MSc Program

**Renewable Energy in Central & Eastern Europe**

# Potential of Small Hydro Power in Slovakia

A Master Thesis submitted for the Degree of

"Master of Science"

Supervised by

Ao.Univ.Prof. Dipl.-Ing. Dr.techn. Reinhard Haas

DI Alexander Simader

9040337

Vienna, October 27th 2009

# Affidavit

I, **Alexander Simader**, hereby declare

1. that I am the sole author of the present Master Thesis,
   'Potential of Small Hydro Power in Slovakia´,
   <60> 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, October 27th 2009 _____

Date Signature

## Abstract

Alexander Simader has worked in Slovakia since 2000. His main work has been the privatization of municipal services, as well as project development in waste management. Together with his Slovakian team he has developed a biomass heating plant with 7 MW for the Eastern Slovakian City Rimavska Sobota in 2009.

In Slovakia the development of energy infrastructure has got more and more important in the last years. Especially private investors have a focus on renewable energy projects with all kind of technologies.

This master thesis deals with the potentials for new projects of small hydro power in Slovakia. The definition of small hydro power belongs to a maximum capacity of less than 10 MW. Indeed the average power of such plants is less than 500 kW.

There are currently 200 hydro power plants in operation in Slovakia and the author asks if there is enough space for new SHPs, especially in artificial channels where new investments would be smaller than in natural rivers. By the way in these channels could be a much faster development process because of shorter EIA procedure.

The results are some potential places for new small hydro plants. Furthermore the master thesis gives answers to all important market parameters, like legislation, feed-in tariffs and national energy parameters.

The master thesis interprets the national legislative of renewable energy and the national support for SHP.

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## 1. Introduction and Motivation

Utilization of renewable energy sources (RES) seems more and more one of preliminary assumptions for securing the sustainable development of the society. European Union's ambitious target is to reach 20% share of renewables on total energy consumption until 2020.[1] This target can be reached by systematic implementation of BAT-technologies based on renewable energy sources. In case of hydro electricity this could be Micro-SHP with a minimum power of 10 kW.

There is currently no coordinated capacity expansion planning, either in Austria or at the EU level. Incentives arise to invest fully in new capacity for companies in the market only, when it is assured that the prices will be long term above the level of long term marginal cost of production.[2] Therefore, the study placed a focus on easily accessible and locations which could be easily realized for SHP´s. Slovakia does not have the SHP potential, which is available for example in the Alpine regions in Austria[3], but there are many artificial channels with fixed dams, which could be used for new hydroelectric technologies very well (e.g. Drinking Water Power Stations for Vienna). So the master thesis will look at chances for connection of rivers with existing channels, too.

In Slovakia, there exists a master plan for the further development of small hydropower. On the other hand, there is no intention to create more specifying local or regional development plans.
Small hydro power is defined as installed hydropower capacity of up to 10 MW. There exists approximately 200 SHPs in Slovakia, but not all of them are registered. Various sources speak about different potentials, but with a relatively high electrical power (10 MW). There is no information about the potential for SHP´s with power less than 500 kW. The average size of a SHP plant is about 0.44 MW (0.70 MW in EU-15) in Europe.[4]

This study should provide independent and accurate status analysis and review of the potential for electricity generation by small hydro power plants with less than 500 kW in Slovakia and provide a map of promising sites for this particular technology.

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[1] COMMISSION OF THE EUROPEAN COMMUNITIES; Renewable Energy Road Map - Renewable energies in the 21st century: building a more sustainable future (2007)
[2] Haas R., Auer H. (2004)
[3] Pelikan B. (2005)
[4] Punys, P; Pelikan, B. (2007)

The objective should be reached by fulfilling the following tasks:

- To analyse the energy sector conditions;
- To analyse the economic and legislative framework related to hydro power generation and sale including the market conditions, grants and other tools for the promotion of small hydro power generation;
- To analyse the status of large water consumers of cooling and process water of individual industry types including the assessment of the present economic climate of the industry in question and market allocation with the target of investments in SHP
- To analyse the status of water channels suitable for small hydro power generation including the essential technical data;
- To estimate the market potential;
- To prepare an extensive list of possible locations for SHP

## 1.1 Goal of the Master thesis and Research Questions:

1. How big is the potential for new small hydro power plants in Slovakia which could be realized quickly?
2. Does Slovakia have a strategy for electricity of small hydro power?
3. Does the eligibility requirements of the state match to the free potential of hydro power?

## 2. Assumptions and Method

### 2.1 Data Collection & Information Sources

#### 2.1.1. General & Legislation Data

The main source of the general overview of the energy sector in Slovakia and its related legislation was the web page of The Ministry of Economy of Slovakia.
Statistic data has been taken either from the Slovak Statistic Office or Eurostat.

#### 2.1.2. Market Data

Information for the overview of the energy market in Slovakia has been compiled from several various sources – URSO (State Regulatory Office for Network Industries), public information portal for environmental impact assessment process and web pages of individual energy companies.

Information on industrial cooling & process water consumers has been acquired upon request from SHMU (Slovak Hydrometeorological Institute). It is a summarized record of water use permissions of state offices for surface water use and discharge of wastewater into the surface water bodies. It contains information on the subject (name, seat, location of the plant), basic kind of water use and the amounts of water (volumes per year). The information has been provided in an Excel-file.

#### 2.1.3. Technical Data

Collection of technical data was confronted with an unexpected lack of available information on the subject of the water channels. The background is the very inadequate level of the monitoring and records keeping system on a national basis.

The responsibilities of the water management in Slovakia are divided among four state organisations, three founded by Ministry of Environment – "SHMU" Slovak Hydrometeorological Institute, "SVP" Slovak Water Management Enterprise and "VUVH" Water Research Institute and one belonging under Ministry of Land Management – "HM" Hydro Meliorations.
The study has been primarily focused on the water channels as artificial, manmade waterways. The reason for this was that the channels have some of the structures (e.g. side walls) already built which could be used for the SHP which lower investments.

Another point was an assumed faster environmental impact assessment process due to lack of original natural biotopes. There is a national documentation of waterways classified as water channels at SVP but the information contained therein is very limited.

Responsibility for management of the individual channels lies with various operators:

- Hydro meliorations operate the different irrigation channels
- Slovak Water Management Enterprise

However, most of these subjects do not monitor or keep records of the specific parameters required by this study.
Due to the specific data missing there was need to define and apply new method of input data gathering and a throughout research of all available information sources related to water management has been done.

**List and description of information sources:**

**Slovenský Vodohospodársky Podnik, a.s. (hereafter ŠVP)**

**Slovak water management company**

List of water channels contains information on all water bodies characterized as channels: name, identification number, hydrological system number, length, map number, name of the manager. Although the water bodies are listed as "channels" there is no guarantee that their character is in full accordance with the primary assumptions – the walls and no biotopes. Due to historical water management in Slovakia many of the channels have been actually built in order to preserve or maintain the original natural environment, especially while changing the original course of the river when building water dams, irrigation of the agricultural land or as the flood-prevention measures; typical example is the complex system of channels in southern Slovakia, especially on Danube – so called Žitný ostrov area.

**Slovenský hydrometeorologický ústav, š.p. (hereafter SHMU)**

**Slovak Hydrometeorological Institute**

Selected data from 373 water measurement stations published on annual basis contain average monthly flows, average annual flows, maximum culminated hour flows and minimum average daily flows for years 2001-2007. Long term (up to 50 years monitoring) data is available to purchase. Information pays for the exact point of the monitoring station. The information is available online at www.shmu.sk/sk/?page=25.

**Výskumný ústav vodného hospodárstva (hereafter VUVH)**

**Slovak Water Research Institute**

VUVH is the only institution in Slovakia providing the complex water management research and other related activities resulting from the needs of water management of the Slovak Republic. Basic Activity of the Institute is scientific research, expertise and development activity, professional water management consulting and dealing with water management - ecological problems.

- List of water bodies with flowing water (category of rivers) as a part of EU Water Framework Directive implementation contains list of 1737 water bodies which are being evaluated according to the rules of the Directive.
- The data are part of the document "Proposal of the River-basins Management Plans in SR"[5] available in pdf file at http://www.vuvh.sk/rsv/docs/PMP/prilohy.

There are still water bodies "in testing" and there are a lot of water bodies with "no data". In addition, the works are focused on the main and 2nd level rivers only; rarely to the 3rd level and all water bodies of length under 2 km have been excluded from the evaluation. That restricts the utilization of this data for the purpose of this study.

**Hydromeliorácie, š.p. (hereafter HM)**

**Hydro meliorations**

Hydro meliorations is state enterprise owning, operating and renting hydro melioration and de/watering installations in Slovakia.

- The information on the water channels in responsibility of HM has been provided upon personal interview with Mr. Ing. Mihálek from the water channels section of HM. According to this interview all the water channel HM is managing are seasonally used only (from April till October); the water is standing and has very little flow in them (only 1 channel has flow over 3 $m^3/s$).

[5] Holubová Katarína

## 2.2. Creation of the List of Possible Locations

The checklist is a list of the necessary basic data to be collected in order to assess the water channels and their suitability for SHP.
The basic formula for the calculation of the energy potential[6]:

$$P = Q * \rho * g * \eta * H$$

P – Capacity Output, [kW]

Q – Water flow, [$m^3/s$]

ρ – Density of water, [$kg/m^3$]

g – Acceleration of gravity is a constant; 9,81 $m/s^2$

η – Efficiency of the technology [%]; the declared efficiency of the technology in question is 70%

H – head, [m]

According to the formula the necessary data to fill in are the water flow and the head. Due to the type of information available there was no possibility to gather data on the head or the slope of neither the rivers nor the water channels. Therefore the head had to be taken as a constant, too. According to the basic technical details on SHP- turbine construction and size of smallest turbine it has been assumed that the head of 1,5 m is reached by the installation itself and this value has been therefore used as the minimum reference value for the furthers calculations.
The search for potential SHP sites has been carried out with the focus on estimated output of 100 kW with two additional indication levels at 50 kW and 250 kW. [7]

With all the other values being constant the water flow was the only variable parameter. The necessary water flow for given minimum output of 50 kW is 3,3 $m^3/s$. Therefore this value has been used for evaluation and selection of potential waterways (rivers and channels) further on.

