-operation Fund.[64]

Phase 1 of this project is the construction of Lakatnik and Svrazhen Plants with subsequent monitoring of the plants' operation and their impact on the environment. Phase 2 should take place from July 2009 through September 2010 with the construction of Opletnia, Levishte, and Gabrovnitsa SHPPs; Phase 3 will be the construction of the remaining four power plants, Bov South, Bov North, Tserovo, and Prokopanik scheduled to take place between October 2010 through December 2011. The Svoghe Municipality and Petrovilla intend to have the construction and assembling works being subcontracted to a Bulgarian engineering company. The turbines and the rest of the electro generation machinery as well as the

pressurization equipment (valves, sector breeches etc.) shall be sourced from international top suppliers companies in order to guarantee high efficiency and transfer of knowhow for the benefit of the Bulgarian producer.[65]

3.11.5 BEERECL – Projects

Since 2004 BEERECL has developed a high number of various sustainable energy projects disbursing loans and providing grants to project developers. In the SHPP sector the following projects have been assisted by BEERECL:

Table 35: Projects under BEERCEL support

Project Name	Project Cost	BEERECL Loan	Detail Project Status	Estimated Date of Completion	Installed Capacity Electricity Production	Electricity Production
SHPP	**000' EUR**	**000' EUR**		**Month/Yr**	**MWe**	**(MWh/Yr)**
Approved Loans						
Hydroenergostroy	2.110	1.687	Loan	December 2007	**6,9**	23.692
Tamrash	2.147	1.329	Operating	July 2005	**5,14**	15.115
Loziata	1.800	1.500	Operating	Sep.07	**5,054**	34.040
Kunino Energy	4.690	970	Loan	June 2008	**4,41**	27.615
Katunci	1.200	750	Operating	Nov.06	**3,8**	13.985
Inertstroi-Kaleto	4.328	2.300	Loan	Aug.07	**3,49**	19.706
VEZ Svoghe	3.000	2.212	Loan	January 2008	**3,46**	23.210
Lukel	1.875	1.500	Loan	TBD	**2,3**	13.499
Delectra-Hydro AS	700	280	Operating	January 2006	**1,7**	5.580
Lesitchevo	884	380	Operating	February 2005	**1,527**	10.880
KID 2226	1.500	1.400	Operating	Sep.08	**1,404**	5.624
Comves	429	250	Loan	Sep.07	**0,78**	2.301
Treshtena	316	258	Operating	February 2006	**0,756**	1.876
TAS	435	330	Operating	February 2006	**0,75**	2.944
Cherna Mesta	1.000	1.000	Operating	Apr.07	**0,65**	4.019
Byala Mesta	1.250	1.000	Operating	Apr.07	**0,65**	3.849
SEK	429	333	Operating	July 2007	**0,585**	2.003
Hydro Eco Group	559	500	Operating	December 2007	**0,51**	2.468
RDS	362	317	Operating	October 2008	**0,459**	2.250
Hydroenergetika	330	250	Loan	Sep.07	**0,42**	1.070
Total Approved Loans	**29.344**	**18.546**			**44,75**	**215.726**

Source: http://www.beerecl.com/cms/sites/default/files/stats/table_e.htm
retrieved on 03.07.2009 16:01

3.12 Limiting Factors and Barriers

There are no major resistances reported neither on environment protection nor on competition with other water uses but losses from compulsory compensation flow can be in excess of 10% causing operational losses. Arranging financing for capital-intensive projects is one of the major obstacles. Also reported reluctance of private power companies to conclude RES-E supply agreements are cumbersome. Finally state company NEK tends to be reluctant towards development activities in the RES sector with the reasoning of the limitations set by the weak grid.

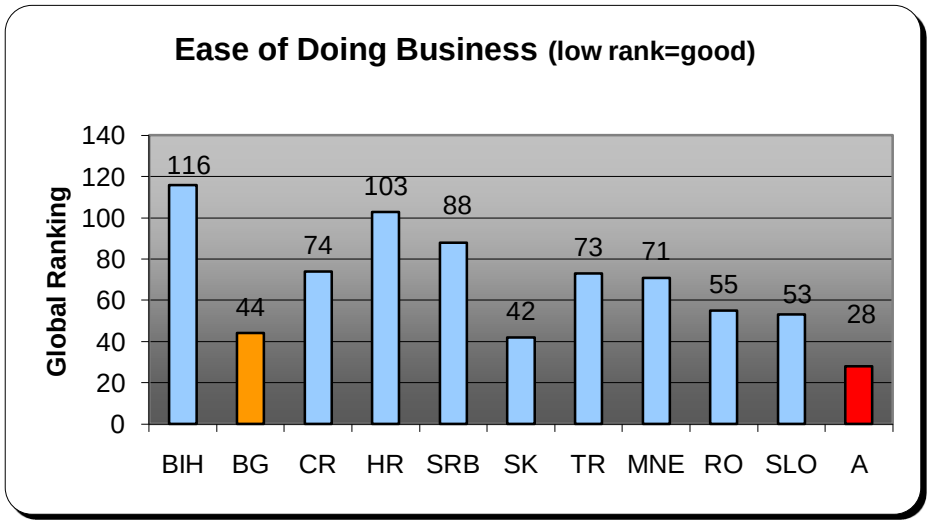


Figure 36: Ease of Doing Business in BG

Source: The World Bank Group, 2009 in

http://www.doingbusiness.org/ExploreEconomies/?economyid=13

Graph created by Kopecek, C

BG seems to be an easygoing country for doing business. The World Bank survey only detected weaknesses with respect to “Dealing with Construction Permits”.

4 Czech Republic

Figure 37: Map of Czech Republic

Total area:	78,866 km² (world ranking 112th)
Population:	10.3 Million (world ranking 78th)
GDP (PPP):	USD 265.2 billion - 2008 estimate; (world ranking 43rd)
Inflation:	1.2% - 2009 estimate
Rating:	A S&P; A1 Moody's [66]

4.1 General Country Information

Czech Republic (CR) is landlocked, surrounded by mountains and located in the centre of Europe. Almost 95% of the population are Czech, 73% is urban population. [67]

Before the World War II the Czech Republic (CR) was one of the 10 most industrialized countries. After collapse of the communist regime in 1989, CR quickly mastered to regain economical strength. The split from Slovakia in 1993 was done peacefully and in 2004 CR joined EU. However, an adoption of the Euro, which was planned for 2010 initially, had to be

delayed and the replacement of the – recently very strong – Czech Koruna is not seen realistic for the next 2-3 years.
Economic reforms and privatizations were mostly successful and after Slovenia, CR can be regarded as the most developed country in CEE. It's GDP of € 20.200 (at purchase power parity) reaches already 80% of the corresponding EU 27 average and due to its perfect positioning in the centre of the European market, the traditional industry structures and the high education and productivity levels of the local workforce, CR has been in the focus of foreign investors since two decades. Wages have risen but are still lower than European average. The increased purchase power now turns CR into an interesting export market for foreign companies.
With an unemployment rate of 6.4% CR is still well below the EU 27 average of 9% (harmonized rate). The labour cost index lies on the EU 27 level.

The Export quota of 70% of the GDP shows the high integration into EU economy and allows a trade surplus since 2005. The downside of this high export orientation is seen now, in the global crisis. Industrial production decreased higher than in the EU27 average and shows a downturn of -16.09% compared to -14.82%. [68]

However, CR is a highly competitive industrial country and it can be assumed, that once the economical recovery starts in Western Europe, CR will highly profit again.

Manufacturing has a high importance for the economy. Energy intensive industry like steel and iron production is concentrated in the Moravia region.
Despite vast arable land (almost 40%), agriculture only plays a minor role and only contributes 2.6% to the GDP compared with services with 58.7% and industry with 38.7%.

CR still has – for European standards – a serious environmental problem. Especially air and water pollution in areas of NW-Bohemia and around the city Ostrava in N-Moravia as well as acid rain are now in the focus of national and EU-wide efforts. Flooding is one of the most natural hazards. [67]

CR is - after Poland – the country which mostly profits from EU grants deriving from the Cohesion Fund. Being classified under "Objective 1" (except Prague) more than €40 bn are allocated to CR out of € 347 bn total 2007-2013 EU's Structural Funds for the new eligible EU member states. [69]

The three main regions have their own centres i.e. Bohemia with the capital Prague (1.22 Mio population), Moravia with Brno (1.15 Mio) and in the North-East Ostrava (1.25 Mio) as regional capital of the Moravian-Silesian Region.

Figure 38: Bohemia (W) - Moravia (SE) -Silesia (NE)
Source: http://de.wikipedia.org/wiki/M%C3%A4hren

4.2 Energy

CR has a large proportion of coal pit, fossil fuels and nuclear energy in its energy mix. It is a net exporter of hard coal. The vast coal resources are mainly located in Northern Bohemia and consist of 3.5 Gt lignite and 2.5 Gt hard coal. There are no significant oil and gas deposits.
Lacking own reserves oil and gas are imported, mainly from Russia followed by Kazakhstan and Norway. Thanks to this pipeline connection to Norway, CR suffered less than some other CEE countries during the gas conflict between Russia and the Ukraine. However, energy security and diversity are of paramount importance for CR.

Although coal has a dominant role for the energy production, its share is continuously decreasing as shown in the graph “Energy production by Fuel in CR” below, mostly replaced by nuclear energy since the mid eighties but also by the commencement of energy production from RES and waste. The graph “Total Primary Energy Supply in CR” signals the same development in the primary energy supply and also shows a replacement of oil by gas as primary energy source.

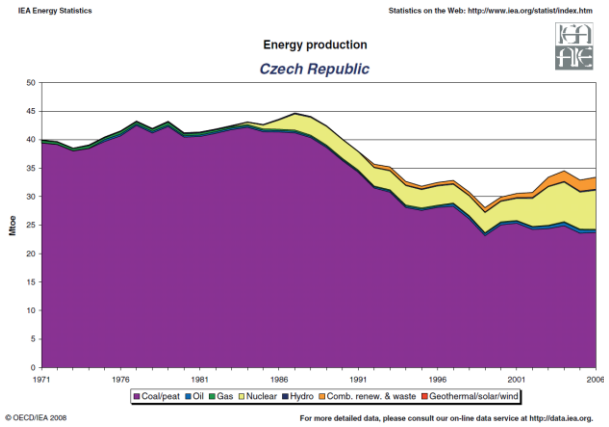


Figure 39: Energy Production by Fuel in CR

Source: OECD/IEA 2008

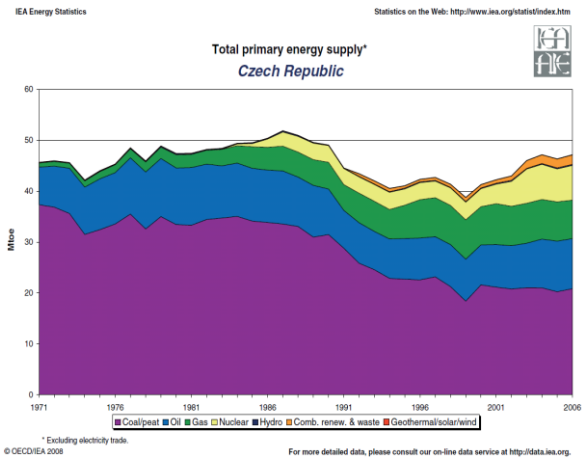


Figure 40: Total Primary Energy Supply in CR

Source: OECD/IEA 2008

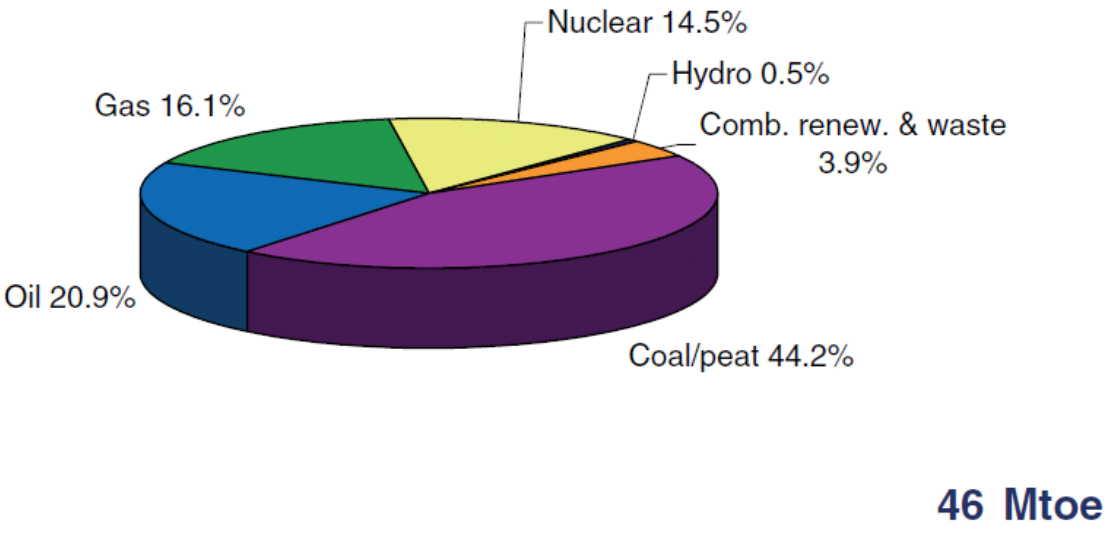


Figure 41: Share of Total Energy Supply in CR

(Excluding electricity trade), 2006

Source: OECD/IEA 2008

As per 2006 coal and pit still supplied 44.2% of the total primary energy of 46 million tons of oil equivalent.

The energy demand is declining, mainly due to the lesser energy needs of the industry. However, both the energy intensity as well as the GHG emission intensity is on the top of the EU-27.

4.2.1 Overview Electricity Market

The total installed power capacity in CR is 17,724 MW as per end of 2008. ČEZ a. s. is the dominating power producer and contributes 12,231 MW. Other power companies exist but without significant market shares. ČEZ, a. s., E.ON Ceska republika; Prazska energetika, a.s. are dominating the supply and distribution of electricity to customers almost totally. The Deregulation of the Electricity market was done in steps and since 2006 all customers are eligible to free choice of supplier. The network offers a regulated Third Party Access and distribution is unbundled from generation. The tariffs are set by a regulator. But the privatisation of ČEZ is still a pending main issue.

Table 36: Total Net Electricity Generation by Main Contributor

		2008	2007
Total net electricity generation GWh		77 084,6	81 412,7
of which:	Thermal PS	46 416,6	51 565,2
	CCGT + SCGT	3 029,3	2 417,6
	Hydro PS	2 365,1	2 512,3
	Nuclear PS	25 015,3	24 624,4

Source: http://www.eru.cz/user_data/files/statistika_elektro/english/2008/index.htm

Total Electricity production in 2008 was 77 TWh, the main part of which derives from Coal/pit. Coal power plants use approximately 60% lignite from ČEZ's own mines.
ČEZ has 100% free allocation of CO_2 allowances for NAPII (National Allocation Plan) until 2012, which is a competitive advantage with expiry date. Therefore, the question of substitution of Thermal Power Plants is a main issue.
Nuclear power with its very low operating costs replaces thermal power and gas replaces oil for electricity production. Hydropower is decreasing from an already low level.

Power production decreased from 81 TWh in 2007 in line with reduced industrial demand and because of uneconomical production of high emission thermal plants in the prevailing low power price scenario.

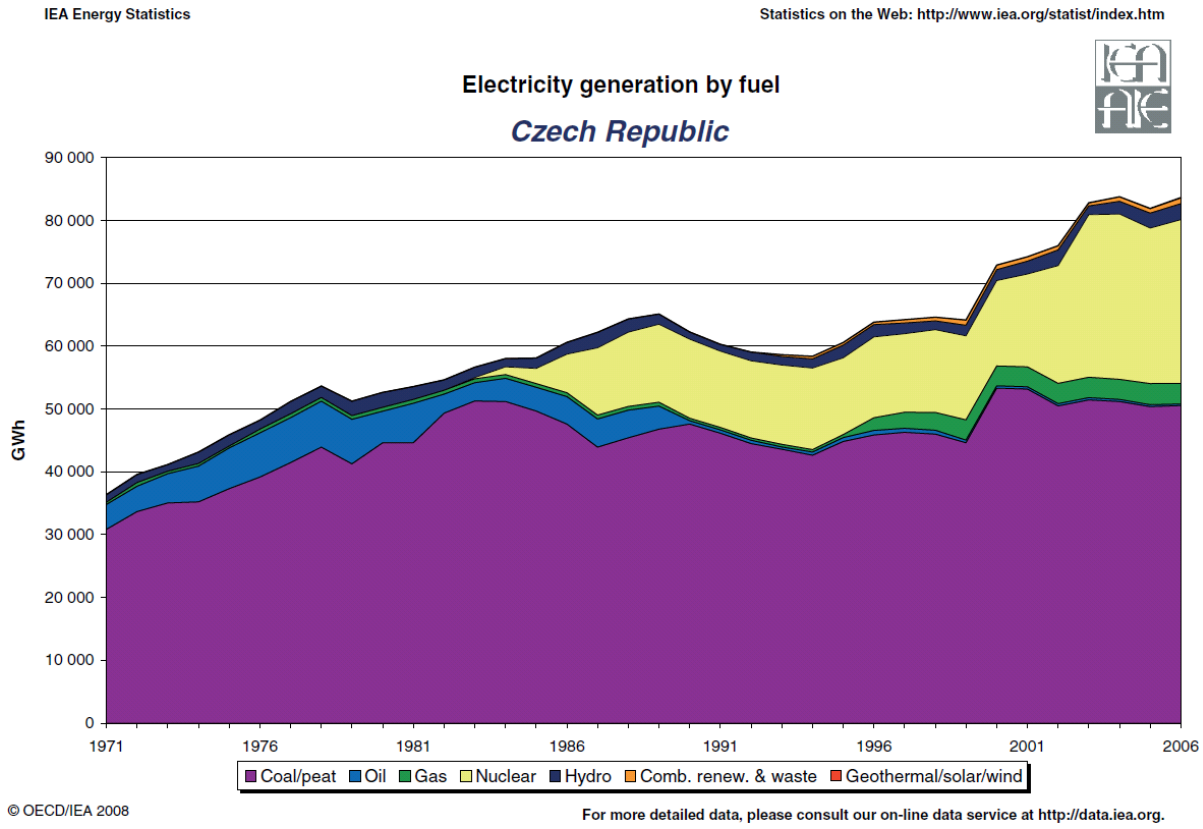


Figure 42: Electricity Generation by Fuel in CR

Source: OECD/IEA 2008

4.2.2 Electricity Import-Export

CR is part of the Central Eastern Region electricity market consisting of Germany, Poland, Czech Republic, Slovakia, Hungary, Austria and Slovenia. It is a net Electricity producer and important exporter to the EU, due to its vast thermal and nuclear power capacities.

Table 37: Total Electricity Import/Export Balance of CR

		2008	2007
Total electricity import	GWh	8 520,5	10 203,7
Total electricity export	GWh	19 989,1	26 356,8
Total import/ export balance	GWh	-11 468,6	-16 153,1

Source: http://www.eru.cz/user_data/files/statistika_elektro/english/2008/index.htm

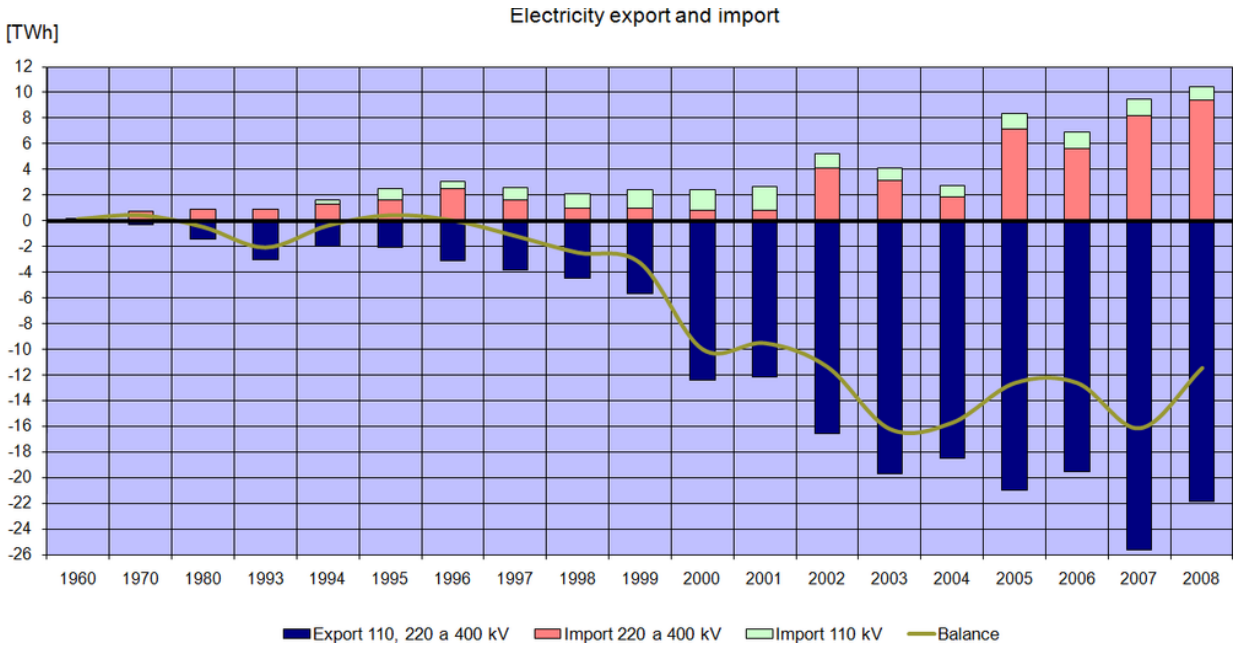


Figure 43: Electricity Export and Import in CR

Source: http://www.eru.cz/user_data/files/statistika_elektro/english/2008/index.htm

The slump in exports compared to all time high 2007 is due to the reduced demand in neighbour countries, which were hit by the economic crisis but also due to the reduced production caused by declining prices.

4.2.3 The Grid

The power transmission system is operated by ČEPS a.s. with the 400, 220 and 110 kV lines at 50 Hz and is fully integrated in the European Electricity (UCTE) network. On a regional level ČEZ distribuce a.s. and E-On are operating on 110, 35, 22 and 0.4 kV levels for supplying electricity to the end users. [70]

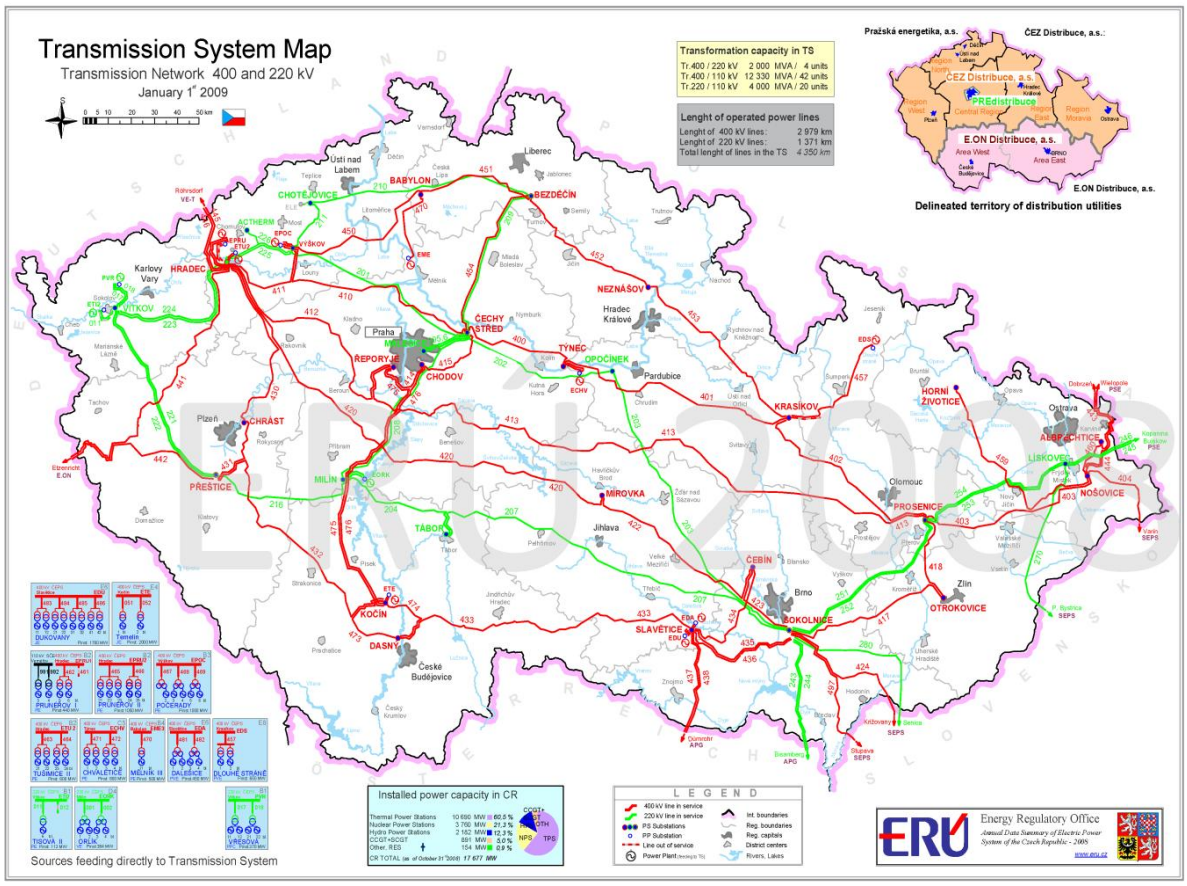


Figure 44: Transmission System Map of CR

Source:

http://www.eru.cz/user_data/files/statistika_elektro/english/2008/index.htm

Recently the transmission grid experienced overuse but additional capacity is expected to be provided within the next years. It has two circuit networks that are connected at two points. This sound topology offers frequency toleration and grid stabilities and prevented it from major problems so far. Coping with the dynamics of the increasing wind energy certainly will become a challenge for the Czech Grid.[71]

Table 38: Network Losses and Consumption per Voltage

	Values in GWh	2008	2007
Network losses		4 661,8	4 914,5
Domestic net supply		60 477,8	59 752,6
Consumption of high voltage consumers		35 768,1	35 710,1
of which:	from 110, 220, 400 kV	8 677,3	9 517,2
	from middle voltage	23 479,6	23 234,3
	Consumption of autoproducers	3 611,2	2 958,6
Consumption of low voltage consumers		23 173,1	22 564,4
of which:	commercial	8 470,2	7 918,7
	residential	14 702,9	14 645,8

Source: http://www.eru.cz/user_data/files/statistika_elektro/english/2008/index.htm

The power consumption of the energy intensive industrial sector is far above the EU-27 average.

The Electricity balance as per 2008 shows clearly the dominant role of ČEZ in the power production. But in the much more decentralized RES sector, ČEZ has no significant capacities so far and the development of renewable energy is mostly the hands of independent producers.

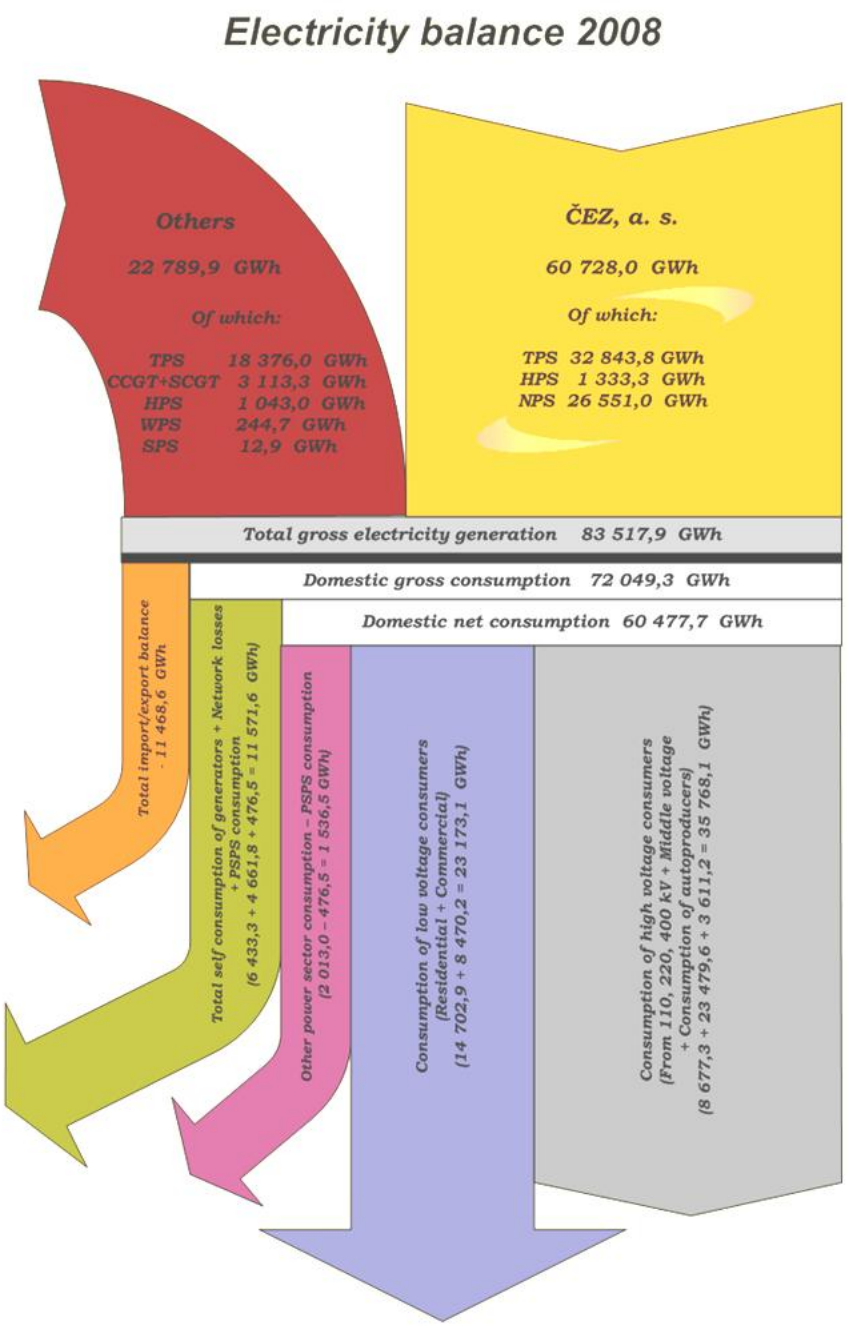


Figure 45: Electricity Balance 2008 of CR

Source: ERU 2009

Abbreviations:

CCGT - Power Station with Combine Cycle Gas Turbine

HPS - Hydro Power Station

NPS - Nuclear Power Station

SCGT - Simple Cycle Gas Turbine

SPS - Solar Power Station

TPS - Thermal Power Station

WPS - Wind Power Station

4.3 Renewable Energy

The share of RES in gross electricity consumption was 5.2 % as of 2008 and is dominated by **HPP**, which contribute 54.3% of total renewable energy production in 2008 (down from 72,5% in 2006), but not even 3% of the overall electricity generation.[ix] Large hydro does not have significant growth potential lacking suitable new areas. There are considerations to build additional pumped-storage hydroelectric plants (PSHP) but no concrete projects. As per 2006 there were already capacities of almost 1,150 MW installed generating 706.6 GWh per anno.

SHP is nowadays regarded as more environmental friendly still does have some potential sites in the mountainous regions of CR.

Wind-energy recently experiences strong growth as the transmission system operators did not set a limit so far on wind energy generation levels. Consequentially, installed capacity grew from 4 MW in 2003 to 245 MW in 2008.

Biomass has the highest potential and reached already a 33% share of RES electricity production in 2008. This high potential is because there is extensive agricultural land available for biomass production.

Table 39: Energy Output from RES in CR

RES		**Electricity**	**Electricity**
		(MWh)	**(MWh)**
		2003	**2008**
Wind		4.000	244.661
Hydro	SHP<10 MW	750.000	966.884
	LHP>10 MW	1.165.000	1.057.451
Photovoltaics		30	12.931
Biomass		420.000	1.231.210
Total		**2.339.030**	**3.726.769**

Source: Authors own compilation of data from Association for the Utilisation of RES, 2003 and ERU, 2009 [x]

[ix] Except Dalešice, Mohelno and Dlouhé Stráně all large HPP are situated at the Vltava River forming the so called Vltava Cascade. They are producing cheap power which is mainly used in the peak-load periods.[ix]

[x] Notification of assessment of the share of electricity from renewable sources in gross electricity consumption and the expected impact to support the production of electricity from renewable sources to the total cost to end customers

18th 06th 2009

http://www.eru.cz/user_data/files/sdelen%C3%AD_elektro/090618%20V%C4%9Bstnik%20-%20Pod%C3%ADl%20OZE%202008_%C4%8Dist%C3%A1%20verze.pdf

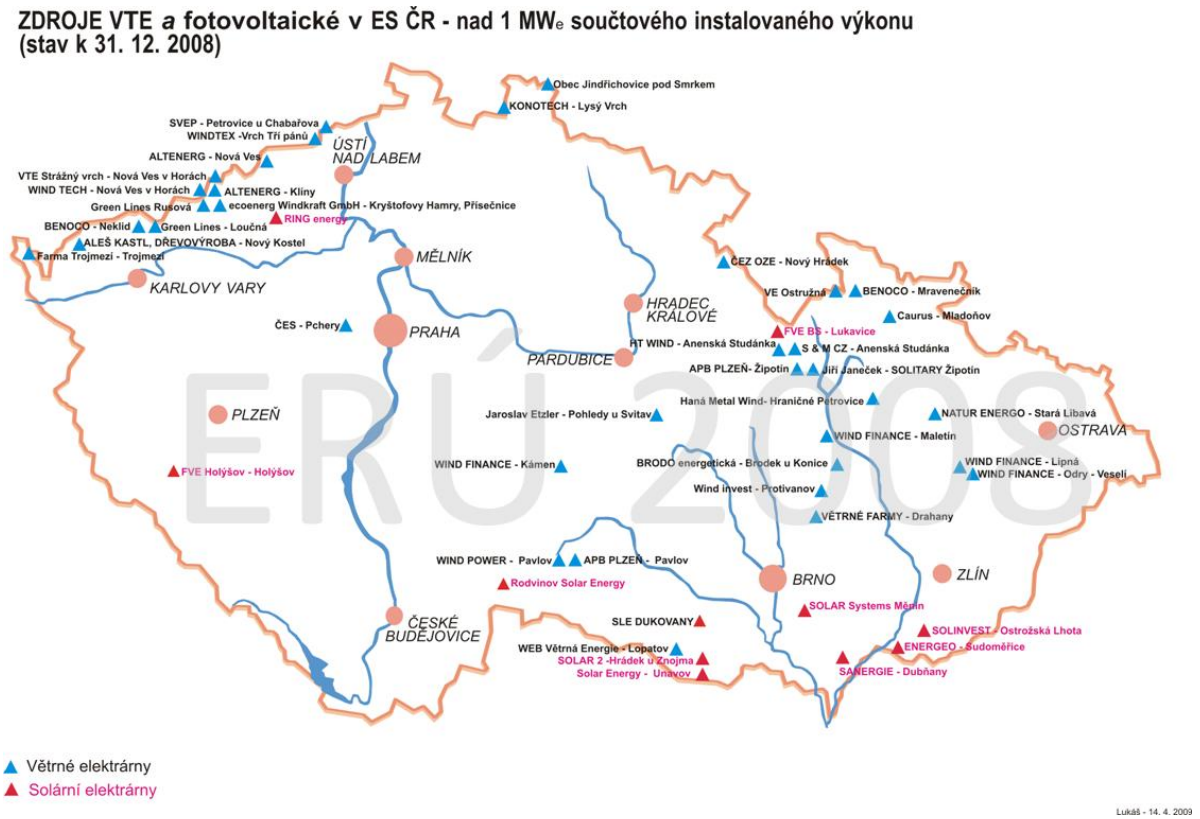


Figure 46: Map of Wind- and Solar Energy Plants in CR

Wind (Větrné) and Solar (Solární) Energy Plants in CR with > 1MWe installed capacity

Source: Source: http://www.eru.cz/user_data/files/statistika_elektro/rocni_zprava/2008/mapy/2.htm

Retrieved: 27/09/2009 07:31

The outlook of the individual RES contribution to the energy production is shown underneath. It would confirm, that biomass and wind energy have a high potential but also biogas and SHP could significantly contribute to the energy generation in the future.

Table 40: RES-Energy Split 2005-2020

TWh	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Biogas	0,16	0,20	0,23	0,32	0,42	0,55	0,71	0,86	1,00	1,15	1,29	1,42	1,55	1,69	1,82	1,95
Biomasse	0,56	0,73	0,75	0,80	0,91	1,05	1,19	1,38	1,57	1,80	2,00	2,23	2,46	2,79	3,04	3,30
Biologisch abbaubare Abfälle	0,01	0,01	0,01	0,01	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02
Geothermal	0,00	0,00	0,00	0,00	0,00	0,00	0,03	0,05	0,07	0,10	0,13	0,17	0,22	0,29	0,37	0,48
Wasserkraft bis 10 MW	1,07	1,08	0,94	0,95	0,95	0,97	1,00	1,01	1,02	1,04	1,08	1,11	1,14	1,18	1,24	1,26
Wasserkraft über 10 MW	1,31	1,45	1,17	1,17	1,17	1,17	1,17	1,17	1,17	1,17	1,17	1,17	1,17	1,17	1,17	1,17
Fotovoltaik	0,00	0,00	0,01	0,06	0,11	0,15	0,20	0,28	0,35	0,41	0,50	0,61	0,72	0,83	0,89	0,98
Windkraft	0,02	0,05	0,12	0,26	0,42	0,60	0,82	1,07	1,32	1,56	1,75	1,89	2,07	2,23	2,40	2,55
Gesamt	**3,1**	**3,5**	**3,2**	**3,6**	**4,0**	**4,5**	**5,1**	**5,8**	**6,5**	**7,2**	**7,9**	**8,6**	**9,3**	**10,2**	**10,9**	**11,7**

Source: SIEMENS

A study undertaken by Energy Economic Group, ECOFYS and Fraunhofer in order to facilitate informed decision making on future RES targets and policy in 2008 came to the assessment that within the new EU-member countries Poland has by far the highest RES potential followed by CR and Slovenia. In those countries, the major part of RES potential lies in on-shore wind power and biogas. [72] Achieved (2004) and additional mid-term potential 2020 for electricity from RES in EU -10 countries –are shown by country (left) and by RES-E category (right).

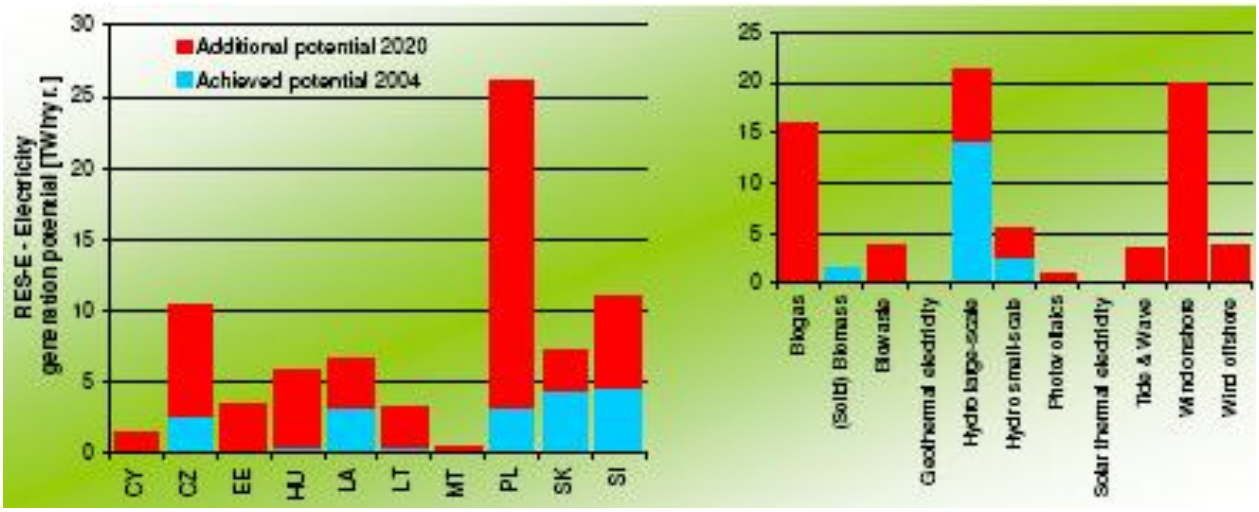


Figure 47: Achieved and potential RES-EL in CR

Source: Progress Report 2008

4.4 Small Hydro Power

4.4.1 SHP Potential

A survey of Energy Resources of the World Energy Council in 2007 came to the following conclusion:

"The overall potential for all sizes of hydropower is quite modest (technically exploitable capability: 3 978 GWh/yr). Total hydroelectricity output in 2005 was 2 401 GWh, representing 60% of the technical potential. Hydropower furnishes about 3% of the republic's electricity generation. A relatively high proportion (nearly 40%) of the technically exploitable capability is classified as suitable for small-scale schemes; installed capacity in this category at the end of 2005 was 277 MW, equivalent to about 27% of the Czech Republic's hydro capacity. Actual generation from small-scale schemes in 2005 accounted for nearly 45% of hydro output, reflecting the higher average capacity factor achieved by small hydro compared with the larger stations." [73]

The latest SHERPA survey[11] concludes that as per 2006 **1.389 SHPPs with 287 MW installed capacity generate 964 GWh/p.a.**

The evolution of SHPP in CR and extrapolation to 2010, 2015 and 2020 as analysed by SHERPA study (based on the TNSHP survey[74]) shows that SHP might indeed significantly contribute to the increase in RES, to which CR has committed itself. However, those forecasts vary depending on the underlying assumptions.

Table 41: SHP Evolution and Forecast 2000-2020

	2000	2001	2002	2003	2004	2005	2006	FC 2010	FC 2015	FC 2020
Total Number of SHPP	1.244	1.273	1.302	1.330	1.352	1.372	1.389	1.440	1.480	1.520
Capacity MW	269	271	273	275	279	283	287	300	315	330
Generation GWh	508	516	750	660	903	1.070	964	970	1.080	1.260

Source: SHERPA, 2008

The graph below illustrates the trend in the development of number, capacity and electricity generation of SHP over the analysed period:

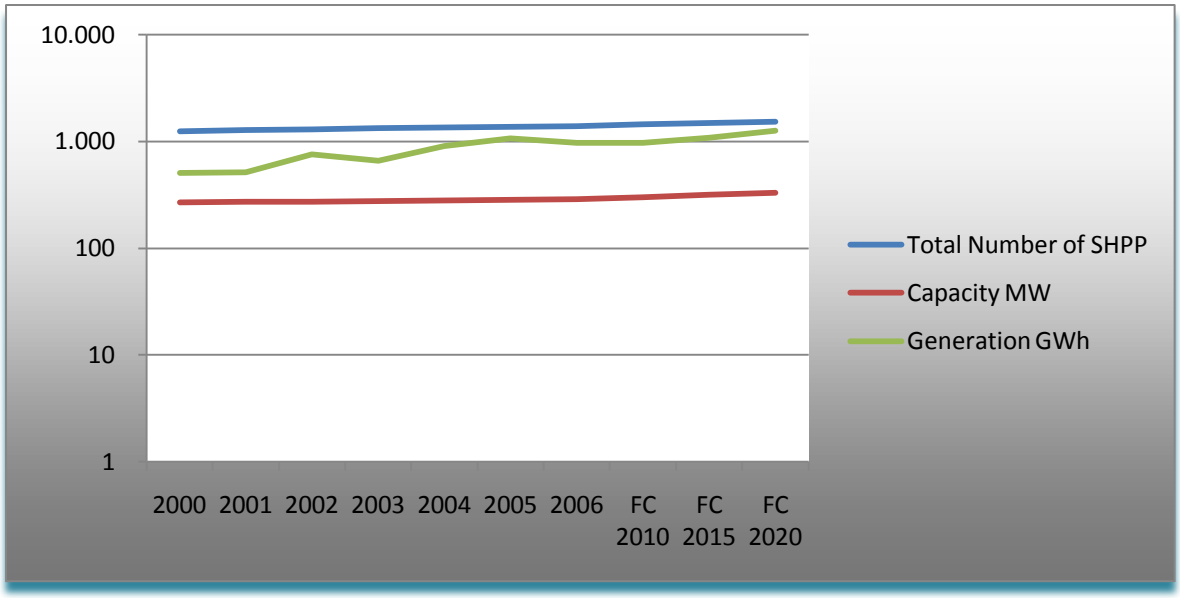


Figure 48: SHP Development/Forecast 2000-2020 in CR

Source: Created by author based on SHERPA study 2008

The following figure shows the development of the installed SHP capacity. The annual increase was around 3.7 MW in the average over this 10 years time period.

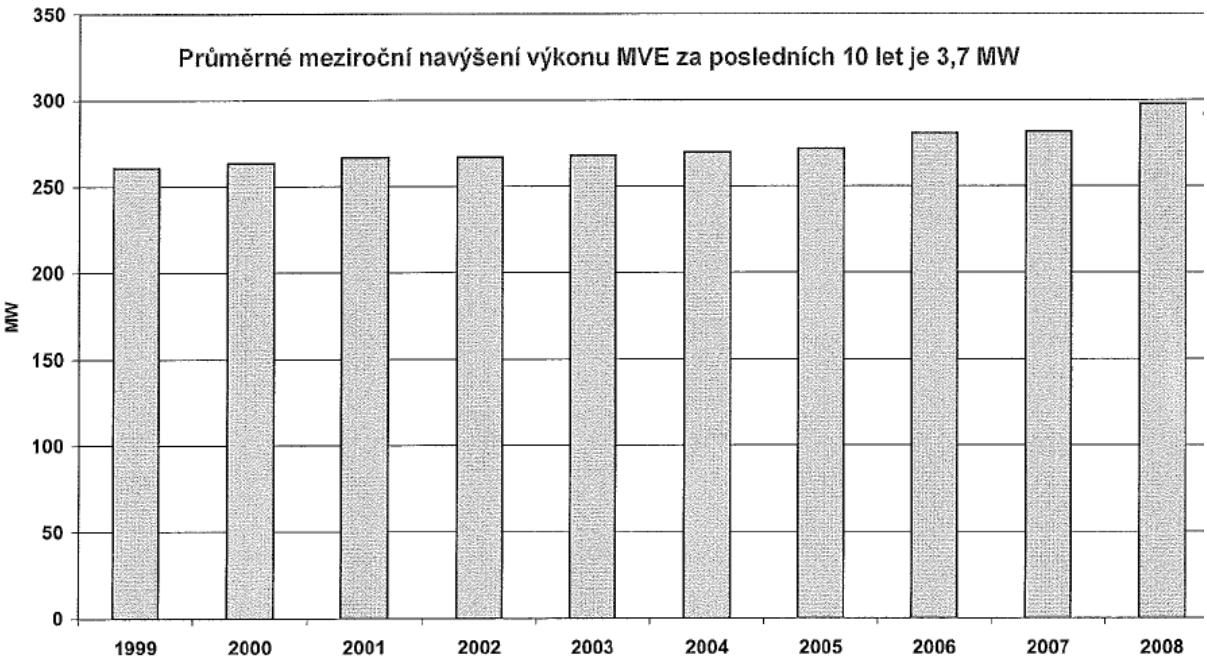


Figure 49: Comparison of Installed SHP Capacity from 1999-2008 in CR

Source: SIEMENS

Experts assess, that 70% of total hydro energy potential is already used, the remaining can be grouped as follows according to percentage occurrence of head range and emphasise the importance of SHPP:

Head < 2 m: 35%
Head 2-5 m: 55%
Head > 5 m: 10% [75]

The **technically useable potential** for SHP can be allocated to the respective river basin as follows:

Table 42: Technical useable Potential for SHP Location per River Basin

River basin	Installed Capacity (MW)	Power Production (GWh/yr)
Labe	114	420
Vltava	164	430
Ohře	78	300
Odra	56	100
Morava	100	250
Total	**512**	**1.500**

Source: „Renewable energy sources and possibilities of their application in Czech Republic";ČEZ, a.s., Prague, 2007 in Sluka, 2008 page 62

According to ČEZ sources, there are over 500 SHPP with a total installed capacity of 110 MW currently in operation in the Labe basin, where the upper reaches are already fully exploited and the middle section is also intensively utilised with some remaining potential in the head range 1.2-2.5 m. The lower section of the Labe still offers opportunities for SHPP construction. Potential on other rivers in the Labe basin are limited due to ecological restrictions. The Vltava water basin is roughly half utilized, the Ohře basin already at a 72% rate and the Odra is about 46% used. Unlike Vltava and Ohře, where the unexplored portion is caused by the unattractive economical factors for development, the Odra is still relatively unexplored because of the restrictive watercourse administration and also because of the instable water conditions with possible sudden large flows. This natural phenomena also applies for some rivers in the lower reaches of the Morava water-basin, where 59% are still unexploited by SHPP. The possible heads of less than 2m are not rendering those sites attractive either.

Further potential can be found in the utilisation of dam and retentive reservoirs as well as fishponds.[76]

Various studies dealt already with the potential of SHP in CR. In 2003 a study ordered by the government identified **potential SHPP capacities** in the region of **130 MW from 430 new plants and 15 MW resulting from repowering.[77]**

Table 43: Study Hydropower Potential ex 2003 in CR

Potential	Generation (GWh/yr)	Capacity (MW)	Number of plants
theoretical	13.100		
usable	2.280	1.134	1.618
of which SHP	1.115	398	1.610
in use	1.850	1.004	1.188
of which SHP	**750**	**268**	**1.180**
not used yet (only SHP)	**410**	**130**	**430**
repowering	**40**	**15**	**200**

Source: Association for the Utilisation of RES, 2003

Another study differentiates between economical, technical or environmental aspects for evaluating potentials. Neglecting the restrictions due to environmental aspects it arrives at an economically and feasible potential of 190 MW for installed capacity.

Table 44: SHERPA Study SHP Potential ex 2008 in CR

Potential	Generation		Capacity
	GWh/yr	%	MW
Gross theoretical	13.100	100	n/a
Technically feasible	1.500	12	500
Economically feasible	1.300	10	400
Economically feasible taking environmental constraints into account (EFEN)	1.300	10	387
EFEN for refurbishing / upgrading estimate	350		80

Source: SHERPA 2008 adapted by author

A third study used by SIEMENS comes to the result, that the unused SHP potential for installed capacity would be 110 MW.

Table 45: HP and SHP Potential in CR

	GWh/a	%	MW	# of HP
theoretical potential	13.100			
useable potential	2.475	100	1.144	1.678
HP > 10 MW	1.165	47	736	8
SHP < 10 MW	1.310	53	408	1.670
used potential	2.085	84	1.034	1.258
HP > 10 MW	1.165	100	736	8
SHP < 10 MW	920	70	298	1.250
unused potential	390	16	110	420
HP > 10 MW	-	-	-	-
SHP < 10 MW	**390**	30	**110**	420

Source: SIEMENS CZ, Praha

The studies show actually, that in CR a good portion of economical and technical potential has not been developed yet and compared to other countries, those figures do not seem exaggerated.

But development of new SHPP's in CR is reported as being sometimes difficult due to conflicts with other interest group because of environmental, fishery end sometimes bureaucracy reasons. Administrative concessions have to be obtained which bear a relatively small annual cost. Those are not an obstacle to development of a project but it could involve a lengthy process.[xi]

[xi] The "Progress Report 2008" [72] also included a survey by Fraunhofer and ISI analysing barriers to the development of renewable energy. Criteria were the number of authorities involved in permission procedures, clearness of procedures for licensing, lead time for overall authorisation procedure, grid connection, rate of permit rejections and various grid problems. The result was that within around 20 EU member countries CR never stood out with serious barriers. However, as main bottlenecks in CR the authority of buildings and environmental activists were named.

The range of **investment cost for a new SHPP** is between 1.000 – 6.000 €/kW with average **production cost** of 1 €ct/kWh.[11]

By **refurbishment**, meaning an extensive overhaul possibly including change of equipment and **upgrading SHPP's** by replacing existing equipment with more efficient one, the potential of the existing plants could be further developed. But there are economic and environmental constraints like e.g. lack of funding and minimum water flow.

4.4.2 SHP Comparison with other Countries

The BlueAge study, which was finalized in 2002 and covered the SHP-sector in 26 European countries, found out, that CR was the one of the very few then called Eastern European countries with significant number of SHPP and capacity. Its 250 MW accounted for almost 34% of the total production of the whole area. [78]

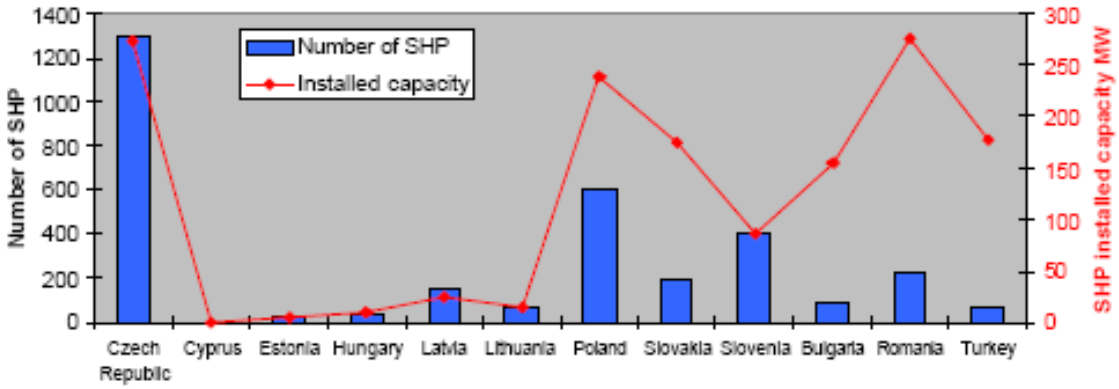


Figure 50: Comparison of Number and Installed Capacity in some CEE/SEE countries
Source:TNSHP, 2004

The number of SHPP reached 10.500-12.000 in the Thirties of the previous century and slumped down to around 100 operating plants in the Seventies. [79] This was mainly due to complete negligence of individual undertakings and focusing on large thermo plants in the communist era. Many of the old sites have been put into operation again so that explains the relatively old age of the SHPP's in CR. [80]

Only one fifth of the plants can be regarded as modern. CR has a very high private ownership (90%) of its SHPP.[74]

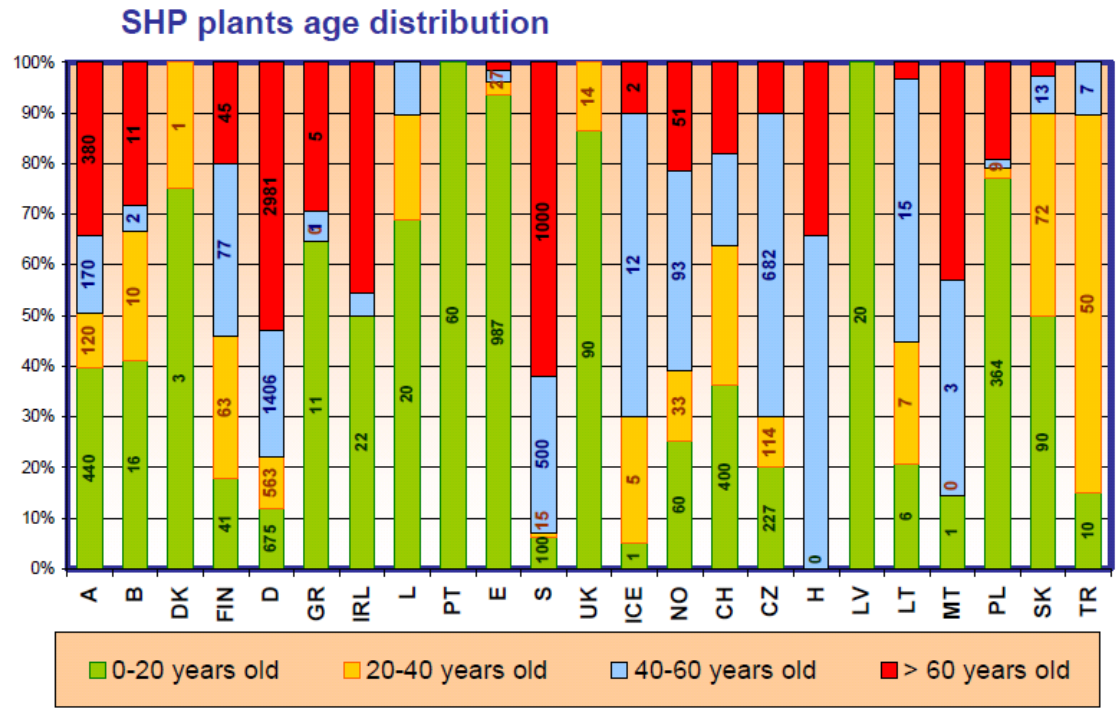


Figure 51: Age Structure of SHPP in CR compared to other countries

Source: BlueAge 2002

4.4.3 Geography and Topography

Almost the whole country is covered with hills or mountains. The Labe (Elbe) and Vltava (Moldau) river basin drain the Bohemian region which consists of rolling plains, hills, and plateaus surrounded by low mountains like the Krkonoše (Giant-) Mountains, part of the Sudetes range. The Morava and Odra (Oder) river drain the hilly eastern region.

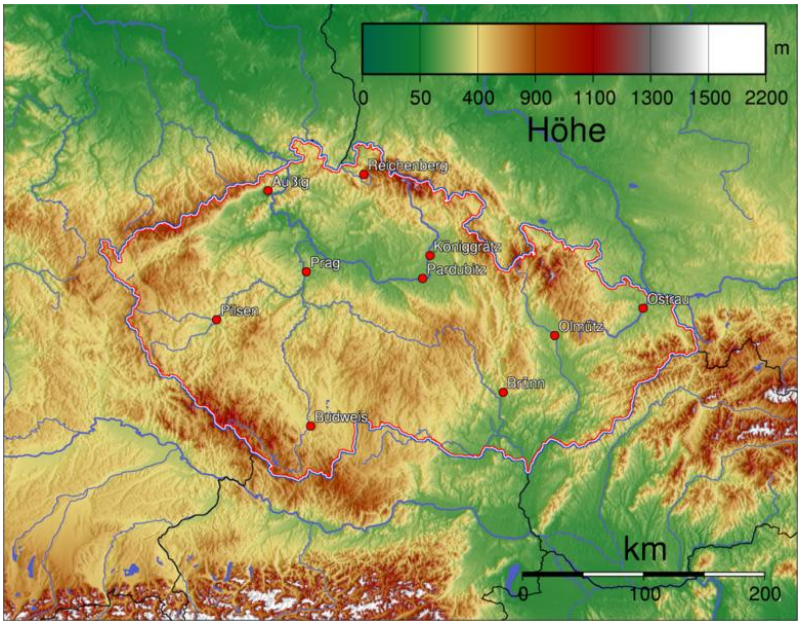


Figure 52: Topographical Map of CR

Source:http://de.wikipedia.org/w/index.php?title=Datei:Tschechien_topo.png&filetimestamp=20070409211418

Forests and woodland extend to 26,450 sq km and covers almost one third of the whole country, arable land (40%) and permanent pastures (12%) make up for the rest of the country.[81]

4.4.4 Hydrography

The whole length of water currents in CR is about 76.000 km, which corresponds to 0.96 km/km². [79] Annually between 8-19 bn m³ of water is drained off from CR to the three different seas, the North Sea, Baltic Sea and Black Sea.

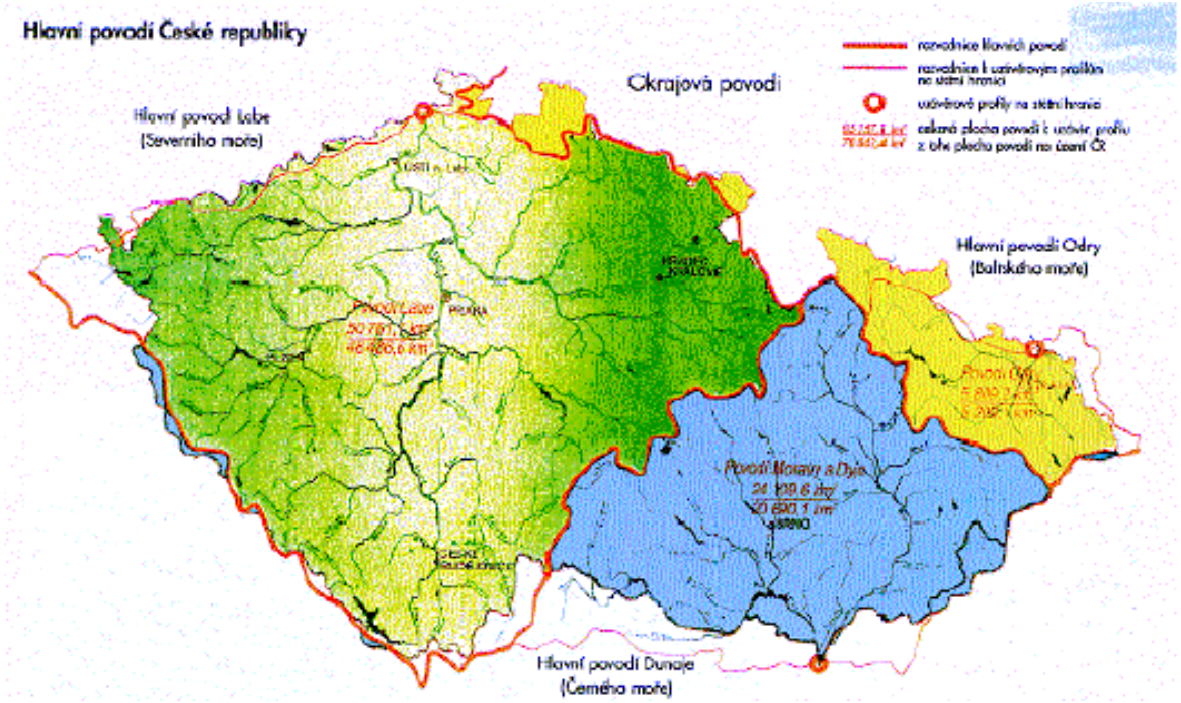


Figure 53: Main River Basin Area in CR

Centre-West:	Labe (Elbe)	> North Sea
South East	Morawa (March)	> Black Sea
North East	Odra (Oder)	> Baltic Sea

Source: Strasky 2005

Figure 54: Odra Basin

Figure 55: Labe Watershed

Labe (Elbe) watershed (left) drains West and the Centre
and Odra (Oder) Basin (right) drains North-East regions
Source: http://en.wikipedia.org/wiki/Elbe / http://de.wikipedia.org/wiki/Oder

Another important river basin is formed by the Vltava. The following figure illustrates the course and drainage basin of the Vltava (Moldau) from its source to its confluence with the Labe:

Figure 56: Vltava Basin and Course

Source: http://en.wikipedia.org/wiki/Vltava

4.4.5 Climate

The temperate continental climate can have snowy and cold winters and relatively hot summers with frequent rainfalls. Autumn is the driest month. Being landlocked in the centre of Europe high differences in temperatures between summer and winter are experienced. The map below demonstrates that the precipitation increases with higher elevation, which can be found in the mountains surrounding the country.

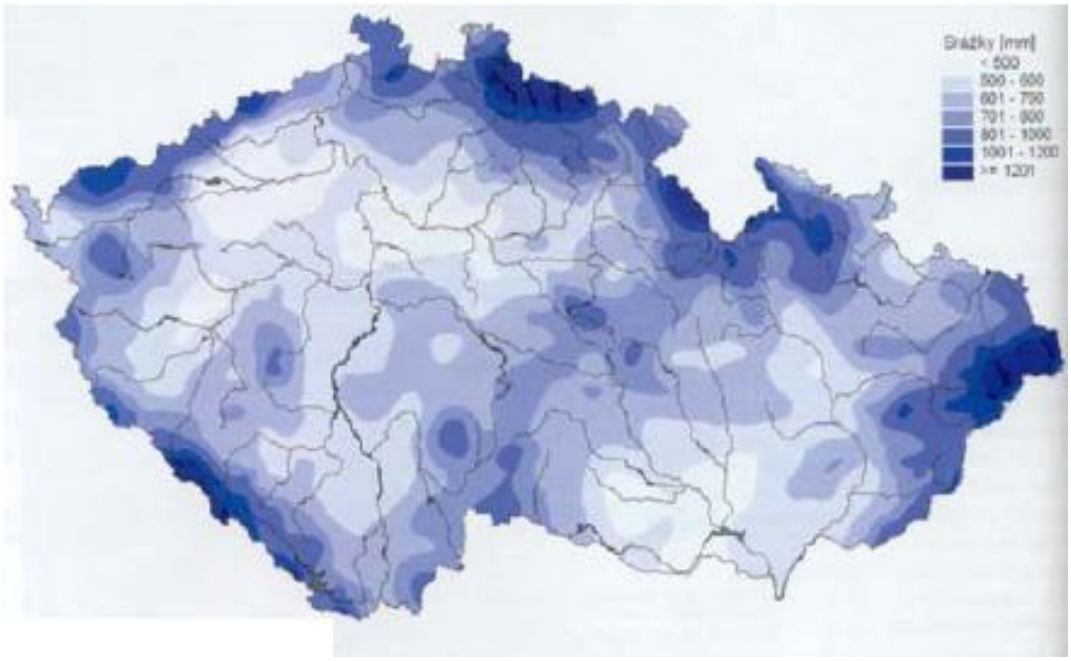


Figure 57: Precipitation in year 2000 in CR

Figure: Source: Strasky 2005

(Precipitation in mm)

Water levels in the rivers and currents show their peak in spring when rain becomes more often and when due to fast warming up snow is melting and often causing flooding.

4.4.6 Protected Zones

CR differentiates between several forms of Nature Protection Areas such as National Parks, Protected Landscape Areas, Natural Nature Reserves, Nature Reserves, National Nature Monuments, etc.

The oldest NP, the **Krkonoše National Park** (1963) stretches over an area of 363 km² with a protected zone area of 186 km² (thereof 17 km² are strictly protected) has been listed as a UNESCO Biosphere Reserve and it borders the Karkonosze National Park in Poland. It

includes the highest peak of the country, Mount Sněžka (1602m) and the upper section of the River Labe.

The **Šumava National Park** is the biggest protective zone with almost 1000 km² area along the border to Austria and Bavaria comprises the source and early section of the Vltava and its tributary, the river Otava.
It protects a little-inhabited area of the mountain range of the same name, the Šumava (Böhmerwald).

Figure 58: Sumava National Park
Source:http://en.wikipedia.org/wiki/File:%C5%A0umava_National_Park_and_Landscape_protected_Area_(CZE)_-_location_map.svg

Podyjí National Park is the smallest national park in CR, includes the 220-meter deep Dyji canyon with a unique, meandering river and many deep valley tributaries, and is located to Austrians NP Thayatal.

The **České Švýcarsko National Park** along the right side of the Labe River approaching the German border in the Saxon Switzerland area is the youngest NP in the country, stretches over 79 km² on the Czech side of the border, and is adjacent to the Saxon Switzerland NP.[82]

Nature 2000

Directive 79/40+/EEC was implemented into the law on the Protection of Nature and Landscape. Nature 2000 lists many protected sites in the whole country. [83]

4.5 Legal Framework RES and SHP

The national policy until 2030, as resolved by the CR-parliament in 2004, defines the energy concept with various scenarios for future development. The Energy Strategy plans to decrease the share of coal and other solid fuels from more than half to less to a third of

primary energy supply and the share of gas would slightly increase to 21%, the share of Nuclear and RES would increase considerably until 2030 to almost 21% (Nuclear) and 16% (RES) respectively.

CR had a feed-in tariff system for energy from RES and Co-generation since 2002 but the prices under that regime were not guaranteed for longer than one year. This system did not bring the desired results.
By adopting a new RES Act in 2005 the legal framework with respect to Renewable Energy has been strengthened in order to achieve the above mentioned targets.

The relevant Acts in place dealing with RES and Power are the following:

4.5.1 Legislation for RES and HP Utilization

- Act 458/2000 sb rules on the one side certain privileges of RES-E producers like connecting to the grid, transmission and distribution of green electricity and on the other side the obligation to purchase green electricity by the power companies.
- Act N. 91/2005 Coll., full text of the statute N. 458/2000 Coll. regulates the conditions of business activities and the execution of the state administration in the power engineering and deals with alternations of some acts (Power Act).
- Act N. 406/2000 Coll. regulates the power management. It mainly stipulates the state power-, the territorial power conceptions and means of accomplishments of power savings.
- Act N. 180/2005 Coll. on the support of the electric production from RES and about an alternation of some acts (Act on support of RES)
- Act N. 254/2001 Coll. so-called "Waters Act" rules the water management sphere [84]

4.5.2 EU targets

CR has set its target at 8% for the share of electricity production from RES by 2010, but realistically this can't be reached as only 5,19 % have been reached at the end of 2008. [84]
For 2020 the share of renewable consumption to gross final energy consumption is set at 13%. This compares with 6.1% reached in 2005. By 2030 a share of 15-16% of RES in total primary energy consumption has been set as a target at national level. [85]

In 2003 the Association of the Utilisation of RES undertook a cost analysis on several hundred successful projects in CZ and abroad. It was concluded that technically and economically the set targets for 2010 would be achievable. [77]

The actual realisation of the targets would depend on the establishment on a proper legal framework promoting and enabling investments into RES. Expecting generation of 6.750 GWh in 2010, the avg. generation cost per kWh were projected to be 0,104 € (3,23 CZK), the final cost would be 0,141 (4,5 CZK) per kWh. The resulting cost burden for conventional electricity will only be minor and is funded by a dedicated energy tax. Since 2008 a green-tax is in place to finance the promotion of RES.

Taking into account external cost from coal, RES would in most cases already be competitive.

Consequentially, given the relatively flat cost curve, the potentials for increase of RES-Energy towards the national targets seem to be realisable.

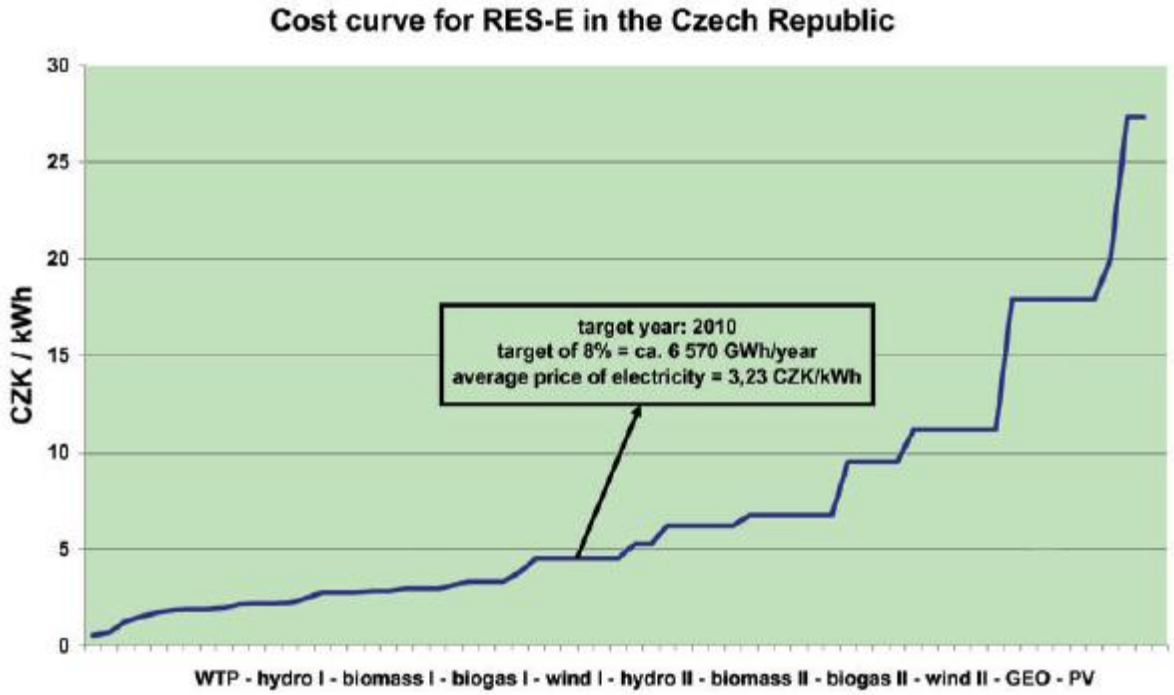


Figure 59: Cost Curve of RES-E

Source: Association of the Utilisation of RES, 2003

4.5.3 RES Promotion - Feed-in Tariff and Green Bonus

CR has established a **Feed-in Tariff** system in 2000 which was complemented by the **"Green Bonus"** system by the new RES Act 2005, offering an alternative incentive in form of an additional amount to be paid on top of the market price; those schemes cannot be combined. [86]

The Feed-in Tariff is a guaranteed favourable purchase price, the Green Bonus is an amount paid on top of the market price.

The **actual tariffs** and **green premium** are regulated in the Energy Regulatory Office's Price Decision No. 8/2008 of 18 November 2008. [12]

Table 46: Tariffs and Green Premium for RES-Energy in CR

Purchase Price and Green Premiums for SHPP (up to 10 MW)			**VT-Band**	**NT-Band**	**VT-Band**	**NT-Band**
Date of Commissioning	**Purchase Price**	**Green Premiums**	**Purchase Price**	**Purchase Price**	**Green Premiums**	**Green Premiums**
	CZK/MWh	CZK/MWh	CZK/MWh	CZK/MWh	CZK/MWh	CZK/MWh
SHPP commissioned on new sites after 31.12.2007 °)	2.700	1.260	3.800	2.150	1.700	890
SHPP commissioned on new sites from 1.1.2006 to 31.12.2007	2.540	1.100	3.800	1.910	1.700	650
SHPP commissioned after 31.12.2004 incl. refurbished SHPP *) °)	2.300	860	3.470	1.715	1.370	455
SHPP commissioned before 1.1.2005 +)	1.790	350	2.700	1.335	600	75

VT - the band of high rate applicability, set by the distribution system operator with a duration of 8 hours a day

NT - the band of low rate applicability, outside the VT applicability band.

°) age of generating process equipment less than 5 years old, otherwise tariff +) applies

*) refurbished SHPP means an existing electricity generating plant in which after 13 August 2002 refurbishment was completed include the following:

- Replacement or overhaul of the turbine
- Replacement or new winding of the generator
- Repair of the electrical installations, consisting in measures protecting the network
- Replacement of regulating apparatus

[12] Article 23 of the COMMISSION REGULATION (EC) No 800/2008 regards investment aid for the promotion of energy from RES as compatible with the common market within the meaning of Article 87(3) if it does not exceed 45 % of the eligible costs. The aid intensity may be increased by 20 percentage points for aid awarded to small enterprises and by 10 percentage points for aid awarded to medium-sized enterprises.

- Replacement or installation of a new automated control system

Source. The Energy Regulatory Office's Price Decision No. 8/2008 of 18 November 2008
http://www.eru.cz/user_data/files/english/Price%20decision/CR8_2008en.pdf
retrieved 02/10/2009 13:27

The feed-in tariffs and green premiums are available throughout the service life of the SHPP which is assumed to be 30 years.
During the whole useable life of the plant feed-in tariffs are indexed to the producer price index, maximum 4%, minimum 2%. The green premiums are guaranteed for one year only as their level depends on the market price of energy.

Feed in tariffs for electricity generated from renewable sources may not drop by more than 5% annually for new plants. When feed in tariffs drop, the level of revenues per unit of electricity from renewable sources must be maintained for 15 years.
There are some minimum efficiency requirements stipulated in the provisions, i.e. the efficiency of a newly installed turbine should have at least 85% at its operating optimum, 80% for retrofitted older models. Also limitations are set regarding unit capital expenditure and annual utilisation of the plants installed capacity. [87]

4.5.4 Other Support Programs for RES

The main support systems were implemented according to the Act. No 180/2005 and refer to promotions provided under the State Programme for the Promotion of Energy-Saving and the Use of Renewable Energy Sources, supports from EU structural funds.

The ECO-energy – Call II program is administered by Czechinvest and follows previous ECO energy Call I. [88] It promotes the use of RES, e.g. refurbishing a hydro power plant and is eligible for all small and medium companies (SME). Large enterprises are only eligible regarding energy efficiency investments, not regarding Energy production from RES.[13]

[13] Grants range from CZK 500,000 to CZK 100,000,000 and can be between 15%-40% of the project cost. Eligible expenses are purchase of land up to 10%, utility networks, infrastructure, project design documentation for construction, engineering work, refurbishment and retrofitting, new machines and equipment. Application deadline was June 14th 2009. New dates for registration will be published at year end by the ministry.

Other more general incentives like full tax relief for 5 years for new companies, 50,000 CZK job creation grants in certain regions, etc. shall attract new investments but again only during announced calls for a specific area of intervention.

The **Operational Program Environment** (OPE) has almost **EUR 673 million** available from the Cohesion Fund for projects like in producing electric energy from RES. [89] Grants are available for public and non profit organisations and business organizations owned by municipalities and towns. Grants are given for the construction of new facilities and the modernization of existing facilities with the aim to increase the use of RES e.g. electric energy generation. Almost EUR 363 million have been reserved for this area. [14]

4.6 SHP Market-Participants

4.6.1 Institutions and Authorities

- The Ministry of Trade and Industry (MTI) is responsible for energy questions and policy.
- The Czech Energy Agency (CEA) is under supervision of the MTI and is responsible for the promotion of RES and energy efficiency.
- The State Energy Inspection Board (CR-SEI) is an organizational supervising unit of the state and subordinate to the MTI.
- ERÚ Energetický regulační úřad is the Energy Regulatory Office responsible for the obligatory licences, the support of use of RES, etc
- Electricity Market Operator (OTE, a.s.) was established by the MTI with various tasks like data collecting and reporting in the individual electricity and derivatives markets (short-term markets and balancing market, and greenhouse gas emission allowances, etc)
- The Ministry of Environment allocates funds for the RES support programme.
- Small Hydropower Association (SPVEZ)

[14] The grants can amount to 85% of a project's total eligible expenditures with a minimum amount of eligible expenses being CZK 0.5 million and explicitly includes small water power plants.
Here grants may account for 20% of the total eligible expenses, however, there is a maximum limit of CZK 50 million.

4.6.2 Market Players

- ČEZ a.s. is the state controlled major power group and also coal mining group. Among others it owns 34 hydro plants. It provides roughly 60 TWh of electricity per year representing two thirds of CR power generation
- CEPS is the Transmission System Operator and – whilst unbundled - a subsidiary of ČEZ
- Eight regional distribution companies which are partly owned by ČEZ, partly owned by foreign utilities service the final customer

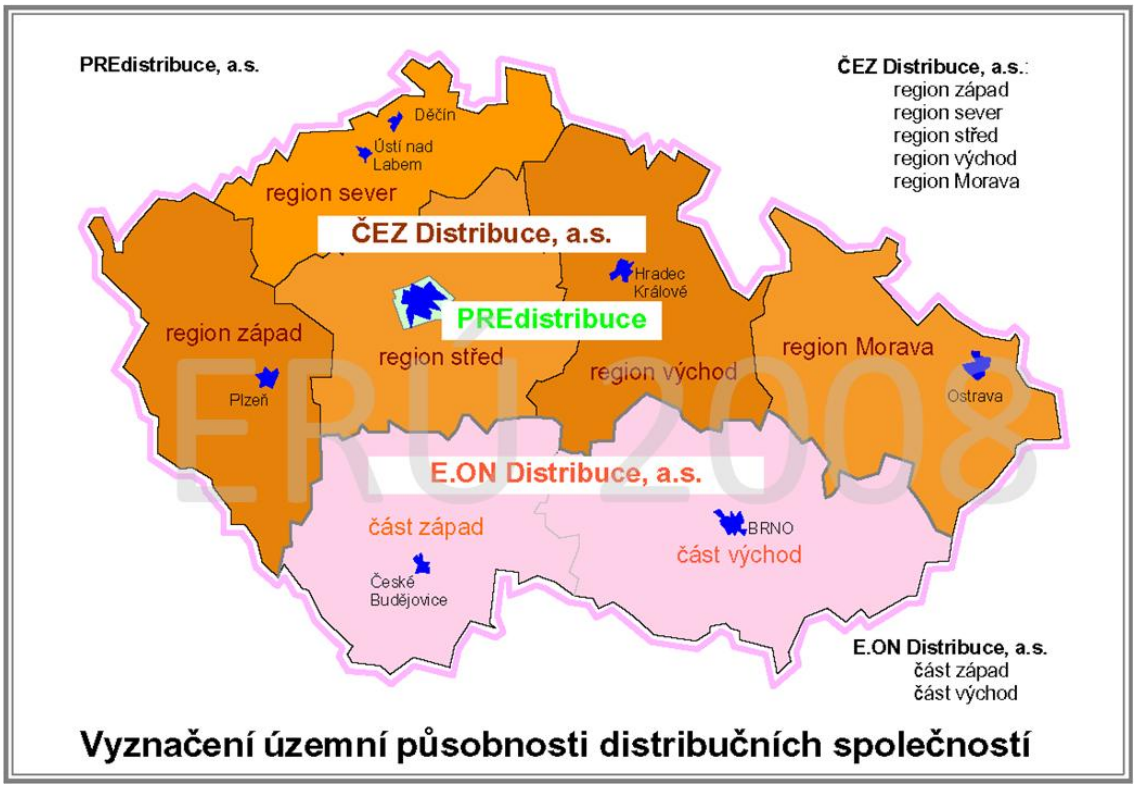


Figure 60: Electrivcity Distribution Regions in CR

http://www.eru.cz/user_data/files/statistika_elektro/rocni_zprava/2008/

- In the SHP sector many **producing companies** share the market, again dominated by ČEZ:

Table 47: SHP-generating Companies

SHP-Producer	Installed Power Capacity	SHP-Producer	Installed Power apacity
Comany	**MW**	**Comany**	**MW**
ČEZ Obnovitelné zdroje, s.r.o.	63,67	AMAPRINT - Kerndl, s.r.o.	0,77
ENERGO-PRO Czech, s.r.o.	30,84	Severomoravské vodovody a kanalizace Ostrava a.s.	0,74
E.ON Trend s.r.o.	29,64	HYDROENERGO s.r.o.	0,74
Povodí Vltavy, státní podnik	18,38	SP Dražice s.r.o.	0,74
Povodí Ohře, státní podnik	16,95	Ing. Jiří Čáp	0,7
1. elektrárenská s.r.o.	6,91	TROUBKY MVE s.r.o.	0,7
Povodí Labe, státní podnik	5,89	Martin Mádle a spol., s. r. o.	0,66
Povodí Odry, státní podnik	5,73	Duropack Bupak Papírna s.r.o.	0,65
KREDIT CENTRUM s.r.o.	4,5	ENERGIE spol. s r.o.	0,61
Severočeské vodovody a kanalizace, a.s.	4,25	Oldřich Hromádko	0,61
Povodí Moravy, s.p.	3,53	Ing. Jana Válková	0,6
AQUA ENERGIE s.r.o.	2,45	EURO SPRO a.s.	0,59
F O B O S spol. s r.o.	2,12	ORC group s.r.o.	0,55
Rida Consulting, a.s.	2,1	ENERGO PLUS CZ o.p.s.	0,54
LobCon, s.r.o.	1,98	LINEA leasing s. r. o.	0,54
KIPP,s.r.o.	1,96	MVE Bukovec - Mlýn s.r.o.	0,54
INCOS a.s.	1,92	Ing. Vítězslav Veselý	0,53
Klavarská elektrárenská v.o.s.	1,58	MVE Šestidomí, spol. s r.o.	0,53
A - ENERGY s.r.o.	1,56	Vodní elektrárny Ploučnice a.s.	0,53
MVE-HYDRO s.r.o.	1,47	EWA Libochovice, s.r.o.	0,5
RenoEnergie, a.s.	1,39	Milan Hynek	0,5
Elektrárna Kolín a.s.	1,06	MVE Pátek, s.r.o.	0,5
PREDAX FINANCE,s.r.o.	1	Přerov MVE s.r.o.	0,5
VÍT a SPOL, spol. s r.o.	0,99	Pražská vodohospodářská společnost a.s.	0,44
RNDr. Luděk Liška	0,89	Olšanské papírny a.s.	0,35
UNIPOL spol. s r.o.	0,89	SLEZAN Frýdek - Místek a. s.	0,32
První elektrárenská Liberec spol. s r.o.	0,88	Brněnské vodárny a kanalizace, a.s.	0,21
TEODICEA s.r.o.	0,8	Ostravské vodárny a kanalizace a. s.	0,06
Vodovody a kanalizace Jižní Čechy, a.s.	0,79	MORAVSKÁ VODÁRENSKÁ, a.s.	0,05
Ing. Jiří Jehnička	0,78	**TOTAL**	**232,2**

Source: created by author from ERU data

http://www.eru.cz/user_data/files/statistika_elektro/english/2008/index.htm

4.7 SHPP Inventory

The following inventory shows that there is a high number of SHPP, especially of micro size plants. From the available data, the average age comes close to 50 years. The organization Calla, an association for preservation of the environment lists close to 500 SHP with some technical data attached. [90]

Some regions in the map have not been investigated yet for the existence of SHPP:

Figure 61: Map of location of SHPP in CR
(incomplete)
Source: Strásky 2005

Grouped according to the Distribution region the larger SHPP are shown in ANNEX IV:

ČEZ, a.s. operates the following SHP in CZ, which are in some cases exceeding the typical 10 MW limit as those are composed units of 10 MW each.