[6] Bretschneider (1993) p.652

[7] „In jedem Fall lauten die Trends ‚hoher Wirkungsgrad' und ‚ökologische Verträglichkeit'." (Werner Panhauser, Kössler GmbH)

**Table 1** - Calculation of necessary water flow for energy output 50 kW

| **Potential output $P_{pot}$ [kW]** | **Usable head [m]** | **Flow Q [m³/sec]** |
|---|---|---|
| 50 | 0,5 | 10,0 |
| 50 | 1,0 | 5,0 |
| 50 | 1,5 | 3,3 |
| 50 | 2,0 | 2,5 |
| 50 | 2,5 | 2,0 |
| 50 | 3,0 | 1,7 |
| 50 | 3,5 | 1,4 |
| 50 | 4,0 | 1,3 |

**Table 2** - Calculation of necessary water flow for energy output 100 kW

| **Potential output $P_{pot}$ [kW]** | **Usable head [m]** | **Flow Q [m³/sec]** |
|---|---|---|
| 100 | 0,5 | 20,0 |
| 100 | 1,0 | 10,0 |
| 100 | 1,5 | 6,7 |
| 100 | 2,0 | 5,0 |
| 100 | 2,5 | 4,0 |
| 100 | 3,0 | 3,3 |
| 100 | 3,5 | 2,9 |
| 100 | 4,0 | 2,5 |

**Table 3** - Calculation of necessary water flow for energy output 250 kW

| **Potential output $P_{pot}$ [kW]** | **Usable head [m]** | **Flow Q [m³/sec]** |
|---|---|---|
| 250 | 0,5 | 50,0 |
| 250 | 1,0 | 25,0 |
| 250 | 1,5 | 16,7 |
| 250 | 2,0 | 12,5 |
| 250 | 2,5 | 10,0 |
| 250 | 3,0 | 8,3 |
| 250 | 3,5 | 7,1 |
| 250 | 4,0 | 6,3 |

## 2.3. Data Processing

Due to the non-existence of specific data on water channels there was the need to gather more details out of various information sources. These data sets have been put together in aim to "zoom in" to deeper detail and the results from their penetration have been "filtered" in order to sort out the potential sites with desired parameters for the list of potential sites for SHPs.

1. The rivers have been evaluated according the data of the flow in individual monitoring stations. Data of averaged annual flows of years 2001 – 2007 have been considered and averaged. The monitoring stations where this 2001-2007 average annual flow has been higher than 3,3 $m^3/s$ have been used as starting points for the river parts with potential for the SHP. The potential river parts have been highlighted in the maps.

2. The maps of potential river parts have been compared with maps of protected areas – Natura 2000 and the national system of protected areas. The river parts situated in the protected areas have been excluded.

3. The list of water channels has been processed: the melioration channels have been excluded and the remaining channels have been sorted according to the rivers they are connected to and sequenced according to the position – from those closest to the river spring to those closer to the river mouth or country border. The channels connected to the river parts resulted from the step 2 have been selected as the potential water channels.

4. The list of surface water consumers and discharges of wastewater to surface waters has been processed: the annual volumes of water have been used to calculate the actual water flow in $m^3/s$. The subjects using less than 3,3 $m^3/s$ have been filtered out.

## 3. Overview of Slovakia

Slovakia, with its mountains and rivers, has a large hydropower potential. However, this is used traditionally strong. It is estimated that already 53% of the potential are used[8].

### 3.1. Overall Hydro Morphological Situation

The major part of the river network in Slovakia is a part of the Danube basin, and only a small part is draining north to the Wisla basin.[9] The discharge and hydro morphology in many of the larger rivers in Slovakia is highly regulated. Dams and regulated reservoirs are very important due to power production, transport and water supply. In parts of the river network, adjacent canals are constructed, and only a minor part of the water is directed to the "natural" river bed. In these rivers the hydrological and hydro morphological conditions in channel and flood plains are highly modified, and very altered compared to natural conditions.

In the mountainous parts of the country, which covers a major part, a part of the small and medium sized rivers in general obtain their natural hydrological regime and hydro morphological characteristics with high gradients, large and quick variations in flow and coarse bed material.
In the lowland rivers, where agriculture is the predominant land use, many of the smaller streams are regulated and canalized (straightened) to provide drainage and irrigation facilities. The runoff in the lowland areas is quite small compared to the mountainous areas.

The Slovak hydrometric station network includes about 390 gauging stations. Water level is monitored continuously at the stations, and at 373 of the stations the discharge is measured. The major part of the stations has been in operation for several decades, and a few stations have a continuous time series for more than 100 years. The network is homogeneously distributed geographically and in the range of all river sizes. It covers the range of catchment size from very small (<10 km²) up to very big (170.000 km² in the Danube).

At 168 of the stations the water temperature is being measured, and suspended sediment is measured at 16 of the stations. The Slovak Hydrometeorological Institute (SHMI) operates the stations, including the discharge measurements, data handling, interpretation and storage. 4 local branches of

[8] Hromada (2001)
[9] Kriš (1996)

SHMI, situated in the different parts of Slovakia, are responsible for their part of the network. A part of the station network is equipped with electronic devices and on-line connections, and is included in the national flood-warning system. Daily values of level and discharge are stored in a central database in SHMI, Bratislava. Data from the network is published in annual reports, including tables, hydrographs and maps. All time series on discharge is included in the database, but some of the old water stage data is only available in paper form.

To characterize the extreme discharge and runoff regime the T-year (e.g. 1 year, 10 year) event is used for the maximum events and the M-day discharge for the low flow events (e.g. 355- day, 364-day discharge).

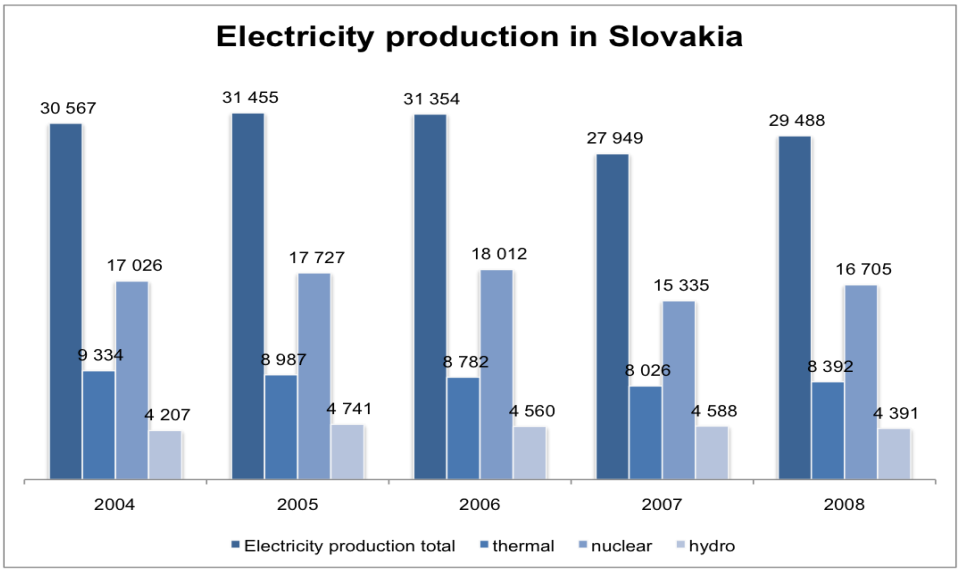
### 3.2. Energy Mix of Slovakia

The energy system in Slovakia is characterized by an extensive natural gas distribution system, a high dependence on fossil fuels, a significant share of nuclear power in the electricity mix and its importance as a transit route for both gas and electricity. Energy demand is dominated by industry, which accounts for 42% of final energy and 50% of electricity consumption. The iron and steel sector alone accounts for 46% of the energy consumption in the industry. Among all fuels, natural gas accounts for the highest share (29%) and is used widely in households, the services sector, and the industry as well as for energy use in the chemical industry.
The electric power sector is dominated by nuclear, which took a share of 57% in gross electricity generation in 2006, and has accounted for much of the increase since 1991. The share of coal decreased from 26% to 17% over this period while hydro increased in share from 8% to 15%.