Table 48: SHPPoperated by ČEZ, a.s. as per 31. 12. 2008

	Location	Installed			
Distribution		capacity	capacity	Gross / net	
company			factory		
		[MWe]	[MWe]	[GWh]	
E. ON West	**Lipno II**	1 x 1.5	**1,50**	**5,4** / 5,3	Vltava
E. ON West	**Kamýk**	4 x 10.0	**40,00**	**56,8** / 56,7	Vltava
CEZ center	**Štěchovice I**	2 x 11.25	**22,50**	**77,4**/ 77,0	Vltava
CEZ center	**Vrané nad Vltavou**	2 x 6.94	**13,88**	**54,8** / 54,6	Vltava
E. ON West	**Hněvkovice**	2 x 4.8	**9,60**	**25,0** / 24,6	Vltava
E. ON West	**Kořensko 1**	2 x 1,9	**3,80**	**9,9** / 9,8	Vltava
E. ON East	**Mohelno**	1.2 + 0.56	**1,76**	**5,4** / 5,3	Jihlava
CEZ north	**Želina**	2 x 0.32	**0,63**	**2,2** / 2,1	Hea
E. ON West	**Kořensko 2**	1 x 0.94	**0,94**	**1,7** / 1,7	Vltava
CEZ Moravia	**Dlouhé Stráně 2**	0.16	**0,16**	**0,5** Mg/0,5	Desna Wild
TOTAL			**94,77**		

Source: http://www.eru.cz/user_data/files/statistika_elektro/rocni_zprava/2008/
Retrieved: 24/09/2009 08:59

The Vltava River hydro-plant cascade (Lipno, Hnevkovice, Korensko, Orlik, Slapy, Kamyk, Stechovice, and Vrane) are owned by Povodi Vltavy, s.p. (Vltava River Basin State Enterprise), and the ČEZ, a. s. only assumes the position of the hydro-plant operator. [91]

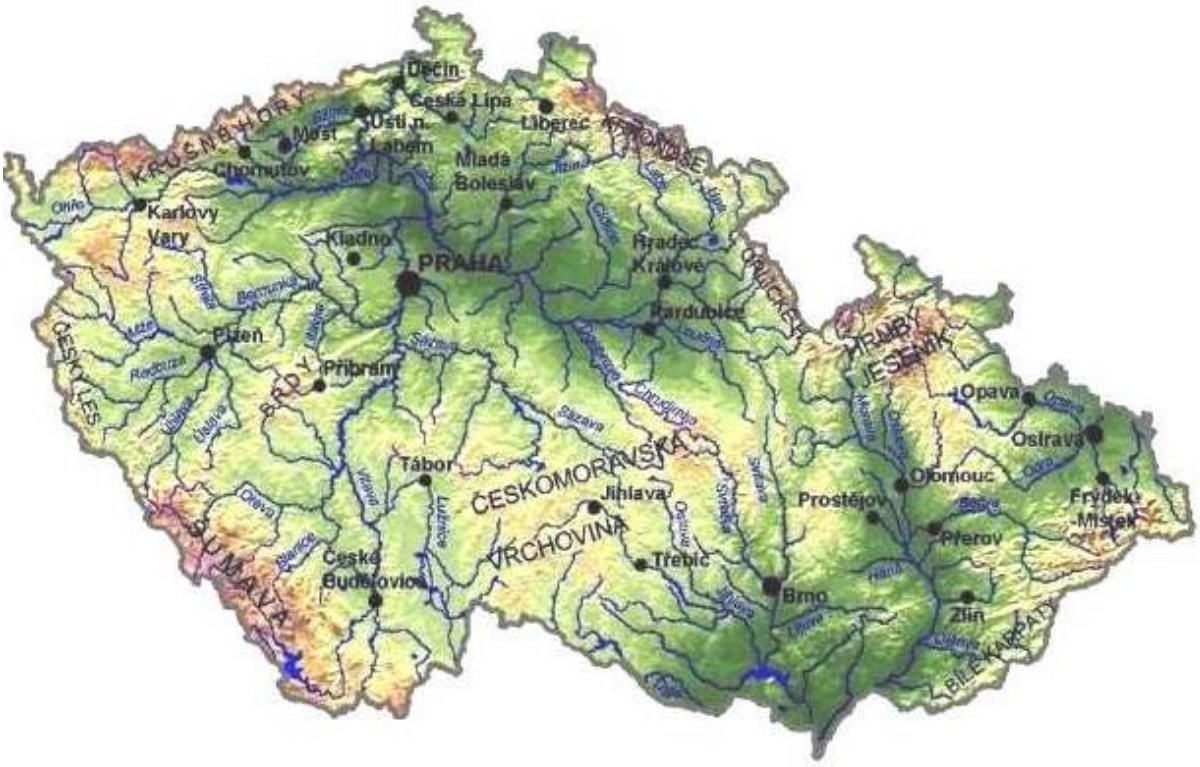


Figure 62: River Map of CR

Source:

http://www.esha.be/fileadmin/esha_files/documents/workshops/hidroenergia/PNO_1_Bartusek.pdf

4.8 Recent SHP Projects

Table 49: SHP Projects

Main projects	installed capacity MW	avg. annual production GWh	River region
Velký Osek	0,75	4,30	
Čelákovice	1,10	3,40	Labe
Břkovice	4,50	18,60	
Štětí	5,20	30,00	Labe
Roudnice	5,40	28,80	Labe
České Kopisty	5,20	29,00	Labe
Žatec - RenoEnergie,a.s., SOP 2006	0,66	3,40	Ohre
total	**22,81**	**117,50**	

Source: Siemens, 2009, compiled by Kopecek, C.

Table 50: Theoretical SHP Potential in CR with River and Site reference

Plant Site	MW	avg GWh p.a.	Mouth region	Plant Site	MW	avg GWh p.a.	Mouth region
Pětikolsky Weir	0,240	1,000	Vltava	Lito I	0,012	0,078	Morava
Havlickuv Brod	0,100	0,300	Vltava	Zlin-Louky	0,044	0,146	Morava
Ceske udoli	0,280	1,100	Vltava	Moravska Nova Ves	0,503	1,788	Morava
Klabava	0,180	0,750	Vltava	Tvrdonice	0,254	1,775	Morava
Radotin	0,630	2,780	Vltava	Lanzhot - skluz	0,411	2,285	Morava
Klecany	1,560	8,300	Vltava	Podhradi - Zatisi	0,043	0,235	Morava
Watergate Horin	1,000	6,500	Vltava	Prizrenice	0,132	0,530	Morava
Herlikovice	0,076	0,364	Labe	Kamenny mlyn	0,176	0,924	Morava
Pec pod Snezkou	0,030	0,143	Labe	Paulinja	0,044	0,268	Morava
Ceska Skalice	0,075	0,477	Labe	Radlas	0,047	0,260	Morava
Dolsko	0,012	0,075	Labe	Jihlava - Cesky Mlyn (Cesjy jez)	0,029	0,149	Morava
Litice II	0,200	0,870	Labe	Komarov	0,244	0,889	Odra
Dobra Voda	0,060	0,332	Labe	Haj	0,304	1,185	Odra
Tynec nad Labem	0,543	2,676	Labe	Dehylov	0,400	2,234	Odra
Tzehun	0,100	0,434	Labe	Trebovice	0,276	1,202	Odra
Harachov I	0,070	0,238	Labe	Privoz	0,628	2,050	Odra
Harachov II	0,078	0,290	Labe	Przno	0,176	0,536	Odra
Smrzovka	0,050	0,214	Labe	Hodonovice	0,272	1,013	Odra
Dolanjy	0,070	0,519	Labe	Vysni Lhoty	0,032	0,268	Odra
Sojovice	0,305	1,333	Labe	Lisko	0,176	0,663	Odra
Roudnice (RU)	3,640	18,000	Labe	Stolberk	0,194	0,805	Odra
Roudnice (LU)	1,820	9,800	Labe	Olesna	0,005	0,044	Odra
Decin	7,900	46,900	Labe	Vratimov	0,224	0,915	Odra
Hermankovice	0,026	0,120	Labe	Vitkovice	0,572	2,034	Odra
Kynsperk	0,155	0,665	Ohře	Sovinec	0,172	0,477	Odra
Radosov	0,250	1,200	Ohře	Smilovice	0,001	0,012	Odra
Kadan II	1,840	10,192	Ohře	Detmarovice	0,234	0,756	Odra
Zatec	0,800	3,800	Ohře				
Terezin	0,800	3,900	Ohře	**TOTAL**	**28,495**	**146,8**	

Source: Siemens, 2009, compiled by Kopecek, C.

Flood Prevention Project

In order to limit the damaging effects of massive floods as experienced in the years 1992 and 2002, the "Flood Prevention Project" and the "Support for Renewal, Dredging and Reconstruction of Fishponds and Construction of Water Reservoirs" were founded and implemented from 2002 to 2006. Those programs focus on increasing the possibilities of water retention in the territory and development of dams allowing harmless the water overflow into river flood plain areas and also on enlarging the capacity of river-beds. The total costs of the project are estimated to be approx. CZK 15 billion. [92] The following SHP-Projects have been named in that context:

Table 51: SHP Projects - Flood Prevention

Site	Q	H	P	E
	m^3/s	m	MW	GWh
Spalov	2,9	52	9,3	10,8
Zimrovice	6,5	46	7,3	18
Hosejn	1,8	59	7,3	5,8
Hlucin	14,9	13	6,5	13,7
Nedvedice	4,5	32	6,4	9,7
Stepanovice	5,7	28	6,2	10,3
Sokoli	5,1	28	6,2	9,2
N. Herminovy	3,1	34	5,7	7,1
Cucice	3,2	54	5,3	12,2
Lesnice	1,9	33	4,4	5
Hovezi	4	28	4,1	7
Buko	1,2	48	3,9	3,7
Borovnice	1,5	39	3,7	4,1
DL SHPs	9,7	35	3,5	15
Vysociny	1,2	44	3,5	3,2
Potstejn	5,7	58	3	12,2
Hnevkov	4,2	24	2,8	6,4
Vilemov II	4,7	60	2,4	5,3
Skrye	1,4	37	2,4	3,4
Lostice	2,2	30	2,3	4,7
Prisnecnice	0,9	230	2,3	18
Benesov II	9,5	25	2,2	9,6
Klasterec	3,1	76	2,1	8,7

Celadna	0,8	40	2,1	2,2
Hanusovice II	1,7	28	2	3
Kyselka	25,5	8	1,9	7,6
Hermanky	3,2	21	1,8	4,1
Krasna	0,9	33	1,8	2,1
N.Losiny	1,2	33	1,8	2,5
Modletice	2,7	17	1,7	3,1
Paseky	4,7	42	1,7	3,6
Krka	12	18	1,4	6,2
Pecin II	1,6	97	1,4	3,8
Vlovice	1,7	20	1,4	2,2
Korunni	28	6	1,3	6
Suchovrsice	5,6	24	1,2	5,8
TOTAL			**124,3**	**255,3**

Q = Water Discharge

H = Gross Head

P = Installed Capacity

E = Annual Average Production

Source: SIEMENS 2009, compiled by Kopecek, C.

The Map below with the main water sheds as yellow dotted line and the low areas show the regions, threatened by flooding. The Moravian Gate is the low area intersecting from North to South.

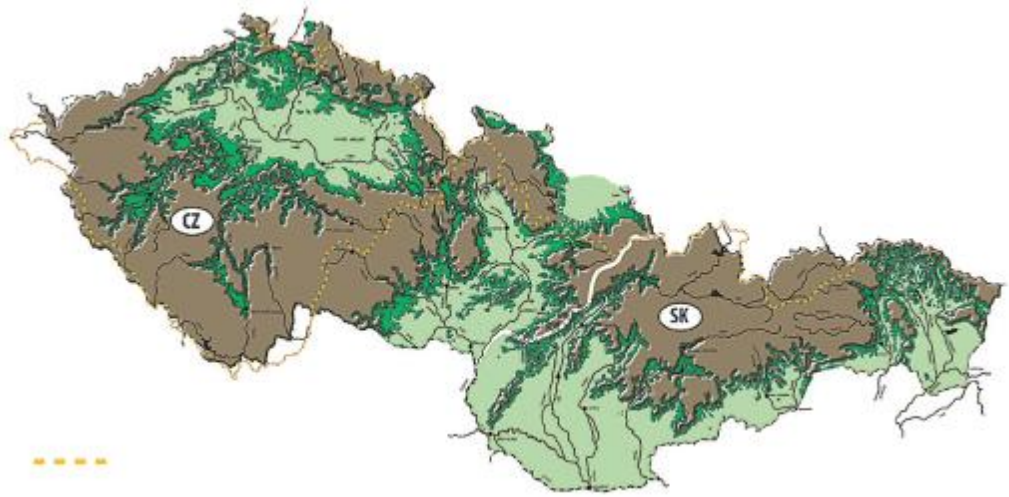


Figure 63: Water Sheds and Low Areas threatened by Flooding

Rozvodnice / Watershed divide

http://machinery.podzimek.cz/galerie/voda/D_O_L-%20cesko-anglicky.pdf

Table 52: SHP Projects in Bohemia with Investment Cost

Site	P	E	Running	Investment	Investment		IN/E	IN/E
Bohemia	**MW**	**GWh**	**hours**	**TKč**	**T€**		**T Kč/GWh**	**T €/GWh**
Adam Nr. 1	1,112	0,286	2.554	10.800	428,9		37.762	1.499,7
Adam Nr. 2	0,090	0,306	3.400	11.100	440,8		36.275	1.440,5
Adam Nr. 3	0,030	0,128	4.267	5.100	202,5		39.844	1.582,0
Adam Nr. 4	0,053	0,196	3.698	8.600	341,5		43.878	1.742,3
Adam Nr. 5	0,100	0,448	4.480	17.500	695,0		39.063	1.551,3
Adam Nr. 6	0,400	1,360	3.400	35.200	1.397,9		25.882	1.027,9
Klecany II	1,560	8,300	5.321	320.000	12.708,5		38.554	1.531,1
Havl. Brod	0,100	0,300	3.000	15.000	595,7		50.000	1.985,7
Ceske udoli	0,280	1,100	3.929	40.000	1.588,6		36.364	1.444,2
Strakonice	0,240	1,000	4.167	35.000	1.390,0		35.000	1.390,0
Troja	2,200	12,700	5.773	385.000	15.289,9		30.315	1.203,9
Litomerice	7,000	29,000	4.143	1.188.170	47.187,1		40.971	1.627,1
Lovosice II	1,400	3,319	2.371	216.000	8.578,2		65.080	2.584,6
Steti	7,000	30,000	4.286	1.132.000	44.956,3		37.733	1.498,5
Celakovice	1,100	3,360	3.055	186.851	7.420,6		55.610	2.208,5
Velky Osek	0,750	4,300	5.733	180.000	7.148,5		41.860	1.662,4
Breoun	0,800	3,310	4.138	130.000	5.162,8		39.275	1.559,8
Zelezny Brod*)	0,986	4,300	4.361	192.000	7.625,1		44.651	1.773,3
Kamenny mlyn	0,176	0,924	5.250	41.436	1.645,6		44.844	1.781,0
Paulinka	0,044	0,268	6.091	17.204	683,2		64.194	2.549,3
TOTAL	**25,420**	**104,910**		**4.166.961**	**165.487**	**AVG**	**42.358**	**1.682,2**
*) in construction								

Source. Siemens 2009, compiled by Kopecek, C.

Table 53: SHP Projects in Moravia with Investment Cost

Site	P	E	Running	Investment	Investment		IN/E	IN/E
Moravia	**MW**	**GWh**	**hours/yr**	**TKč**	**T€**		**T Kč/GWh**	**T€/GWh**
Kamenny mlyn	0,176	0,924	5.250	41.400	1.644,2		44.805	1.779,4
Paulinka	0,044	0,268	6.091	17.200	683,1		64.179	2.548,8
Zlin-Louky	0,044	0,146	3.318	17.700	702,9		121.233	4.814,7
Jihlava-Cessky jez	0,040	0,150	3.750	13.200	524,2		88.000	3.494,8
Litovel	0,012	0,078	6.500	6.700	266,1		85.897	3.411,3
Lanzhot A	0,411	2,286	5.562	319.900	12.704,5		139.939	5.557,5
Lanzhot B	0,188	1,324	7.043	214.000	8.498,8		161.631	6.419,0
Pohradi zatisi	0,043	0,236	5.488	17.200	683,1		72.881	2.894,4
Tvrdonice A	0,407	2,190	5.381	326.200	12.954,7		148.950	5.915,4
Tvrdonice B	0,254	1,775	6.988	216.100	8.582,2		121.746	4.835,1
Moravska Nova Ves	0,503	1,788	3.555	267.500	10.623,5		149.609	5.941,6
Radlas	0,047	0,260	5.532	37.000	1.469,4		142.308	5.651,6
TOTAL	**2,17**	**11,43**		**1.494.100**	**59.337**	**AVG**	**111.765**	**4.438,6**

Source: Siemens 2009, compiled by Kopecek, C.

The often very small and low head (LH) plants in CR can hardly compete with other electricity generation, as long as external effects like emissions are not taken into consideration as a cost factor. By using already existing weirs, ponds and storage reservoirs both environmental impact and cost can be reduced significantly. The low heads plant sites in CR with high flow generally incur high cost due to larger civil engineering works and turbine machinery. Additional features like flood control can ameliorate the economics of such a project.[93] However, the comparison of investment and production cost of SHPP in

some European countries in the TNSHP study from 2003 shows, that CR was lower than average of the analysed countries. The range given for LH SHPP was determined to be 1.200-2.000 €/kW, for MH SHPP 800-1.400 €/kWh and for the HH 600- 1.000 €/kWh.

Table 54: Comparison of Investment and Production Cost with CEE/SEE Countries

	CR	EST	HU	LA	LI	PL	SK	BG	RO	TR	avg
Investment cost €/kW											
Low head	**1.600**	1.400	2.750	1.200	2.500	1.000	1.750				**1.743**
Medium Head	**1.100**	1.800	3.250	800	2.200	850	1.750	1.300		400	**1.494**
High Head	**800**						1.750	700		350	**900**
Production cost €cts/kWh											
Low head	**3**	1,9	4,2	2,7	3	3,5					**3,05**
Medium Head	**2,5**	1,7	4,2	2,2	2,5			6,5		0,65	**2,89**
High Head	**2**							0,5	2,8	0,55	**1,46**

Source: TNSHP 2004

The other principal cost elements, operation and maintenance (O&M), including repairs and insurance, differ considerably depending on the head height of the plant.

4.9 Limiting Factors and Barriers

The protection of fish life came out of the TNSHP survey as the major limiting factor for SHP development in CR. Environmentalists do not regard SHP as a contribution to environmental protection. The licensing process is rather lengthy and could take up to 2 years.

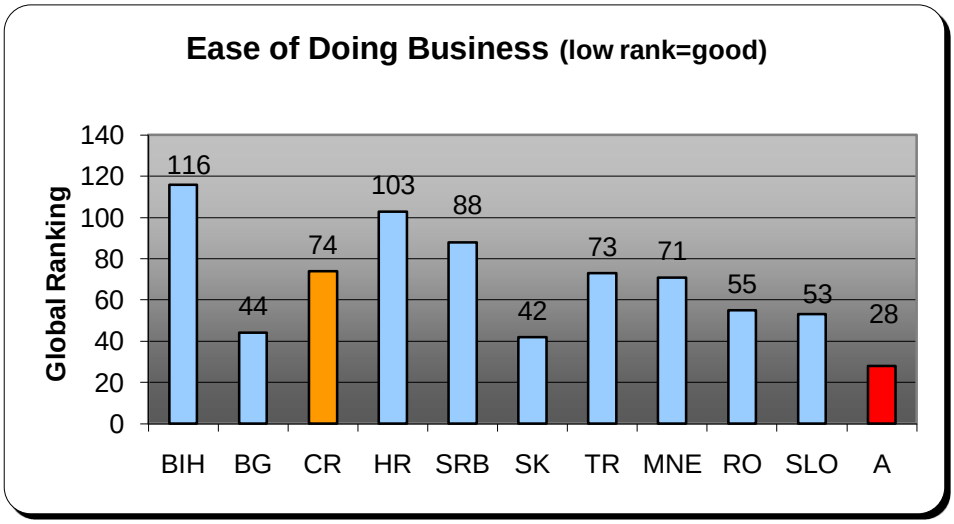


Figure 64: Ease of Doing Business in CR

Source: The World Bank Group, 2009 in

http://www.doingbusiness.org/ExploreEconomies/?economyid=13

Graph created by Kopecek, C.

CZ came first in the Peer Group comparison in the category “Employing Workers” but had some bad rankings with respect to “Starting and Closing a Business” and “Paying Taxes”.

5 Croatia

Figure 65: Map of Croatia

Source: http://www.erranet.org/AboutUs/Members/Profiles/MAPS/CroatiaMap

03/06/2009

The current energy supply of Croatia (HR) is derived from hydro, crude oil and natural gas. With an electricity consumption of 17,380 GWh and a corresponding production of only 11,064 GWh HR needs to import a large of its power needs.[94]

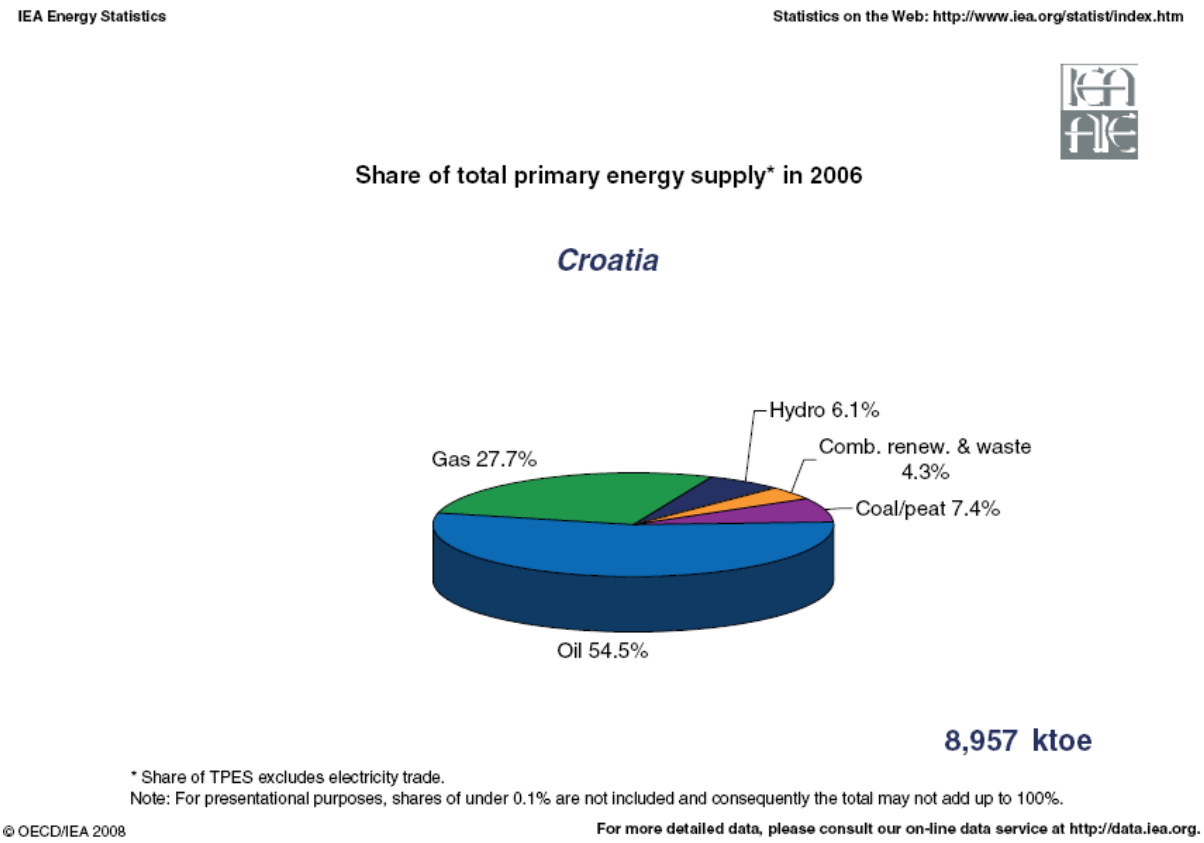


Figure 66: Share of total Primary Energy Supply in HR

Source: OECD/IEA

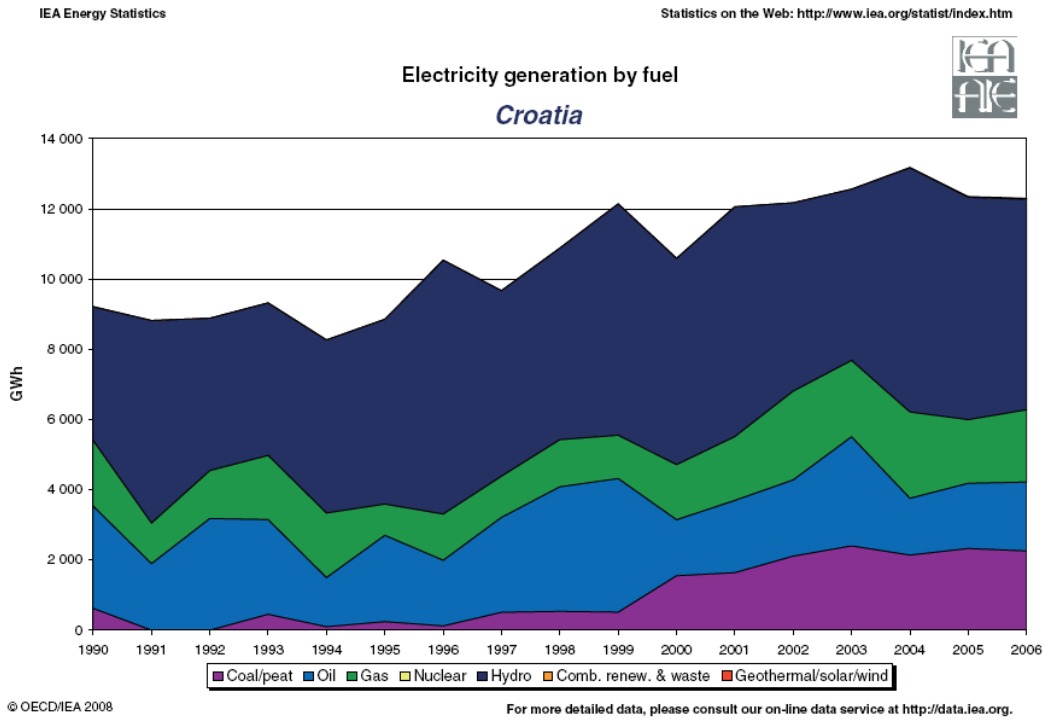


Figure 67: Electricity generation by fuel in HR

Source: OECD/IEA

The RES share in gross electricity consumption for 2006 was around 34% which equals 6.1 GWh or 43% of domestic production.
This relatively large share is because HR has a high number of hydro plants (25) with a total built in capacity of 4,029 MW. The contribution of large hydro power is 98%, SHP 1.6% (or 26.7MW) and wind 0.3%.

Table 55: Forecast of RES structure to 2020 (view on 2030) in HR

		2010	**2020**	**2030**
Biomass	PJ	18,14	36,27	68,72
Bio fuel	PJ	2,50	9,55	14,35
Wind				
Energy	PJ	1,02	9,50	15,84
SHPP	**PJ**	**0,40**	**0,97**	**1,55**
LHPP	PJ	21,06	23,76	23,76
Geothermal	PJ	0,15	5,51	8,54
Solar	PJ	0,51	5,27	13,87
TOTAL	**PJ**	**43,78**	**90,83**	**146,63**
	TOE	1.042.000	2.105.000	3.491.000

Source: MINGORP and UNDP, 2008

Whereas there would be high **potential** for **wind-power** in HR, due to the restrictions of the instable grid, only a minor part of the possible 1,500 MW will be realised. **Geothermal** and **Biomass** also have some promising potentials.

The potential for further **hydropower** is limited, mostly because of the already high utilization rate of the rivers.[94] Approximately half of the technically exploitable hydro power potential of 12.45 TWh/year is presently used for power generation.

The unexploited **SHP potential** is estimated to be around **560 GWh/year** [97] and **177 MW** [94] **installed capacity.** But the environmental and planning constraints are barriers to the development and only some pilot projects have been realised with local authorities so far. Interest of private investor is – if any – concentrating on SHPP owned by HEP.

The SHERPA study of 2008 arrived to **an inventory of 32 SHPPs with an installed capacity of 33 MW and an annual generation of 99 GWh per 2006**.

Table 56: Evolution and Forecast of SHP from 2001-2020 in HR

	2000	2001	2002	2003	2004	2005	2006	FC 2010	FC 2015	FC 2020
Total Number of SHPP	n/a	n/a	n/a	n/a	n/a	n/a	32	40	50	70
Capacity MW	n/a	38	38	34	32	33	33	38	43	50
Generation GWh	n/a	91	96	72	124	107	99	120	140	180

Source: SHERPA 2008, compiled by author

The evolution shows generally an increase but has some extraordinary peaks and drops which are probably simply wrong data in the underlying reports filed.

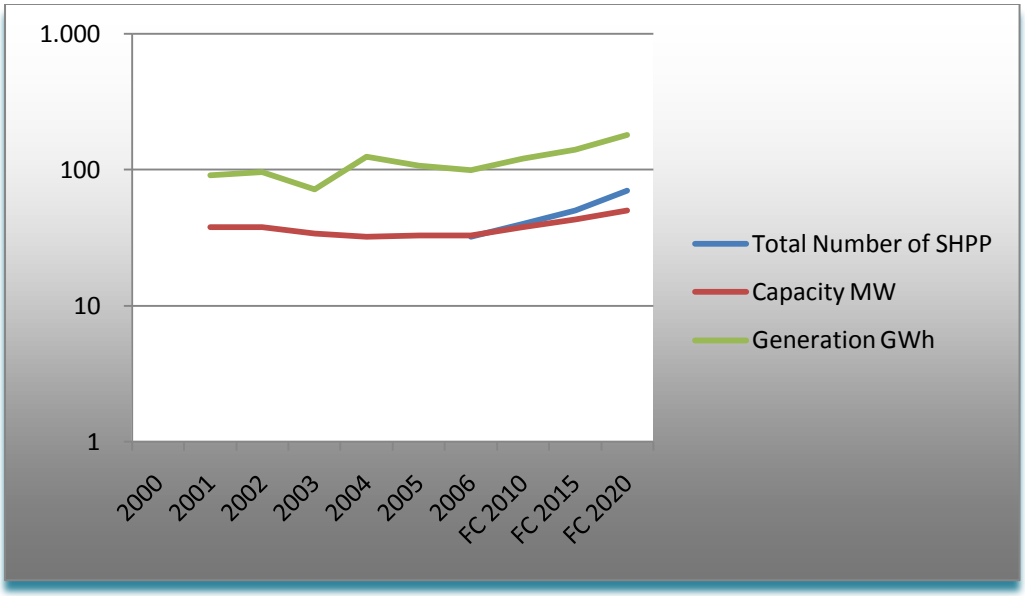


Figure 11: Evolution and Forecast of SHP from 2001-2020 in HR

Source: SHERPA 2008, graph by author

The range of **investment cost** is between 1,300 – 2,500 €/kW with avg. **production cost** of 1.5 €cts/kWh. [95]

The realizable potential reported by SHERPA for new (retrofit) SHPPs is an installed capacity of 123 (8) MW with an annual generation of 435 (28) GWh.

Table 57: Potential of SHP in HR

Potential	Generation		Capacity
	GWh/yr	%	MW
Gross theoretical	118	100	n/a
Technically feasible	568	48	177
Economically feasible	475	40	130
Economically feasible taking environmental constraints into account (EFEN)	435	37	123
EFEN for refurbishing / upgrading estimate	28		8

Source: SHERPA 2008, compiled by author

HR offers sites with high precipitation, especially in the regions between Rijeka and Gospic and around Dubrovnik, with above 2,000 mm annual precipitation.

Figure 68: Precipitation in HR

Source: http://www.bestcountryreports.com/Precipitation_Map_Croatia.html

HR has established the national energy program called MAHE (SHP construction program) with the goal to remove all barriers in order to facilitate the construction of SHPP.[96]

A research on 130 **small water courses** has been undertaken resulting in a cadastre (Katastar mali vodnih snaga) where the total gross potential inspected was around 1,310 GWh/year, 90% on defined exploitation sites for SHP up to 5 MW. Almost 700 SHP sites on 63 water courses gave hope to 570 GWh technically exploitable potential. Rivers identified in the cadastre were Boljuncica, Bijeka, Bregana, Brzaja, Butisnica, Cabranka, Cuckov jarak, JAdova, Jadro, Krupa, Kipcina, Kupica, Ljuta, Orljava, Ovrlja, Ruda Velika, Rumin Veliki, Slapnica, Vitunjica, Vocinka and Zrnovnica.

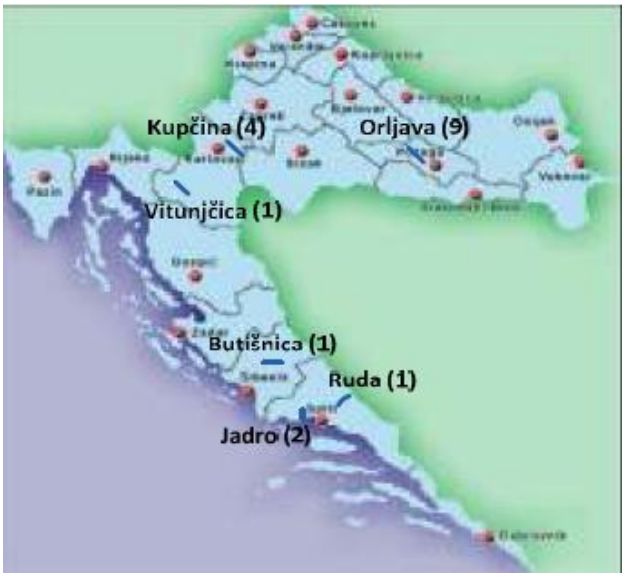


Figure 69: Potential sites of SHPP in HR
Source: MINGORP and UNDP, 2008

Subsequently the analysis resulted in a possible annual production at 67 locations of 100 GWh and after considering other restrictions for construction of SHPP due to environment and cultural heritage protection, 6 water courses with possible 18 exploitable plant sites and an installed capacity of 2 MW and an estimated generation of 8.3 GWh were left.

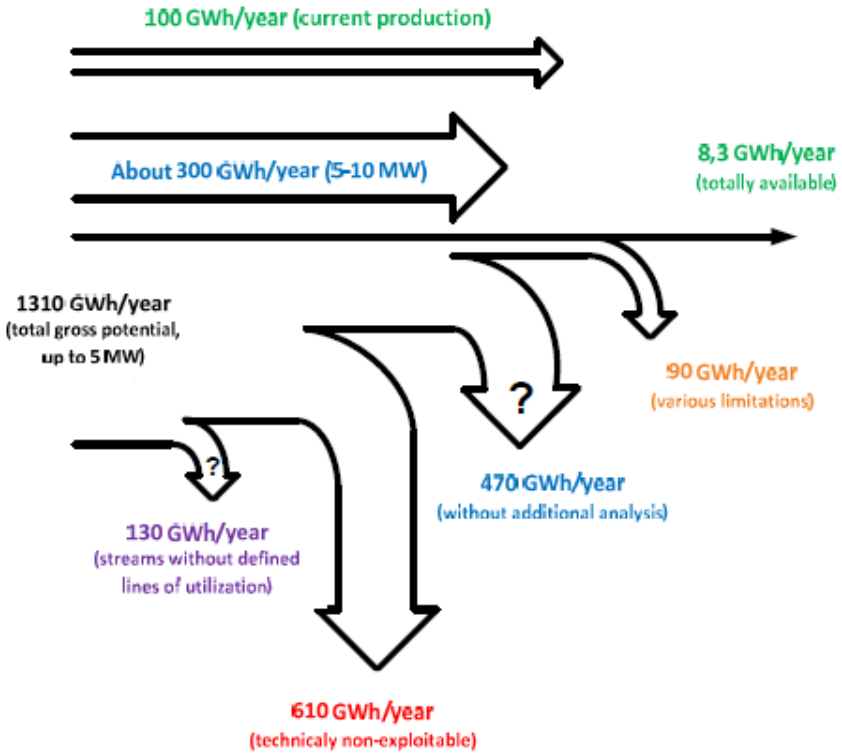


Figure 70: Deriving to potential of SHP during cadastre research of 700 sites in HR

Source: MINGORP and UNDP, 2008

Based on the experiences from that research, the Ministry of Energy, Labour and Entrepreneurship (MINGORP) considers the following **potential** estimates **for SHP** as realistic:

	2010	2020	2030
Electricity production [GWh]	110	270	430
Electricity production [PJ]	0.40	0.97	1.55

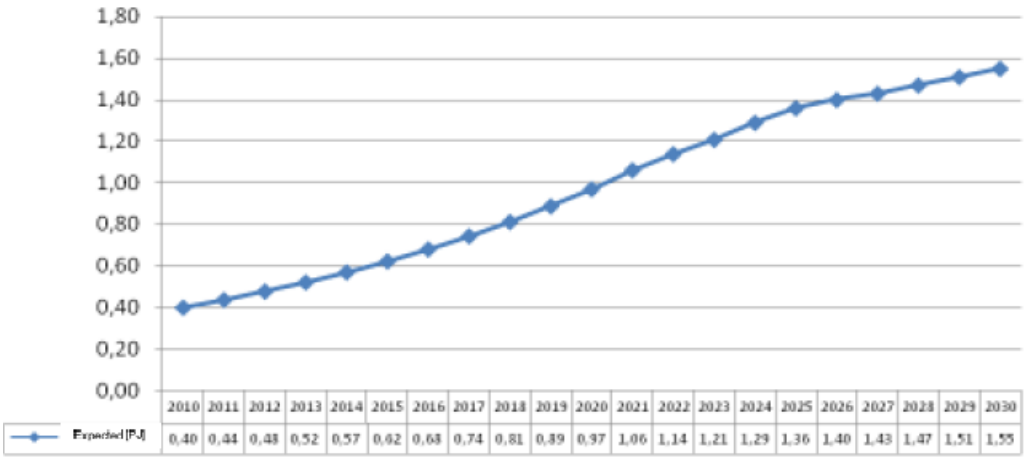


Figure 71: Growth in the exploitation of energy from SHP in HR until 2030

Source: MINGORP 2008

HR has become a **candidate country for full membership of the EU** and the Energy Community Treaty has been signed and ratified. HR has also ratified the Kyoto Protocol. In order to integrate into the Energy systems of EU and the SEE Energy market major changes will become necessary like a harmonized legislative, regulatory and institutional framework, market opening, and unbundling.[97]

- The Ministry of Economy, Labour and Entrepreneurship (Mingorp) monitors the implementation and compliance with set targets for RES and Co-Generation.
- The Energy Regulatory Agency (Hera) is responsible for granting the status of eligible producer
- The Energy Market Operator (Hrote) is responsible for the collection and distribution of incentives
- The System Operator is responsible for connecting and taking deliveries of electricity from RES and CHP.

State owned quasi monopolist HEP generates around 95% of Croatia's power and is also responsible for the grid. HR intends to restructure and privatize the energy group.

HR aims to diversify its energy sector also encouraging RES E.

HR has set itself a mandatory target of 20% share in RES in the final energy consumption by 2020 and a 35% share of electricity generation from RES including LHP by 2020 in the overall electricity generation. [97]
The Ordinance on Fees for Incentivizing Electricity Production from Renewable Energy Sources and Co-Generation (Official Gazette 33/2007) is the legal framework dealing with RES.

HR **promotes RES** with

- a favourable feed-in tariff scheme for 12 years guaranteed period together with
- interest-free loans and capital grants for eligible producers. [94]

Table 58: Feed-in Tariff System for RES Plants ≤ 1MW in HR

Group	Type of plant	C for 2007 (kn/kWh)	Consumer Price Index for 2007 XII 2007/XII 2006	C for 2008 (kn/kWh)	Consumer Price Index for 2008 XII 2008/XII 2007	C for 2009 (kn/kWh)
Plants with installed capacity ≤ 1 MW						
1.a.1.	solar power plants with installed capacity up to and including 10 kW	3,40	105,8	3,5972	102,9	3,7015
1.a.2.	solar power plants with installed capacity exceeding 10 kW up to and including 30 kW	3,00	105,8	3,1740	102,9	3,2660
1.a.3.	solar power plants with installed capacity exceeding 30 kW	2,10	105,8	2,2218	102,9	2,2862
1.b.	hydro power plants	0,69	105,8	0,7300	102,9	0,7512
1.c.	wind power plants	0,64	105,8	0,6771	102,9	0,6967
1.d.1.	solid biomass from forestry and agriculture	1,20	105,8	1,2696	102,9	1,3064
1.d.2.	solid biomass from wood-processing industry	0,95	105,8	1,0051	102,9	1,0342
1.e.	geothermal power plants	1,26	105,8	1,3331	102,9	1,3718
1.f.	biogas power plants from agricultural plants and organic remains and waste from agriculture and food processing industry	1,20	105,8	1,2696	102,9	1,3064
1.g.	liquid biofuel power plants	0,36	105,8	0,3809	102,9	0,3919
1.h.	water gas power plants and power plants using gas from water treatment plants	0,36	105,8	0,3809	102,9	0,3919
1.i.	power plants using other renewable energy sources	0,60	105,8	0,6348	102,9	0,6532

C - The amount of the tariff item (Article 4, paragraph (1) of the Tariff System for the production of electricity from renewable energy sources and cogeneration) corrected for every year according to Article 5, paragraph (1)

Source: Hrote in: http://www.hrote.hr/hrote/en/Renewables/RES_up_to_incl_1_MW.pdf

Table 59: Feed-in Tariff System for RES Plants > 1MW in HR

Group	Type of plant	C for 2007 (kn/kWh)	Consumer Price Index for 2007 XII 2007/XII 2006	C for 2008 (kn/kWh)	Consumer Price Index for 2008 XII 2008/XII 2007	C for 2009 (kn/kWh)
Plants with installed capacity > 1 MW						
2.a.	hydro power plants (≤10 MW) with electricity up to and including 5000 MWh produced in the calendar year	0,69	105,8	0,7300	102,9	0,7512
	hydro power plants (≤10 MW) with electricity exceeding 5000 MWh up to and including 15000 MWh produced in the calendar year	0,55	105,8	0,5819	102,9	0,5988
	hydro power plants (≤10 MW) with electricity exceeding 15000 MWh produced in the calendar year	0,42	105,8	0,4444	102,9	0,4573
2.b.	wind power plants	0,65	105,8	0,6877	102,9	0,7076
2.c.1.	solid biomass from forestry and agriculture	1,04	105,8	1,1003	102,9	1,1322
2.c.2.	solid biomass from wood-processing industry	0,83	105,8	0,8781	102,9	0,9036
2.d.	geothermal power plants	1,26	105,8	1,3331	102,9	1,3718
2.e.	biogas power plants from agricultural plants and organic remains and waste from agriculture and food processing industry	1,04	105,8	1,1003	102,9	1,1322
2.f.	liquid biofuel power plants	0,36	105,8	0,3809	102,9	0,3919
2.g.	water gas power plants and power plants using gas from water treatment plants	0,36	105,8	0,3809	102,9	0,3919
2.h.	power plants using other renewable energy sources	0,50	105,8	0,5290	102,9	0,5443

C - The amount of the tariff item (Article 4, paragraph (1) of the Tariff System for the production of electricity from renewable energy sources and cogeneration) corrected for every year according to Article 5, paragraph (1)

Source: HROTE, in http://www.hrote.hr/hrote/en/Renewables/RES_up_to_incl_1_MW.pdf

Barriers for the development of SHP might lie in the still poor quality of government services in the administration and the unreliable legal system of the country. Another limiting factor might be in nature protection restrictions.

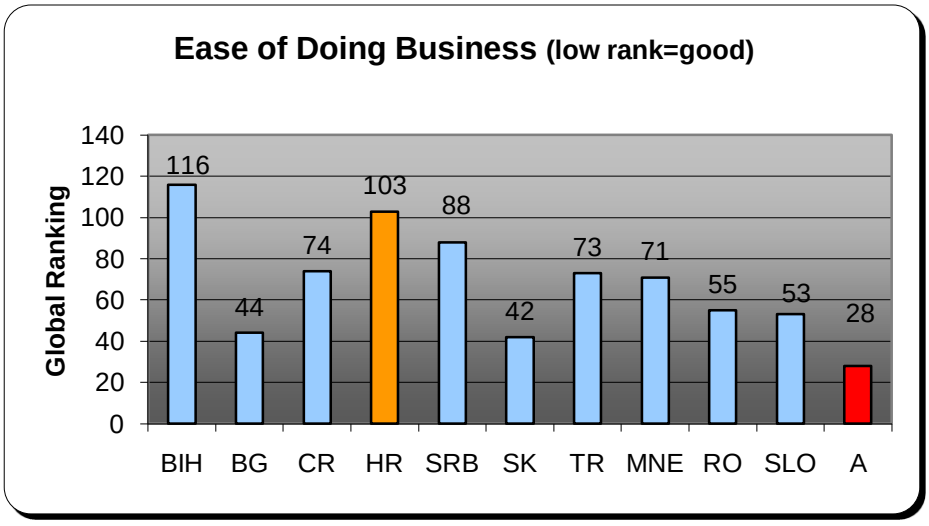


Figure 72: Ease of Doing Business in HR

Source: The World Bank Group, 2009 in

http://www.doingbusiness.org/ExploreEconomies/?economyid=13

Graph created by Kopecek, C.

HR must be regarded as one of the more difficult countries to do business with. In categories “Employing Workers” and ”Protecting Investors” it is ranked worst in the Peer Group and also “Dealing with Construction Permits” does not seem to be an easy matter. HR scores best with “Paying Taxes” and second in Peer Group in “Enforcing Contracts”.

6 Serbia

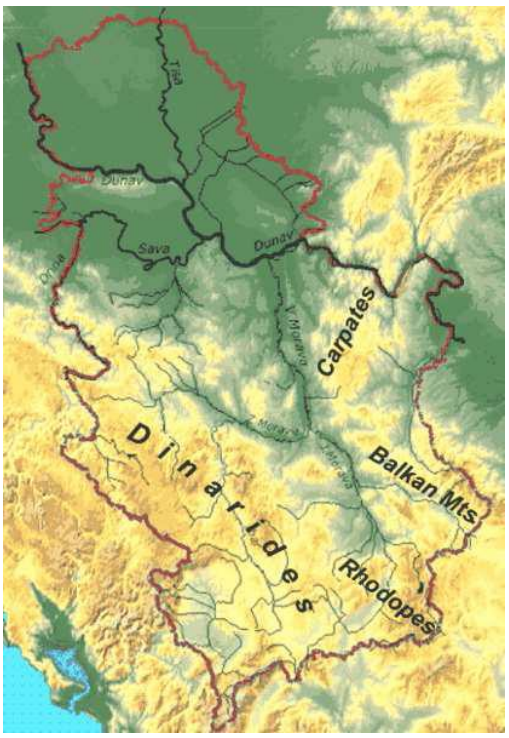


Figure 73: Map of Serbia

Source: http://en.wikipedia.org/wiki/File:Serbia_mountain_ranges.png

Serbia (SRB) is extremely depending on energy imports, although it has large own lignite resources.
Hydro and thermal power facilities are by far the most important source of energy. [98]

Serbia's energy sector is still suffering from severe damage after the Kosovo conflict in 1999. Frequent blackouts occur especially in the winter month. High priority was to restore the basic infrastructure, so little attention has been paid to renewable energy in the recent years.

Total installed power in SRB was around 8,800 MW of which thermal contributed 5.600 MW and hydropower 3,200 MW (36%), total generated power was around 31,564 GWh/p.a. [101]

In 2006 the hydro sector generated around 10,235 GWh of electricity.
The total built in capacity was 2,217 MW (without pumped storage power plants), the average age of the plants is 29 years.

New Energy Policy in SRB now wants to develop the unused RES-potential and one of the goals is to increase the share of RES in final energy consumption by 1.5-2% by 2015. [99]

A presentation of the Ministry of Mining and Energy (MME) concludes, that on mere technical aspects, neglecting economical feasibility there would be a significant potential for RES-E. Due to the large portions of arable land and forests the potential for Biomass are considerable, followed by Solar Energy and SHP.

	Potentials (Mtoe)
Biomass	2.40
SHPP	0.40
Solar	0.64
Geothermal	0.20
Wind	0.19
TOTAL	3.83

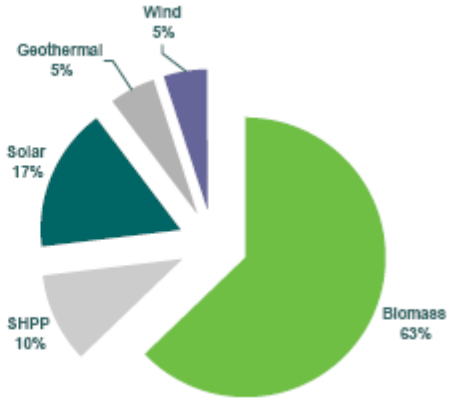


Figure 74: Share of RES Potentials in SRB

Source: Stojadinovic, Assist. Minister, Ministry of Mining and Energy, Presentation in Belgrade, May 2009

The **hydro sector** should be further developed especially on small rivers. The whole hydro sector has an estimated **potential** of 25,000 GWh/year of which 17,500 GWh/year could be regarded as technically and economically feasible.

At present SRB only has a relatively small number of SHPP and a big portion of which is out of operation.

An OSCE report concludes, that only **31 SHPP with total installed power of 34.6 MW** and an annual production of **150 GWh** would be in operation, while out of operation were 38 SHPP with 8.7 MW total power and 37 GWh in annual production. Considerable opportunities exist for embedding SHPP into existing hydroelectric power facilities, which may also lower the construction and maintenance costs.[101]

The official MME reports a number of 39 plants with an installed capacity of not even 50 MW. But the MME states, that there would be more than 850 technical feasible sites available for exploitation, most of them in the MHPP category < 1MW. Due to negligence, war damages and lack of funding, many of existing sites are awaiting refurbishment.

Table 60: New SHPP Categorized in Usage Types in SRB

	Installed Capacity in kW	**Production in MWh/year**
New units from the SHP registry	**442.632**	**1.544.985**
Embedding of SHPP units into existing HE systems	**23.464**	**114.530**
SHPP at outlets for biological minimum	1.064	7.500
SHPP at water supply units	7.000	35.000
SHPP in irrigation systems	3.000	11.000
SHPP as part of the DTD system	10.400	54.030
SHPP at river basin transitions	2.000	7.000
Reconstruction of existing systems	**25.769**	**134.000**
Reconstruction of existing SHPP plants	8.769	54.000
Embedding of SHPP into wind mills	10.000	45.000
Regeneration of existing SHPP	7.000	35.000
TOTAL	**491.865**	**1.793.515**
DTD =	Danube-Tisa-Danube	
HE =	Hydro Electric	

Source: OSCE Jankovic, 2004

Below graph illustrates the variety of SHPP in Serbia.

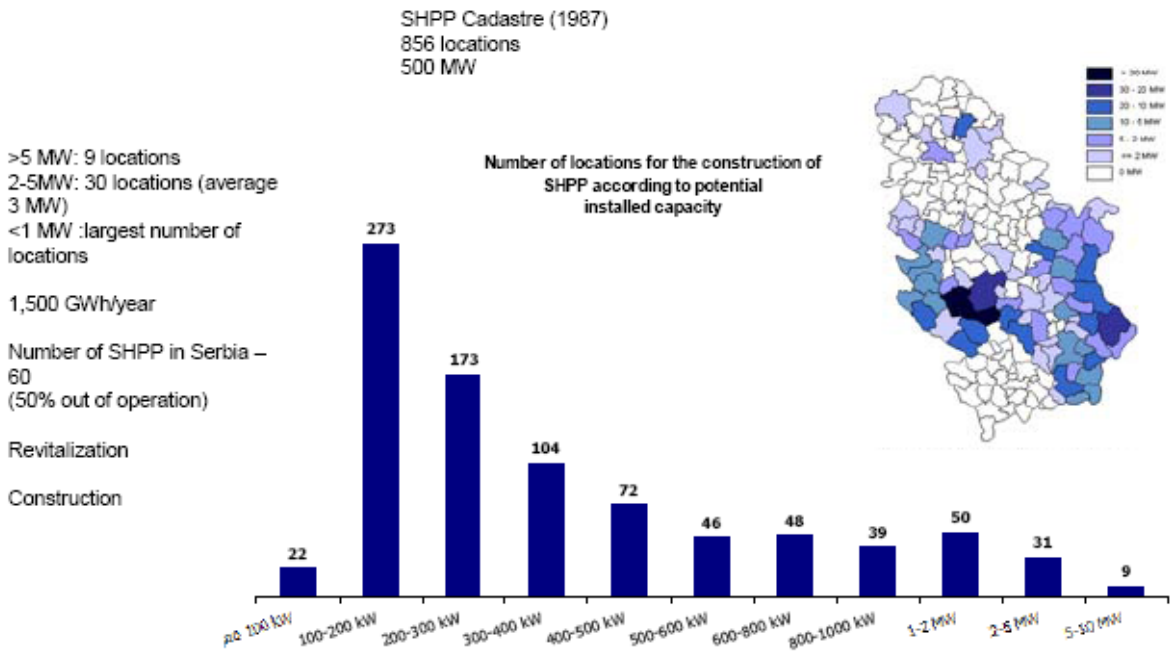


Figure 75: Number of SHP in Serbia according to potential installed capacity

Source: Stojadinovic, 2009

Another source states that the **exploited SHP potential** in SRB is only 13 MW with a corresponding generation of 45.5 GWh produced by 2 plants. [100]

The **unused potential** would be in the region of **450 MW** and **1,500 GWh** respectively and a number of around **850 plants**.

A big portion of that potential is located in the region near Užice, Niš and Kragujevac, where it can be utilized by numerous small-scale power plants with the total capacity of around 340 MW, distributed to around 700 locations. [101]

Figure 76: Precipitation Map of SRB

Source: http://www.bestcountryreports.com/Precipitation_Map_Serbia.html

Normal annual precipitation for whole SRB is around 900 mm, the rainiest regions are towards west and southwest (Pesterska visoravan and Kopaonik) with up to 1000 mm.[102]

Market liberalisation and unbundling in SRB did not take place so far, so the only market player and sole producer, distributor and buyer is state company Electroprivreda Srbije. Electricity prices to customers are kept at an extremely low level in order by the government. Prices for RES-E have to be negotiated as there is no **promotion system** in place yet. A RES promotion system is planned to be established still in 2009.
Serbia joined the SEE-Energy community which intends to open the markets in the region. A gradual liberalisation of the market will follow next.

Institutions and authorities:

- Ministry of Mining and Energy - RES Policy
- Ministry of Environment and Spatial Planning – Building standards
- Environmental Protection Fund – Finance assistance RE- and Energy Efficiency programs

The draft amendments to the **Energy Law** provide for SHPP<10MW to be privileged power producers for a period up to 12 years with guaranteed grid access. Local power distribution companies are required by law to purchase RES-E.

Feed-in tariffs will be introduced as promotion for RES investments being a guaranteed purchase price for 12 years with the aim to provide a payback of invested capital within this period and offering an internal rate of return of at least 14%. Revitalisation and re-entering into operation of old plants (out of operation > 5 years) will be promoted by a separate regime. [103]

Table 61: Draft version of New RES-E Promotion Scheme –SHP 2009 for SRB

	Installed Capacity	**Feed-in tariff in c€/kWh**
SHPP	up to 500 kW	9,70
	500kW - 2 MW	10,316-1,233*P
	> 2 MW	7,85
Existing infrastructure		5,90
Existing water storage		3,80

Source: Stojadinovic, 2009

SRB undertakes to offer various investment incentives:

- Grants between € 2.000-5.000 for each new created job for minimum investment between € 1-3 million and minimum number of created jobs is 50
- Tax holiday for maximum10 years upon minimum investment of € 6.8 million € with employing at least 100 people
- Free import of goods representing foreign investors nominated capital in case of environment protection

Water rights are issued via public tender for a duration of 30 years. There is no annual fee. [100]

There is already great interest from investors, especially from Italy, regarding SHP-projects. After introduction of the new RES-E promotion scheme a tender for sale of large SHPP (5-10MW) is expected. Italy has signed a co-operation agreement in energy matters with Serbia. [104]

Investment costs are estimated to be in the region of € 600/kW compared to € 400-500 for a lignite powered thermal plant.

Barriers are the extremely burdensome bureaucracy regarding permits and authorisations. More than 20 such documents are needed which might be a consequence of the fact, that the energy production is ruled in 14 ordinances.[104]

There are no reliable hydrological data, not enough topographical information to define the best scope of investment.[101] Generally, the lack of transparency is discouraging many investors.

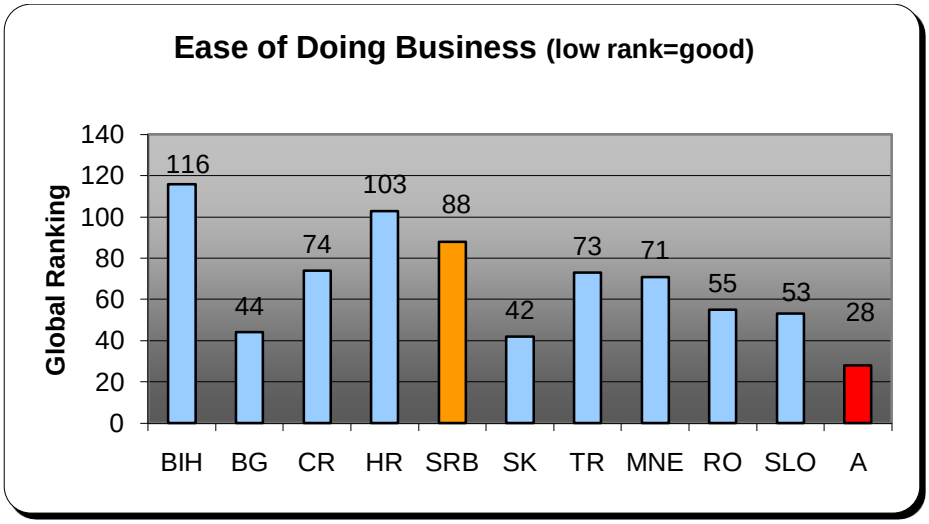


Figure 77: Ease of Doing Business in SRB

Source: The World Bank Group, 2009 in

http://www.doingbusiness.org/ExploreEconomies/?economyid=13

Graph created by Kopecek, C.

Doing business in SRB seems to be extremely cumbersome when "Dealing with Construction Permits" and also in the category "Paying Taxes". It beats all Peer Group members but equal ranked BG in the category "Getting Credit".

7 Slovakia

Figure 78: Map of Slovakia

Source: http://www.erranet.org/AboutUs/Members/Profiles/MAPS/SlovakiaMap

03/06/2009

Since the partially shutting down of the nuclear plant Bohunice, Slovakia (SK) is depending on energy imports. The supply disruptions in January 2009 due to the Gas conflict between Russia and Ukraine caused a severe energy crisis. SK is determined to improve its energy supply via promoting new technologies especially in the field of Biomass, -gas and **SHP.**

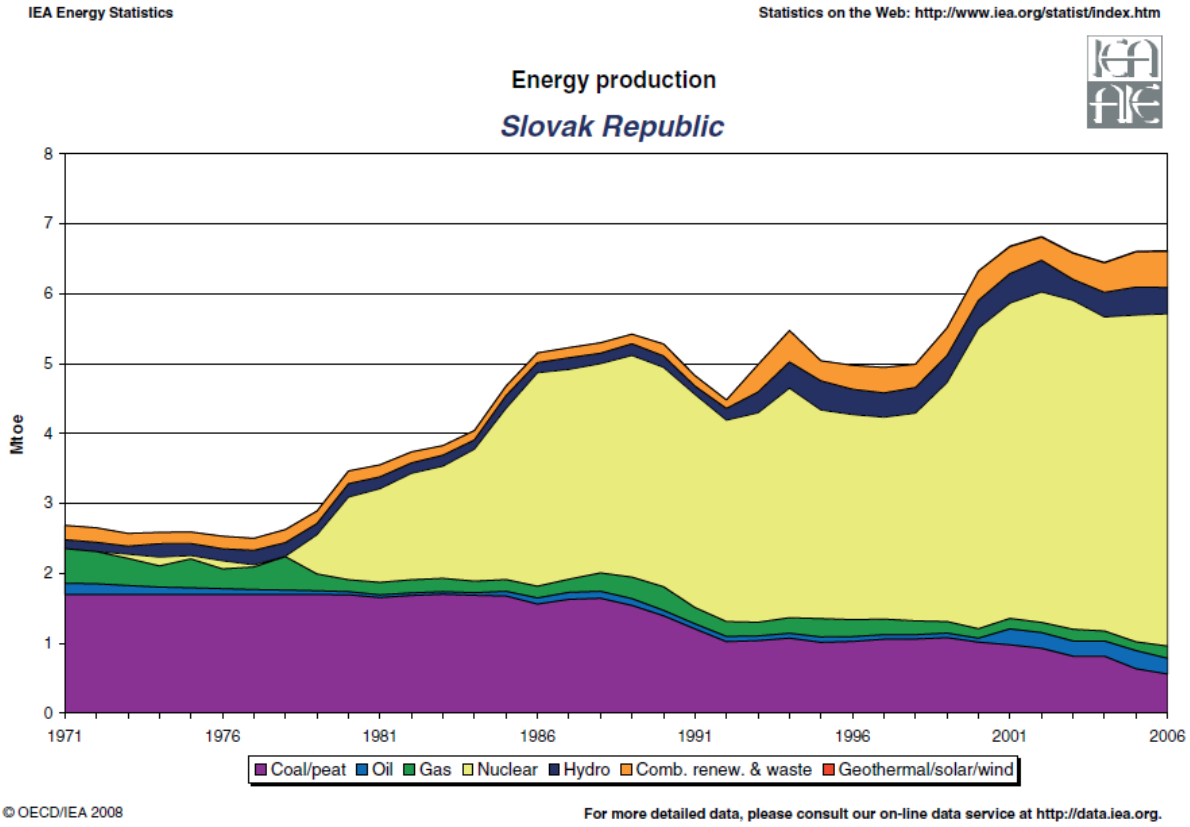


Figure 79: Energy Production in SK

Source: OECD/IEA

Nuclear power is playing an important role in SK and will become an even more important source of energy in the future thus compensating for declining thermal power generation. Also RES is in the focus of the Slovakian Energy Strategy for 2030 in order to cope with the requirements of EU.

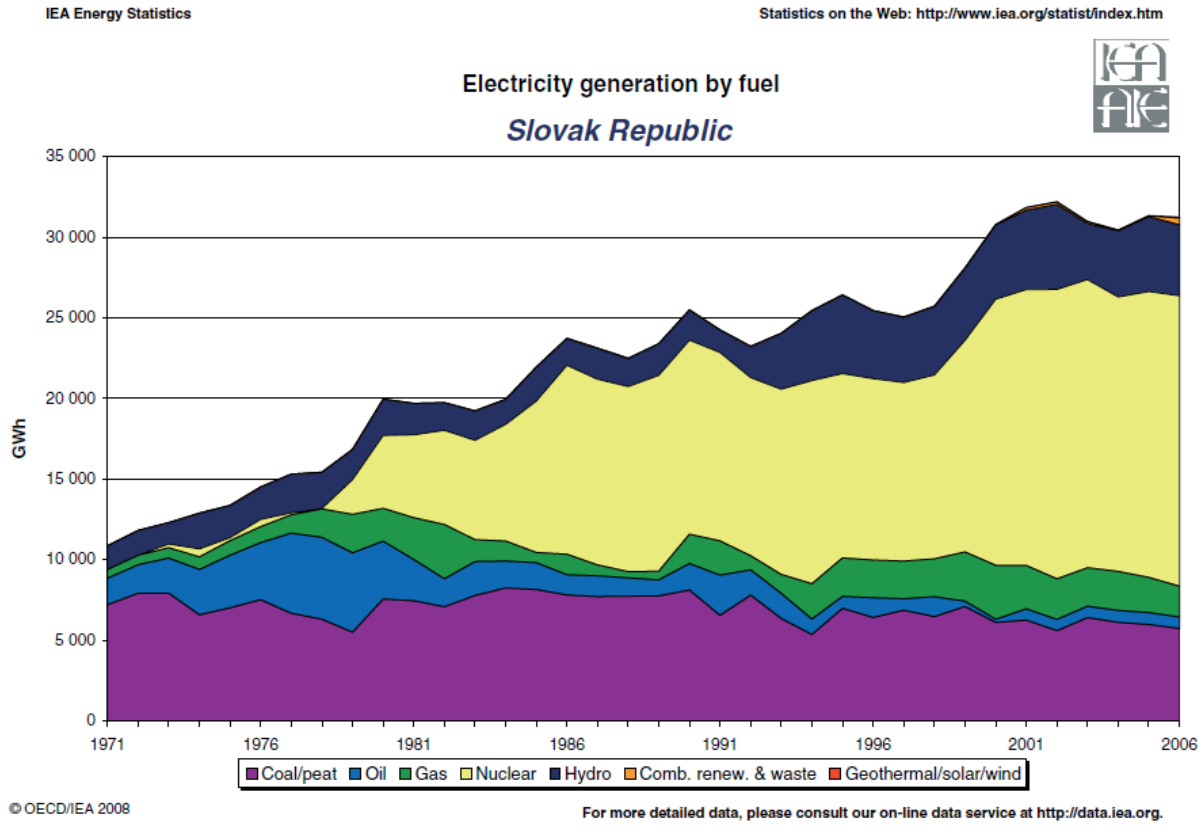


Figure 80: Electricity Generation by Fuel in SK

Source: OECD/IEA

The total electricity production in 2007 was around 26,080 GWh, the corresponding consumption was 27,581 GWh. The share of RES-E in 2006 was around 4,434 GWh (production) or 17.12% of consumption.

The **RES** contributors are Hydro (99.1%), Biomass (0.7%) and Wind (0.2%) as per 2006. The dominant hydro generation is due to the favourable topographical and climate conditions in SK. The Draft to the **New Energy Policy** in SK estimates a huge potential of 2,400 GWh for non-hydro RES-E until 2020 especially in Biomass, the large hydro potential is already utilised to a great extent.

Hydropower Plants in Operation

Electricity:	**GWh**
Hydro All Plants	4.527
of which:< 1 MW	25
1-10 MW	21
10+ MW	4.317
pumped storage	164

Source: AWO 2007

SHP has a growing importance in RES-E generation in SK. The following figure shows the exploited and unused potential of various RES. [105] Only a small fraction of the potential is used so far.

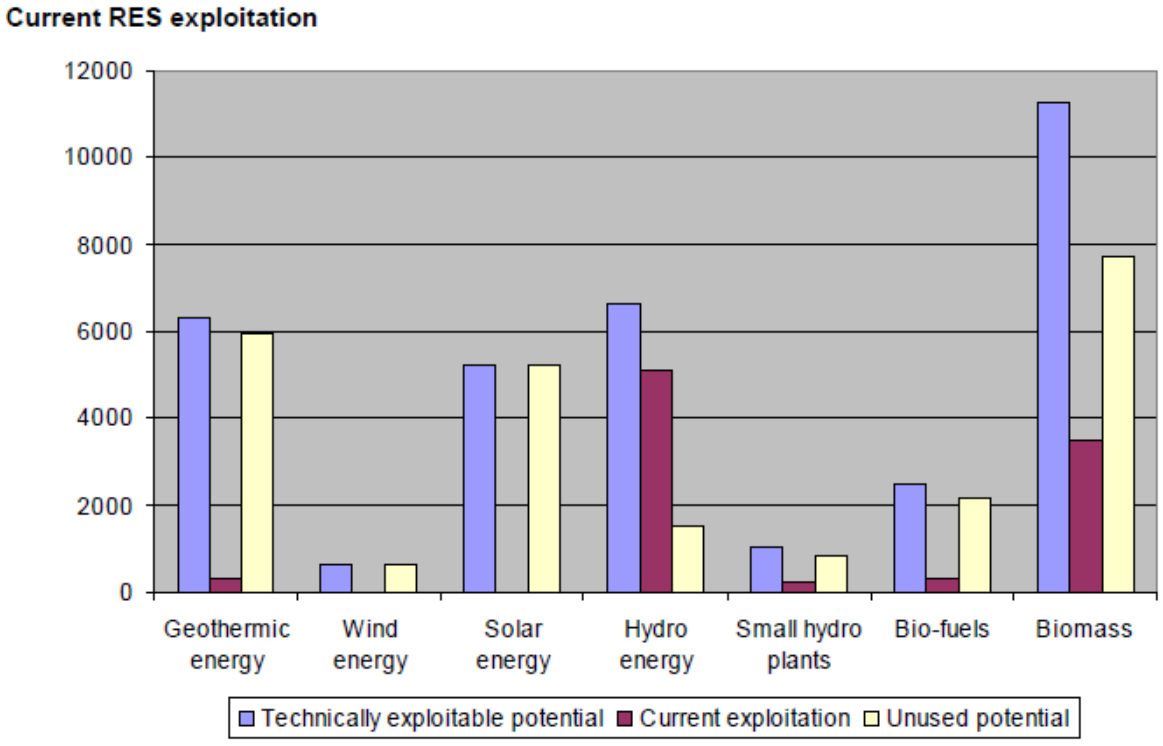


Figure 81: Technical-Current-Unused RES Potential in SK

Source: Iliaš, Igor, DI, Energy Center Bratislava, 2008

The Energy Center Bratislava states that the chances for alternative energy are especially concentrated in geothermal, solar and biomass energy. **SHP** in SK would have an **unused potential of 832 GW/h** per year.

Table 62: Potential of RES in SK

Kind of RES	Technically exploitable potential	Current exploitation	Unused potential
	GWh / year		
Geothermic energy	6300	340	5960
Wind energy	605	0	605
Solar energy	5200	7	5193
Hydro energy	6607	5093	1514
Small hydro plants (up to 10 MWe)	1034	202	832
Bio-fuels	*2500*	*330*	*2170*
Biomass	*11237*	*3523*	*7714*
Forest biomass	*1864*	*494*	*1370*
Heating plants	*1837*	*0*	*1837*
Wood processing industry	*4406*	*2638*	*1768*
Agricultural biomass	*2322*	*60*	*2262*
Waste-water treatment plants (sludge)	*230*	*13*	*217*
Waste from households	578	318	260
Total	26876	4402	22004

Source: Energy Center Bratislava, 2008

The **inventory** reported in the SHERPA 2008 survey comprises **202 SHPPs** with **an installed capacity** of around **68 MW** with approximately **255 GWh annual generation**. Figures vary considerably because different definitions of SHP in SK. Many of them are not working properly because of technical and economic problems.[106] Slovenské Elektrárne, a.s. (SE) is the dominant power producer in SK and operates 10 SHPP.

The evolution of SHPPs shows a steady growth with ambitious figures in the forecast periods:

Table 63: Evolution and Forecast of SHP from 2003-2020 in SK

	2003	2004	2005	2006	FC 2010	FC 2015	FC 2020
Total Number of SHPP	200	200	201	202	210	220	235
Capacity MW	67	67	67	68	70	80	85
Generation GWh	250	250	250	255	260	300	320

Source: SHERPA 2008, compiled by author

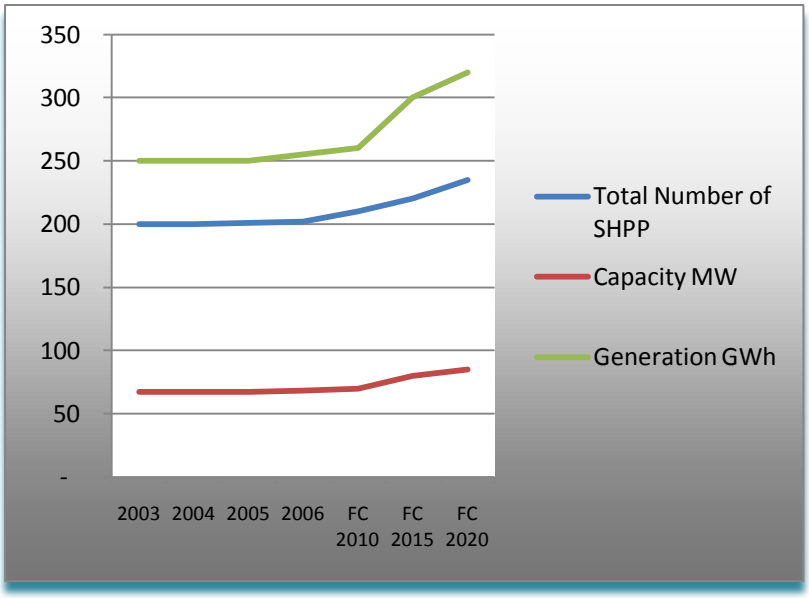


Figure 12: Evolution and Forecast of SHP from 2003-2020 in SK

Source: SHERPA 2008, graph by author

Table 64: Installed Capacities of SHP in SK

SHHP/HPP	installed capacity in MW	number of turbo sets	power generation in GWh	year of commission
Bešenová	4,64		18,030	1976
Dobšiná II	2,00	1	3,810	1994
Domaša	12,40	2	11,497	1966
Ilava	15,00	2	79,400	1946
Krompachy	0,33	1	0,737	1931
Krpelany	24,75	3	59,400	1957
Ladce	18,90	2	76,000	1936
Rakovec	0,50	1	0,633	1912
Ružín II	1,80	1	6,000	1974
Švedlár	0,09	2	0,097	1939
Trencín	16,10	2	83,400	1956
Tvrdošín	6,10	3	18,020	1979
Velké Kozmálovce	5,32	2	16,000	1988

Source: Slovenské elektrárne

in http://www.seas.sk/power-plants/hydro-power-plants-en/domasa/

Slovenské elektrárne shows in the above table SHPPs with a total of 107.9 MW and 373 GWh annual generation.

Approximately a half of the existing capacity is in private hands and has been built in the last 20-25 years.

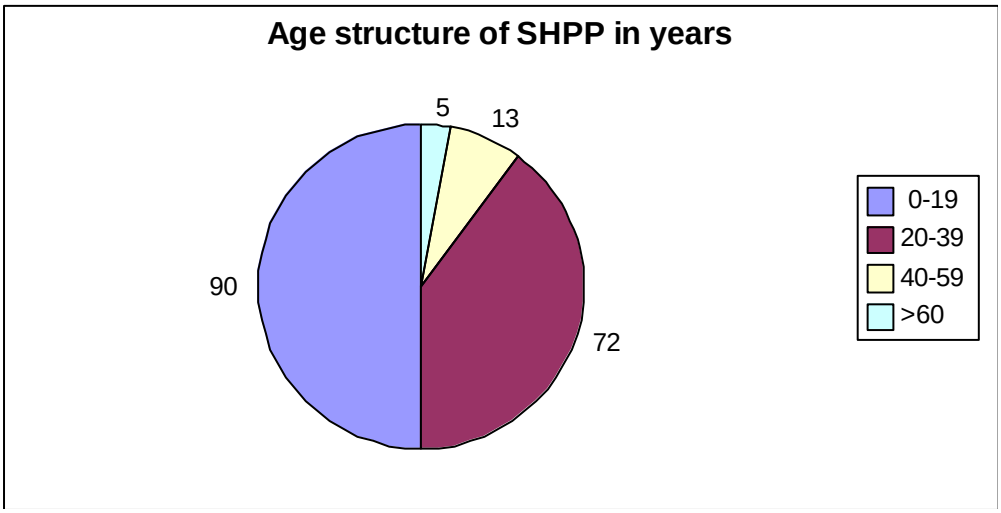


Figure 82: Age Structure of SHPP in SK

Source: TNSHP 2004

Investment cost for a new SHPP is around 2,000 €/kW with avg. production cost of 0.6-0.8 €cts/kWh. [95]

The total potential for additional hydropower is quoted with 3.4 TWh. [108]

Other sources state, that total Hydro **potential** is up to 6.6 TWh of which **SHP** is around **one TWh** and that at least 0,789 TWh of SHP potential is still unused.[105]

The recent SHERPA study quantifies a **realizable potential** for new (retrofit) SHPPs with an **installed capacity of 258 (17) MW** and an annual **generation of 965 (64) GWh.**

Table 65: Potential of SHP in SK

Potential	Generation		Capacity
	GWh/yr	%	MW
Gross theoretical	n/a	n/a	n/a
Technically feasible	1.200	n/a	n/a
Economically feasible	1.000	n/a	270
Economically feasible taking environmental constraints into account (EFEN)	965	n/a	258
EFEN for refurbishing / upgrading estimate	64		17

Source: SHERPA 2008, compiled by author

The **potential** for further **SHPP** is quantified with 250 possible locations. New capacities of 100 MW could be constructed on the Rivers Vá, Hron, Bodrog and Hornád**.**[94] But also Horný Váh and Popra have been quoted as suitable rivers for SHP. Several **SHP projects** are in a planning phase. The Energy Center mentions SHP-projects in the 1-3 MW class on Rivers Váh and Hron, 1 MW on other water courses except the river Orava.

Projects:

- Banská Bystrica – Šalková or in Bzenica. The investment cost for both projects are quoted with € 8 Mio. [108]
- SE is planning to build at least four SHPP on the Váh and Hron rivers with installed output being projected to be around 12 megawatts.
- Energo-Aqua, a.s. has drafted plans for two power plants, one on the Váh River near Trenčín for about €4.98 million and the second on the Hron River in Banská Bystrica, in the Šalková district. Costs are projected at €3.25 million
- Hydroenergia plans a small hydropower plant costing €13.28 million on the Hron River near the municipality of Želiezovce and a 2x196 kW plant on the River Nitra (SHPP Chynoriansky Mlyn) with a planned generation of 1,515 MWh.
- Velma ZH intends to construct a plant on the Hron River in the municipality of Bzenica for almost €4.647 million.

The above plants should generate over 41 MW hours of electricity per year.

The communal sector also undertakes first modest efforts to revive the SHP tradition and has one demonstration SHPP in Necpaly and plans to build additional three plants there.[106, 108]

Below figure demonstrates the concentration of hydropower on few rivers like the Rivers Váh and Hornád only.

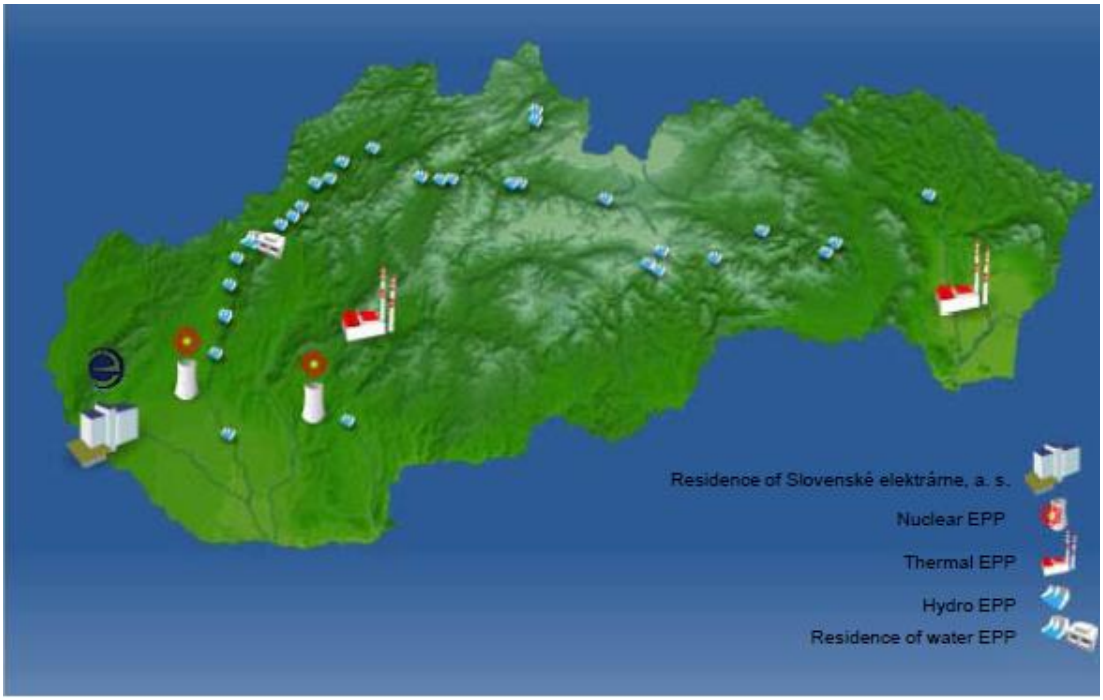


Figure 83: Location of existing Power plants in SK

Source: Slovenské Elektrárne, a.s.

The **Precipitation** shows a trend of decrease in summer and the southern central part of SK and an increase in winter up to 800 m.a.s.l. and in the mountainous northern parts of SK. [107]

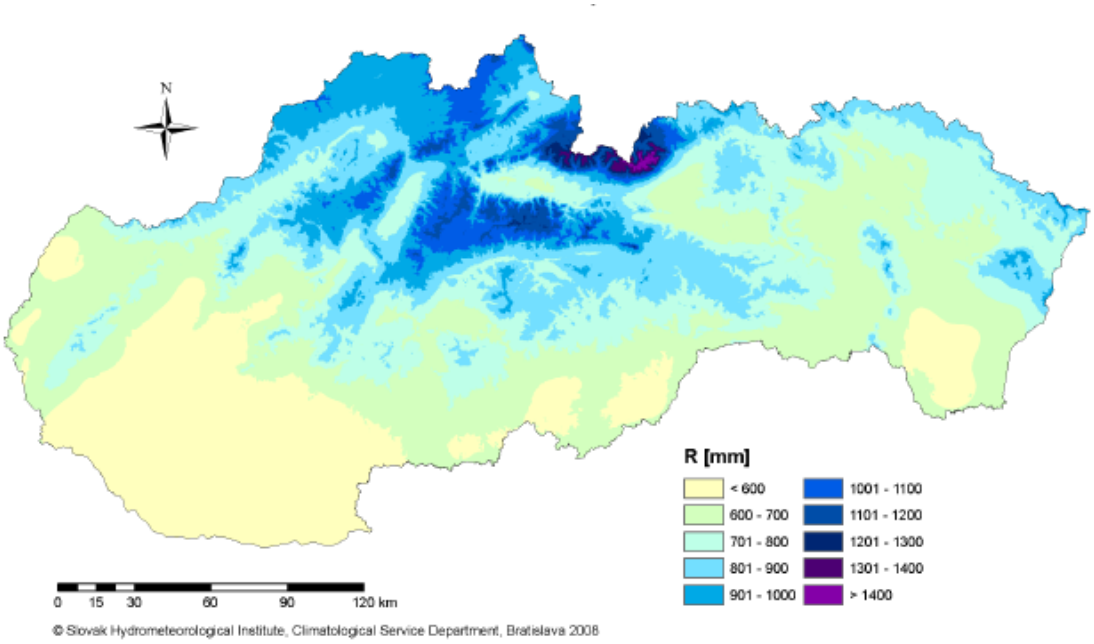


Figure 84: Annual mean Precipitation total (mm) in SK between 1988-2007

Source: Pecho, Mgr. Jozef, Slovenský hydrometeorologický ústav, 2009

The **authorities** dealing with RES-E are:

- Slovak Ministry of Economy: is responsible for policy-making in the energy sector, and bears the mandate to develop energy legislation
- Regulatory Office for Network Industries responsible for the technical and financial regulation of the energy sector
- Slovak Ministry of Construction and Regional Development
- Slovak Innovation and Energy agency
- Združenie alternatívnej energie Slovenska (Association of Alternative Energy)

The EU targets for SK are set with 14% energy generation from RES by 2020, of which 7% are achieved by now. SK promotes Biomass, Biogas and **SHP** with a supportive new legal framework.

The Act on the promotion of Renewable Energy Sources of Energy and High-Efficiency Cogeneration was introduced on September 1st 2009.[108]

Other relevant legislation is found in Act No. 70/1998 Coll. on Energy Sector and in Act No. 455/1991 Coll. on Small Businesses.

The new regulations provide a 15 years guaranteed period.[94, 108]

The **promotion system** in place offers **feed-in tariffs**.