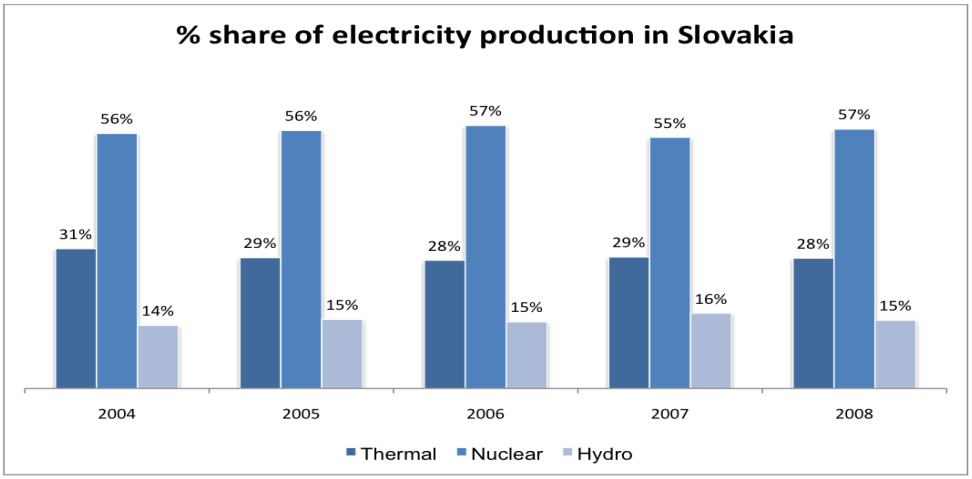
#### 3.2.1. RES Share, Hydro Power, SHPs

**Table 4 -** Electricity production in Slovakia [GWh] and % (Source: Eurostat, 2009)

| in GWh | 2004 | | 2005 | | 2006 | | 2007 | | 2008 | |
|---|---|---|---|---|---|---|---|---|---|---|
| Prod-uction | 30 567 | 100,0% | 31 455 | 100,0% | 31 354 | 100,0% | 27 949 | 100,0% | 29 488 | 100,0% |
| Thermal | 9 334 | 30,5% | 8 987 | 28,6% | 8 782 | 28,0% | 8 026 | 28,7% | 8 392 | 28,5% |
| Nuclear | 17 026 | 55,7% | 17 727 | 56,4% | 18 012 | 57,5% | 15 335 | 54,9% | 16 705 | 56,7% |
| Hydro | 4 207 | 13,8% | 4 741 | 15,1% | 4 560 | 14,5% | 4 588 | 16,4% | 4 391 | 14,9% |




**Graph 1** – Electricity production in Slovakia (Source: Eurostat, 2009)




**Graph 2** - Share of electricity production in Slovakia in % (Source: Eurostat, 2009)

**Table 5** - Hydroelectricity generation in Slovakia - comparison to EU and neighbour countries [GWh] (Source: Eurostat, 2009)

| | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 |
|---|---|---|---|---|---|---|---|
| EU (27 countries) | 381 936 | 402 051 | 347 929 | 338 307 | 357 147 | 341 388 | 344 614 |
| EU (25 countries) | 364 207 | 384 957 | 329 179 | 321 747 | 337 271 | 316 451 | 321 679 |
| EU (15 countries) | 345 325 | 365 630 | 310 188 | 306 596 | 318 438 | 297 074 | 303 546 |
| Czech Republic | 2 313 | 2 467 | 2 845 | 1 794 | 2 562 | 3 027 | 3 257 |
| Hungary | 178 | 186 | 194 | 171 | 205 | 203 | 186 |
| Austria | 43 498 | 41 837 | 42 004 | 35 292 | 38 966 | 38 612 | 37 664 |
| Poland | 4 115 | 4 220 | 3 906 | 3 293 | 3 691 | 3 778 | 3 020 |
| **Slovakia** | **4 975** | **5 117** | **5 483** | **3 672** | **4 207** | **4 741** | **4 560** |

There are 25 big hydroelectric power plants build in Slovakia with the installed capacity of 2.446

MW. The biggest power plant is the VD Gabčíkovo with the installed capacity of 720 MW10, which delivers over 50% of all renewable electricity, produced with hydropower in Slovakia. 4 pump storage power plants with the total of 917 MW installed capacity (Čierny Váh 735 MW, Liptovská Mara 98 MW, Ružín 60 MW, Dobšiná 24 MW)11 are used for the peak load and as an emergency reserve.

From the technical potential of hydroelectric power plants of 5.600 GWh shows us utilization rate close to 75%.

The technical potential for small hydropower (SHP's) of 1.000 GWh (18% of the hydroelectric potential) is currently used under 25%. The rest of the technical potential of 750 GWh, after evaluation of environmental aspects and other constraints, it is reduced to an range of 400 to 450 GWh, which respond to an installed capacity of close to 100 MW, according to the Ministry of Economy of Slovak Republic.

**Table 6** – Hydro power potentials in Slovakia (Source: Ministry of Economy of SR)

| Energy Source | Total potential | | Technical potential | |
|---|---|---|---|---|
| | TJ | GWh | TJ | GWh |
| Hydro energy total | 23 760 | 6 600 | 23 760 | 6 600 |
| *Hydroelectric power plants* | *20 160* | *5 600* | *20 160* | *5 600* |
| *Small hydropower* | *3 600* | *1 000* | *3 600* | *1 000* |
| Other RES (biomass, biogas, wind, geothermal, solar) | 194 831 940 | 54 119 900 | 179 140 | 49 750 |
| Total | 194 855 700 | 54 126 500 | 202 900 | 56 350 |

**Table 7** - Hydro power potentials and utilization in Slovakia (Source: Concept of exploitation of RES in Slovakia, MoE SR)

| Energy source | Technical potential | | Recent exploitation | | Unused potential | |
|---|---|---|---|---|---|---|
| | TJ | GWh | TJ | GWh | TJ | GWh |
| Small hydro power | 3 722 | 1 034 | 727 | 202 | 2 995 | 832 |
| Hydropower | 23 785 | 6 607 | 18 335 | 5 093 | 5 450 | 1 514 |

The potential of SHP's to the total RES utilization in Slovakia isn't very substantial (only 1.000 GWh to 56.350 GWh, which is not even 2% of total potential), due to considerable reserves in utilization of solar, geothermal and biomass sources. The technical potential shows the maximum

[10] Hromada (2001)
[11] ECB – Energy Center Bratislava (2007)

possible sources, which have been raised by the technical point of view. The cost effectiveness puts some other view in the utilization of hydropower, esp. SHP's, which shows also the next table, where only increase of 100 GWh between 2005 and 2010, respectively another 100 GWh between 2010 and 2015 should be reached in best case scenario. This increase represents installed capacity of about 100 MW in SHP (all technologies), for which round 250 possible locations are determined.

**Table 8** - Electricity production targets in 2010 to 2015 with SHP [GWh] (Source: Ministry of Economy of SR)

| | 2005 | 2010 | 2015 |
|---|---|---|---|
| Small hydro power | 250 | 350 | 450 |

**Table 9** - Sources of electricity in Slovakia [GWh] (Source: Statistical Office of Slovak republic)

| | 2005 | 2006 | 2007 | 2008 |
|---|---|---|---|---|
| Gross electricity production | 31 508 | 31 354 | 27 949 | 29 488 |
| Hydroelectric plants | 4 724 | 4 560 | 4 588 | 4 391 |
| % Contribution of hydropower | 14,99% | 14,54% | 16,42% | 14,89% |

## 3.3. Legal Environment

### 3.3.1. Energy and RES - Related Acts

- Act Nr. 656/2004 Coll. on energetic from z 26.októbra 2004 with amendments
- Act. Nr. 73/2009 Coll., which amends and complements the act Nr. 656/2004 Coll. which took effect at 15/3/2009
- Act No. 276/2001 Coll. on Regulation in Network Industries
- Act No. 107/2001 Coll. amending and supplementing the Act No. 276/2001 Coll. on Regulation of Network Industries (hereinafter only „the Act on Regulation") entered into effect on 15 March 2007.
- Decree of the Regulatory Office for Network Industries No. 7/2009, which establishes the quality standards for delivered electricity and services, took effect on 20/9/2008
- Decree of the Government No. 317/2007 Coll. – The generally binding legal provision that defines the rights and duties of electricity market stakeholders and the conditions necessary for non-discriminatory and transparent electricity market organization
- Degree of the Regulatory Office for Network Industries Slovakia Nr. 315/2008 Coll., which establishes the quality standards for delivered electricity and services, took effect on 1/9/2008

- The Government decree No.124/2005, setting the rules for operation of the electricity market (hereinafter only as “Rules for the electricity market operation”),
- The Office Decree No. 2/2005 dated 30 June 2005, setting the scope of price regulation in the electricity sector and the method of its implementation, the scope and the structure of justified costs, method of determining the level of reasonable profit and background documents for price proposal (hereinafter only as “Office Decree No. 2/2005“),
- Operating rules of the regulated entity of the Slovenská elektrizačná prenosová sústava, a. s. (“Operating Rules of SEPS“), as the transmission system operator.

### 3.3.2. Authorities

The Regulatory Office for Network Industries is a state administrative authority established by the Act No. 276/2001 on Regulation of Network Industries. Its objective on the market is to ensure transparency, non-discriminating performance, protect consumers, reliable delivery, licensing and certificating and of course ensure the compliance with the energy politics of Slovak Republic.

The regulatory office approves the methods, procedures, conditions and also prices for the following:

- production of electricity, production of electricity from RES, combined heat and power production, etc.
- a connection and access to the grid, transmission system, the distribution system and the transportation system,
- electricity transmission in a specified service area,
- gas transportation and distribution in a specified service area,
- provision of ancillary services in the electricity and gas sectors,
- provision of services of the transmission system operator and the distribution system operator,
- access and a connection of new electricity and gas producers to the system,
- heat production and distribution

### 3.3.3. Environment Related Legislation

The main act influencing the planning, preparation and installation of SHP is the Act No. 24/2006 Coll. on Environmental Impact Assessment.

According to this act every SHP planed for installation in Slovakia must pass the environmental impact assessment procedure (EIA) no matter the installed capacity or the location of SHP (whether artificial or natural water flow). The procedure has number of tasks to be realized by the investor, regulating body (Ministry of environment), other related bodies (e.g. Ministry of economy, local municipality, Flood-prevention Committee, Public Health and Safety Office, etc) and the local public. The work of the investor of SHP can be basically divided in two levels concerning the difficulty:

1. The planed SHP must be assessed in the "first level" of the procedure – the preliminary environmental study must be elaborated. It is a general study of present conditions and expected environmental impacts, no special examinations or researches are executed. For a SHP size considered in this study the preparation of the study is estimated to take 3-4 months and the recent costs on the market for its elaboration are ca 10 000 €.