Table 66: Promotion System in SK

SHPP	**Tariff (€cts/KWh)**
SHPP **up to 1 MW**	
SOP until 31.12.2004	8,30
SOP until 1.1.2005-31.12.2008	9,96
SOP **after 1.1.2009**	11,29
Refurbished after 1.1.2009	13,28
	-
SHPP **from 1 MW to 5 MW**	
SOP until 31.12.2004	7,47
SOP until 1.1.2005-31.12.2008	8,96
SOP **after 1.1.2009**	10,16
Refurbished after 1.1.2009	11,95

SOP=Start of Production

Source: AWO Bratislava 2009

Funding of projects can be assisted by various programs[109] like the

- EU Structural funds (-2013)
  - Investment support 2007-2013 for private companies, RES
- SLOVSEFF up to € 2 mio per project, 15% of loan amount[110]
- IFC – CEEF program support for energy efficiency and RES as 50% loans and guarantees of basic loan amount up to USD 2 Mio
- Slovak National Environmental Fund
- Bilateral Co-operations e.g.
  - Norwegian Financial Mechanism
  - European Economic Area Mechanism (EEA grants)

Barriers for SHP projects are in connection with fish protection and land acquisition[45]. **Limitations** are the ban of SHPP in the countries nine national parks and thirteen country reservations with a total area of 8,800 m² (18% of the country).[111]

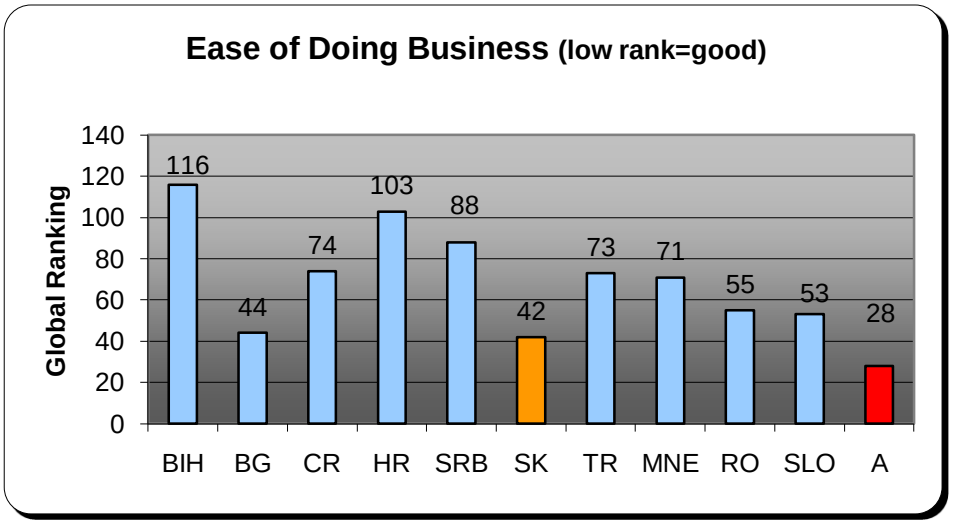


Figure 85: Ease of Doing Business in SK

Graph created by Kopecek, C.; Source: The World Bank Group, 2009 in http://www.doingbusiness.org/ExploreEconomies/?economyid=13

The World Bank Survey on "Ease of Doing Business" qualifies SK as easy country. Especially in the categories "Dealing with Construction Permits" and "Starting" and "Winding up a Business" SK beats all its competitors in the Peer Group.

8 Turkey

Figure 86: Map of Turkey

Source: http://www.dsi.gov.tr/english/pdf_files/TurkeyWaterReport.pdf

Turkey (TR) is a developing country, which through the implementation of liberal economic policies is one of the most attractive emerging markets for the investors community. TR will most likely recover as one of the first countries next year and the economic growth for 2010 is expected in the region of 3.7% again. This continuous growth of the Turkish economy implies a parallel increase of the energy consumption that triggers enormous investments in that sector.

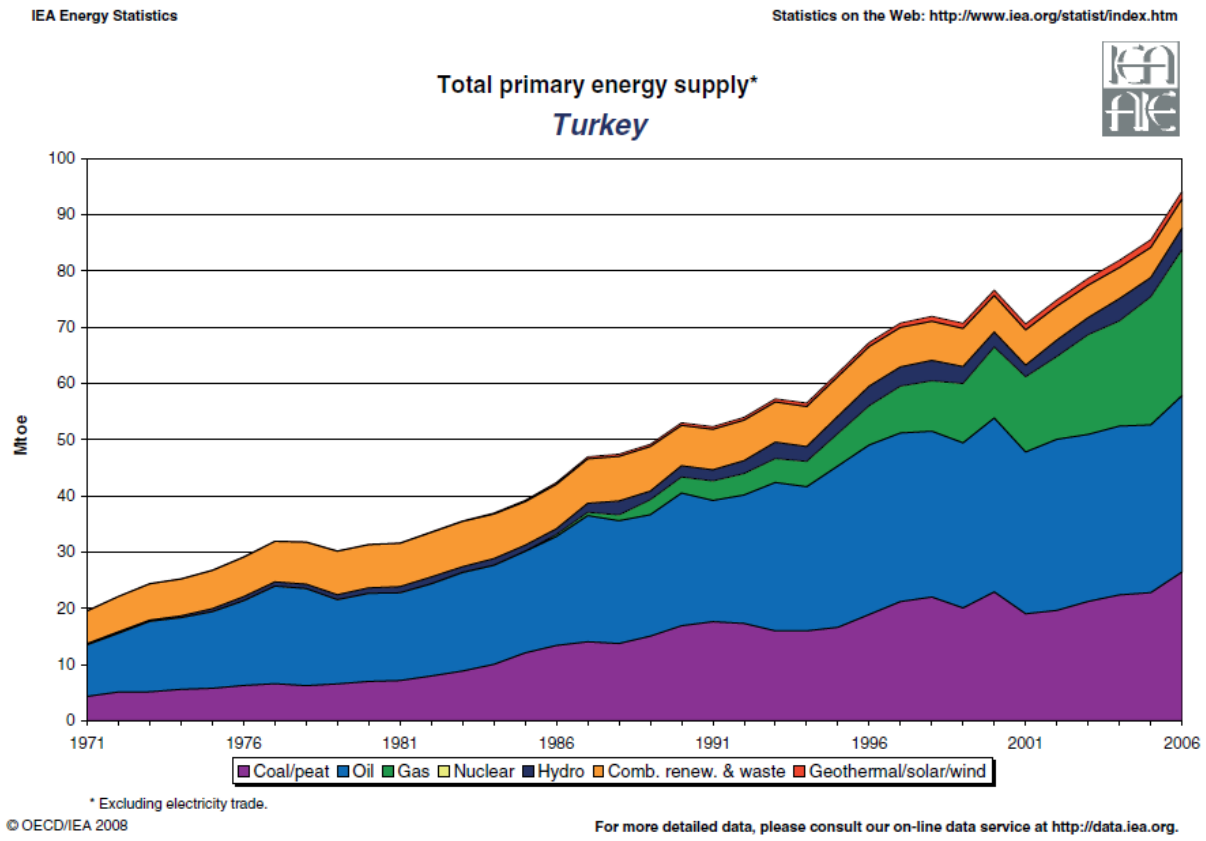


Figure 87: Total Primary Energy Supply in TR

Source: OECD/IEA 2008

Oil and gas play a dominant role and a large portion (75%) of primary energy needs to be imported in the absence of enough own fossil resources. Also biomass is extraordinary high - due to the wide spread, traditional agricultural sector – but with decreasing importance. The main biomass sources are agricultural, forestry, animal and organic wastes and are used as almost exclusively non-commercial fuels mainly in the residential sector for heating.

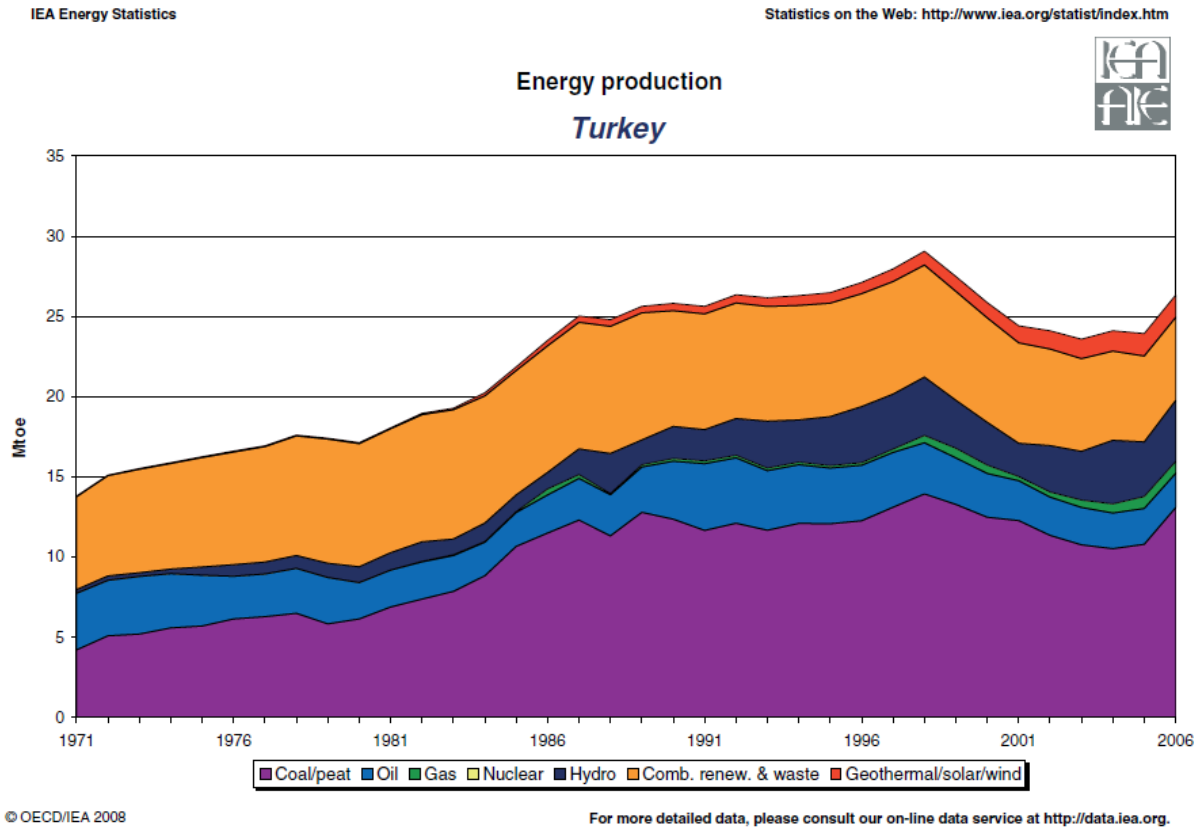


Figure 88: Energy Production in TR

Source: OECD/IEA 2008

Whilst the electricity consumption rose by approximately 8.5% annually, the installed capacity fell short by only rising 5.3% in the previous decade. After the crisis year in 2001 the increase in generation strongly went up and the forecasts from 2007-2016 show an annual growth in power generation of 8.1%.[112]

The Turkish government is dedicated to harvest its own energy sources in order to lessen dependency from oil and gas imports in future. The focus is on various RES as the country offers the whole variety with vast potentials. Hydro will play an important role in the future.[113]

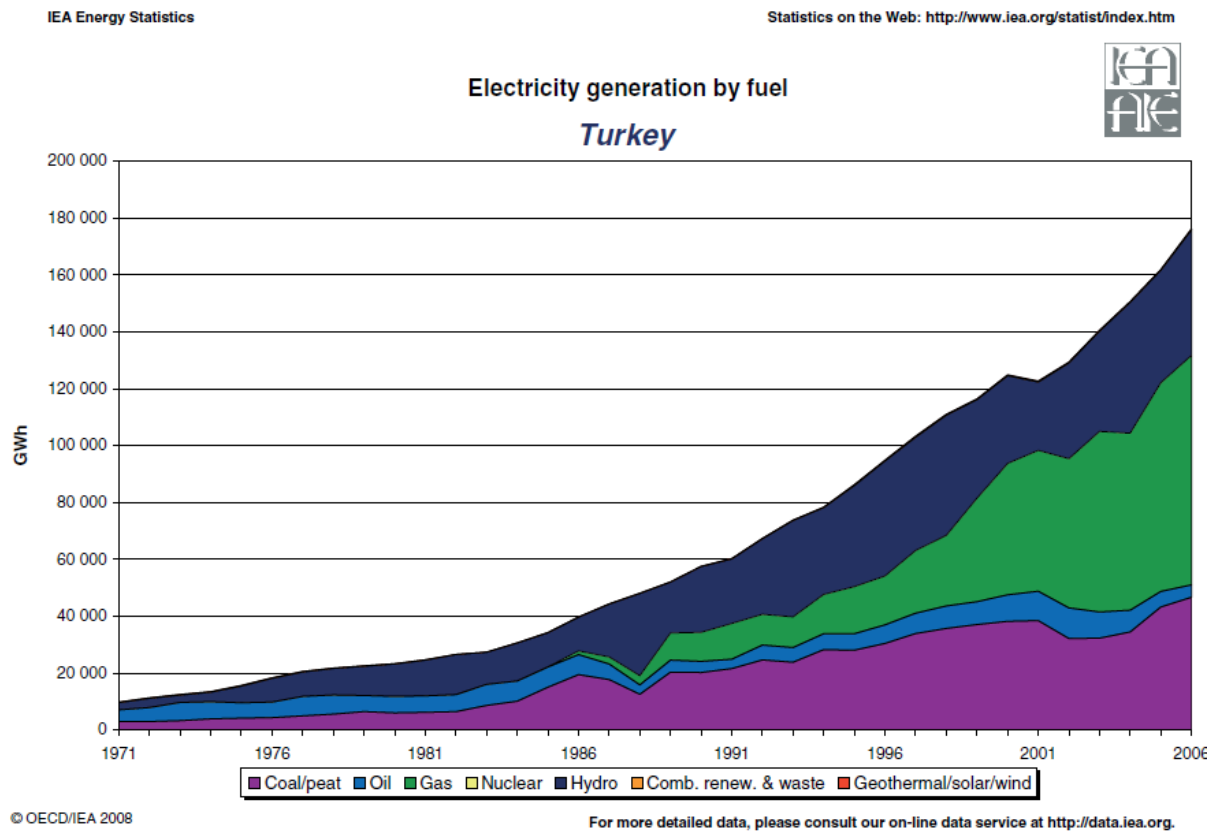


Figure 89: Electricity Generation by Fuel in TR

Source: OECD/IEA

Most of the 780.000 km² area has mountainous characteristic. Below figure shows the few humid and semi humid parts of the country in dark/green. The bright/yellow regions are semi-arid.

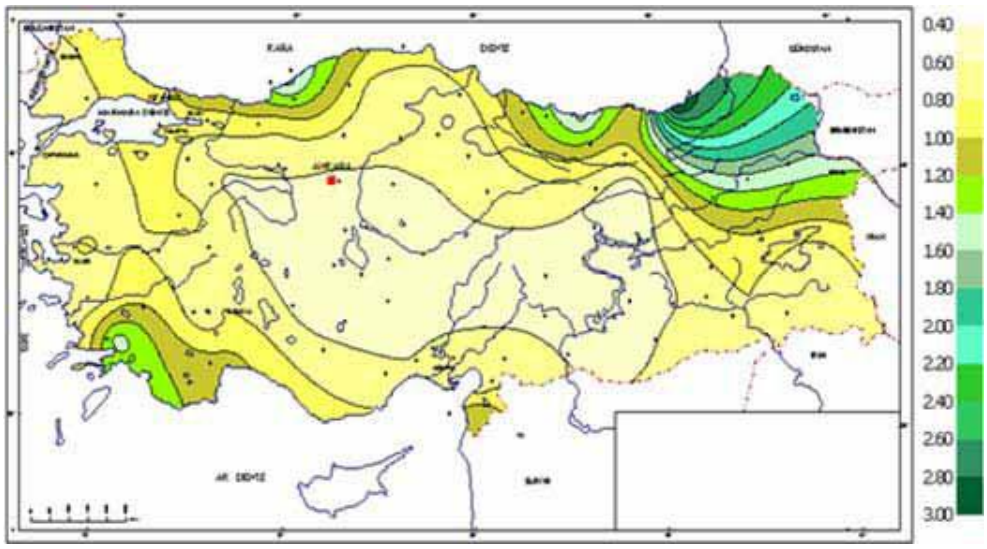


Figure 90: Aridity assessment of Turkey

Source: Adem Avni Ünal, MSc, et alt. in: Turkey Water Report 2009

In the semi-arid **climate** great variance prevails. From dry Central Anatolia with the driest regions in Lake Tuz area receiving only 250-350 mm average annual **precipitation** to the Marmara and Agean regions and the plateaus of East Anatolia with 500-1000 mm up to between 1,000 and 2,500 mm in the mountainous coastal area of north-eastern Black Sea a great variety prevails. Most rain falls between October and April, very little rain falls during summer.[114]

Figure 91: Precipitation Map of TR

Source: http://www.bestcountryreports.com/Precipitation_Map_Turkey.html

The average trend during six decades shows a decrease of around 30 mm in the observed period. This trend could continue and global climatic models project that until 2030 TR might face dry and hot climatic conditions with rainfalls further decreasing by 5-15% during summer.[114]

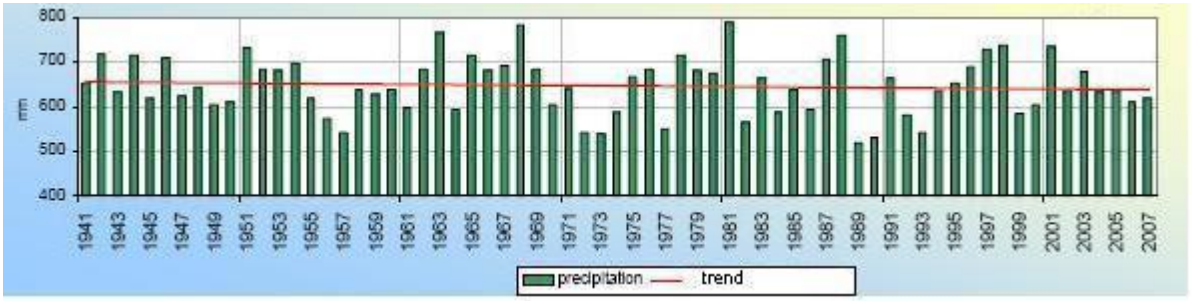


Figure 92: Trend of annual precipitation in TR

Source: Adem Avni Ünal, MSc, et alt. in: Turkey Water Report 2009

TR has only low water resources per capita compared to other parts of the world and the projections signal, that the water supply will become a sensitive issue in this country in the future. Therefore water is a political issue and TR tries to follow a sustainable water management addressing the increasing demand for domestic water supply, for agriculture and energy generation and also conservation of the environment.

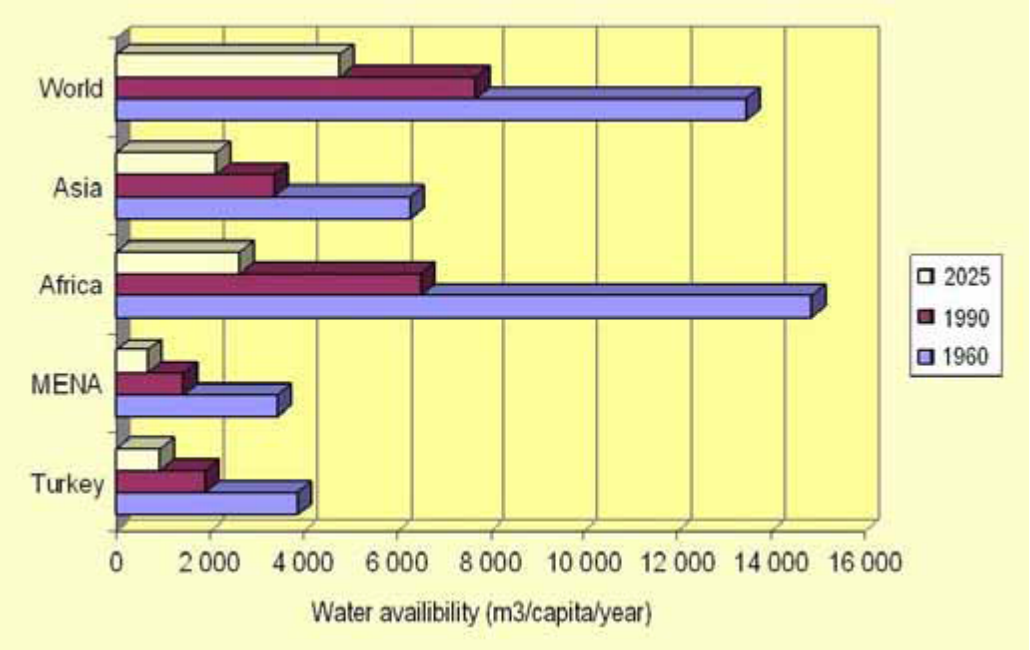


Figure 93: Water availability TR in comparison with other regions

Source: Adem Avni Ünal, MSc, et alt. in: Turkey Water Report 2009

A high portion of electricity generation comes from hydro with 34%, but SHP only generates 0.52%. The share of Hydro in the RES is around 98% thereof SHP 2%. Regarding watercourses there is also great variety in the 25 hydrological basins in TR with irregular water regimes.

Table 67: SHP Evolution and Forecast in TR

	2000	2001	2002	2003	2004	2005	2006	FC 2010	FC 2015	FC 2020
Total Number of SHPP	67	70	71	76	n/a	n/a	n/a	n/a	n/a	n/a
Capacity MW	152	201	158	157	175	175	185	250	300	350
Generation GWh	344	411	509	469	545	502	502	750	900	1.050

Source: SHERPA 2008, compiled by author

With only 185 MW installed capacity and 502 GWh generation p.a., SHP in Turkey has a comparatively low significance in relation to the size of the country and its potential but the forecasts are clearly showing an upward trend in future.

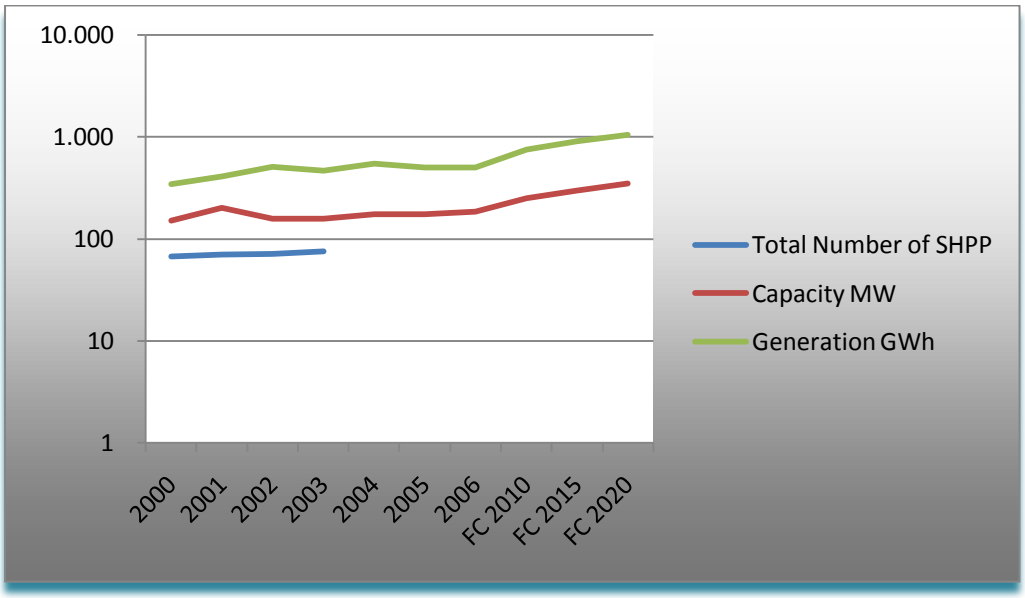


Figure 94: Number, Installed Capacity and Annual Generation of SHPP in TR

Source: SHERPA 2008, graph composed by author

Most of Turkey's SHPP are owned privately, are relatively new and have been built within the last 20-25 years. Below table shows the age structure in per cent.

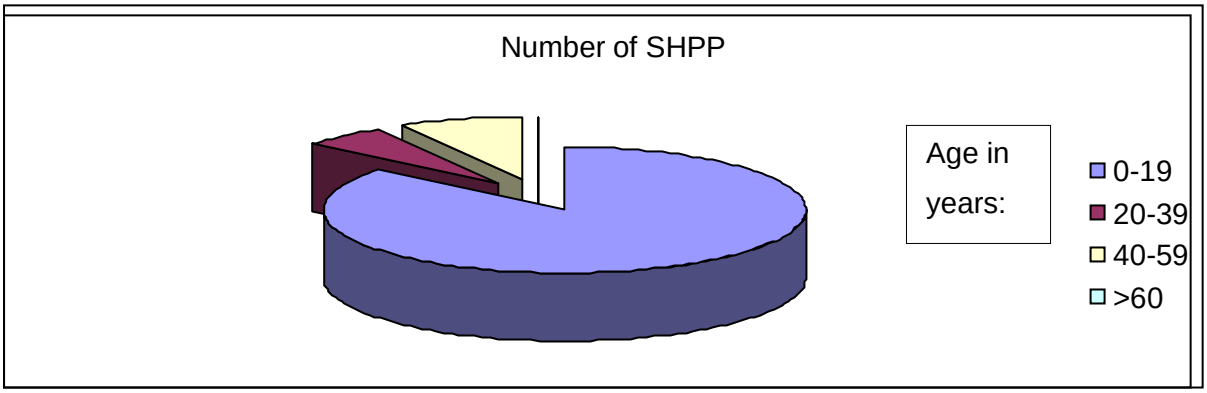


Figure 95: Age structure of SHPP in TR

Source: TNSHP 2004

TR has vast unexploited feasible SHP potentials. Even deducting environmental restriction such as prohibited damming, more than 6,500 MW capacity could be additionally installed according to estimates. This compares to installed capacities in the region of 200 MW so far.

Table 68: SHP Potential in TR

Potential	Generation		Capacity
	GWh/yr	%	MW
Gross theoretical	50.000	100	16.500
Technically feasible	30.000	60	10.000
Economically feasible	20.000	40	65.000
Economically feasible taking environmental constraints into account (EFEN)	19.520	39	6.485
EFEN for refurbishing / upgrading estimate	350		80

Source: SHERPA 2008, compiled by author

TR mostly uses SHPP with high gross head:

LH < 5m 0%
MH 5-15m 5%
HH > 15m 95%

The range of **investment cost** is between 500 – 1,100 €/kW with avg. production cost of 0.2 €cts/kWh. [95]

Environmental aspects in TR are still on a low profile and therefore not much resistance to construction of SHPPs is experienced with respect to visual impact, fishery and water regulation. However, when it comes to irrigation and compensation flow [cf], the regulations are much tougher and can lead to less power generation between 5-10% in case of cf.
Environmental impact assessments are only obligatory for plants > 10 MW

Greenfield **Investment Cost** for the most prevailing HH-SHPP (MH) are in the region of € 300-400 (350-450) €/kWh. The avg. **Production Cost** of a unit of electricity for HH (MH) is around 0.5-0.6 (0.6-0.7) €cts/kWh.

Projects are mainly financed privately. Build and Operating schemes are not very common.[45]

Institutions and Authorities

- The Ministry of Environment and Forestry is in charge with the protection of the environment and prevention of pollution
- State Planning Organisation prepares development plans

- General Directorate of the State Hydraulic Works (DSI) is responsible for the water resource management
- General Directorate of the Electrical Power Resources Survey and Development Administration is responsible for the electrical power issues
- The Bank of Provinces is responsible for urban planning, public works and drinking water supply for municipalities

Legal Frame

Reflecting its paramount importance, water-related issues are centrally planned. The water resource management is planned in 5 years programs.
In TR the definition of SHP is up to 50 MW installed capacity.
Licensing is administered by the Electric Market Regulatory Authority and granted for 20-40 years with possible renewal, Water Rights are issued by the State Hydraulic Works.

TR did not have a spatial planning nor a SHP master plan as per the TNSHP study 2004.

The Renewable Energy Law (REL) 2005 guarantees a selling price of RES-E of 9.67 Ykr/kWh (2008) with **a floor of equivalent of cts€ 5 and a cap of equivalent cts € 5.5.,** i.e. there is a floor on the currency risk of the Turkish Lira to the €. Eligible producers, who **can sell above that price to the market,** are allowed to do so. Due to the high demand, the market price is generally more attractive than the Feed-in tariff. The Feed-in tariff is valid the first **ten years** for plants that are put into operation before the 31.12.2011 with a possible prolongation period of two years.
For RES-E producers 1% of normal license fee and for the first eight years no annual license fee applies. [115]
An amendment with new SHP tariffs in the region of **cts € 7** is expected in the coming month.

Barriers:
Excessive bureaucratic administration are prohibitive to many SHP-Projects.

Annex V shows an **inventory of SHPs** in Turkey with production characteristics.

There were no special limitations or barriers observed in the TNSHP study except relatively tough competitor irrigation and relatively high compensation flow for SHP plants [45]

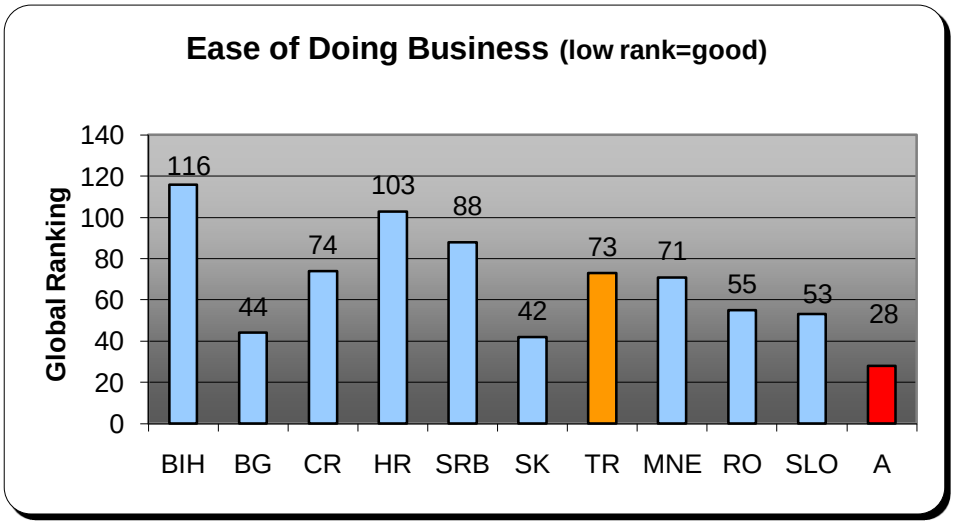


Figure 96: Ease of Doing Business in TR

Source: The World Bank Group, 2009 in

http://www.doingbusiness.org/ExploreEconomies/?economyid=13

Graph created by Kopecek, C.

Doing business in Turkey has been described as easy compared to the Peer Group regarding “Enforcing Contracts” and also regarding “Registering Property” but it bears risks in “Closing a Business”, “Employing Workers” and “Dealing with Construction Permits” .

9 Montenegro

Figure 97: Map of Montenegro

Source: http://www.travelbilder.de/montenegro/image/montenegro_karte.jpg

Since June 2006 Montenegro (MNE) is a small independent state with an area of less than 14,000 m², 85% of the country is covered with mountains.

It wishes to become a member of EU and of NATO. MNE uses the Euro as a currency.

Lignite, brown coal and hydro-energy are the main own energy sources. Oil and gas as well as electricity need to be imported.

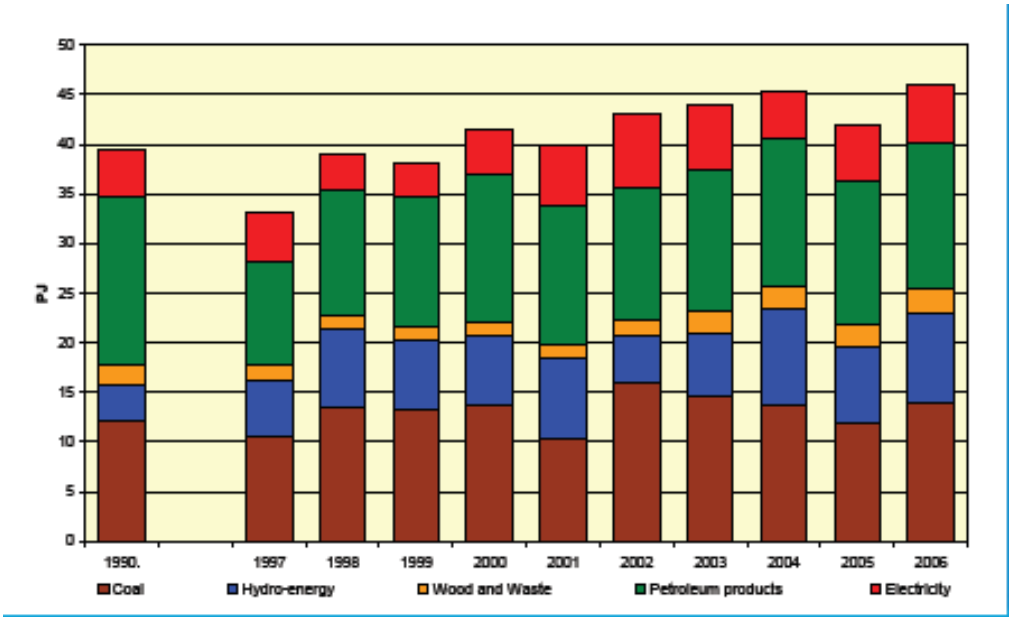


Figure 98: Total Energy Balance of MNE

Source: Ministry of Economic Development Montenegro 2009

One thermal and two large hydropower plants as well as **7 SHPP** produced around 2,600 GWh in 2007. Imports were 2,112 GWh, 712 GWh of which for the energy consumption of the Aluminium Plant in Podgorica.(KAP) [116] But not industry is responsible for the recent demand surge for electricity, it's the private households, whose consumption has doubled in the last 2 decades, benefiting from extremely subsidised power prices. The following table shows some parameters of the 10 power plants in operation for the years 2005/06:

Table 69: Installed Capacity and Power Generation in MNE

	Installed capacity		Net capacity		Average generation realised		Realised in 2005		Plan for 2006	
	MW	%	MW	%	GWh	%	GWh	%	GWh	%
7 SHPPs	**9.0**	**1.0**	**9.0**	**1.1**	**21.4**	**0.9**	**22.9**	**0.8**	**21**	**0.8**
HP (Piva and Perucica)	649.0	74.8	649.0	76.3	1 552.0	62.2	1818	66.6	1673	60.5
TPP (Plevlja)	210.0	24.2	193.0	22.7	922.0	36.9	890	32.5	1073	38.7
Total production	868.0	100	851.0	100	2495.4	100	2730.9	100	2 767	100

Source: GEF 2007 in http://gefonline.org/projectDetailsSQL.cfm?projID=3256

The seven SHPP are mostly aged and far away from their potential output.

Table 70: Age Structure of SHPP in MNE

Age	0-19 Year	20-39 Year	40-59 Year	>60 Year	Total
Number of SHPP	2	1	3	1	**7**
Share of SHPP in %	29	14	43	14	**100**

Source: GEF in http://gefonline.org/projectDetailsSQL.cfm?projID=3256

Since more than 10 years there was no refurbishment done on those plants and according to EPCG the production cost from those sites would be approximately € 6.5 cents/kWh. Government wants to sell all SHPP but has to agree on a tariff for SHP first.[117]

The energy sector needs urgent restructuring and investment. The **Energy Development Strategy** ex 2007 defines the main investment needs up to 2025 and includes the promotion of RES.

In a so-called "Moderate Construction Scenario" following new power plants are planned:

Table 71: Construction Plan New SHPP

Operational in	Installed Power in MW	Investment in Mio €
2010	20	30
2015	30	45
2020	20	30
2025	10	15
	80	**120**

Source: Ministry of Economy, MNE, 2008

Another **€ 4 Mio. investment** will be needed for rehabilitation of SHPPs.
MNE is actively searching for investors and is prepared to consider all sort of models of participations and project finance.

The SHERPA 2008 study expects a not as dramatically growth than the Government but still is expects a high future realization of SHP projects:

Table 72: SHP Evolution and Forecast in MNE

	2000	2001	2002	2003	2004	2005	2006	FC 2010	FC 2015	FC 2020
Total Number of SHPP	7	7	7	7	7	7	7	9	14	n/a
Capacity MW	9	9	9	9	9	9	9	14	20	25
Generation GWh	18	15	16	17	24	23	19	35	60	75

Source: SHERPA 2008, compiled by author

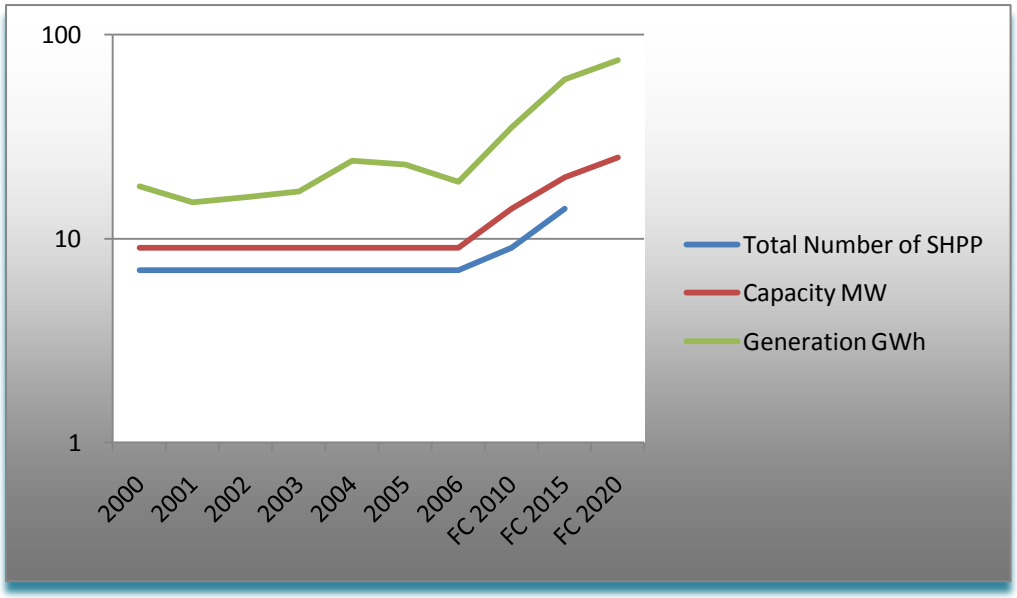


Figure 13: SHP Evolution and Forecast in MNE

Source: SHERPA 2008, graph by Kopecek, C.

The **Legal Framework** for RES is fragmented. There are currently no firm targets nor transparent support mechanism. The secondary legislation is missing and the institutional capacities for promoting the use of RES are insufficient.

Privatisation of the Energy sector was already on the government agenda in 2005 but the tender process was put on hold at that time.

In 2008 the government has resolved, that 55% of the loss making state energy group (EPCG) have to remain in state ownership and MNE is now searching for a strategic partner who wants to invest in its energy sector.

MNE only produces 30% of its electricity consumption and is depending on imports. The energy intensive Aluminium Podgorica and the Steel plant Niksic have special discounts on their power contracts. Nevertheless, **80 % of the hydro potential is unexploited**, mostly on smaller watercourses suitable for SHP.[118]

Theoretical potential on the main watercourses is estimated to be in the region of **9,846 GWh**, of which only 1,800 GWh are exploited at present.
Although a part of scenic Tara River is a protected as a UNESCO World natural heritage, many small watercourses could theoretically contribute between 800 GWh and 1,000 GWh, 40% of which through SHPP.

According to a study from the year 2000 which identified 70 locations for **SHP with a total capacity of 232 MW or 644 GWh** generation per year, in theory SHP could close the future gap between electricity demand and own production. But it can be assumed, that not all sites are technically, economically and environmentally feasible so in a second step a more detailed survey is needed. [117]

Table 73: SHP Potential in MNE

Potential	Generation		Capacity
	GWh/yr	%	MW
Gross theoretical	n/a		n/a
Technically feasible	n/a		n/a
Economically feasible	n/a		n/a
Economically feasible taking environmental constraints into account (EFEN)	600		220
EFEN for refurbishing / upgrading estimate	6		2

Source: SHERPA Strategic Study short version 2008, compiled by Kopecek, C.

A 3 year lasting GEF (Global Environment Facility) financed project has the goal to expand the installed capacity of SHP by 15-20 MW until the end of the project in 2011 (instead of 2015 as declared in their strategy).

The government recently **tendered SHP Projects** in 43 different areas as shown in the map below:

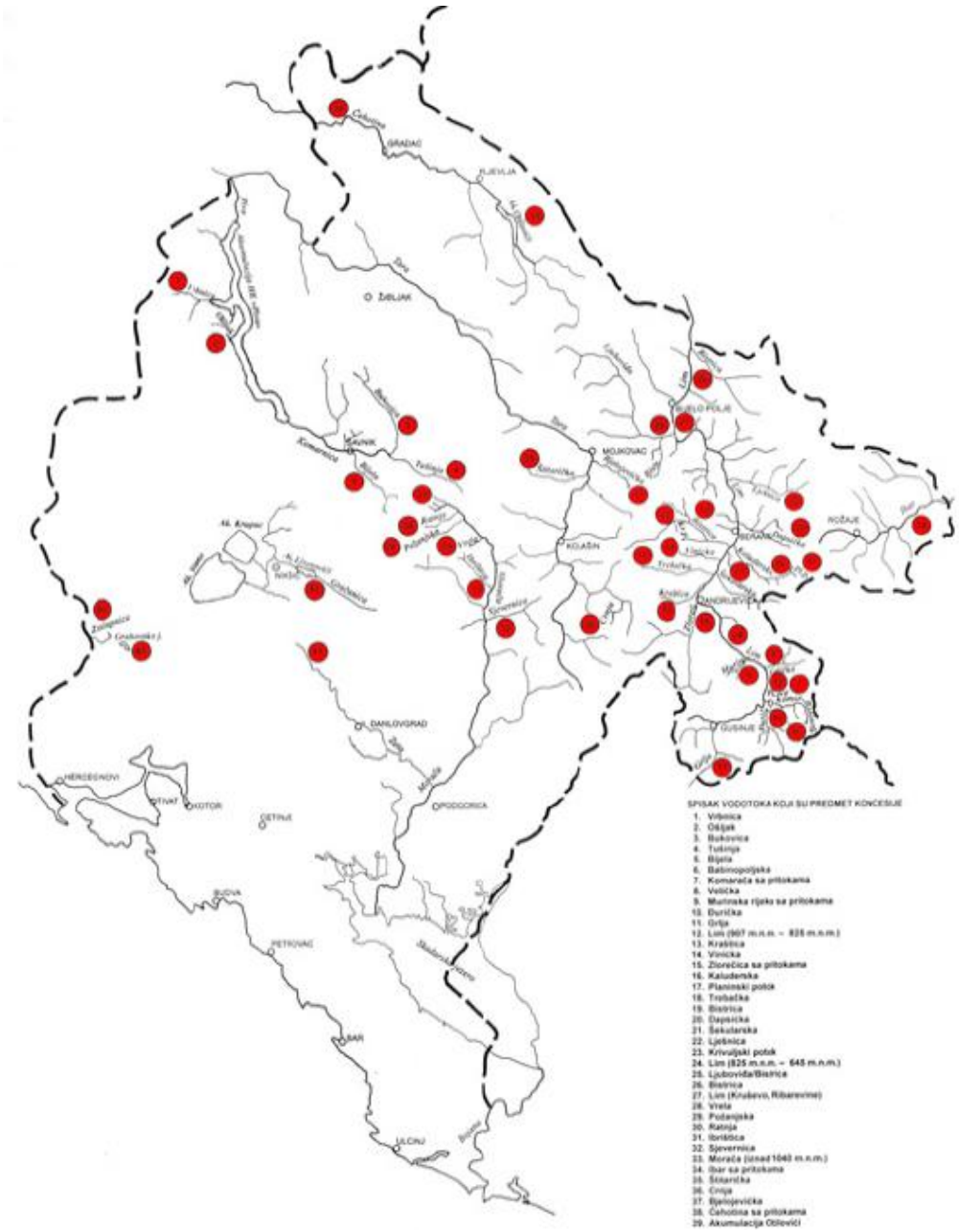


Figure 99: Originally Tendered Projects in MNE

Source: UNDP SHP Development in MNE Project

http://fei.rec.org/presentations/3.5_Boskovic_Small_Hydro_in_Montenegro.pdf

After a response of 140 potential investors, the tender commission proposed to cut back the scope of the **tender to 8 regions and 8 interested companies**. The guaranteed power purchase price is quoted with €cent 6.7 per kW/h[104]

	Concession for River	Concession Holder
1	Lim-opština Plav	Kroling DOO - Danilovgrad
2	Lim-opština Plav	Energie Zotter Bau GmbH & Co KG-Judenburg
3	Lim-opština Berane i Andrijevica	Hidroenergija Montenegro DOO - Berane
4	Lim-opština Berane i Andrijevica	Hidroenergija Montenegro DOO - Berane
5	Lim-opština Bijelo Polje	Haider Extrem Energy- Sarajevo
6	Tara-opština Kolašin	Dekar DOO - Podgorica
7	Tara-opština Mojkovac	Haider Extrem Energy - Sarajevo
8	Zaslapnica	Bast DOO - Nikšić.

Figure 100: Issued Concessions for SHP-Projects in MNE

Source: http://fei.rec.org/presentations/3.5_Boskovic_Small_Hydro_in_Montenegro.pdf

In an invitation to the investors community to give concessions for construction of SHPP the following details of water stream and catchment were given by the government:

Ref. No.	Water Stream	Catchment	Q_{sr} [m^3/s]	P [MW]	E [GWh]
1	Vrbnica	Piva	1,31	2,8	12,7
2	Bukovica	Komarnica	1,85	3,2	14,2
3	Tušina		1,14	0,5	2,5
4	Bijela		1,54	1,4	5,4
5	Trepačka	Lim (Berane)	0,76	2,9	12,1
6	Kraštica		0,83	0,8	3,1
7	Murinska rijeka	Lim (Plav)	0,51	2,1	8,8
8	Velička rijeka		0,30	0,3	1,5
9	Komarača		2,35	2,6	10,8
10	Đurička (Trokutska)		0,54	1,4	6,0
Total				**18,0**	**77,1**

Figure 101: Details of Water Stream and Catchment for SHP Concessions in MNE

Source: Ministry of Economic Development, 2008

MNE offers extremely high precipitation which can have its maxima locally beyond 5,000 mm per year.[119]

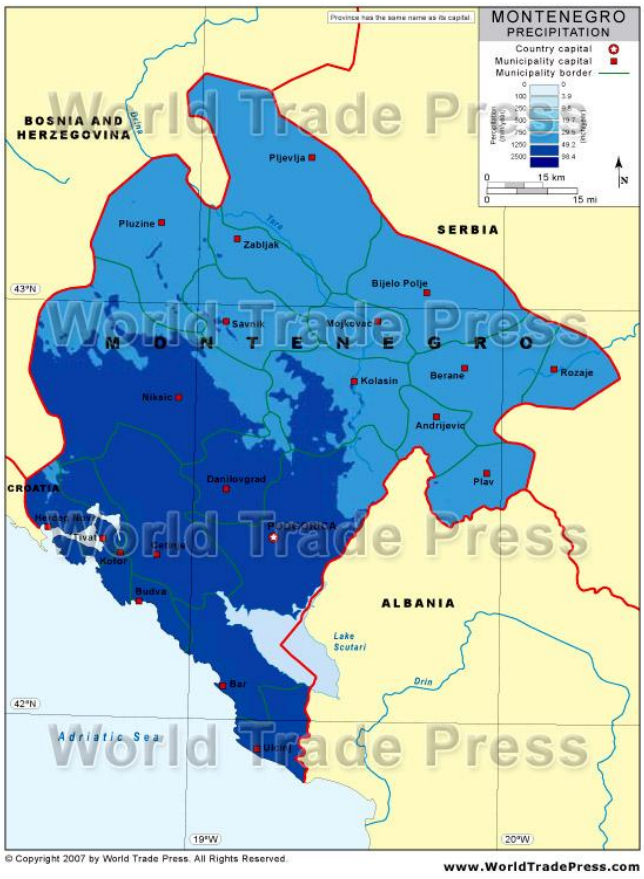
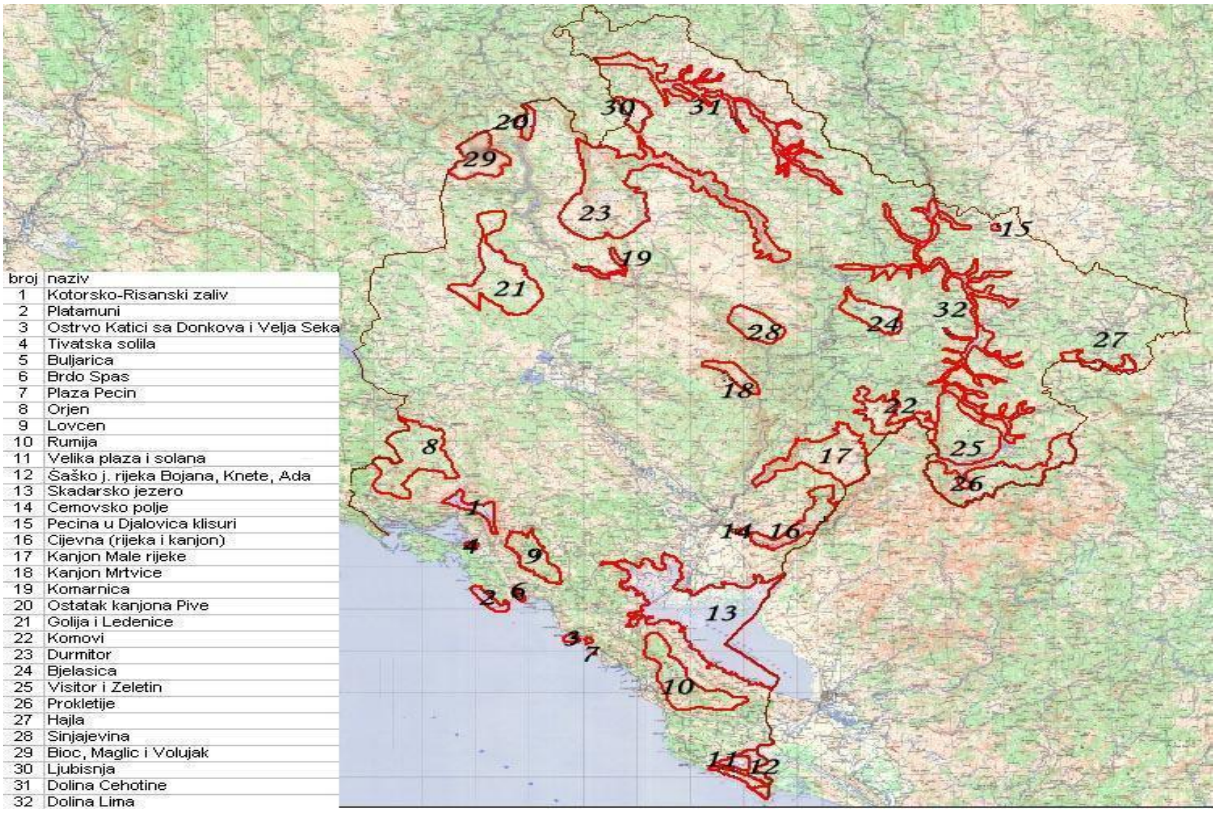


Figure 102: Precipitation Map of MNE

http://www.stockmapagency.com/Precipitation_Map_Montenegro_C-Mont-2007-Precip.php

Barriers and Limitations:

Tourism is the fastest growing sector in MNE and already contributes 15% to the GDP. With four National Parks and five Canyons, Montenegro offers precious tourist attractions. The government and also the international donor community are sensitive regarding environmental issues when it comes to use the watercourses for power production. In 2008 the national Environmental Policy has been resolved and in 2009 the National Biodiversity Strategy followed. A Project of Establishing an Emerald Network was finalized in 2008 and areas of special conservation interest are defined now. 2 more national parks and other protection zones are included in the spatial plan until 2020.[120] The construction of SHP is more accepted by the tourism industry and also by environmentalist than the construction of further large HP or Thermal plants.



broj	naziv
1	Kotorsko-Risanski zaliv
2	Platamuni
3	Ostrvo Katici sa Donkova i Velja Seka
4	Tivatska solila
5	Buljarica
6	Brdo Spas
7	Plaza Pecin
8	Orjen
9	Lovcen
10	Rumija
11	Velika plaza i solana
12	Šaško j. rijeka Bojana, Knete, Ada
13	Skadarsko jezero
14	Cemovsko polje
15	Pecina u Djalovica klisuri
16	Cijevna (rijeka i kanjon)
17	Kanjon Male rijeke
18	Kanjon Mrtvice
19	Komarnica
20	Ostatak kanjona Pive
21	Golija i Ledenice
22	Komovi
23	Durmitor
24	Bjelasica
25	Visitor i Zeletin
26	Prokletije
27	Hajla
28	Sinjajevina
29	Bioc, Maglic i Volujak
30	Ljubisnja
31	Dolina Cehotine
32	Dolina Lima

Figure 103: Protected Zones in MNE

Source: Ministry of Tourism and Environment, 2009

For **investors**, doing business in MNE has some inherent challenges. The high crime rate and corruption are still a major problem for the development of the country.

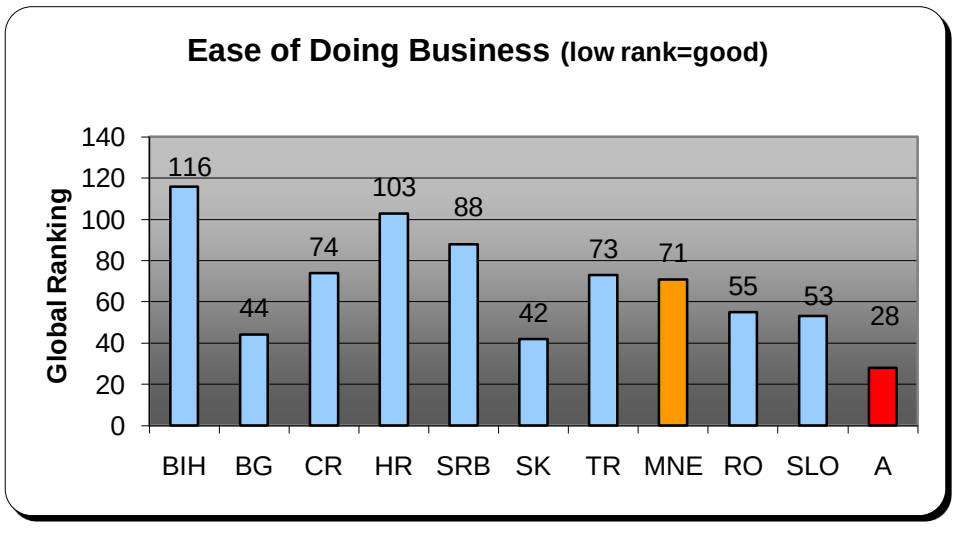


Figure 104: Ease of Doing Business in MNE

Graph created by Kopecek, C.; Source: The World Bank Group, 2009 in http://www.doingbusiness.org/ExploreEconomies/?economyid=13

MNE got its worst global ranking in the category “dealing with construction permits” and was last in the peer group in the category “enforcing contracts”.

Registering property and tax issues are other problem zones causing higher ranking. But there are also compensating factors like “Employing Workers”, “Closing a Business”-which mainly refers to bankruptcy laws and “Protecting Investors” which at the end give a good overall picture.

10 Romania

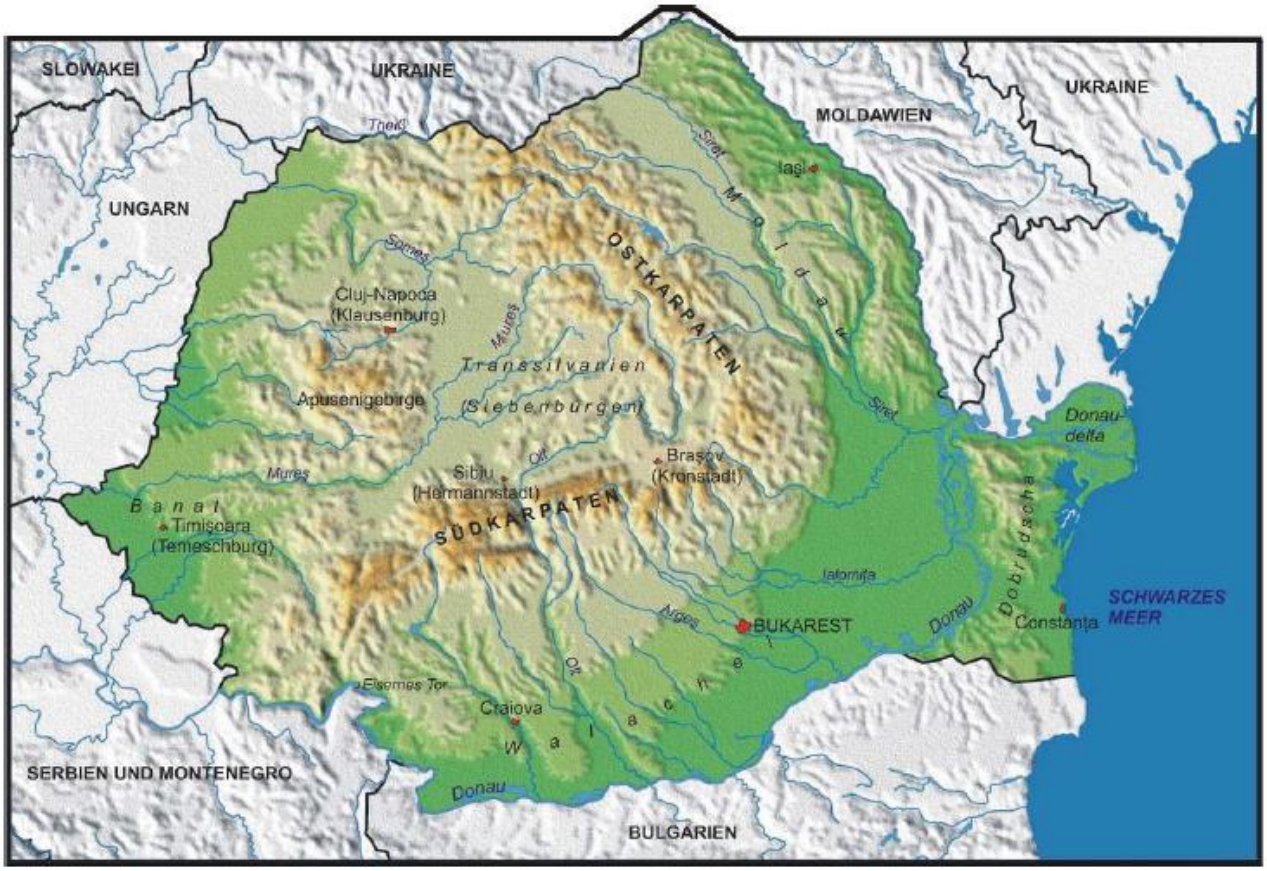


Figure 105: Map of Romania

Source: http://upload.wikimedia.org/wikipedia/commons/f/f5/ROMANIA_Fizic.jpg

Romania (RO) has a 70% energy autonomy possessing vast crude oil and natural gas reserves as well as large coal deposits. In addition, its hydroelectric potentials are enormous and 12 TWh hydro power out of a potential of 40 TWh have already been developed.[121]

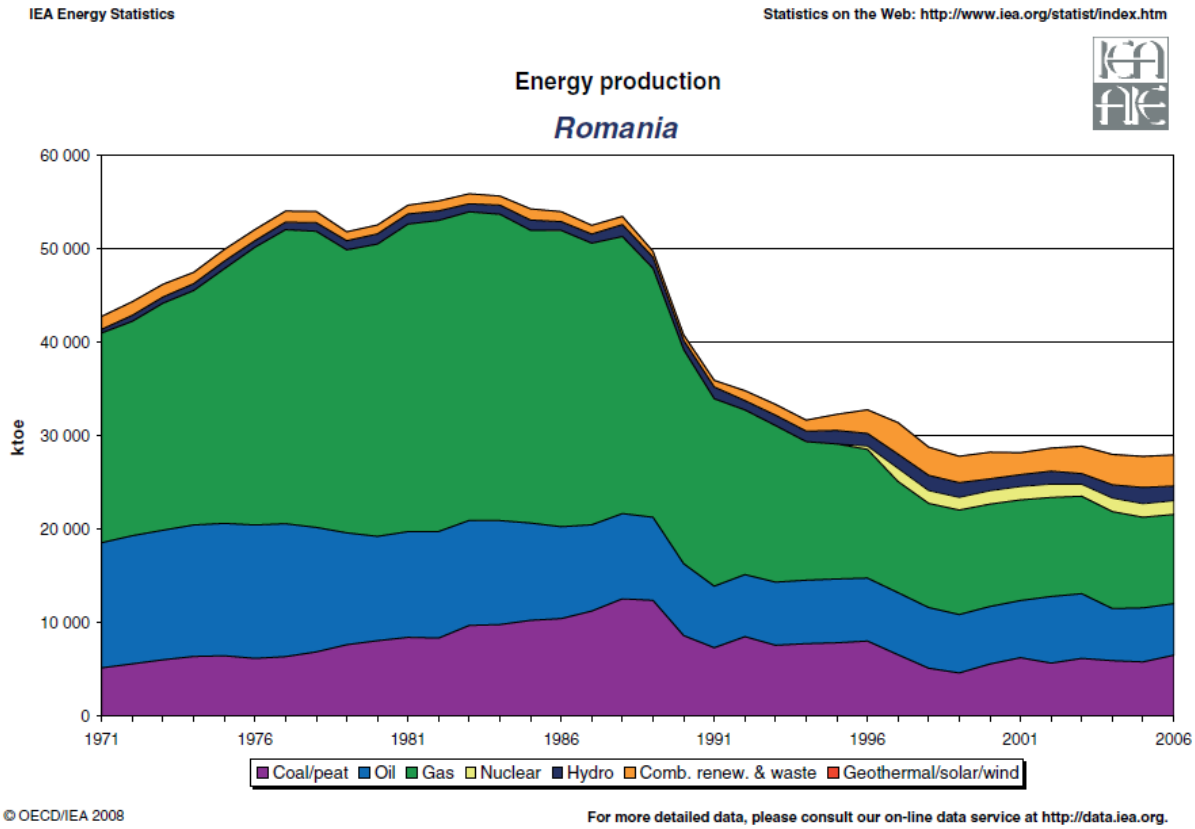


Figure 106: Energy Production in RO

Source: OECD/IEA

Since the 1990s, Electricity demand has declined leading to the decommissioning of several older thermal plants. This demand now has moved up again in the recent past reflecting the expansion of the economy. [122, 123] After the breaking up of the state power monopolist, RENEL, seven state controlled power companies are responsible for energy production, transmission and distribution. Besides there are a variety of smaller producing companies engaged in RO.

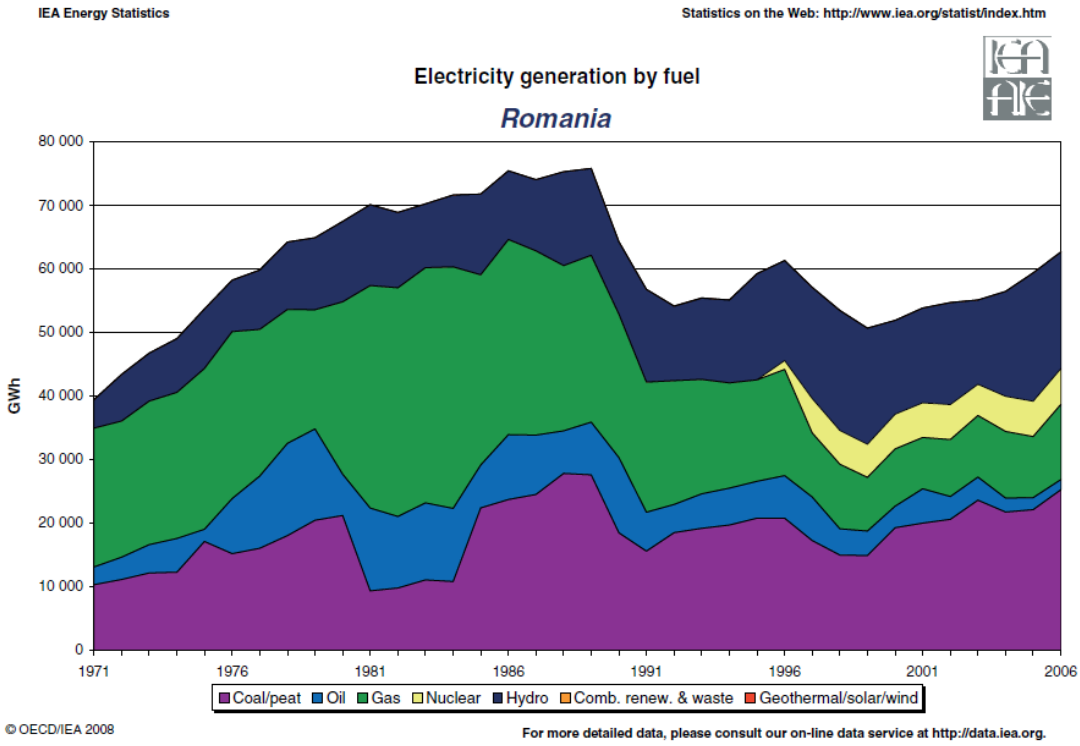


Figure 107: Electricity Generation by Fuel in RO

Source: OECD/IEA

The major share of the total electricity production (60.65 TWh) results from thermal power generation (37.66 TWh or 62.18%), followed by hydro (15.9 TWh or 26.25%) and nuclear (7.01 TWh or 11.6%) in 2007.

The EU target of the share of electricity produced by RES was 33% of the total consumption including large HP. Without LHPP the target is 8.3% by 2010.

Directive 77 provides incentives for RES-E. Most promising RES are wind, biomass and hydro. Biomass could expand to 4000 MW, wind to 3000 MW and **SHP over 2,600 MW** from around 5,000 locations.[122]

Almost 100% of Electricity produced from RES is provided by hydro power but other RES are growing fast. Hydropower is dominated by state controlled Hidroelectrica S.A. with 386 HPP and pumping stations. The total installed power was roughly 6,400 MW.

The recent SHERPA study identifies 221 SHPPs with a total installed capacity of 325 MW and a total annual generation of 693 GWh per 2006.

Table 74: SHP Evolution and Forecast in RO

	2000	2001	2002	2003	2004	2005	2006	FC 2010	FC 2015	FC 2020
Total Number of SHPP	230	233	234	244	225	226	221	280	320	350
Capacity MW	n/a	n/a	346	348	319	325	325	400	420	450
Generation GWh	n/a	n/a	436	470	774	752	693	900	1.000	1.100

Source: SHERPA 2008, compiled by author

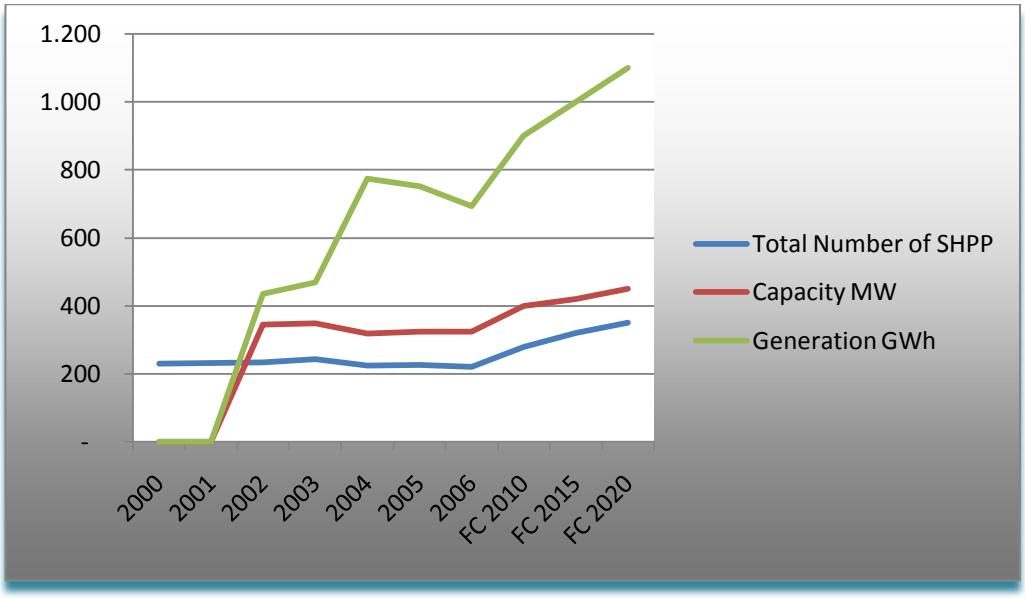


Figure 14: SHP Evolution and Forecast in RO

Source: SHERPA 2008, graph by author

According to EBRD the share of **SHPP** is much higher and has an installed capacity of around 1,125 MW.[124] Most of the 621 SHPPs are younger than 25 years and have a High Head design (>70%). [125] Around 150 SHPP have been listed for **privatisation** as a commitment relating to EU accession.[126]

Recent privatisations were the acquisition of SHPP by Electromagnetica in 2006 with a plan to reach 15 MW after investments and the successful tendering of 17 SHPP by Wienstrom at a price of € 28 Mio. Other players are Electrica, which intends to reach an installed SHP-capacity of 50 MW by 2012.

Up to 31.12.2008 in 22 auctions, 87 SHPPs were privatised:

Table 75: Privatised SHPP in RO

year of privatisation	Name of SHPP	River	No of SHPPs	Buyer
2006	Suceava	Suceava	10	Electromagnetica
2004	Topolog	Arges	5	Energy Holding
2004	Firiza	Maramures	5	ESPLE
2006	Casin	Bacau	5	Eviva Hidro S.R.L.
2006	Iod	Mures	3	Hidroconstructia S.A.
2006	Iuhod	Mures	2	Hidroconstructia S.A.
2004	Novaci	Gorj	5	ISPH SA
2004	Bistrita	Valcea	3	ISPH SA
2005	Doftana	Prahova	7	Luxten&Isph
2005	Manaileasa	Valcea	3	Romelectro
2008	Suha Mare	Suceava	4	Romenergo S.A.
2008	Suha Mica	Suceava	3	Romenergo S.A.
2008	Tur	Satu Mare	1	SC Beny Alex S.R.L.
2008	Fenes	Alba	2	Wienstrom GmbH
2008	Ialomita	Dambovita	5	Wienstrom GmbH
2008	Ilfov	Dambovita	5	Wienstrom GmbH
2008	Olteţ	Gorj	3	Wienstrom GmbH
2008	Gurghiu	Mures	4	Wienstrom GmbH
2008	Sovata	Mures	2	Wienstrom GmbH
2008	Dorna	Suceava	2	Wienstrom GmbH
2008	Moldova	Suceava	6	Wienstrom GmbH
2008	Negrisoara	Suceava	2	Wienstrom GmbH
TOTAL			**87**	

Source:Hidroelectrica in:

http://www.hidroelectrica.ro/content/activitati/privatizare/mhcr1_eng.pdf

Table 76: SHPP tendered for Privatisation

Name SHPP	River	Year Commission	Installed Capacity in MW	Generation in GWh/year	No. turbines
Astileu I	Crisu Repede	1955	2,8	14.000	4
Astileu II	Crisu Repede	1982	1	7.600	1
Barnar	Barnar	1983	0,45	3.000	1
Bistra Nouă	Bistra	1989	0,675	2.717	1
Borsa Complex Baru Mare	Muncel	1986	1,858	3.470	1
Bran 0	Turcu	1988	0,56	1.800	2
Bran 1	Turcu	1987	0,64	2.500	2
Bran Vechi	Turcu		0,12	390	2
Bucecea	Siret	1983	1,2	4.200	2
Buta	Buta	1994	0,491	1.153	2
Capra 2	Capra	1987	0,375	1.100	2
Capra 3	Capra	1990	1,23	3.512	3
Caralita	Trotus	1994	1	4.400	3
Cernavoda	Canal Dun.	1998	3,15	19.650	1
Chiojd 1	Bâsca	1987	0,69	2.100	1
Chiojd 2	Bâsca	1987	0,75	2.100	1
Chiojd 3	Bâsca	1988	0,62	3.208	2
Chiuzbaia	Chiuzbaia	1987	0,495	1.750	3
Cincis	Cerna	1985	0,85	3.500	1
Cluj 1	Somesul Mic	1988	0,94	3.800	6
Cracau	Cracău	2001	0,745	1.952	2
Dezna	Sebis	1986	0,098	352	1
Fălticeni	alim.cu apă	1984	0,26	1.521	2
Floresti II	Somesul Mic	1986	1,3	5.200	6
Gresu	Putna	1987	0,9	2.760	2
Gura Haitii 1	Neagra Şarului	1987	1,26	2.910	2
Gura Haitii 2	Neagra Şarului	1990	1	2.467	2
Hemeiusi	Canal CHE	1985	0,085	478	1
Iosăsel	Iosăsel	1990	0,126	330	1
Izvoarele	Runcu	1987	0,592	2.072	4
Lesu	Iad	1976	3,4	6.400	1
Lopătari	Slănic	1986	0,84	2.180	1
Lucaciu	Pârâul cu Pesti	1989	0,38	736	2
Mânzălesti	Slănic	1987	0,94	4.400	1
Marga	Marga	1996	1,26	2.000	2
Neagra Sarului1	Neagra Şarului	1987	0,75	1.941	2

Neagra Sarului2	Neagra Şarului	1990	1,832	3.916	2
Nedelea 1	Teleajen	1987	0,75	2.350	4
Nedelea 2	Teleajen	1986	0,9	2.900	4
Panaci	Călimănel	1986	0,44	1.440	2
Plai Monah	Neagra Şarului	1992	1,62	5.100	3
Poiana Uzului		1976	4,1	14.000	2
Rasinari	Rasinari	1987	0,06	380	2
Rogojesti	Siret	1988	3,2	9.060	3
Roznov	Bistrita	1984	0,18	760	1
Saru Dornei 1	Neagra Şarului	1987	1,829	8.190	2
Saru Dornei 2	Neagra Şarului	1989	1,26	3.773	2
Sebesu de Jos	Sebes	1984	0,03	92	
Sebis	Sebis	1994	0,27	580	2
Somesul Rece	Somesul Mic	1986	0,28	500	3
Surduc	Surduc	1986	1,7	4.300	2
Talmaciu	Sadu	1985	0,235	700	2
Tarlung 1	Tarlung	1984	0,73	4.230	1
Tarlung 2	Tarlung		1,8	4.230	3
Valea Cracului1	Valea Cracului	1987	0,536	1.266	2
Valea Cracului2	Valea Cracului	1987	0,415	1.240	2
Valea Cracului3	Valea Cracului	1988	0,56	1.290	3
Valea de Pesti	Valea de Pesti	1984	0,2	720	1
Valea Fetei	Valea Fetei	1994	0,13	320	1
Vicov	Suceava	2000	0,636	1.908	3
Viseut	Viseu	1988	0,718	1.800	3
Zeicani	Valea Cracului	1986	0,365	870	2
TOTAL			**58,606**	**199.564**	

Source: http://www.hidroelectrica.ro/content/activitati/privatizare/mhcr2_eng.pdf

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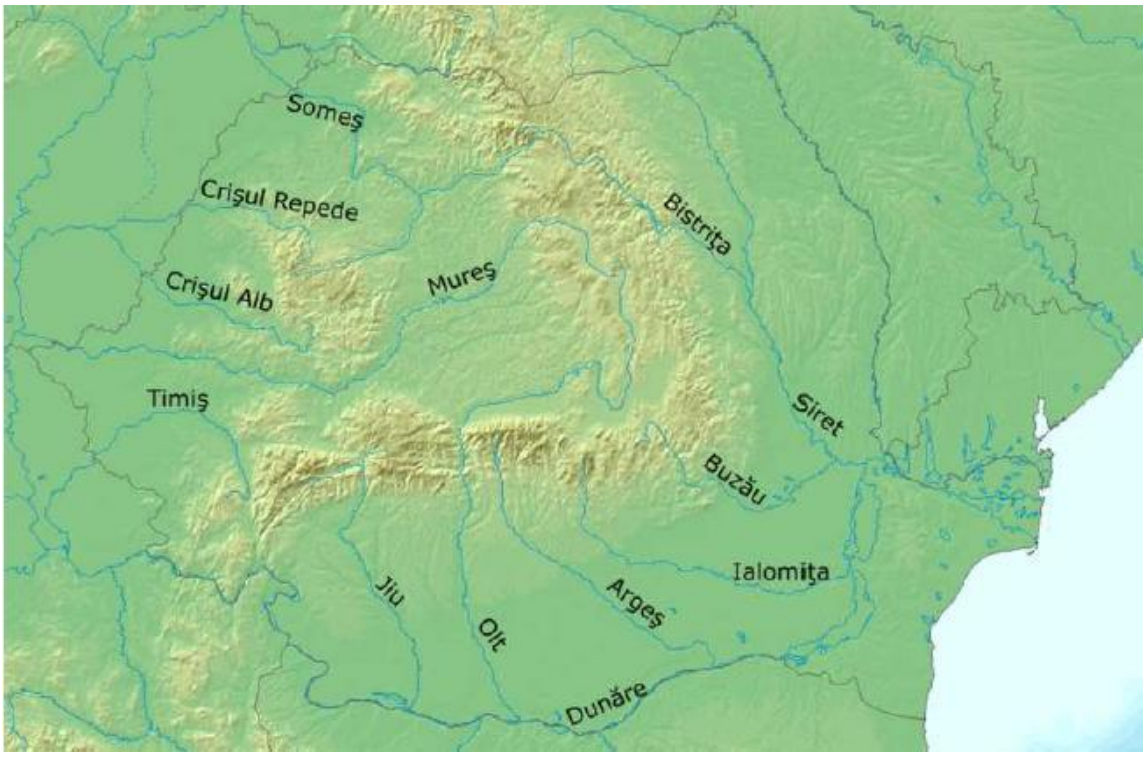

Figure 108: River Map in RO

Source: http://en.wikipedia.org/wiki/List_of_longest_rivers_of_Romania

The SHERPA study arrives to a realizable **potential** for new (retrofit) SHPs with an **installed capacity of 900 (81) MW** and an annual **Generation of 3,193 (173) GWh**.

Table 77: SHP Potential in RO

Potential	Generation		Capacity
	GWh/yr	%	MW
Gross theoretical	6.000	100	n/a
Technically feasible	4.080	68	1.130
Economically feasible	3.200	53	900
Economically feasible taking environmental constraints into account (EFEN)	3.193	53	900
EFEN for refurbishing / upgrading estimate	173		81

Source: SHERPA 2008, compiled by Kopecek, C.

Precipitation varies largely in time and space but has its maximum in June and the minimum in February-March almost all over the territory. In the mountain area 1,000 mm annual precipitation can be exceeded.[127]

Figure 109: Precipitation Map of Ro

Source: http://www.bestcountryreports.com/Precipitation_Map_Romania.html

Due to the varying precipitation, the dense water flow network of RO shows substantial seasonal variations.[127]

The **promotion system** is set up as a **Green Certificate** (GC) mechanism, where suppliers of energy are obliged to source a percentage of sold Electricity from RES. This percentage will be increased from actually 6.78% up to 8.3% from 2010.
For each missing certificate (represents1MWh) between 2008-2012 a penalty of € 84 has to be paid[15]

The RES-E producer receives a remuneration for his GC according to bilateral contracts with purchasers or on the central exchange for those papers, the OPCOM. Prices vary in a range set by the government with a floor and a **cap, which has been fixed as € 27 and € 55 respectively for the period 2008-2012**. High demand drives prices to the maximum price. New plants have a guaranteed period for receiving GC of 15 years.
New or refurbished SHP up to 10 MW receive one GC per one MWh, all others receive two GC for 1 MWh.[126]

[15] KPMG Advisory Ltd: CEE Renewable Electricity Outlook 2008, Budapest 2008

Table 78: Projects – Feasibility Studies in progress

SC Hidroelectrica Company	DESCRIPTION of PROJECT	Installed Capacity MW	Project Value Mil. $
Hunedora	Retezat Hydropower Development (HD)		35,80
Caras-Severin	Bistra – Poiana Maralui HD Raul AlB	18,30	29,80
Caras-Severin	Bistra – Poiana Maralui HD Zervesti	1,70	1,20
Maramures	Rungu – Firiza HD	8,75	13,60
Caras-Severin	Cerna-Belareca HD	15,90	28,10
Caras-Severin	Poneasca HD	1,50	1,20
Gorj	Gilorit HD, upstream of Novaci	11,00	14,70
Caras-Severin	Maru HD	13,00	12,50
TOTAL			**136,90**

Source: Hidroelectrica 2008

Table 79: Hydropower Developments (HD) in RO

Project	Project value in Mio. USD
Borea-Poliana Teiului HD Galu HPS (Frumosu location)	36,00
HD of the Siret River on Cosmesti-Movileni stretch	43,30
HD of the Jiu River on Valea Sadului Stretch	147,00
HD of the Strei River on Subcetate Simeria Stretch	70,00
HD of the Olt River on Fagaras-Hoghiz stretch	133,00
Siriu – Surduc HD	106,24
Rastolita HD	24,80
Downstream Tismana 2 HPP from Cerna-Motru-Tismana hydrotechnical and power complex	15,20
Pitesti HPS upstream (New Project)	10,00
Tisza River HD Sapanta-Teceu Stretch	72,50
TOTAL	**658,04**

Source: Hidroelectrica 2008

Investment cost for a new SHPP are around 1,250 €/kW with avg. production cost of 4 €cts/kWh. [95]

The main **barrier** for further development is the lack of financing. There exist a large number of unfinished SHP schemes. [128]

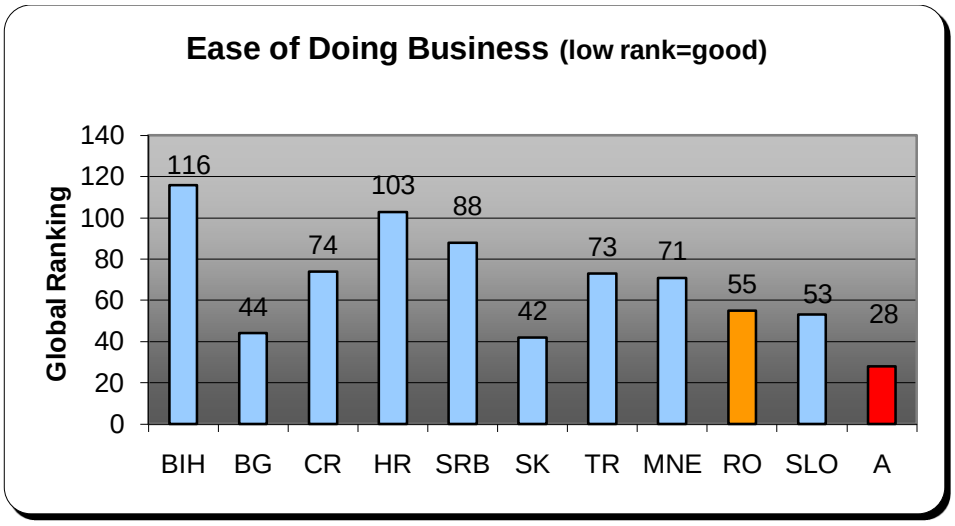

Figure 110: Ease of Doing Business in RO

Source: The World Bank Group, 2009 in

http://www.doingbusiness.org/ExploreEconomies/?economyid=13

Graph created by Kopecek, C.

RO got its worst marks in the category “paying taxes” where it also is ranked worst within the peer group.

11 Slovenia

Figure 111: Map of Slovenia

Source: Wikipedia

Being independent from former Yugoslavia since 1991 this small country is the most successful of the former communist countries in CEE in economic terms.

Since 2004 it is EU member and beginning of 2007 SLO introduced the EURO as currency. However, privatization has come to a standstill since 2002 resulting in one of the highest levels of state control in the EU. [129]

Slovenia has committed itself within EU to increase the share of RES in domestic consumption to 15%. [130]

Installed power capacity in SLO is 3,070. Thermal plants generate 1,360 MW using mostly coal, hydro contributes 1,010 MW and the nuclear plant Krsko generates 700 MW.