2. The study is then evaluated by the ministry decides whether the preliminary study is sufficient for the complex assessment of the potential environmental impacts and then either gives final statement – permission for building or decides that the project must be 20 assessed in the second level which is much detailed, profound and difficult (e.g. it may contain requirement for long period monitoring of the fauna or flora on the site by a professional organisation). This step is not possible to estimate in terms of time and finance because it depends very much on the decision of the ministry and comments from the related bodies.

In general, the lower the planned installed capacity of SHP is and the less construction and adjustments of the natural water flow are planed and the less the surrounding (environment and society) are influenced, the easier and faster the process is supposed to be. The preview of the EIA cases of other SHPs in Slovakia show that the majority of the planned installations have succeeded in the first level and there was no need for further assessment of environmental impact.

## 3.4. Market Conditions

### 3.4.1. Current Use of Hydropower in Slovakia

Hydropower generation was established in Slovakia more than a century ago. Hydro plants in Slovakia can be divided between those that are situated on a artificial river-basin (eg the river Váh) and those located on water reservoirs and small privately owned on various creeks, small rivers, etc.

There are many old water mills and sawmills on Slovak rivers and streams. By means of them the man taught to get control over this nature power. Slovakia with its broken territory has excellent ability for water streams use.[12]

The first hydro power plant with the output of 22 kW, 110 V in Western Slovakia started to run in Krompachy in 1889.

In the period of the first Slovak Republic (1939-1945) the thought about constructing of dam on the river Hronec and using the level difference between the level of the river and the river Slan came into existence.[13]

According to the list of hydro power plants produced by the Ministry of Public Work in Prague in 1930 there were more than 3000 small power plants in Slovakia. After the Second World War the most of them were closed.[14]
However, after 1945 in Czechoslovakia many hydro power plants were buildt. Especially in the North Western part of Slovakia with its typical topographic. But the most famous hydro power plant is on the Danube in Gabcikovo. The power station has eight vertical Kaplan turbines with runners 9,3 m in diameter and a maximum capacity of 90 MW each. Total capacity is 720 MW at operational discharge of 4000 $m^3/s$.[15] This project has have a very long history at the international courts, because Hungary stopped its cooperation with Slovakia.

In 2002 the hydroelectric power plants generated 5168 GWh. The installed capacity of hydropower plants was 2395 MW, which were 28,9% of the total installed capacity of the interconnected system of Slovakia.[16]

According to the Slovenské Elektrárne web site, the total capacity produced by these hydro plants is 1.652,7 MWe, and in the year 2005 the total produced electricity from hydro plants was 4.483,6 GWh. The biggest advantage of these hydro plants according to the Slovenské Elektrárne is that they are using endless resources and that the hydro plants are able to satisfy the current demand of required electricity needs. They also serve as protection from flooding. They can be used as supply

[12] Dermek J.
[13] Dermek J.
[14] Dermek J.
[15] Chmelar V.
[16] dena – Deutsche Energie Agentur (2004)

station for agriculture and industry. They also function as a regulator of unstable water flows.

Different sources of information on SHP's in Slovakia state distinct numbers on SHP's and its capacity and production. Some state 160 to 220 plants, with different technical characteristics. Therefore here it is done an own survey of all SHP < 5 MW that applied for the feed-in tariff in Slovakia in 2009 and obtained the certificate of RES origin for the planned production in 2009 (from Regulatory Office in Network Industries).

There are exactly 192 SHP's with the total capacity of 64,046 MWe installed. The prospects of feeding the "green energy" into the grid stated by the proprietors of the SHP's for the year 2009 are 228 GWh in total. All SHP`s are listed in attachment No. 1.

It is remarkable that as much as half of these plants have been built only during the past twenty years. As expected due to the topography of the country, low-pressure power stations prevail in Slovakia (about 50 %) with a head of maximally five meters. Medium-pressure power stations (head 5–15 meters) account for one third, and high-pressure power stations with heads of over 15 m are rather rare (15 %).[17]
The biggest operator of SHP's in Slovakia is the company Slovenské elektrárne, a.s. (owned by ENEL and SR state). Their market share is about 28% as seen on the table below. Slovenské elektrárne, a.s. operate also some bigger hydroelectric power plants with the installed capacity from 5 MW up to 720 MW (including pump storage and reservoir power plants).

**Table 10** - Market shares of SHPs under 5 MW of installed capacity

| | **Installed Capacity** | **Planned production 2009** | **% Share Capacity** | **% Share planned production 2009** |
|---|---|---|---|---|
| Slovenské elektrárne, a.s. | 17,720 | 59 058 | 27,67% | 25,90% |
| Slovenský vodohospodársky podnik, | 8,120 | 27 362 | 12,68% | 12,00% |
| Železiarne Podbrezová, a.s. | 5,340 | 24 640 | 8,34% | 10,81% |
| Kremnická banská spoločnosť s.r.o. | 3,990 | 10 000 | 6,23% | 4,39% |
| Other small | 28,877 | 106 943 | 45,09% | 46,90% |
| **Total** | **64,047** | **228 003** | **100,00%** | **100,00%** |

[17] Pelikan B. (2005)

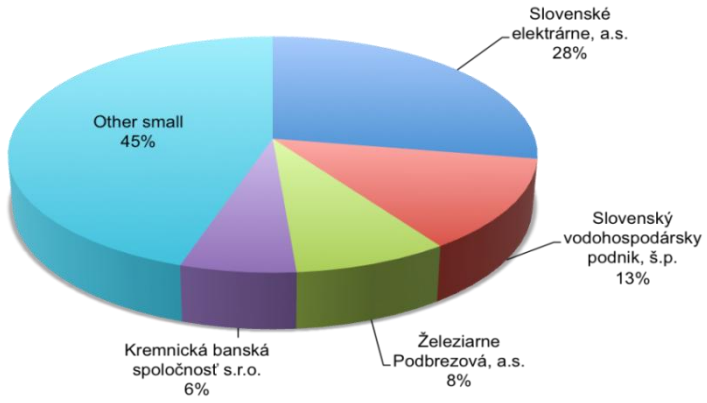



**Figure 1** - Market shares of installed capacity of SHPs under 5 MW (Source: Regulatory Office for Network Industries (certificates of proof of origin for RES))

**Table 11** - Planned investments in SHPs in Slovakia (Source: Newspapers: Trend, Hospodárske Noviny; www.enviroportal.sk – EIA documentation )

| | Owner | Location | Installed capacity [MW] | Yearly product. [MWh] | Invest costs [€] |
|---|---|---|---|---|---|
| 1 | Energo-Aqua | Váh river - Trenčín | 0,560 | 3 000 | 5 mil |
| 2 | Energo-Aqua | Hron - Šalková | 0,600 | 3 800 | 3,3 mil |
| 3 | Hydroenergia | Hron - Želiezovce | 4,000 | 15 200 | 13,3 mil |
| 4 | VELMA ZH | Hron - Bzenica | 1,200 | 6 650 | 4,65 mil |
| 5 | Jurčo Ján s.r.o. EKOREZ | Váh - MVE Lisková | 1,200 | 380 000 | 3 mil |
| 6 | Hydroenergia | Váh - Kraľovany | 4,200 | 25 000 | 16,6 mil |
| 7 | Karol Beliansky | Revúca - MVE Pod Skalným | 0,127 | 500 | 0,45 mil |
| 8 | L'ENERGIE VERTE, a. S | Hron - MVE Bzenica | 2,992 | 8 812 | 7,5 mil |
| 9 | Vodaspol s.r.o. | Hron - MVE Kamenín | 2,360 | 8 620 | 7 mil |
| 10 | Hydroenergia | Nitra - Chynoranský Mlyn | 0,400 | 1 500 | no entry |
| 11 | ENERGOHRON s.r.o. | Hron - MVE Podbrezová | 0,500 | 2 300 | no entry |
| 12 | Benol Steel, a.s. | Hornád - MVE Hornad Margecany | 0,418 | no entry | no entry |
| 13 | Jozef Rusnák | Hornád - MVE Ždaňa | 1,100 | no entry | no entry |
| 14 | L'ENERGIE VERTE, a. S | Hron - MVE Jalná | 1,170 | no entry | no entry |
| 15 | L'ENERGIE VERTE, a. S | Hron - MVE Rudno nad Hronom | 1,300 | no entry | no entry |
| 16 | L'ENERGIE VERTE, a. S | Hron - MVE Šášovské podhradie | 1,034 | no entry | no entry |
| 17 | Hener MVE s.r.o. | Hron - MVE Sliač | 2,200 | no entry | no entry |
| 18 | MVE Tekova s.r.o. | Hron - MVE Tekov | 2,160 | no entry | no entry |
| 19 | HYDRO-ENERGY s.r.o. | Hron – MVE Hronská Dúbrava | 1,210 | no entry | no entry |

**Table 12** - Further SHP projects with no data entry (Source: Newspapers: Trend, Hospodárske Noviny; www.enviroportal.sk – EIA documentation)

| | Owner | Location | Installed capacity [MW] | Yearly product. [MWh] | Invest costs [€] |
|---|---|---|---|---|---|
| 1 | Ľupčianka s.r.o. | Ľupčianka - MVE Ľupča | no entry | 340 | no entry |
| 2 | SE, a.s. | Váh | no entry | no entry | no entry |
| 3 | SE, a.s. | Váh | no entry | no entry | no entry |
| 4 | SE, a.s. | Hron | no entry | no entry | no entry |
| 5 | SE, a.s. | Hron | no entry | no entry | no entry |
| 6 | HENER - Arpád Reider | Perec - MVE Starý Tekov | no entry | no entry | no entry |
| 7 | HENER - Arpád Reider | Hron - MVE Vozokany | no entry | no entry | no entry |
| 8 | ENERGOHRON s.r.o. | HRON - MVE Vlkanová | no entry | no entry | no entry |
| 9 | Miroslav Ehn | Slaná - MVE Abovce | no entry | no entry | no entry |
| 10 | ENERSLOV s.r.o. | Hron - MVE Polomka | no entry | no entry | no entry |
| 11 | no entry | MVE Šarovce | no entry | no entry | no entry |

## 3.5. Economical Situation

### 3.5.1. Feed-in Tariffs

The purpose of the law to promote renewable energy is a better use of primary sources of energy supply through high efficiency cogeneration or mechanical energy and heat, resulting in reduction of greenhouse gas emissions, particularly carbon dioxide. The law on the promotion of renewable energy in particular, wants to achieve the following[18]:

- the promotion of electricity from renewable energy and the promotion of electricity through high efficiency cogeneration and
- a long-term price guarantee.

The feed-in tariffs for energy produced from RES are regulated by the ÚRSO (state regulator) and are currently set as fixed prices in Euro per MWh for 15 years. Before September 2009 the fixed prices have only been for 12 years. The new act on RES (zákon o obnoviteľných zdrojoch energie), which has been approved by the government and is in the legislative process, brings some good news into the RES market despite some technical issues which are not as common in similar acts in other countries (responsibility of the RES provider for the sheer output). Unfortanately the new feed-in tariffs are aproximately 5% below than the old ones.[19]

[18] Stessl M., DLA PIPER Weiss-Tessbach Rechtsanwälte GmbH (2009)
[19] Hager B. (2009); http://www.nhwien.eu/Dokumente/NH_News_Slowakei_Einspeistarife_2010.pdf

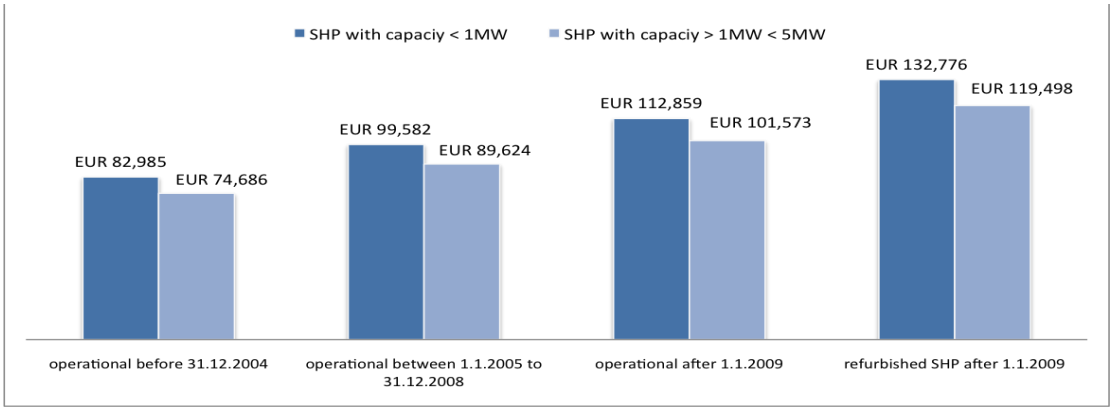
The Feed-in tariff is 61,72 €/MWh, if the hydroelectricity would be produced by plants with higher capacity than 5 MW. Electricity produced from RES is considered "green" only when it is produced by technologies stated under the provisions of Art. 32, subparagraph. 1, of the Act No. 656/2004 Coll. and after obtained a proof of origin stated by the provisions of Art. 10 of the regulation of the government of the Slovak Republic No. 317/2007 Coll., which execute the rules of the system of the energy market.

**Table 13** - Feed-in tariffs for hydropower with installed capacity up to 1 MW (Source: Regulatory Office for Network Industries edict Nr.2/2008 from 28/7/2008):

| | | **Euro/MWh** |
|---|---|---|
| 1. | Operational before 31.12.2004 | 82,985 |
| 2. | Operational between 1.1.2005 to 31.12.2008 | 99,582 |
| 3. | Operational after 1.1.2009 | 112,859 |
| 4. | Refurbished SHP after 1.1.2009 | 132,776 |
| 5. | Operational after 1.1.2010 | 109,080 |

**Table 14** - Feed-in tariffs for hydropower with installed capacity from 1 up to 5 MW (Source: Regulatory Office for Network Industries edict Nr.2/2008 from 28/7/2008)

| | | **Euro/MWh** |
|---|---|---|
| 1. | Operational before 31.12.2004 | 74,686 |
| 2. | Operational between 1.1.2005 to 31.12.2008 | 89,624 |
| 3. | Operational after 1.1.2009 | 101,573 |
| 4. | Refurbished SHP after 1.1.2009 | 119,498 |
| 5. | Operational after 1.1.2010 | 97,980 |




**Graph 3** - Feed-in tariffs for SHPs in Slovakia (Source: Regulatory Office for Network Industries edict Nr.2/2008 from 28/7/2008)

The feed-in tariffs for SHP´s that are taken in operation before 31.12.2009, will be calculated every year with a coefficient. This coefficient is written in the act for RES. But for the new SHP´s which starts after 1.1.2010 the new feed-in tariffs wil be fixed for 15 years.

URSO may determine the feed-in tariffs for new plants each year, which are taken in the particular year in operation. However, the feed-in tariffs should not be more than 10% below that of last year. Plants whose commissioning was carried out earlier, are not covered by such changes.[20]

If the SHP (or any other RES) was build with the help of state aid or EU funds and brought to operation after 1.1. 2005, the feed-in tariffs would be lowered by this scheme:

**Table 15** - Reductions to feed-in tariffs (Source: Regulatory Office for Network Industries edict Nr.2/2008 from 28/7/2008)

| | | |
|---|---|---|
| a) | state aid/ EU funds to max 30% of total acquisition costs | -4% |
| b) | state aid/ EU funds to max 40% of total acquisition costs | -8% |
| c) | state aid/ EU funds to max 50% of total acquisition costs | -12% |
| d) | state aid/ EU funds over 50% of total acquisition costs | -16% |

**Table 16** - Reduction of feed-in tariffs for SHPs under 1 MW (Source: Regulatory Office for Network Industries)

| | Euro/MWh | - 4% | - 8% | -12% | -16% |
|---|---|---|---|---|---|
| Operational before 31.12.2004 | 82,985 | 79,665 | 76,346 | 73,027 | 69,707 |
| Operational between 1.1.2005 to 31.12.2008 | 99,582 | 95,598 | 91,615 | 87,632 | 83,649 |
| Operational after 1.1.2009 | 112,859 | 108,345 | 103,831 | 99,316 | 94,802 |
| Refurbished SHP after 1.1.2009 | 132,776 | 127,465 | 122,154 | 116,843 | 111,532 |

**Table 17** - Reduction of feed-in tariffs for SHPs 1 to 5 MW (Source: Regulatory Office for Network Industries)

| | Euro/MWh | - 4% | - 8% | -12% | -16% |
|---|---|---|---|---|---|
| Operational before 31.12.2004 | 74,686 | 71,699 | 68,711 | 65,724 | 62,737 |
| Operational between 1.1.2005 to 31.12.2008 | 89,624 | 86,039 | 82,454 | 78,869 | 75,284 |
| Operational after 1.1.2009 | 101,573 | 97,510 | 93,448 | 89,385 | 85,322 |
| Refurbished SHP after 1.1.2009 | 119,498 | 114,718 | 109,938 | 105,158 | 100,378 |

[20] Hager (2009); http://www.nhwien.eu/Dokumente/NH_News_Slowakei_Einspeistarife_2010.pdf

### 3.5.2. Electricity Prices and Distribution

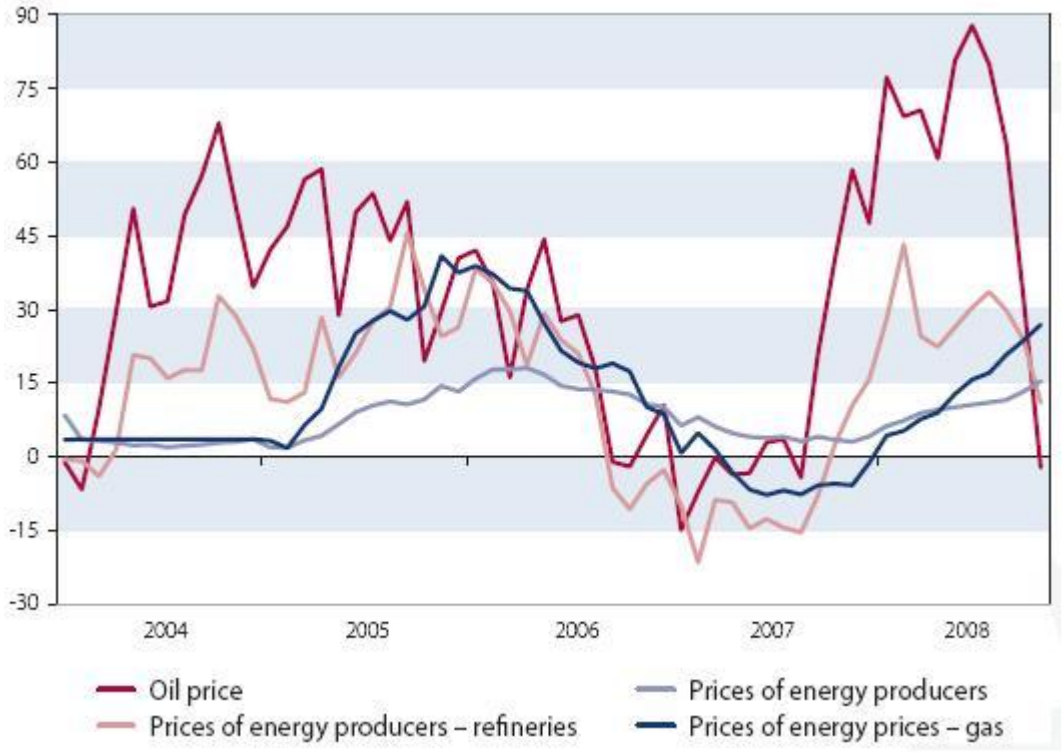
In connection with EU‘s growing energy dependence on oil1 and with growing influence of energy prices on the product prices and consumer prices, the energy industry is at the centre of attention of all Central European institutions. After a relatively long-discussed package of proposals for liberalization of the energy sector, the Energy Council adopted the basic lines of an agreement in June 2008 and the energy ministers confirmed a compromise procedure focused on the separation of energy production from its transmission and supply to consumers (the so-called proprietary unbundling) in October 2008, with the former national monopolies (such as EDF, E.ON or RWE) keeping the possibility to retain control of the distribution networks, provided that they subject them to external supervision.[21]