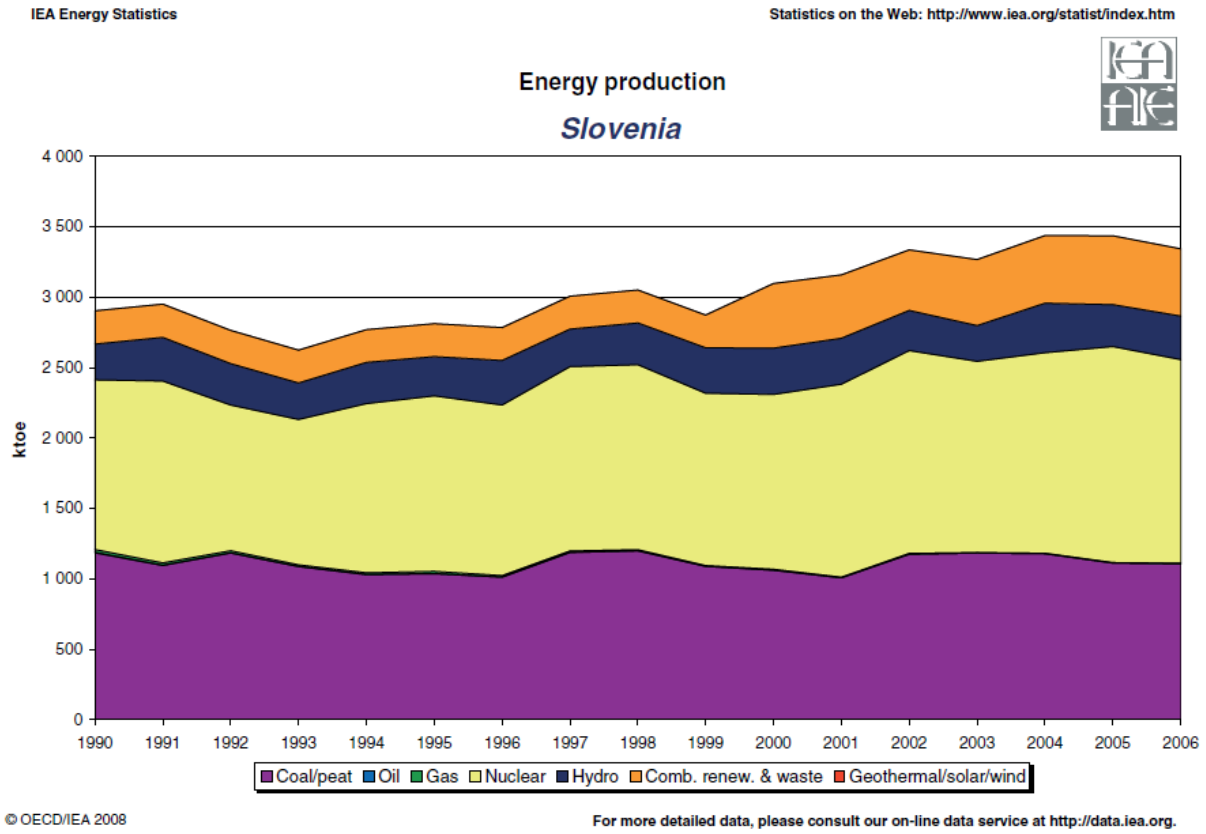

Figure 112: Energy Production in SLO

Source: OECD/IEA

Electricity consumption was 13,488 GWh in 2007 and the share of RES reached almost 24% (2006). Hydropower produced 2,600 GWh of electricity in 2006 and contributed 96.7 % to this RES share.

SHP generates 13.7 % of Renewable Energy. This is roughly 3 5 % of all electricity consumed in Slovenia.

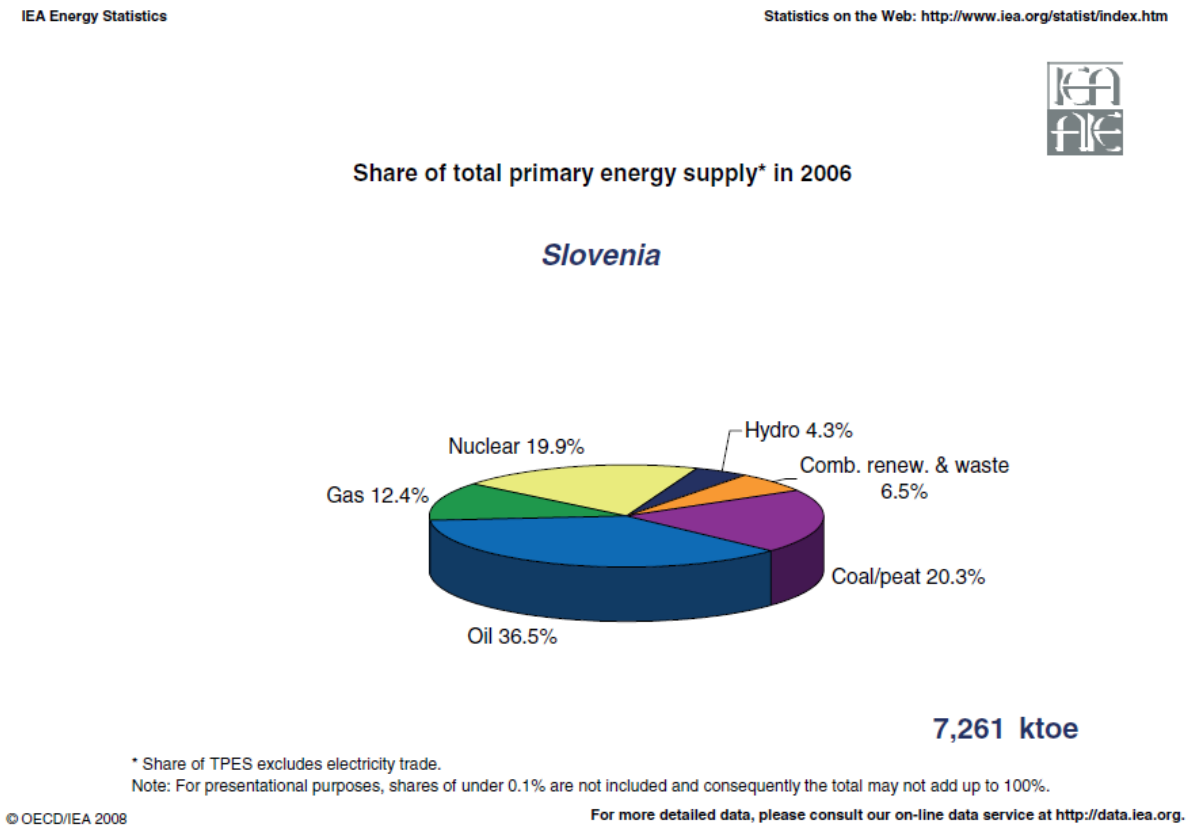

Figure 113: Share of Total Primary Energy Supply in SLO

Source: OECD/IEA 2008

There are no significant own oil and gas resources and with a more than 50% share of those fuels in the primary energy supply this lack makes SLO heavily dependent on energy imports. There is an ongoing substitution from oil by gas, which in the absence of alternative infrastructure increases the risk of another gas crisis due to the dependency of Russian gas supplies.[131] The own lignite deposits are used for production of electricity and heat and will last for future years.

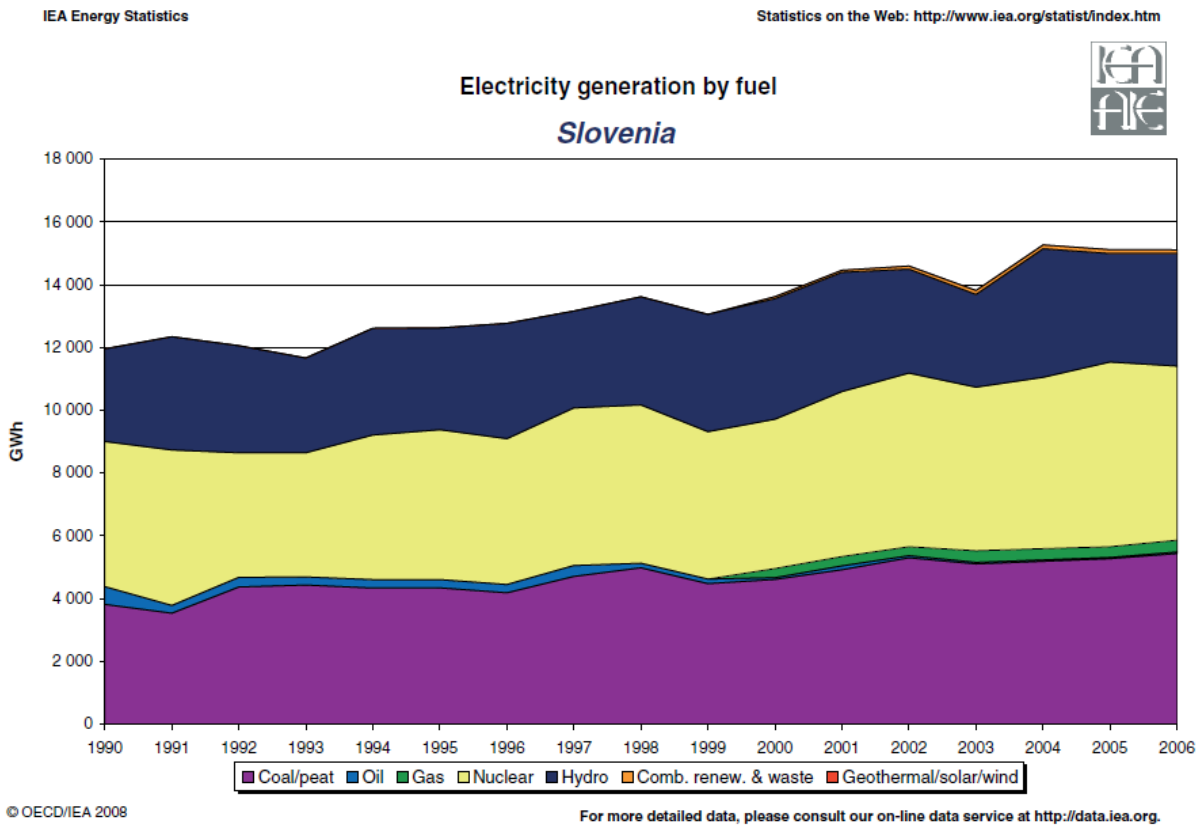

Figure 114: Electricity Generation by Fuel in SLO

Source: OECD/IEA 2008

The graph of the energy generation shows a steady increase following the needs the continuously growing economy. (The slump in energy production in 2003 has been caused by a single severe drought). The electricity market is not very competitive because of limited cross boarder capacities and as SLO is a net importer.

The prognosis of the use of electricity shows an increase at an annual rate of 1.5% until 2015. This higher consumption needs will be partly covered by an overhaul of the old thermal power plants but also by developing roughly 900 MW new capacities including RES.
Until 2020 the potential of SHP to be exploited is almost 1,500 GWH. [136]

SLO is the country with the second highest annual precipitation in this Peer-Group of ten countries reaching around 3,000 mm as a maximum mean precipitation in the western mountainous part and still 800 mm in the north eastern part as a minimum.[132] This explains the large number of SHPP in operation.

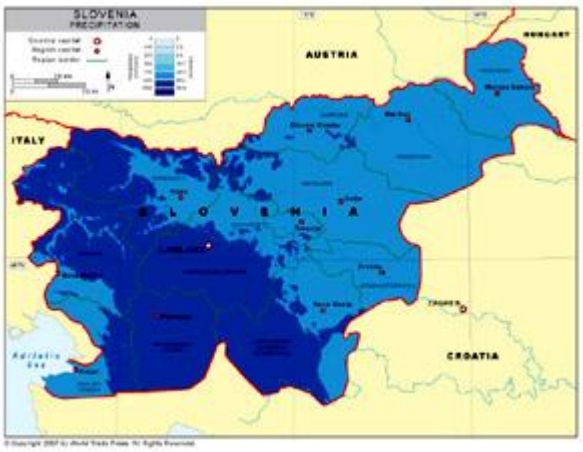

Figure 115: Precipitation map of SLO

Source: http://www.bestcountryreports.com/Precipitation_Map_Slovenia.html

But so far only a third of the total estimated hydro power potential of 8,800 GWh/year has been developed and it is a strategic goal to increase its share, thus reducing the energy dependency. New projects include the intended development of five sites on the lower Sava River promoted by Slovenske Elektrarne (HSE). This could add another 200 MW by 2018.[133] [134]

The actual installed hydro power capacity is around 930 MW (UDI 2009)[135]. The **inventory of SHPP comprises 477** mainly privately owned plants with a yearly net **production of about 370 GWh** and an **installed capacity of 144 MW**. [136] Almost 90 % of the plants are younger than 25 years, 60% medium head (5-15m), 30% high head (> 15m). But around 40 SHPP along the Sava and the Soca Rivers are older than 70 years and need refurbishment in order to remain operational. Refurbishment activities alone could add 150 MW installed capacities and are part of the governments' renewable energy strategy.

Table 80: SHP potential in SLO

	2000	2001	2002	2003	2004	2005	2006	FC 2010	FC 2015	FC 2020
Total Number of SHPP	476	477	478	480	480	480	477			
Capacity MW	127	147	156	151	143	143	144	160	160	180
Generation GWh	340	371	327	266	437	383	370	452	480	540

Source: SHERPA 2008, compiled by author

The range of **investment cost** for SHPP is between 1.500 – 3,000 €/kW. [95]

The **potential for new SHP** development is shown below:

Table 81: Potential for SHP in SLO

Potential	Generation		Capacity
	GWh/yr	%	MW
Gross theoretical	1.400	100	365
Technically feasible	1.000	71	250
Economically feasible	700	50	250
Economically feasible taking environmental constraints into account (EFEN)	585	42	194
EFEN for refurbishing / upgrading	104		36

Source: SHERPA 2008, compiled by author

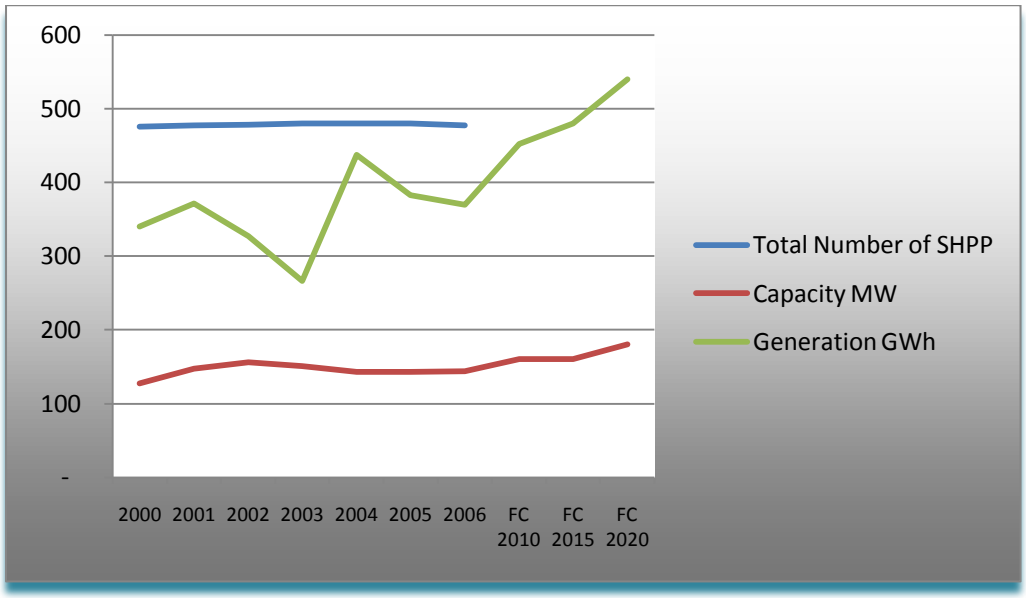

Figure 15: Potential for SHP in SLO

Source: SHERPA 2008, graph by Kopecek, C.

The Sava River has almost 22,800 GWh of useable potential and only 18% is being utilized. The Drava River offers the most potential with almost 2900 GWh (technical potential) but is almost fully exploited (97.8%) Soca and the other rivers have 3.455 GWh of potential and only 22% of being used. [137]

The state owned grid is reaching its maximum capacity but very reliable until now. Investments are undertaken now in the power lines and transformers.

The **new promotion schemes 2009** is rather complex and highly differentiated system of tariffs and bonus payments and offers a choice of either

- Fixed feed-in tariffs for SHPP up to 5 MW or
- Operational aid based on reference cost of SHP based on fixed (over the 15 years duration) and variable cost8periodically revised)[138]

Table 82: Feed-in Tariffs in SLO

Size category of generating plant	Guaranteed Purchase Price[EUR/MWh]
micro (< 50 kW)	**105,47**
small (< 1 MW)	**92,61**
Medium (up to 5 MW)	**82,34**

Source:

http://www.feed-in cooperation.org/wDefault_7/content/documents/slovenia_documents_index.php

The validity of the power purchase agreement is 15 years and the flat prices are set at least once a year.

Other promotions include subsidies of up to 40% or loans with interest rate subsidies with additional 20% special subsidies in rural areas without access to the grid. [139]

As main **barriers** the environmental protection especially due to Natura 2000 as well as the cumbersome, lengthy concession process have been identified.[136] Also unannounced decrease of premiums, increase of water tax concession cost from 3% to 8%; rejections of 34 concessions applications in 2007[140]

The recent augmentation of environmental flow rate results in a reduced output of more than 5%.[141]

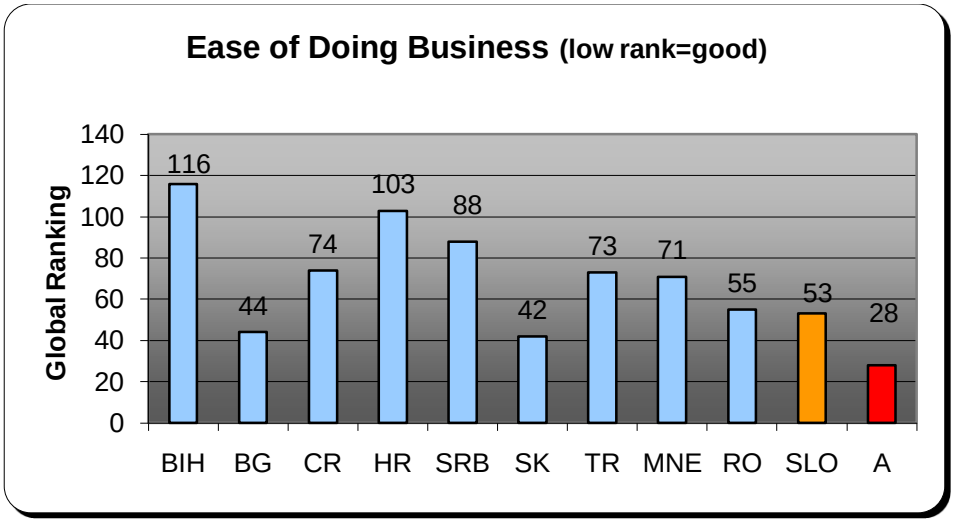

Figure 116: Ease of Doing Business in SLO

Source: The World Bank Group, 2009 in

http://www.doingbusiness.org/ExploreEconomies/?economyid=13

Graph created by Kopecek, C

SLO is best in categories “Starting a Business” and “Protecting Investors” compared with the peer group but lacks behind in “Employing Workers” and “Getting Credit” which mainly is due to dry labour market and lack of good credit information found by the survey.

12 Rating and Results

The average marks per country indicate the attractiveness of each country. The lower the mark, the more attractive (= the less challenge for realizing a good project)
It seems that countries like CR, SK and SLO are more attractive and BIH, SRB and HR are more a challenge for a SHP project. MNE is in between the extremes.

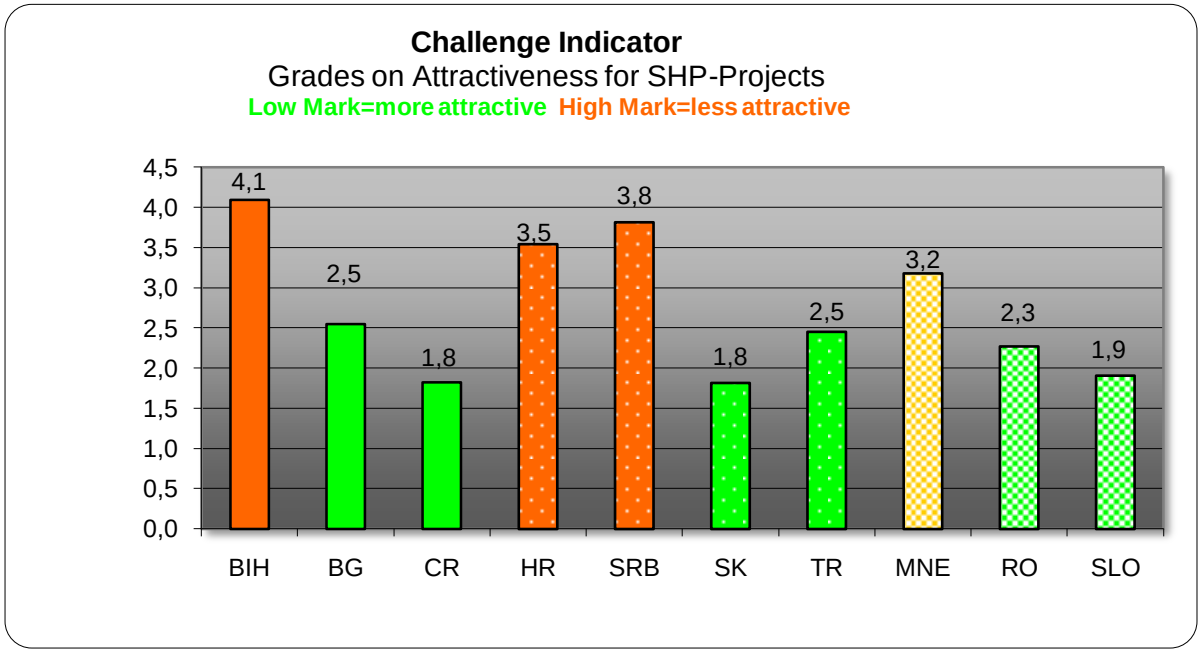

Figure 16: Challenge Indicator- Grades on Attractiveness for SHP-Projects

Source: Kopecek, C.

Behind those condensed indicators are marks which are the result of an evaluation of the relating information to each criterion:

Table 83: Country Rating – Marks per Criteria

	Focus1			Focus 2				Focus 3		
CRITERIA	**BIH**	**BG**	**CR**	**HR**	**SRB**	**SK**	**TR**	**MNE**	**RO**	**SLO**
avg Mark	**4,1**	**2,5**	**1,8**	**3,5**	**3,8**	**1,8**	**2,5**	**3,2**	**2,3**	**1,9**
Ease of Doing Business	5	2	3	5	4	2	3	3	3	3
Potential	2	2	3	3	2	2	1	3	1	3
Water Availability	3	3	3	2	4	3	2	1	3	2
Liberalisation/3rd Party Access	4	3	2	5	5	3	4	4	1	1
Transparency Promotion System	4	3	1	3	4	1	1	3	2	2
Legislation	4	2	1	3	4	1	3	4	2	1
Incentives	5	1	1	2	3	1	3	4	2	1
Economy	5	4	1	4	4	1	3	4	4	1
Political Situation	5	3	1	4	4	1	3	3	4	1
Limiting Factors	4	3	2	4	4	2	2	3	2	3
Barriers	4	2	2	4	4	3	2	3	1	3

Source: Compiled by author

CR as the best country of the "Focus 1" and the total Peer Group does not score so much on the potential or water availability but more on criteria, which let a project – once started - materialize and run successfully. It offers a superior and flexible two-tier promotion system, which the plant operators can individually optimize. With a high number of relatively old aged SHPPs existing, there should be a good opportunity for refurbishment.

BIH as last in group would promise good potential, but the chances that the project becomes real and profitable are less than in the other analysed countries. **BG** is in between and has attractive incentives and good investment climate although the economy is in bad shape.

The other countries of Focus 2 and 3 have been investigated to a lesser extent, therefore the results have to be verified more intense.

In the "**Ease of doing business index**" economies are ranked according to their quality in each individual segment. A low rank means the regulatory environment is conducive to the operation of business. This index is issued by World Bank Group for 183 countries each year.

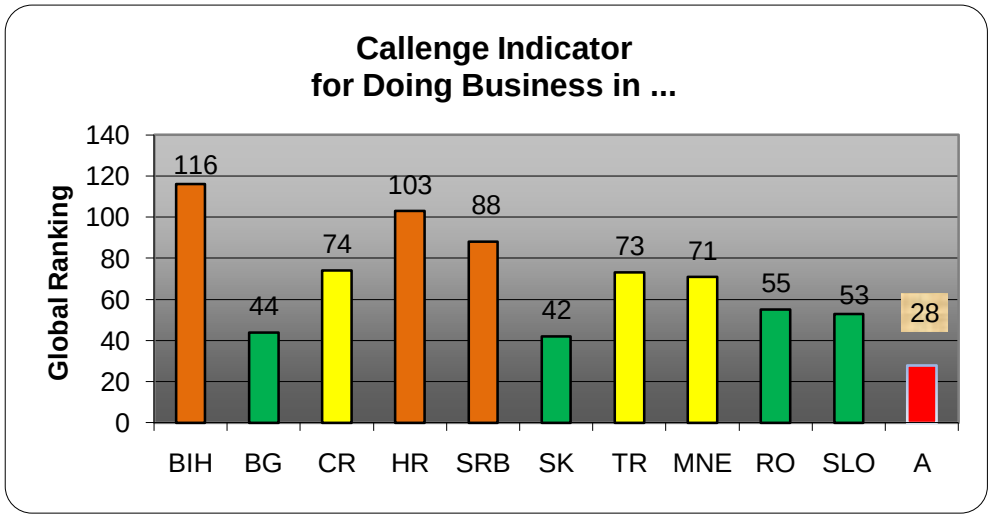

Figure 117: Ease of doing Business – Challenge Indicator

Source: compiled by author , data from
http://www.doingbusiness.org/ExploreEconomies/?economyid=13

For each category the scores are shown per country (the values for Austria are added as reference):

Table 84: Ease of Doing Business Index – Country/Criterion Matrix

CATEGORIES	BIH	BG	CR	HR	SRB	SK	TR	MNE	RO	SLO	A
Ease of Doing Business	116	44	74	103	88	42	73	71	55	53	**28**
Starting a Business	160	50	113	101	73	66	56	85	42	26	**122**
Dealing with Construction Permits	136	119	76	144	174	56	133	160	91	59	**54**
Employing Workers	111	53	25	163	94	81	145	46	113	162	**60**
Registering Property	139	56	62	109	105	11	36	131	92	108	**39**
Getting Credit	61	4	43	61	4	15	71	43	15	87	**15**
Protecting Investors	93	41	93	132	73	109	57	27	41	20	**132**
Paying Taxes	128	95	121	39	137	120	75	145	149	84	**102**
Trading Across Borders	63	106	53	96	69	113	67	47	46	84	**24**
Enforcing Contracts	124	87	82	45	97	61	27	133	55	60	**11**
Closing a Business	63	78	116	82	102	39	121	44	91	40	**20**
	160	119	121	163	174	120	145	160	149	162	**132**

Source: The World Bank Group 2009, data compiled by Kopecek, C.

The **Potential for further SHP Exploitation** is not easily to be determined, as the available data differs considerably. Therefore, the results of the analysis have to be seen as rough estimates only.

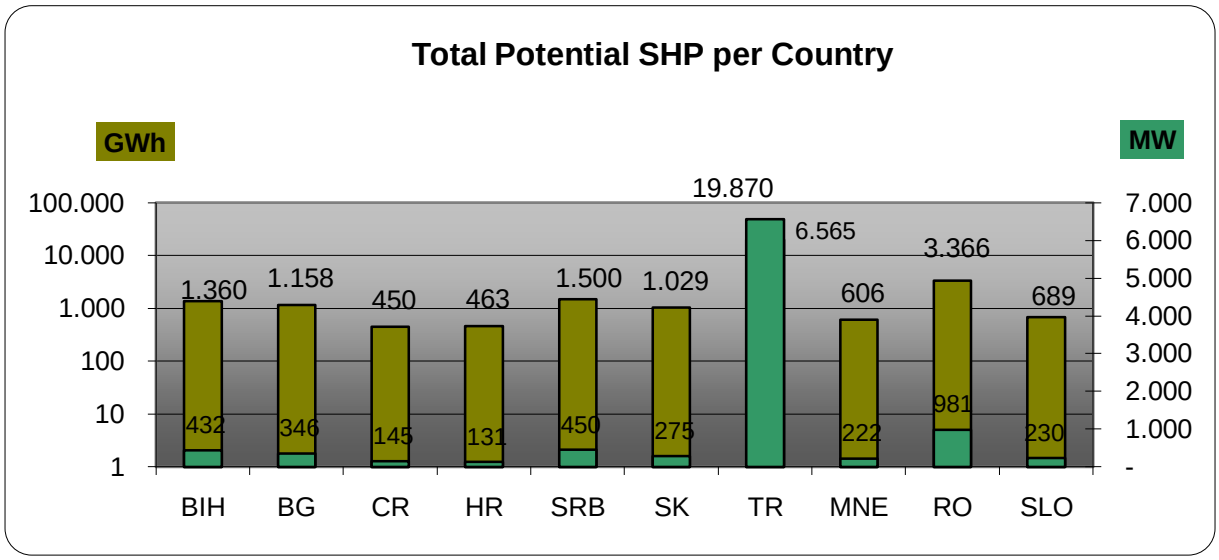

Figure 118: Potential Generation & Capacity for Small Hydro Power

Source: Various publications, compiled by Kopecek, C.

Potential SHP Construction Cost per Country

By multiplying the construction cost in €/MW one gets a rough picture of potential total investment amount for future SHP projects per country. Total Construction Costs for SHPP vary considerably and are not available for all countries. Applying those costs to the potential installed capacity, the following potential total investment is estimated:

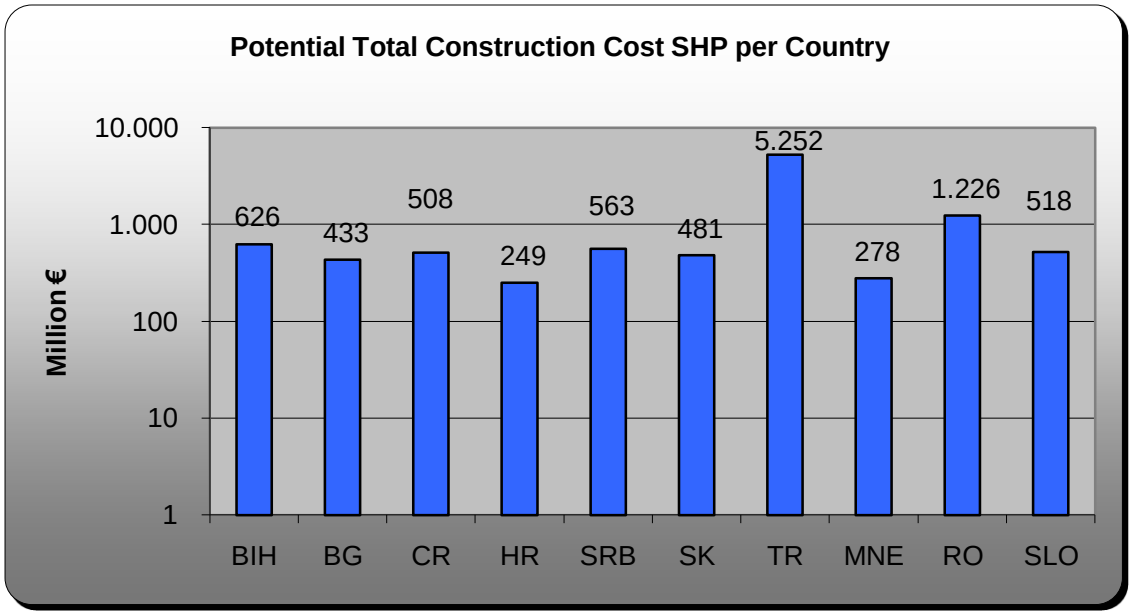

Figure 119: Potential estimated Investment Cost for Small Hydro Power Plants per Country
Source: Various publications. The cost levels for BIH, HR, SRB, MNE and SLO were estimated by author
Construction costs/MW vary substantially as can be seen underneath. Reasons are different technologies used in individual countries (e.g. high-low head), different cost level of countries (e.g. TR vs. CR), aged and/or unrepresentative data.

Table 85: Potential Total Construction Cost per Country

POTENTIAL	BIH	BG	CR	HR	SRB	SK	TR	MNE	RO	SLO
Generation in GWh	1.360	1.158	450	463	1.500	1.029	19.870	606	3.366	689
Installed Capacity in MW	432	346	145	131	450	275	6.565	222	981	230
Construction Cost in T€/MW	1.450	**1.250**	**3.500**	*1.900*	1.250	**1.750**	**800**	1.250	**1.250**	*2.250*
Construction Cost in Mio €	*626*	*433*	*508*	*249*	*563*	*481*	*5.252*	*278*	*1.226*	*518*
POTENTIAL	**BIH**	**BG**	**CR**	**HR**	**SRB**	**SK**	**TR**	**MNE**	**RO**	**SLO**

Source: TNSHP 2004, ESHA u. Sherpa Strategic Study 2008 . Marked cells for SRB and MNE contain estimates by Kopecek, C.

The condensed information mainly relevant for the marks is found in Annex I, the details are provided in the individual chapters above.

Annex I Rating Table

Table 86: Condensed data and Marking

Mark		Potential				Exploited							Highest RES Potential	Potential
1=very good, 5=very bad	km²	MW	GWh	No. of SHPP	GWh / km²	MW	GWh	No. of SHPP	avg estim. Age of SHP	Mean of Range of Invest. Cost	Mean of Range of Production Cost	SHP Density		Mark
BIH	51.129	432	1.360	250	0,027	37	186	23	n/a	1.450	2	0,004	Hydro, Wind	2
BG	110.910	346	1.158	305	0,010	196	627	102	54	1.250	1	0,006	Biomass, Wind	2
CR	78.866	145	450	430	0,006	268	750	1.180	50	3.500	1	0,010	Biomass	3
HR	56.542	131	463	699	0,008	33	99	32	n/a	1.900	2	0,002	Wind	3
SRB	88.528	450	1.500	850	0,017	35	150	31	n/a	n/a	n/a	0,002	Biomass	2
SK	49.035	275	1.029	250	0,021	68	255	202	25	2.000	1	0,005	Biomass	2
TR	783.562	6.565	19.870	> 1000	0,025	185	502	73	under 25	800	0	0,001	Hydro, Biomass	1
MNE	13.812	222	606	70	0,044	9	19	7	40	n/a	n/a	0,001	SHP	3
RO	238.391	981	3.366	n/a	0,014	1.125	1.500	621	under 25	1.250	4	0,006	Biomass	1
SLO	20.273	230	689	n/a	0,034	144	370	477	under 25	2.250	n/a	0,018	SHP, Biomass	3

Mark	Liberalisation & 3rd Party Access	Transparency Promotion System	Legislation	Legislation	Promotion System	Promotion System	Feed-in Tariff new Plants min	Feed-in Tariff new Plants max	Feed-in Tariff refurbish Plants	avg feed-in tariff or higher market	Guaranteed Period
1=very good, 5=very bad	Mark	Mark	Mark		Mark		€ct/KWh				yrs
BIH	4	4	4	Secondary Legislation missing	5	Feed-in tariffs	4,68	5,35	n/a	5,02	no
BG	3	3	2	EU Standard	1	Preferential prices	10,50	10,50	10,50	10,50	15
CR	2	1	1	EU Standard	1	Feed-in and Green Bonus on Top of Market price	6,95	10,49	8,93	8,79	15
HR	5	3	3	unmature	2	Feed in up to 5 MW	6,31	10,36	n/a	8,33	12
SRB	5	4	4	unmature	3	Feed in tariffs planned	*7,85*	*9,70*	*5,90*	7,82	12
SK	3	1	1	EU Standard	1	Feed-in tariffs	10,16	11,29	11,95	11,13	15
TR	4	1	3	unmature	3	Higher Market Price or Feed in tariff as floor	5 (pending elevation)	5,5 (pending elevation)	n/a	**7,00**	10
MNE	4	3	4	unmature, Pending new RE-Law in 09	4	Flat price based on cost +	6,70	6,70	6,70	6,70	n/a
RO	1	2	2	EU Standard	2	Green Certificate	Market price +Green Certificate			**9,00**	15
SLO	1	2	1	EU Standard	1	Feed in cost plus	8,23	10,55	n/a	9,39	15

Mark	Target 2010 of % RES from E-Production	Target 2020	Annual change E-consumption	Electricity Import/Export	Water Availability	Highest Precipiation area in mm	Trend precipitation / Hydro-Topography
1=very good, 5=very bad			%		Mark		
BIH	n/a	n/a	3	Export	3	1.200	mountains, River network good
BG	11	16	tendency +	Export	3	1.400	decrease / River network good
CR	8	13	tendency +	Export	3	1.200	n/a / dense R-network
HR	n/a	20	n/a	Import	2	2.500	n/a / dense R-network
SRB	n/a	n/a	n/a	Import	4	1.000	n/a / mountainous
SK	31	14	tendency +	Import	3	1.300	n/a / hilly
TR	n/a	n/a	8	Import	2	2.500	negativ / good R-network
MNE	2,62	7,56	tendency ++	Import	1	5.500+	n/a / dense R-network
RO	33	24	stagnating	Export	3	1.000+	drought 2007/good R-nw
SLO	33,6	25	1,5	Import	2	3.000	n/a / dense R-network

Mark	Economy	Economy	Economy	Economy	Political Situation	Political Situation
1=very good, 5=very bad	Mark	Expectetd Growth 2010 %			Mark	
BIH	5	Negativ	post war recovery, excessive state organisation and bureaucracy, high government spending		5	Unsolved material problems, Unstable
BG	4	-1	poorest EU Country, high trade deficit		3	EU
CR	1	Negativ	performing well, exports hit by crisis		1	EU
HR	4	Negativ	high debt		4	EU Candidate
SRB	4	Negativ	recovery from mismanagement, war and sanctions	slow privatisation and restructuring; high unemployment	4	Unstable
SK	1	4	performing well		1	EU
TR	3	3,7	dynamic economy, high unemployment	High C/A.deficit and debt	3	reforms needed
MNE	4	n/a	high unemployment,low finance	regional disparities, privatization well progressed	3	Unstable
RO	4	1	high debt	high inflation	4	EU, instable, governent dismissed
SLO	1	n/a	high performer, low grade of privatisation		1	EU

Mark	Limiting Factor	Limiting Factor	Limiting Factor	Barriers	Barriers	Barriers
1=very good, 5=very bad	Mark			Mark		
BIH	4	Finance, regulations, authorities, unattractive promotion schemes	extremely low electricity prices, war-damages	4	Constitutional organization of the state, no state action plan, no structure developed yet	RES is not really encouraged by government, complicate licensing and approval process
BG	3	Finance	NEK calls for restrictions to booming RES sector	2	Reluctance of private power companies to buy RES--E	
CR	2	Licensing process, Fishery		2	Environmentalists	
HR	4	dominant National Power Company	damaged infrastructure, grid	4	poor government services	
SRB	4	Finance, regulations, authorities	extremely low electricity prices, war-damages	4	Lack of transparency in the energy sector, eg. Licensing	
SK	2	Finance	bureaucracy	3	complicate procedures, inadequat implementation of legal framework	
TR	2	competition with other water users		2	bureaucratic administraiv procedures	
MNE	3	Finance, regulations, authorities	infrastructure, grid	3	Lack of secondary legislation, competiotion with tourism, Ecology	
RO	2	Finance	grid connection	1	River life protection	
SLO	3	Authorities, already high density of SHP	Spatial plans	3	Environment, Natura 2000	No real competitive market as net importer with limit gross border trading

Source: Kopecek, C.