The main participants in the Slovak electricity market are a single, dominant generation company and three large distribution/supply companies, which cover the entire territory of the country. Slovenské Elektrárne (SE) is the main generation company with a share of production close to 84%. The three distributors/ suppliers are ZSE, VSE and SSE, which are partially owned (49%) by EON, RWE and EDF respectively, with the remaining share being held by the Slovak government.[22]

These three companies source their supply on negotiated terms from SE and each has a regional distribution area. Recently, competition has started to develop between them for industrial and business customers. Supply licenses have also been awarded to 18 other companies.

Several companies from the Czech Republic have entered the market, including CEZ, while suppliers are also able to source electricity from the Czech, Austrian and German wholesale markets.

[21] Cár (2009)
[22] ECB – Energy Center Bratislava (2007)




**Graph 4** - The development of oil prices, refined oil products and energies (year-on-year change in %) (Statistical Office of the Slovak Republic, www.eia.doe.gov)

From a longer term perspective, the changes in aggregate energy prices in the industry are influenced particularly by the development of gas prices.[23]

**Table 18** - Electricity prices for medium sized company [euro per kW] (Source: EUROSTAT)

| | 2004 | 2005 | 2006 | 2007 | 2008 |
|---|---|---|---|---|---|
| EU (27 countries) | | 0.0672 | 0.0752 | 0.0820 | 0.0900 |
| EU (25 countries) | 0.0623 | 0.0672 | 0.0755 | 0.0825 | |
| EU (15 countries) | 0.0634 | 0.0682 | 0.0766 | 0.0837 | |
| Czech Republic | 0.0492 | 0.0601 | 0.0731 | 0.0783 | 0.1095 |
| Hungary | 0.0654 | 0.0701 | 0.0753 | 0.0812 | 0.1119 |
| Austria | 0.0553 | 0.0621 | 0.0653 | 0.0786 | 0.0897 |
| Poland | 0.0446 | 0.0506 | 0.0543 | 0.0541 | 0.0814 |
| **Slovakia** | **0.0683** | **0.0703** | **0.0773** | **0.0932** | **0.1197** |

This indicator presents electricity prices charged to final consumers. Electricity prices for industrial consumers are defined as follows: Average national price in Euro per kWh without taxes applicable

[23] Cár (2009)

for the first semester of each year for medium size industrial consumers (Consumption Band Ic with annual consumption between 500 and 2000 MWh).

Until 2007 the prices are referring to the status on 1st of January of each year for medium size consumers (Standard Consumer Ie with annual consumption of 2 000 MWh). The electricity prices in EU, Slovakia and surrounded countries after the new methodology of Eurostat:

Prices of natural gas and electricity both for households and for producers are ascertained with semi-annual periodicity for several types of consumers. Data for the so-called standard households or standard producers use to be applied in the case of international comparisons. The data on gas and electricity prices under comparison include taxes and distribution costs.[24]

- DC average annual electricity consumption of households from 2.500 to 5.000 kWh
- ID average annual electricity consumption of producers from 2.000 to 20.000 MWh

**Table 19** - Comparison of electricity prices (Source: EUROSTAT)

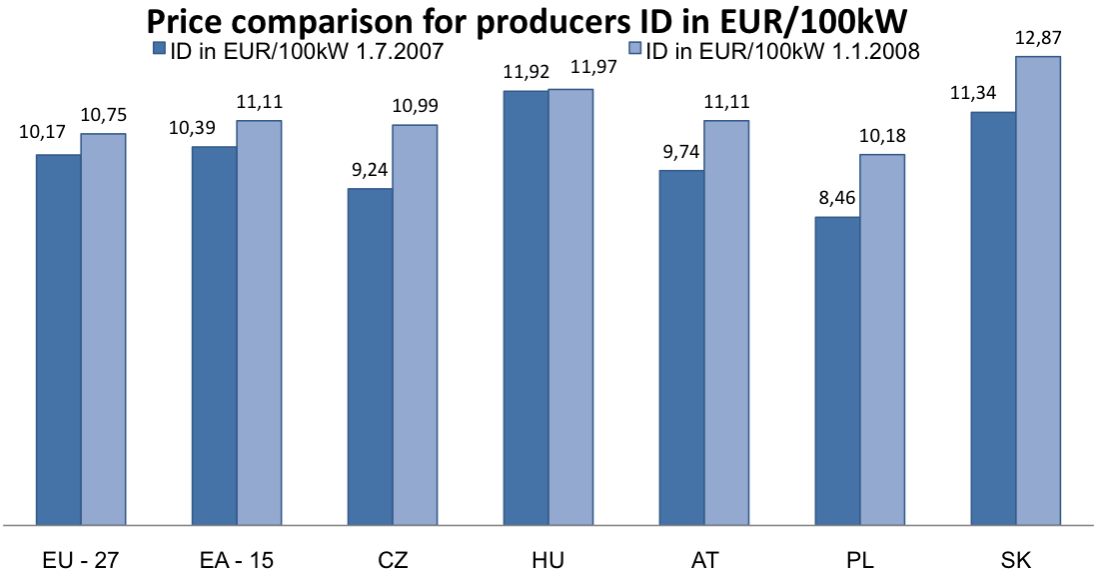
| | **DC in EUR/100kWh** | | **ID in EUR/100kWh** | |
|---|---|---|---|---|
| | **1.7.2007** | **1.1.2008** | **1.7.2007** | **1.1.2008** |
| EU – 27 | 16 | 16,33 | 10,17 | 10,75 |
| EA – 15 | 16,75 | 17,11 | 10,39 | 11,11 |
| CZ | 10,63 | 12,74 | 9,24 | 10,99 |
| HU | 12,96 | 15,48 | 11,92 | 11,97 |
| AT | 17,4 | 17,79 | 9,74 | 11,11 |
| PL | 13,8 | 12,59 | 8,46 | 10,18 |
| **SK** | **13,7** | **14,21** | **11,34** | **12,87** |

The price of electricity for standard households was 14,21 € per 100 kWh (11,94 € per 100 kWh excluding taxes) in Slovakia at the beginning of 2008. The electricity price for households was higher as compared to July 2007 in all countries under review except Poland. Hungary and on average also the EU-27 and the euro area had a higher electricity price for standard households than the current price in Slovakia. At the beginning of 2008, the electricity price for standard producers was 12,87 € per 100 kWh (10,83 € per 100 kWh) in Slovakia in 2008 and it increased by almost 14% over 6 months. It was unambiguously the highest price as compared to the surrounding countries under review and the euro area.

[24] Eurostat methodology for the ascertainment of natural gas and electricity prices

As for the degree of reaching the average price of individual energy types of the euro area, Slovakia reached as at 1 January 2008 in the case:

- gas prices for standard households 68,0% of the euro area average, or 76,7% of the euro area average excluding taxes,
- electricity prices for standard households 94,5% of the euro area average or 99,0% of the euro area average excluding taxes,
- gas prices for standard producers 83,1% of the euro area average or 98,0% of the euro area average excluding taxes,
- Electricity prices for standard producers 115,8% of the euro area average or 132,4% of the euro area average excluding taxes.




**Graph 5** - Price comparison for producers ID in EUR/100 kW (Source: EUROSTAT)

The electricity and gas prices for households in Slovakia are strongly regulated and due to the social politics of Slovakian government also kept very low. As of this politics, the market losses have to be compensated in the producers sector.

### 3.5.3. Subsidies, Grants and EU Structural Funds

There are several possibilities to obtain financial support for installation of SHP in Slovakia. They are either based on national sources (the state aid, Environmental fund) or financed together by EU

and Slovak Republic (EU structural funds). The form of subsidy is either direct (grant) or indirect (price allowances, tax allowances, loans with better interest rate).

**EU Structural funds**

EU Structural funds have the large amount of finances available in general. However, the project preparation, managing, implementation and financing are very challenging. Financing is realized by re-funding which means self-financing the project costs first and apply for payment of the corresponding amount at a later stage. The applications are usually realized quaternary. The corresponding amount is a share of total costs depending on the percent share of the subsidy which varies for kind of beneficiary (private or public sector), region of project realization (3 regions of Slovakia – see table below, excluding Bratislava). This share is then applied to the so called eligible costs of the total project costs. Eligibility of particular type of costs depends on individual program, priority, measure and call for projects. Generally the costs must be directly connected to the project and operational costs are not eligible for beneficiary from private sector.