Annex II SHPP Projects in BIH EPRS

Table 87: SHPP Projects in Bosnia and Herzegovina, EP RS Area

		Q	H	C	P			
SHPP	**River**	**m³/s**	**m**	**MW**	**GWh**	**Data source**	**Region**	**Source info**
San kamen	Bosna	135,00	8,50	8,50	62,00	basis project	Bosna	1)
Blatinica	Usora	10,00	77,00	5,70	26,50	basis project	Bosna	1)
Vrucica	Usora	11,50	33,00	2,90	13,50	basis project	Bosna	1)
Bistrica B-2	Bistrica	18,46	73,00	9,44	29,95	study 1984	Drina	1)
Bistrica B-2a	Bistrica	12,00	87,10	8,40	33,24	study 1984	Drina	1)
Bistrica B-4	Bistrica	5,20	69,60	2,90	11,91	study 1984	Drina	1)
Bistrica B-5	Bistrica	3,50	49,60	1,20	3,83	study 1984	Drina	1)
Bistrica B-6	Bistrica	1,00	136,60	1,00	5,18	study 1984	Drina	1)
Dracenica B-D-1	Bistrica	4,20	23,60	0,71	2,74	study 1984	Drina	1)
Dracenica B-D-2	Bistrica	1,80	83,50	1,00	4,22	study 1984	Drina	1)
Dracenica B-D-3	Bistrica	0,26	101,00	0,20	0,91	study 1984	Drina	1)
Govza B-G-1	Govza	8,00	129,70	8,40	30,94	study 1984	Drina	1)
Govza B-G-2	Govza	2,60	113,35	2,10	10,82	study 1984	Drina	1)

Govza B-G-3	Govza	2,40	335,80	6,10	22,78	study 1984	Drina	1)
Govza B-G-4	Govza	2,20	46,70	0,70	2,17	study 1984	Drina	1)
Govza B-G-5	Govza	0,50	138,00	0,53	2,36	study 1984	Drina	1)
Grabovik	Grabovik	6,00	214,00	10,50	49,00	basis project	Drina	1)
Klobučarica S-K-J-1	Klobučarica	1,80	70.00	0,90	3,92	study	Drina	1)
Klobučarica S-K-J-1a	Klobučarica	2,30	54,00	0,85	2,84	study	Drina	1)
Krupica B-K-1	Krupica	2,20	72,40	1,20	5,90	study 1984	Drina	1)
Krupica B-K-1a	Krupica	4,60	40,20	1,24	4,62	study 1984	Drina	1)
Miljevika B-M-1	Miljevka	1,20	57,70	0,50	1,75	study 1984	Drina	1)
Miljevina	Miljevka	10,00	103,00	8,00	34,40	basis project	Drina	1)
Miljevka B-M-2	Miljevka	0,40	178,00	0,53	2,56	study 1984	Drina	1)
Otesa B-O-1	Otesa	1,40	212,60	2,30	8,19	study 1984	Drina	1)
Otesa B-O-2	Otesa	0,80	266,00	1,60	6,43	study 1984	Drina	1)
Otesa B-O-3	Otesa	0,30	152,00	0,35	1,59	study 1984	Drina	1)
Otesa B-O-4	Otesa	0,30	95,00	0,23	1,02	study 1984	Drina	1)
Skopotnica	Skopotnica					study	Drina	1)

-1		4,00	35,50	1,00	3,29			
Skopotnica -2	Skopotnica	2,20	182,35	2,70	11,30	study	Drina	1)
Skopotnica -3	Skopotnica	2,50	103,00	1,10	4,99	study	Drina	1)
Skopotnica -4	Skopotnica	0,80	93,25	0,54	2,39	study	Drina	1)
Skopotnica -5	Skopotnica	0,35	270,10	0,73	3,33	study	Drina	1)
Stovici	Stovici	16,00	82,20	10,20	51,20	basis project	Drina	1)
Sućeska R-S-1	Sućeska	8,00	89.60	4,00	4,35	study	Drina	1)
Sućeska R-S-2	Sućeska	1,40	109.70	0,74	3,36	study	Drina	1)
Sućeska R-S-3	Sućeska	0,90	157.85	0,70	3,24	study	Drina	1)
Sućeska R-S-4	Sućeska	0,60	215.90	0,67	3,37	study	Drina	1)
Suha	Suha	1,50	302.00	3,60	18,00	pre-study	Drina	1)
Suha S-S-1	Suha	1,70	95.65	0,80	3,62	study	Drina	1)
Suha S-S-2	Suha	1,20	301.00	3,60	18,56	study	Drina	1)
Suha S-S-3	Suha	0,74	226.60	1,25	5,79	study	Drina	1)
Suha S-S-4	Suha	0,50	275.80	1,00	6,01	study	Drina	1)

MHE Medas	Drinjača	14,00	54,50	5,40	30,80	basis project	Drinjača	1)
MHE Ravne	Drinjača		146,00	6,20	32,70	basis project	Drinjača	1)
MHE Sekovi?i	Drinjača		98,50	3,30	14,80	basis project	Drinjača	1)
Janjina J-1a	Janjina	3,60	146,00	4,20	18,14	study	Janjina	1)
Janjina J-1	Janjina	3,60	140,40	3,80	16,62	study	Janjina	1)
Janjina J-2	Janjina	1,45	166,35	1,70	7,93	study	Janjina	1)
Janjina J-3	Janjina	0,60	107,50	0,46	2,20	study	Janjina	1)
MHE Banja Stijena	Prača	8,00	100,00	6,00	40,00	basis project	Prača	1)
MHE Prača I	Prača	18,00	87,70	8,90	44,60	basis project	Prača	1)
MHE Prača I	Prača	22,00	49,70	12,40	67,50	basis project	Prača	1)
Radojna R-1	Radojna	5,60	188.00	7,90	25,56	study	Radoina	1)
Radojna R-2	Radojna	4,00	47.20	1,50	4,40	study	Radoina	1)
MHE Rzav	Rzav	14,00	90,00	10,20	41,60	basis project	Rzav	1)
HE Ključ accumulated	Sana	64,00	87,00	48,70	211,30	pre-study	Sana	1)
MHE Prizren Grad	Sana	12,00	36,00	3,50	28,00	basis project	Sana	1)

MHE Medna	Sana	7,00	51,00	3,50	17,00	basis project	Sana	1)
Hrčavka S-H-2	Hrčavka	2,20	98.00	1,70	6,98	study	Sutjeska	1)
Jabučnica S-J-1a	Jabučnica	5,00	185.20	6,80	31,42	study	Sutjeska	1)
Jabučnica S-J-1b	Jabučnica	8,00	85.00	4,40	13,52	study	Sutjeska	1)
Jabučnica S-J-2	Jabučnica	2,00	102.75	1,55	6,73	study	Sutjeska	1)
Jabučnica S-J-3	Jabučnica	1,00	223.00	1,70	8,21	study	Sutjeska	1)
Jabučnica S-J-K-1	Jabučnica	6,80	185.00	9,20	42,38	study	Sutjeska	1)
Sutjeska S-1	Sutjeska	30.00	21.70	5,34	18,32	study	Sutjeska	1)
Sutjeska S-2	Sutjeska	5,50	172.50	7,50	30,75	study	Sutjeska	1)
Sutjeska S-2a	Sutjeska	5,50	90.50	3,80	15,78	study	Sutjeska	1)
Sutjeska S-3	Sutjeska	2,00	212.90	3,20	16,68	study	Sutjeska	1)
HE Kostajnica	Una	300,00	8,00	20,00	110,40	basis project	Una	1)
Basici	Janj	20,00	9,00	1,40	7,60	wmp	Vrbas	1)
Bobas	Vrbanja	0,76	20,00	0,10	0,40	n/a	Vrbas	1)
Bobas na Jakotini	Vrbanja			0,10	0,40	n/a	Vrbas	1)
Čelinac	Vrbanja	30,00	37,00	9,50	28,70	wmp	Vrbas	1)
Crkvenica	Vrbanja					n/a	Vrbas	1)

		0,12	120,00	0,10	0,35			
Cvrcka	Vrbanja	0,45	60,00	0,19	0,65	n/a	Vrbas	1)
Demici	Vrbanja	0,25	160,00	0,27	1,00	n/a	Vrbas	1)
Divici	Vrbanja	1,50	250,00	3,20	10,90	wmp	Vrbas	1)
Dragovac	Vrbanja			0,06		n/a	Vrbas	1)
Duboka	Vrbanja	0,15	170,00	0,18	0,61	n/a	Vrbas	1)
Duljci	Pliva	44,00	3,00	1,10	7,50	wmp	Vrbas	1)
Glavica	Pliva	22,00	5,00	0,90	7,10	wmp	Vrbas	1)
Grabovica	Vrbanja	15,00	52,00	6,70	13,70	wmp	Vrbas	1)
Grabovica	Vrbanja	0,35	195,00	0,49	1,70	n/a	Vrbas	1)
Gradina	Vrbanja	30,00	16,00	4,10	17,90	wmp	Vrbas	1)
Jovići	Pliva	22,00	3,00	0,60	4,20	wmp	Vrbas	1)
Jurići	Vrbanja	15,00	45,00	5,70	16,70	wmp	Vrbas	1)
Kilovat	Vrbanja	0,10	90,00	0,06	0,21	n/a	Vrbas	1)
Koritine	Vrbanja	15,00	15,00	2,00	5,50	wmp	Vrbas	1)
Kotor Varos	Vrbanja	15,00	26,00	3,40	17,50	wmp	Vrbas	1)
Krusevo	Vrbanja	1,50	15,00	0,20	1,30	wmp	Vrbas	1)
Liskovcki	Vrbanja					n/a	Vrbas	1)

potok				0,06				
Meduraca	Vrbanja	0,07	185,00	0,09	0,35	n/a	Vrbas	1)
Melina	Ugar	5,00	120,00	5,10	22,50	wmp	Vrbas	1)
Mrkonjić Grad	Crna Rijeka	4,00	80,00	2,70	7,10	wmp	Vrbas	1)
Obodnik	Vrbanja	15,00	18,00	2,40	9,10	wmp	Vrbas	1)
Orahovo	Vrbanja	15,00	15,00	1,20	3,90	wmp	Vrbas	1)
Roca	Vrbanja	0,13	200,00	0,18	0,65	n/a	Vrbas	1)
Rudina	Vrbanja	30,00	4,70	1,20	5,30	wmp	Vrbas	1)
Sibovi	Vrbanja	15,00	21,00	2,70	15,30	wmp	Vrbas	1)
Siprage	Vrbanja	7,00	79,00	4,70	11,80	wmp	Vrbas	1)
Sokoljanac	Vrbanja	0,07	260,00	0,12	0,42	n/a	Vrbas	1)
Sokoljanac	Vrbanja			0,12	0,42	n/a	Vrbas	1)
Staro Selo	Crna Rijeka	4,00	50,00	1,70	6,90	wmp	Vrbas	1)
Stopan	Vrbanja	7,00	79,00	4,70	11,80	wmp	Vrbas	1)
Suturlija Seher	Vrbanja	1,40	13,00	0,13		n/a	Vrbas	1)
Vrbanja I	Vrbanja	30,00	10,00	2,50	10,90	wmp	Vrbas	1)
Vrbanja II	Vrbanja	30,00	4,70	1,20	5,50	wmp	Vrbas	1)
Vrbanja II	Vrbanja	30,00	4,70	1,20	5,50	wmp	Vrbas	1)

Vrbanjci	Vrbanja	15,00	26,00	3,30	12,70	wmp	Vrbas	1)
Zapeće	Ugar	5,00	40,00	1,60	8,00	wmp	Vrbas	1)
MHE Sudići	Prača	8,00	51,40	3,00	24,00	basis project	Vrbnicka Rijeka	1)
MHE Zepa	Zepa	8,00	160,00	10,70	35,30	basis project	Vrbnica	1)
Vrbnica (Bjelava) VB-1	Vrbnica	4,50	91,40	2,80	10,84	study	Vrbnica	1)
Vrbnica (Bjelava) VB-1'	Vrbnica	4,50	91,40	2,90	11,07	study	Vrbnica	1)
Vrbnica (Bjelava) VB-1a	Vrbnica	6,00	91,25	3,80	11,75	study	Vrbnica	1)
Vrbnica (Bjelava) VB-1a'	Vrbnica	6,00	91,25	3,90	11,89	study	Vrbnica	1)
Vrbnica (Bjelava) VB-2	Vrbnica	0,50	296,85	1,22	3,10	study	Vrbnica	1)
Vrbnica (Bjelava) VB-2a	Vrbnica	2,20	296,70	5,20	16,06	study	Vrbnica	1)
Vrbnica (Bjelava) VB-3	Vrbnica		520,00			study	Vrbnica	1)
Vrbnica (Bjelava) VB-3a	Vrbnica	2,00	124,00	1,90	5,14	study	Vrbnica	1)
Vrbnica (Bjelava) VB-4	Vrbnica	0,60	103,50	0,46	2,15	study	Vrbnica	1)
Vrbnica (Bjelava) VB-5	Vrbnica	0,30	167,60	0,38	1,79	study	Vrbnica	1)

HPP Paklenica	Bosna	0,70		0,24		SEA	Bosna	2)
HPP Sajinkamen	Bosna	< 176		10,00		SEA	Bosna	2)
HPP Doboj	Bosna	< 176		8,00		SEA	Bosna	2)
HPP Cijevna 1	Bosna	176,00		14,10		SEA	Bosna	2)
HPP Cijevna 2	Bosna	176,00		14,20		SEA	Bosna	2)
HPP Cijevna 3	Bosna	176,00		13,90		SEA	Bosna	2)
HPP Cijevna 4	Bosna	>176		13,90		SEA	Bosna	2)
HPP Cijevna 5	Bosna	>176		12,90		SEA	Bosna	2)
HPP Cijevna 6	Bosna	>176		13,20		SEA	Bosna	2)
TOTAL				**426,965**	**1847,546**			

Q = Water Discharge

H = Gross Head

C =Installed Capacity

P = Annual Production

Wmp = Water Management Master Plan

1) = EPRS at http://www.ers.ba/pocetna.htm

2) = Final Inception Report by Pyöry 2008 SEA of River Basins of the Vrbas and Bosna/RS

Source: EP RS http://www.ers.ba/pocetna.htm retrieved 16/09/2009 15:31

Annex III Inventory in Bulgaria

Table 88: **Inventory of SHPP in Bulgaria**

SHPP	Owner	MW	Status	Built
YAKORUDA	BUSINESS BG GROUP CORRECT	0,060	in operation	1932
LEDENIK	RAITUR	0,080	in operation	1929
HUBCHA 1	DANI-M-97	0,084	in operation	1950
HUBCHA 2	DANI-M-97	0,084	in operation	1950
USTOVO 2	RODOPI HYDRO	0,084	in operation	
KAJLAKA 1	NATSIONALNA ELEK KOMP (NEK)	0,100	in operation	1960
SEVLIEVO 1	HIDRO SOFIA	0,100	in operation	2003
STARA ZAGORA MINI 1	ENERGO-PRO BULGARIA AD	0,110	in operation	1957
SINI VIR	NATSIONALNA ELEK KOMP (NEK)	0,180	in operation	1925
MEZDRA 1	NATSIONALNA ELEK KOMP (NEK)	0,190	in operation	1924
MEZDRA 2	NATSIONALNA ELEK KOMP (NEK)	0,190	in operation	1924
FALKOVETS	RUNO KAZANLAK AD	0,200	in operation	1949
MIDZUR	RUNO KAZANLAK AD	0,200	in operation	1948
RADOMIRTSI 1	FUAT GUVEN	0,200	in operation	1948
RADOMIRTSI 2	FUAT GUVEN	0,200	in operation	1948
RADOMIRTSI 3	FUAT GUVEN	0,200	in operation	1948
LUKOVIT 3	NATSIONALNA ELEK KOMP (NEK)	0,210	in operation	1946
TICHA 1	BULGARIAN ENERGY GROUP	0,220	in operation	1952
TICHA 2	BULGARIAN ENERGY GROUP	0,220	in operation	1952
BELI VIT	ELCOMMERCE-K NIKOLOV	0,240	in operation	
LUKOVIT 1	NATSIONALNA ELEK KOMP (NEK)	0,240	in operation	1946
LUKOVIT 2	NATSIONALNA ELEK KOMP (NEK)	0,240	in operation	1946
LESHNITSA 1	NATSIONALNA ELEK KOMP (NEK)	0,250	in operation	1939
LOVECH	FUAT GUVEN	0,250	in operation	1924
USTOVO 1	RODOPI HYDRO	0,250	in operation	
OSOGOVO 1	NATSIONALNA ELEK KOMP (NEK)	0,260	in operation	1925
OSOGOVO 2	NATSIONALNA ELEK KOMP (NEK)	0,260	in operation	1925
ROSITSA-3	NATSIONALNA ELEK KOMP (NEK)	0,280	in operation	1950

TROYAN-1	NATSIONALNA ELEK KOMP (NEK)	0,290	in operation	
KYUSTENDIL 1	NATSIONALNA ELEK KOMP (NEK)	0,300	in operation	1927
STUDENA 1	NATSIONALNA ELEK KOMP (NEK)	0,315	in operation	1954
STUDENA 2	NATSIONALNA ELEK KOMP (NEK)	0,315	in operation	1954
CHERNI VIT 1	INSTRUMENT GABROVO	0,380	in operation	1962
SREDNOGORTZI 1	NATSIONALNA ELEK KOMP (NEK)	0,400	in operation	2001
SREDNOGORTZI 2	NATSIONALNA ELEK KOMP (NEK)	0,400	in operation	2001
SMIRNENSKI 1	NATSIONALNA ELEK KOMP (NEK)	0,420	in operation	1962
SMIRNENSKI 2	NATSIONALNA ELEK KOMP (NEK)	0,420	in operation	1962
KOINARE 1	NATSIONALNA ELEK KOMP (NEK)	0,480	in operation	1947
KOINARE 2	NATSIONALNA ELEK KOMP (NEK)	0,480	in operation	1947
KOINARE 3	NATSIONALNA ELEK KOMP (NEK)	0,480	in operation	1947
NEVROKOP 1	NATSIONALNA ELEK KOMP (NEK)	0,490	in operation	1947
NEVROKOP 2	NATSIONALNA ELEK KOMP (NEK)	0,490	in operation	1947
PETROVO II 1	NATSIONALNA ELEK KOMP (NEK)	0,510	in operation	1949
MALUSHA	RUNO KAZANLAK AD	0,520	in operation	1940
BATOSHEVO-2 NO 1	ELEFORS	0,670	in operation	1956
BATOSHEVO-2 NO 2	ELEFORS	0,670	in operation	1956
BATOSHEVO-2 NO 3	ELEFORS	0,670	in operation	1956
BATOSHEVO-1	ELEFORS	0,740	in operation	1927
TRESHTENA	TRESHTENA HYDRO	0,756	in operation	2004
BOTUNJA 1	BOTUNJA HYDRO	0,775	in operation	2004
SIMENOVO 1	NATSIONALNA ELEK KOMP (NEK)	0,790	in operation	1925
CHIPROVTSI 1	NATSIONALNA ELEK KOMP (NEK)	0,800	in operation	1957
RAZLOG	START BLAGOVEGRAD	0,800	in operation	1952
TOPLIKA	PRIN VAT HOLDING	0,910	in operation	1949
MEZDRA 3	NATSIONALNA ELEK KOMP (NEK)	1,010	in operation	1947
MEZDRA 4	NATSIONALNA ELEK KOMP (NEK)	1,010	in operation	1947
PETROVO I 1	NATSIONALNA ELEK KOMP (NEK)	1,030	in operation	1949
PETROVO I 2	NATSIONALNA ELEK KOMP (NEK)	1,030	in operation	1949
GORNI LOM	RUNO KAZANLAK AD	1,310	in operation	1963
ROSITSA-2 NO 1	NATSIONALNA ELEK KOMP (NEK)	1,525	in operation	1960
ROSITSA-2 NO 2	NATSIONALNA ELEK KOMP (NEK)	1,525	in operation	1960
LESITCHEVO 1	DELEKTRA HYDRO	1,600	in operation	2005
LESITCHEVO 2	DELEKTRA HYDRO	1,600	in operation	2006
ASENIZITA-2	RUNO KAZANLAK AD	1,750	in operation	
KAMEN RID	FUAT GUVEN	1,750	in operation	1942

CHERNI OSUM 1	CABLE COMMERCE	2,050	in operation	1969
CHERNI OSUM 2	CABLE COMMERCE	2,050	in operation	1969
MALA TSARKVA 1	NATSIONALNA ELEK KOMP (NEK)	2,200	in operation	1933
PASTRA 1	GRANITOID AD	2,300	in operation	1925
RAKITA 1	RUNO KAZANLAK AD	2,435	in operation	1967
RAKITA 2	RUNO KAZANLAK AD	2,435	in operation	1967
TOPOLNITZA 1	NATSIONALNA ELEK KOMP (NEK)	2,630	in operation	1960
TOPOLNITZA 2	NATSIONALNA ELEK KOMP (NEK)	2,630	in operation	1960
SAMARORANOVO 1	NATSIONALNA ELEK KOMP (NEK)	2,800	in operation	1966
SIMENOVO 2	NATSIONALNA ELEK KOMP (NEK)	2,940	in operation	1933
SIMENOVO 3	NATSIONALNA ELEK KOMP (NEK)	2,940	in operation	1933
BARZIA 1	ENERGO-PRO BULGARIA AD	3,000	in operation	1956
BARZIA 2	ENERGO-PRO BULGARIA AD	3,000	in operation	1956
LAKATNIK	VEZ SVOGHE OOD	3,000	in operation	2008
SVRAZHEN	VEZ SVOGHE OOD	3,000	in operation	2008
KRESNA-1	STRUMA-1 JV	3,200	in operation	2006
PASTRA 2	GRANITOID AD	3,200	in operation	1925
RILA 1	GRANITOID AD	3,300	in operation	1928
RILA 2	GRANITOID AD	3,300	in operation	1928
VIDIMA	NATSIONALNA ELEK KOMP (NEK)	3,300	in operation	1951
KAMENITSA 1	GRANITOID AD	3,380	in operation	1940
VACHA I NO 1	NATSIONALNA ELEK KOMP (NEK)	3,500	in operation	1950
VACHA I NO 2	NATSIONALNA ELEK KOMP (NEK)	3,500	in operation	1950
VACHA I NO 3	NATSIONALNA ELEK KOMP (NEK)	3,500	in operation	1950
VACHA I NO 4	NATSIONALNA ELEK KOMP (NEK)	3,500	in operation	1950
VACHA II NO 1	NATSIONALNA ELEK KOMP (NEK)	3,500	in operation	1971
VACHA II NO 2	NATSIONALNA ELEK KOMP (NEK)	3,500	in operation	1971
KLISURA	ENERGO-PRO BULGARIA AD	3,700	in operation	1953
PETROHAN 1	ENERGO-PRO BULGARIA AD	3,780	in operation	1956
PETROHAN 2	ENERGO-PRO BULGARIA AD	3,780	in operation	1956
KALIN 1	GRANITOID AD	4,500	in operation	1948
PASAREL 3	LM IMPEX	4,500	in operation	1962
RILA 3	GRANITOID AD	4,500	in operation	1948
TUJA	NATSIONALNA ELEK KOMP (NEK)	4,900	in operation	
OGOSTA RESERVOIR	MECAMIDI-OGOSTA JV	5,000	in operation	2002
TUMRUSH 1	TRAKIJA GAS LTD	5,300	in operation	2005
KITKA	RUNO KAZANLAK AD	5,450	in operation	1953

MALA TSARKVA 2	NATSIONALNA ELEK KOMP (NEK)	5,900	in operation	1941
ASENIZITA-1	RUNO KAZANLAK AD	7,200	in operation	
SANDANSKI 1	ENERGO-PRO BULGARIA AD	7,200	in operation	1970
SANDANSKI 2	ENERGO-PRO BULGARIA AD	7,200	in operation	1970
ZHREBCHEVO 1	NATSIONALNA ELEK KOMP (NEK)	7,200	in operation	1965
ZHREBCHEVO 2	NATSIONALNA ELEK KOMP (NEK)	7,200	in operation	1965
ROSITSA-1	NATSIONALNA ELEK KOMP (NEK)	7,500	in operation	1954
BELI ISKAR 1	NATSIONALNA ELEK KOMP (NEK)	8,400	in operation	1955
BELI ISKAR 2	NATSIONALNA ELEK KOMP (NEK)	8,400	in operation	1955
KOPRINKA 1	ENERGO-PRO BULGARIA AD	8,830	in operation	1947
TOTAL/AVERAGE		**235,12**		**1955**

Source: Huber, et al.: Atlantis, Szenariomodell der Europäische Elektrizitätswirtschaft, TU-Graz, 2009

Annex IV SHPP Producers in Czech Republic

Table 89: SHPP Producers per Distribution Area in Czech Republic

Supply scope	Location	Name of company factory operated	Installed Capacity [MWe]	Annual electricity Gross / net [GWh]	Water flow
PRE Distribution	Modřany	ENERGO - FOR United, s.r.o.	**3 x 0.550**	**6.88**/ 6.743	Vltava
	Podbaba	Vltava rivers, state enterprise	**2 x 0.648**	**8.425**/ 8.425	Vltava
	CHASE	Vltava rivers, state enterprise	**3 x 1.890**	**17.174**/ 17.174	Vltava
CEZ Distribution	Venice nad Jizerou	RNDr. Ludek Liska	**2 x 0.430**	**4.013**/ 4.013	Jizera
center region	Brandys nad Labem	LobCon, s.r.o.	**2 x 0.990**	**11.186**/ 11.155	Labe
	Dražice nad Jizerou	SP Dražice s.r.o.	**0.740**	**3.315**/ 3.311	Jizera
	I HNĚVOUSICE	HYDROENERGO s.r.o.	**0.500**	**2.6** 2.602	Jizera
	Hradištko	ENERGO - FOR United, s.r.o.	**2 x 1.003**	**6.063**/ 5.944	Labe
	Kácov	Ing. Jana Válková	**2 x 0.300**	**2.743**/ 2.744	Jizera
	Klavary I	Electric power Klavarská C. I.	**2 x 0.315**	**3.038**/ 3.038	Labe
	Klavary II	Electric power Klavarská C. I.	**3 x 0.315**	**2.788**/ 2.788	Labe
	Klecany	Vltava rivers, state enterprise	**2 x 0.600**	**7.009**/ 7.009	Vltava
	Cologne	Elektrárna Kolín a.s.	**0.135, 2 x 0.325, 0.275**	**3.344**/ 3.344	Labe
	Kostelec nad Labem	Rida Consulting, a.s.	**3 x 0.700**	**6.718**/ 6.718	Labe
	Kostomlátky	ENERGO - FOR United, s.r.o.	**2 x 1.350**	**4.697**/ 4.697	Labe
	Libčice nad Vltavou	Vltava rivers, state enterprise	**2 x 2.390**	**25.993**/ 25.993	Vltava
	Lobkovice	Elbe river basin, state enterprise	**2 x 1,100**	**7.97**8 7.978	Labe
	Miřejovice	ENERGO - FOR United, s.r.o.	**5 x 0.700**	**16.174**/ 16.174	Vltava
	Nymburk	MVE-HYDRO, s.r.o.	**(2 x 0.32) + 0.256 + 0.178**	**3.639**/ 3.639	Labe
	Obříství	CEZ, s.r.o.	**2 x 1.679**	**13.994 /** 13.994	Labe
	Podebrady	1st electric power s.r.o.	**4 x 0.240**	**3.135**/ 3.135	Labe
	Three Chaloupky	PREDAX FINANCE, s.r.o.	**1.000**	**5.734**/ 5.734	Labe
	Veletov	Elbe river basin, state enterprise	**2 x 0.315**	**3.459**/ 3.459	Labe
	Vraňany	Vltava rivers, state ent.	**2.500**	11.283 / 11.283	Vltava

Supply scope	Location	Name of company factory operated	Installed Capacity [MWe]	Annual electricity Gross / net [GWh]	Water flow
E. ON Distribution	Czech Vrbné	1st electric power s.r.o.	**2 x 0.980**	**8.615**/ 8.615	Vltava
part of the West	Duropack	Duropack Bupak Papírna s.r.o.	**2 x 0.325**	**2.934**/ 2.934	Vltava
	Husinec	AQUA ENERGY s.r.o.	**0.630**	**1.638**/ 1.638	Blanice
	Plav	Water Supply and Sewerage South Bohemia, a.s.	**0.63 (3 machines)**	**2.568**/ 2.568	Malše
	Soběnov	E. ON s.r.o. Trend	**0.770 + 0.460**	**4.344**/ 4.344	Black
	Sokolský Island	AQUA ENERGY s.r.o.	**3 x 0.253**	**3.936**/ 3.936	Malše
	Římov	Vltava rivers, state enterprise	**2 x 0.500**	**3.177**/ 3.177	Malše
CEZ Distribution	Bukovec	CEZ, s.r.o.	**0.630**	**0.000**/ 0.000	Berounka
West region	PVE Black Lake 1	CEZ, s.r.o.	**1.500**	**0.065**/ 0.065	Úhlava
	Bukovec - Mill	MVE Bukovec - Mill s.r.o.	**0.540**	**0.000**/ 0.000	Berounka
	Hracholusky	CEZ, s.r.o.	**2.550**	**9.292**/ 9.292	Mže
	Skalka	Ohře Basin, state enterprise	**2 x 0.350 + 0.019**	**1.850**/ 1.850	Hea
	Otter	CEZ, s.r.o.	**2 x 3.200**	**29.597** 29.597	Otter
CEZ Distribution	Brandl	F O B O S spol. s r.o.	**2 x 0.25 + 2 x 0.16**	**1.643** 1.643	Nisa
North region	Březiny u Decina	Hydro power Ploučnice a. s.	**2 x 0.250 + 0.03**	**1.804** 1.804	Ploučnice
	Doksany	Ohře Basin, state enterprise	**2 x 0.400**	**2.492**/ 2.492	Hea
	Desna I	F O B O S spol. s r.o.	**0.500**	**1.301** 1.301	White Desna
	Ervěnický Corridor	Ohře Basin, state enterprise	**2 x 0.315**	**2.169**/ 2.169	Hea
	Františkov the Ploučnicí	A - ENERGY s.r.o.	**1 x 0.576**	**2.011**/ 2.011	Ploučnice
	Hradiště	Severočeské water mains and sewers, a.s.	**2 x 1.600**	**12.690**/ 12.690	VD Přísečnice
	Kadaň - Pokutice	Ohře Basin, state enterprise	**2.280**	**10.807**/ 10.807	Hea
	Kořenov	1st electric power s.r.o.	**0.200 + 2 x 0.360**	**2.652**/ 2.652	Nisa
	Kořenov	The first electric power Liberec spol s r.o.	**4 x 0.220**	**3.122**/ 3.122	Nisa

Supply scope	Location	Name of company factory operated	Installed Capacity [MWe]	Annual electricity Gross / net [GWh]	Water flow
CEZ Distribution	Libočany	RenoEnergie, a.s.	**2 x 0.336**	**3.348**/ 3.348	Hea
North region	Libochovice	EWA Libochovice,sro	**2 x 0.250**	**2.260**/ 2.256	Hea
	Líšný	TEODICEA s.r.o.	**2 x 0.400**	**2.64**8 / 2.585	Jizera
	Small Velen	A - ENERGY s.r.o.	**2 x 0.350**	**1.32**/ 1.324	Ploučnice
	Meziboří	ENERGO - FOR United, s.r.o.	**2 x 3.800**	**7.26**/ 7.125	VD Flaje
	Nechranice	Ohře Basin, state enterprise	**2 x 5.000**	**69.126**/ 69.126	Hea
	Friday u Loun	MVE Friday, s.r.o.	**2 x 0.250**	**2.31**/ 2.31	Hea
	Poniklá	CREDIT CENTER	**2 x 0.304**		Jizera
	Urns	CREDIT CENTER	**2 x 0.378**		Kamenice
	Rudolfov I	Elbe river basin, state enterprise	**0.720**	**1.022**/ 1.022	Labe
	Semily - Rivers	CREDIT CENTER	**2 x 0.323**		Jizera
	Spálov	CEZ, s.r.o.	**2 x 1,200**	**10.27**/ 10.071	Jizera
	Střekov	CEZ, s.r.o.	**3 x 6.500**	**80.59**/ 80.592	Labe
	Tanvald	CREDIT CENTER s.r.o.	**0.704 (4 machines)**		Kamenice
	Víska	Milan Hynek	**2 x 0.200 + 0.100**	**2.1**/ 2,1	Smědá
CEZ Distribution	Albrechtice	Ing. George Stork	**(3 uts) 0.556**	**1.588**/ 1.520	Eagle
East Region	Březhrad	VÍT and Co., spol.	**3 x 0.330**	**5.231**/ 5.231	Labe
	Dřevobrus	Mádle Martin et al.	**2 x 0.250**	**1.189**/ 1.189	Labe
	Hradec Králové	CEZ, s.r.o.	**3 x 0.250**	**3.254**/ 3.248	Labe
	Les Kingdom	CEZ, s.r.o.	**2 x 1.105**	**8.707**/ 8.538	Labe
	hellcat	Elbe river basin, state enterprise	**0.720**	**2.688**/ 2.688	Labe
	Pleasure	Elbe river basin, state enterprise	**0.675**	**0.267**/ 0.267	Labe
	Pardubice	CEZ, s.r.o.	**1.960**	**5.98**/ 5.853	Labe
	Grassland I	CEZ, s.r.o.	**3.000**	**5.536**/ 5.502	Wild eagle
	Pracov	CEZ, s.r.o.	**9.750**	**11.284**/ 11.112	Chrudimka
	Předměřice	CEZ, s.r.o.	**2.100**	**6.518**/ 6.464	Labe
	Přelouč	CEZ, s.r.o.	**2 x (0.680 +0.490)**	**8.749** 8.566	Labe
	Sec	ENERGO - FOR United, s.r.o.	**3.120**	**4.342**/ 4.259	Chrudimka
	Smiřice	ENERGO - FOR United, s.r.o.	**2.400**	**10.925**/ 10.719	Labe
	Srnojedy	KIPP, s.r.o.	**2 x 0.980**	**8.159**/ 7.885	Labe

Supply scope	Location	Name of company factory operated by	Installed Capacity [MWe]	Annual electricity Gross / net [GWh]	Water flow
E. ON Distribution	Brno - Kníničky	CEZ, s.r.o.	**3.100**	**6.841**/ 6.841	Svratka
part of the East	Bulgarians	RenoEnergie, a.s.	**(2 machines) 0.720**	**3.504**/ 3.504	Thaya
	Hodonín	Incos a.s.	**2 x 0.960**	**7.616**/ 7.527	Morava
	Mohelská Mill	AMAPRINT - Kerndl, s.r.o.	**0.770 (3 machines)**	**0.336**/ 0.326	Jihlava
	New Mills	Morava River basin, state enterprise	**2.210 + 0.200**	**11.123**/ 11.123	Thaya
	Spytihněv	CEZ, s.r.o.	**2 x 1.300**	**7.616**/ 7.602	Morava
	Ravi	ENERGO - FOR United, s.r.o.	**2 x 0.900 + 1.000**	**6.82**/ 6.689	Morava
	Vortex I	E. ON s.r.o. Trend	**6.000 + 1.100**	**14.657**/ 14.564	Svratka
	Vortex II	E. ON s.r.o. Trend	**1 x 0.742**	**2.534**/ 2.499	Svratka
	Vranov	E. ON s.r.o. Trend	**3 x 6.300**	**23.04**/ 22.904	Thaya
	Znojmo	E. ON s.r.o. Trend	**0.670 + 0.680**	**6.233**/ 6.116	Thaya
	Želivka	1st electric power s.r.o.	**1.260 + 0.350 + 0.550**	**3.543**/ 3491	Želivka
CEZ Distribution	boundary	Unipol spol. s r.o.	**0.63**	**1.904**/ 1.904	Bečva
Moravia region	Kružberk	ENERGO - FOR United, s.r.o.	**4.380**	**16.328**/ 16.03	Moravice
	Přerov	Přerov MVE s.r.o.	**0.500**	**1.492**/ 1.492	Morava
	Silesian Harta	Odra river basin, state enterprise	**2.650 + 0.400**	**20.372**/ 20.143	Moravice
	Chance	Odra river basin, state enterprise	**0.200 + 0.830**	**5.266**/ 4.825	Ostravice
	Lhotka	Odra river basin, state enterprise	**0.628**	**1.828**/ 1.753	Odra
	Troubky	Tubes MVE s.r.o.	**0.500 + 0.200**	**0.608** 0.608	Morava
	Žimrovice	ORC group s.r.o.	**0.550**	**3.738**/ 3.738	Moravice

Source: http://www.eru.cz/user_data/files/statistika_elektro/rocni_zprava/2008/

Annex V Inventory of SHPP in Turkey

Table 90: Inventory of SHPP – Production Characteristics of SHPPs in operation in Turkey

SHPP	No of Units	Unit Capacities	Installed Capacity (MW)	Theoretical Generation per year (GWh)	Achievable Production (Gwh)	BULUNDUĞU	
						Province	River
ARPAÇAY	1	,062	0,06	0,30	-	KARS	
AKCAKOCA	1	0.064	0,06	0,40	-		
ÇAMARDI	2	,069	0,07	0,50	-		
BOZKIR	2	0,05*2	0,08	0,20	-	KONYA	
DEVREKANİ	2	,038*2	0,08	0,30	-		
ORUÇLU ARTVİN	1	0.077	0,08	0,30	-		
GÖKSUN	1	,084*1	0,08	0,40	-		
PINARBAŞI	1	0.099	0,10	0,70	-		
ÇUKURCA NARLI	1	0.112	0,11	0,50	-	HAKKARİ	
ÇEMİŞGEZEK	1	,056*1+1*0,060	0,12	0,70	-		
LADİK	1	0.125	0,13	0,50	-	SAMSUN	
AKYAZI(PAZARKÖY)	2	,89+1*0,088	0,18	0,50	-	SAKARYA	
KOYULHİSAR	2	0.1	0,20	0,50	-		
AHLAT	2	0.1	0,20	1,00	-		
DARENDE	2	,160*1+0,08*1	0,24	1,00	-		
İZNİK DEREKÖY	2	0,12*2	0,24	1,50	0,50	BURSA	
HENDEK ARAKLI	2	0,132*2	0,26	1,00	1,00	SAKARYA	
VARTO	2	0,132*2	0,26	1,00	-	MUŞ	
BESNİ	1	0.3	0,27	0,30	-	ADIYAMAN	
DÖRTYOL KUZUCULU	2	0,136*2	0,27	1,00	-	HATAY	
İNEGÖL CERRAH	2	0,136*2	0,27	1,50	1,00	BURSA	
ESENDAL	1	0.3	0,30	1,00	-		
BAĞCI SU ÜRÜNLERİ			0,30	2,30		MUĞLA	
ERKENEK	2	0,16*2	0,32	1,60	1,00		
ÇAL	3	0.108*3	0,33	0,40	-		
GÜLNAR ZEYNE	1	0.326	0,33	2,40	-	İÇEL	D.AKDENİZ
BOZÜYÜK	2	0,120*2	0,36	1,00	0,50	BİLECİK	
ADİLCEVAZ	2	0,197*2	0,39	1,50	1,00	BİTLİS	
BAYBURT	2	1*,192+1*204	0,40	0,50	-		

KARS	*2*	*0,2*2*	*0,40*	*1,40*	*0,50*	*KARS*	
OSMANİYE-KARAÇAY	*2*	*0,2*2*	*0,40*	*2,80*	*1,00*	*ADANA*	
SİLİFKE	*1*	*0,1*2+0,4*	*0,40*	*2,30*	*2,00*		
DERE	*2*	*0,22*2*	*0,44*	*1,50*	*1,00*	*KONYA*	
KAYADİBİ(BARTIN)	*3*	*2*,152+1*,160*	*0,46*	*2,50*	*2,50*		
M.KEMALPAŞA	*2*	*0,184*1+1*,288*	*0,47*	*1,00*	*-*	*BURSA*	
BOZYAZI	*2*	*0,242*2*	*0,48*	*1,50*	*1,00*	*İÇEL*	*D.AKDENİZ*
KADİRLİ(DEĞİRMENDERE)	*1*	*0.5*	*0,50*	*1,00*	*-*	*ADANA*	
YEŞİLLER			*0,50*	*1,50*		*KIRŞEHİR*	
TURUNÇOVA(FİNİKE)	*3*	*,184*3*	*0,55*	*1,00*	*-*	*ANTALYA*	*ALAKIR Ç.*
BOTAN	*3*	*,5*2+0,7*	*0,58*	*7,00*	*5,00*	*SİİRT*	*DİÇLE*
ULUDERE	*2*	*0,320*2*	*0,64*	*1,00*	*-*	*HAKKARİ*	
ZDİĞER AKS			*0,70*				
DURUCASU	*2*	*0,4*2*	*0,80*	*3,00*	*2,00*	*AMASYA*	*YEŞİLIRMAK*
ERCİŞ	*2*	*0,4*2*	*0,80*	*1,50*	*0,50*	*VAN*	*VAN KAPALI*
KERNEK	*1*	*0.832*	*0,83*	*2,20*	*-*	*MALATYA*	
ANAMUR	*2*	*0,4*2*	*0,84*	*3,00*	*2,50*	*İÇEL*	*D.AKDENİZ*
MUT	*2*	*0,44*2*	*0,88*	*3,50*	*1,50*	*İÇEL*	
İVRİZ			*1,00*	*3,00*		*KONYA*	
DÜZPAN AĞA			*1,00*	*7,50*		*BOLU*	
IŞIKLAR	*2*	*0,52*2*	*1,04*	*2,50*	*-*		
ERMENEK	*2*	*0,56*2*	*1,12*	*0,40*	*-*	*KONYA*	
MALAZGİRT	*2*	*0,608*2*	*1,22*	*2,50*	*2,00*	*MUŞ*	
HAKKARİ OTLUCA	*2*	*0,64*2*	*1,28*	*2,50*	*1,30*	*HAKKARİ*	
BÜNYAN	*3*	*0,32*2+0,72*	*1,36*	*4,00*	*4,00*	*KAYSERİ*	
SU ENERJİ			*1,80*	*8,70*		*ÇANAKKALE*	
SÜTCÜLER HES			*2,00*			*ISPARTA*	*AKSU Ç.*
AHİKÖY 1			*2,10*	*11.430,00*			
KUZGUN	*1*	*2,3*	*2,30*	*9,20*		*ERZURUM*	
AHİKÖY2			*2,50*	*11.300,00*			
KAYAKÖY	*2*	*1,28*2*	*2,56*	*7,00*	*6,00*	*KÜTAHYA*	*SUSURLUK*
KİTİ	*2*	*1,38*2*	*2,76*	*12,00*	*10,00*	*KARS*	*ARAS*
MOLU			*2,80*	*20,40*		*KAYSERİ*	
MURGUL-1			*3,00*	*9,00*		*ARTVİN*	
GİRLEVİK	*3*	*1*2+1*1,04*	*3,04*	*18,00*	*10,00*	*ERZİNCAN*	*FIRAT*

BEREKET			*3,20*	*26,00*		*DENİZLİ*	
ZERNEK(HOŞAP)	*2*	*1,75*2*	*3,50*	*13,00*	*6,00*	*VAN*	*VAN KAPALI*
CEYHAN	*3*	*1,2*3*	*3,60*	*20,00*	*12,00*	*K.MARAŞ*	
ENGİL	*3*	*1,53*3*	*4,59*	*14,00*	*12,00*	*VAN*	*VAN KAPALI*
ATAKÖY	*1*	*4,8*	*4,80*	*8,00*	*8,00*	*TOKAT*	*YEŞİLIRMAK*
DERME			*5,00*	*34,00*		*MALATYA*	
SU ENERJİ			*5,00*	*34,00*		*BİLECİK*	
YÜREYİR	*1*	*6*	*6,00*	*21,00*	*19,00*	*İÇEL*	*SEYHAN N.*
KEPEZ 2	*2*	*3*3*	*6,00*			*ANTALYA*	
SIZIR	*3*	*2,26*3*	*6,78*	*50,00*	*35,00*	*SİVAS*	
SEYHAN-II	*3*	*2,4*3*	*7,20*	*27,00*	*20,00*	*ADANA*	*SEYHAN N.*
KOVADA I	*3*	*2,75*3*	*8,25*	*3,00*	*2,00*	*ISPARTA*	*AKSU Ç.*
KOÇKÖPRÜ	*4*	*2,2*4*	*8,80*	*25,00*	*15,00*	*VAN*	
BEREKET ENERJİ			*8,90*	*32,00*		*AYDIN*	
KAREL ENERJİ			*9,30*	*42,30*		*SAKARYA*	
HASANLAR	*2*	*4,8*2*	*9,60*	*42,00*	*9,00*	*BOLU*	*MELEN Ç.*
KISIK	*3*	*3,2*3*	*9,60*	*32,00*	*-*	*K.MARAŞ*	*CEYHAN N*
BERDAN HES	*3*	*3,3*3*	*10,00*	*48,00*	*10,00*	*İÇEL*	*TARSUS Ç.*
GÖKSU	*3*	*3,6*3*	*10,80*	*70,00*	*60,00*	*KONYA*	*D.AKDENİZ*
TOHMA HES			*12,50*				
ÇAĞ ÇAĞ	*3*	*4,8*3*	*14,40*	*42,00*	*32,00*	*MARDİN*	*FIRAT*
TERCAN	*3*	*5*3*	*15,00*	*51,00*	*18,00*	*ERZİNCAN*	*FIRAT*
İKİZDERE	*3*	*5,04*3*	*15,12*	*110,00*	*100,00*	*RİZE*	*D.AKDENİZ*
ÇILDIR	*3*	*5,12*3*	*15,36*	*30,00*	*20,00*	*KARS*	*ARAS*
AKSU(ÇAYKÖY)	*2*	*8*2*	*16,00*	*36,00*	*35,00*	*ISPARTA*	*AKSU Ç.*
TORTUM	*4*	*7,5*2+2*5,6*	*26,20*	*100,00*	*85,00*	*ERZURUM*	
KEPEZ 1	*3*	*8,8*3*	*26,40*	*200,00*	*130,00*	*ANTALYA*	
ALMUS	*3*	*9*3*	*27,00*	*100,00*	*30,00*	*TOKAT*	*YEŞİLIRMAK*
BİLGİN ELEKTRİK	*5*	*6*5*	*30,10*	*192,00*	*24,00*	*ELAZIĞ*	*HAZAR*

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