**Structure of the grant scheme:**

- Operational Programme: Competitiveness and Economic Growth
- Priority Axis 2 : Energy
- Measure 2.1: Increasing energy efficiency both on the side of generation and consumption
- Intervention category 42: Renewable energy sources: hydroelectric, geothermal, and other
- Managing authority: Ministry of Economy of Slovak Republic

**Eligible activities related to SHP:**

- Energy savings in all areas of industry and services including insulation of buildings with the purpose of improving their thermal properties;
- Combined generation of electricity and heat with maximum installed capacity of 10 MWe;
- Use of renewable energy sources, i.e., the construction, upgrade or refurbishment of: small hydropower plants < 10MWe, biomass and biogas energy utilization with installed capacity > 50kWe or kWt and < 30MWt or MWe solar energy utilization facilities, geothermal energy utilization facilities;
- Refurbishments and upgrades of existing fossil-fuel-based energy sources with the purpose of increasing the efficiency of the plants and effectiveness of their use;

- Refurbishment of existing thermal facilities for heat distribution (e.g., improvement of piping insulation, introduction of heat loss monitoring systems, refurbishment of heat delivery stations and other);
- Other similar eligible activities supporting the objectives of the Measure.

Eligible beneficiaries are subjects of the private sector - micro, small, medium and large entrepreneurs (to 1.000 employees, yearly turnover to max. 50 mil Euro), registered in SK at latest of 1.1.2007.

The minimal financial aid to one project is 60.000 Euro and maximum 6.000.000 Euro, at the maximal total project costs of 25.000.000 Euro.

Planned calls for project proposals and the allocations for individual calls are published on web page of the ministry (www.economy.gov.sk).

**Purpose:**

The purpose of this measure in the energy sector is to drive the energy intensity closer to the level comparable with that of the EU-15, achieving energy savings, increasing the efficiency of the use of primary energy sources with the purpose of reducing energy costs, as well as increasing the proportion of consumption of renewable energy sources in the total energy consumption. Support will be provided to activities leading to increasing the use of renewable energy sources as well as to activities aimed at savings and efficient use of energy in industry and services related thereto.

**Description:**

The measure is designed to support the projects using progressive energy saving technologies and facilities with higher energy use efficiency with a minimum impact on the environment, generally focused on the reduction of production processes' energy intensity.

Support will be further focused also on projects ensuring improvement of thermal characteristics of buildings and equipping facilities with metering and regulation systems. Support will also be provided to projects utilizing new technology equipment for generation of electricity and heat, projects utilizing waste heat from electricity generation while improving environmental aspects of the energy sector and also projects reducing losses by modernization of the equipment serving the distribution of energy media.

Attention will be paid to promoting projects utilizing renewable sources of energy, especially biomass, geothermal energy, building small hydropower stations and energetic utilization of municipal waste.

**Intervention categories:**

40 – Renewable energy sources: solar

41 – Renewable energy sources: biomass

42 – Renewable energy sources: hydroelectric, geothermal, and other

43 – Energy efficiency, combined generation of electric energy (cogeneration), and energy management

**Allocation and calls for proposals in 2009:**

Allocation for the planned call for proposals in October 2009 is 58.560.844 Euro. The minimal financial aid to one project is 60.000 Euro and maximum 6.000.000 Euro, by the maximal project costs of 25.000.000 Euro.

The measure 2.1 has a geographical relevance to whole Slovakia, except of Bratislava self-governing region with a direct form of aid in the form of non-repayable contribution.
The share of direct form of aid is different for individual regions of Slovakia.

**Table 20** - Regional diversity of intensity of aid

| Region | Intensity of aid |
|---|---|
| East Slovakia | 50% of all relevant costs |
| Middle Slovakia | 50% of all relevant costs |
| West Slovakia | 40 % of all relevant costs |

**State aid for investment**

State can provide a financial aid for investment according to the Act Nr. 561/2007 Coll. On the investment aid and state aid scheme – direct and indirect state aid.
Managing authority: Ministry of Economy of Slovak Republic
Aid providers:

- Ministry of Economy – grant for purchase of long term tangible and intangible assets
- Ministry of Labour, Social Affairs and Family – contribution for creation of new jobs
- Ministry of Finance – income tax allowance (via local tax office)
- Any public authority (local, regional, national) – price allowances (lower than real market

prices) for purchase or rent of public space or buildings

Applications for the state aid are submitted to the Ministry according to the rules of the Act.
There is no allocation in national budget for this aid scheme for year 2009.

**Environmentálny fond (The Environmental Fund)**

The Environmental fund (Envirofond) is a state fund under management of Ministry of Environment. Its activity is regulated by the Act Nr. 587/2004 Coll. on Environmental fund. The forms of subsidy and form of applications for the subsidy is regulated by Decree of Ministry of Environment Nr. 157/2005. Deadline for applications is October 31st every year. The final decision about approved projects makes the minister after recommendations of the fund´s committee.

Amongst the other the fund supports projects of electricity production from renewable energy sources:

- Area A: Air and ozone layer protection
- Measure A/1b: Support of heat, hot water and electricity production from renewable energy sources

Fund provides either grants or favoured loans. SHP installation by a private entrepreneur is eligible for the loan only. The loans are managed by Dexia Bank Slovensko.

The conditions are:

- Loan interest rate is 1,00 % p.a.
- Loan payback time is 5-15 years
- Loan guarantee is required in height 130% of the loan (form of guarantee is negotiated)

The Dexia Bank evaluates the applicants, the quality of the guarantee and the quality of the project before approving the project loan. The cost of this assessment is 667-1333 € and the applicant must pay no matter if the evaluation result will be favourable or not. The volume of the loan varies between 300 000 – 1 200 000 €. There are usually two loans in the area approved each year.

### 3.6. Policy & Expected Development

The market opening was completed as of July 2007, but both gas and electricity markets are dominated by a few main suppliers. Two companies accounted for 84% of power generation and five companies accounted for 86% of the retail supply. The gas market is based on a single supplier that

imports only from Russia and consequently there were no other suppliers at wholesale or retail level as of the end of 2006. The role of Slovakia as a major transit route for Russian gas to Western Europe means that developments in its market have a high profile at the EU level.

Similar to the other Eastern European countries, the energy intensity is quite high compared to the EU-average, due mainly to the significant role of energy-intensive industries, including paper and chemicals as well as the iron/steel sector. The government places high priority on improving energy efficiency, given the significant reliance on imported fossil fuels. The National Energy Efficiency Action Plan includes detailed measures that are integrated across different sectors as well as being comprehensive within the key sectors. Industry and transport are expected to account for 50% of energy savings, while horizontal or integrating measures are expected to account for 30% of the savings by 2016.

High dependence on imported oil, natural gas, and coal has raised concerns, and therefore renewable energy contributes to energy security as well as to environmental goals. The indicative target for RES is 14% for 2020. The RES roadmap for 2015 indicates that wind is expected to account for half of the increase in the power sector. With plentiful forests in relation to its population, there is a significant potential for biomass energy, but the government plan has tended to limit exploitation of biomass to remote rural areas where natural gas is not available. Feed-in tariffs and targeted subsidies are used, and there is a heat purchase obligation for distributors to buy from renewable-based heat suppliers under specified conditions.

"Hydro is the unique renewable source, which indeed saw a decrease in its share of primary production over the last six years. This decrease is not attributable to lower production figures but rather to an increase of the other renewable sources. In 2006, 20% of all the EU's hydro energy was produced in Sweden; France and Italy ranked second and third with shares of 18% and 12% respectively. These three countries together were responsible for half of the total energy production from hydro sources in the EU in 2006. In Austria and Slovakia, the energy production from hydro represented nearly 43% of their respective national energy production from renewable sources. Slovenia also recorded a noticeable proportion (40%). Conversely, the shares in Denmark, Estonia and the Netherlands were below 1%. Beyond the EU borders, hydro is by far the main renewable source for energy production in Norway (89%) and, to a lesser degree, in Croatia (56%)."[25]

[25] Panorama of Energy, EUROSTAT 4/2009

## 4. Possible Locations for SHP

Due to information available as described in chapter 2 the long list of potential sites consists of

- Parts of the natural rivers
- Water channels
- Industrial water intakes and discharges
- Existing SHPs (with channels)

### 4.1. Rivers

The area of Slovakia has been divided in 4 main regions, which are managed, by individual regional branches of the SVP – Košice, Banská Bystrica, Piešťany and Bratislava.

The figures below contain maps of individual regions and highlight the potential parts of the rivers with sufficient water flow with information about the first monitoring station where the sufficient parameters have been measured, as well as the information on the end of the river (mouth to another river or crossing the country borders).

The adjacent tables list the rivers and the sites of the monitoring stations closest to the river springs where the sufficient water flows have been measured the. In addition, the average maximum hourly flows and minimum daily flows within years 2001-2007 are listed.

### 4.1.1. Košice Region

For better overview of the relatively dense water ways the region has been divided into eastern and north-western part.

**Eastern part**

The perspective rivers in the eastern part of Košice region are Uh, Latorica, Laborec, Bodrog, Ondava and Topľa.

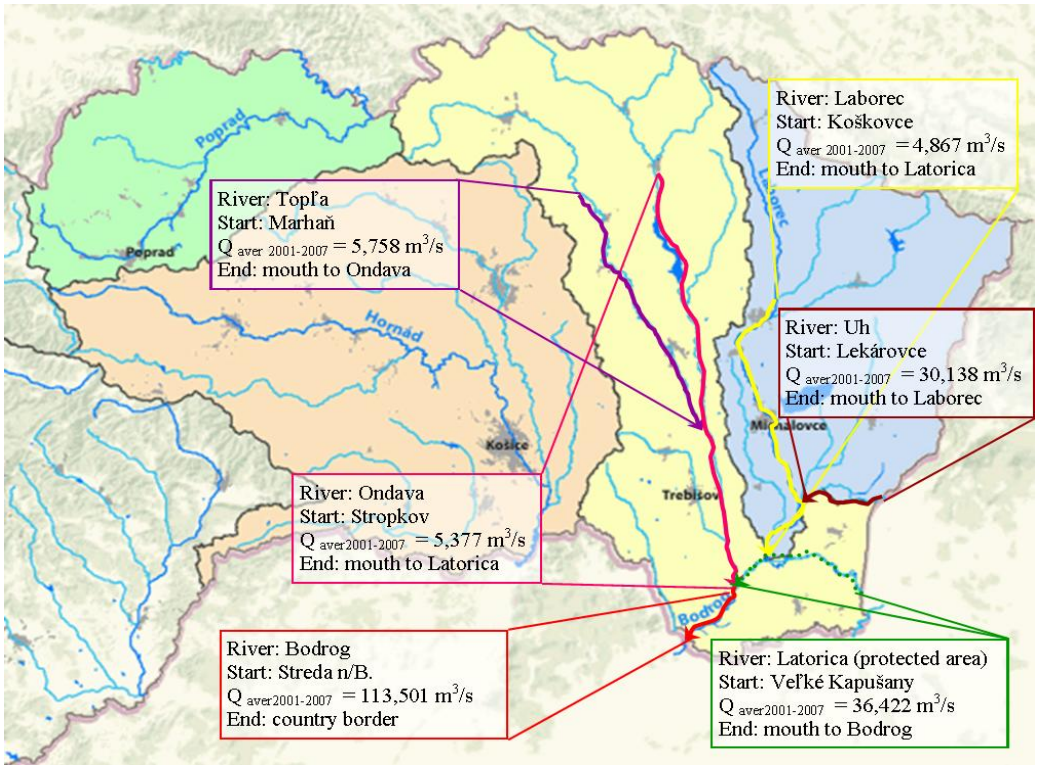



**Figure 2** - Potential river parts in Eastern part of Košice region

**Table 21** - List of perspective rivers and their water flow data in Eastern part of Košice region

| River/Monitoring station | Qa | Qmax h | Qmin d |
|---|---|---|---|
| | 2001-2007 average [$m^3/s$] | | |
| ● Uh/Lekárovce | 30,138 | 486,929 | 3,230 |
| ● Laborec/Koškovce | 4,867 | 119,126 | 0,401 |
| ● Latorica/Veľké Kapušany | 36,422 | 277,900 | 5,904 |
| ● Bodrog/Streda n/B | 113,509 | 532,629 | 31,024 |
| ● Ondava/Stropkov | 5,377 | 154,521 | 0,528 |
| ● Topľa/Marhaň | 5,758 | 118,386 | 0,971 |

## North-Western part

The perspective rivers in Northern part of Košice region are Dunajec and Poprad.

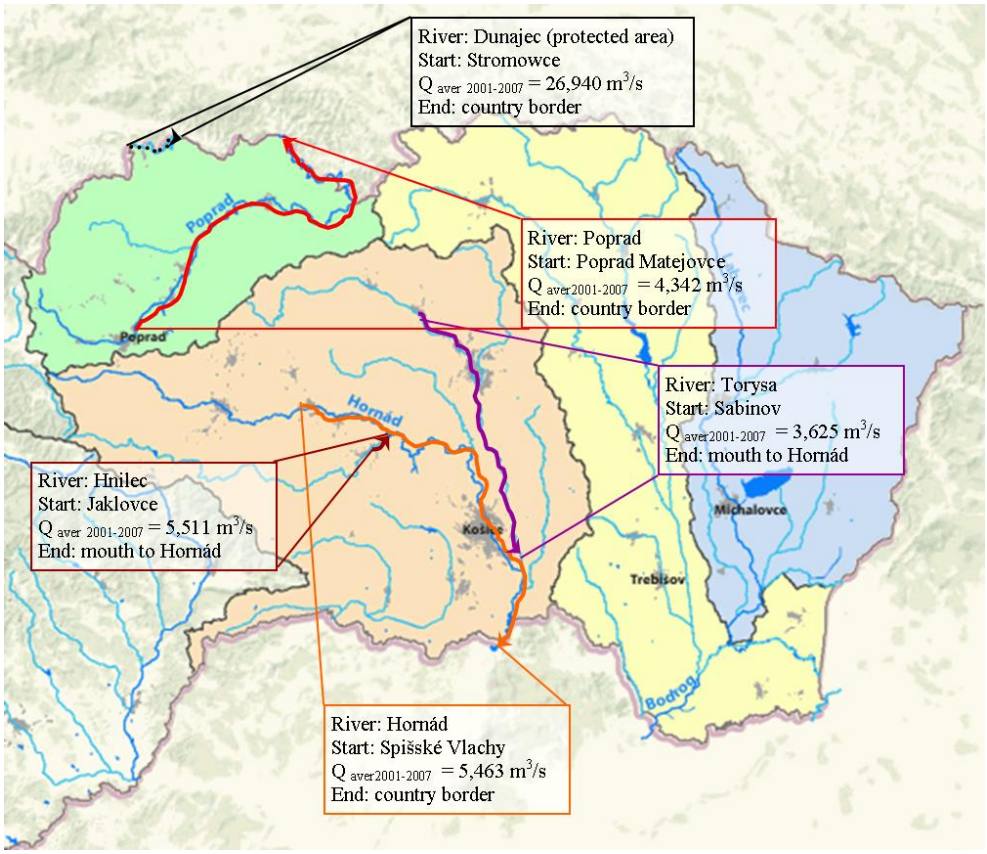



**Figure 3** – The potential river parts in North Western part of Košice region

**Table 22** - List of perspective rivers and their water flow data in North-Western part of Košice region

| River/Monitoring station | Qa | Qmax h | Qmin d |
|---|---|---|---|
| | 2001-2007 average [$m^3/s$] | | |
| ● Torysa/Sabinov | 3,625 | 95,237 | 0,536 |
| ● Hornád/Spišské Vlachy | 5,463 | 76,931 | 1,360 |
| ● Hnilec/Jaklovce | 5,511 | 51,326 | 1,055 |
| ● Poprad/Poprad Matejovce | 4,342 | 52,000 | 1,296 |
| ● Dunajec/Stromowce | 26,940 | 283,257 | 7,632 |

After applying the "filter" of protected areas into the maps of perspective rivers some of the river parts must be either excluded from further evaluation or the risk should be considered

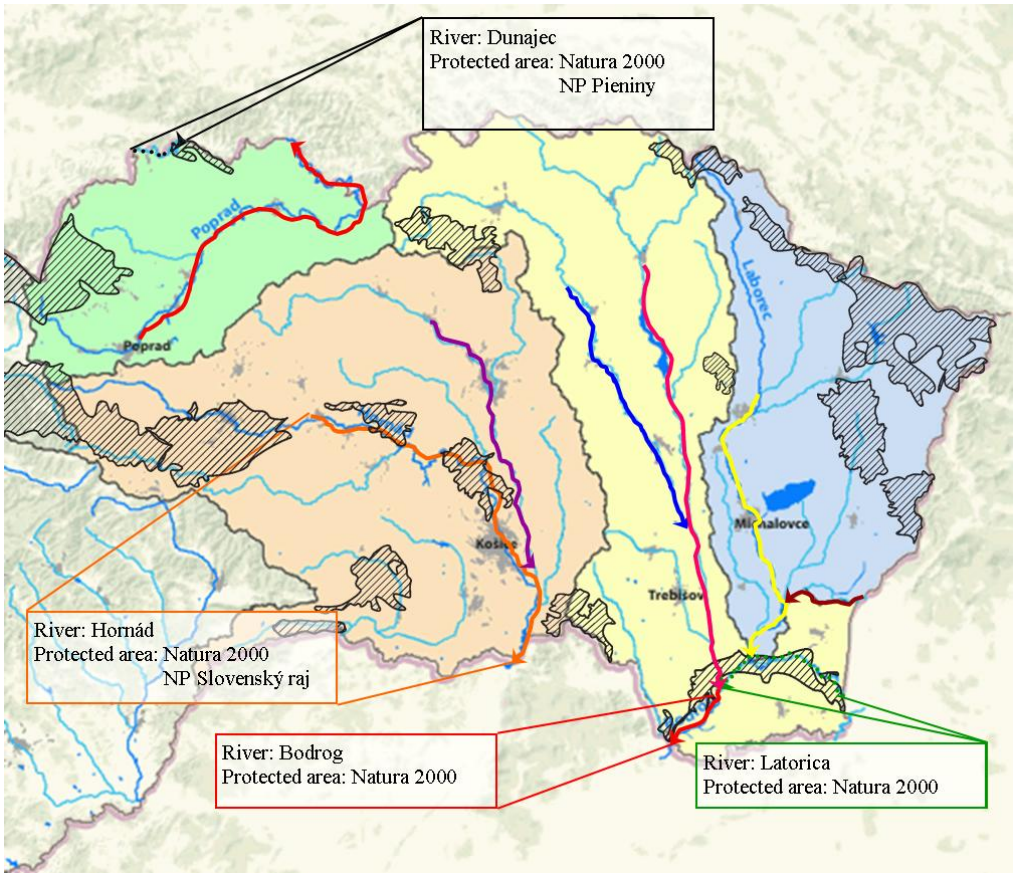



**Figure 4** - Protected areas intersecting the perspective rivers in Košice region

As seen on the map whole courses of rivers Latorica, Bodrog and Dunajec must be excluded from further evaluation due to interfering to areas with high level of environmental protection. There are two sections of river Hornád to be excluded, too, in its middle part.

### 4.1.2. Banská Bystrica Region

The perspective rivers with sufficient water flow are Slaná, Ipeľ and Hron.

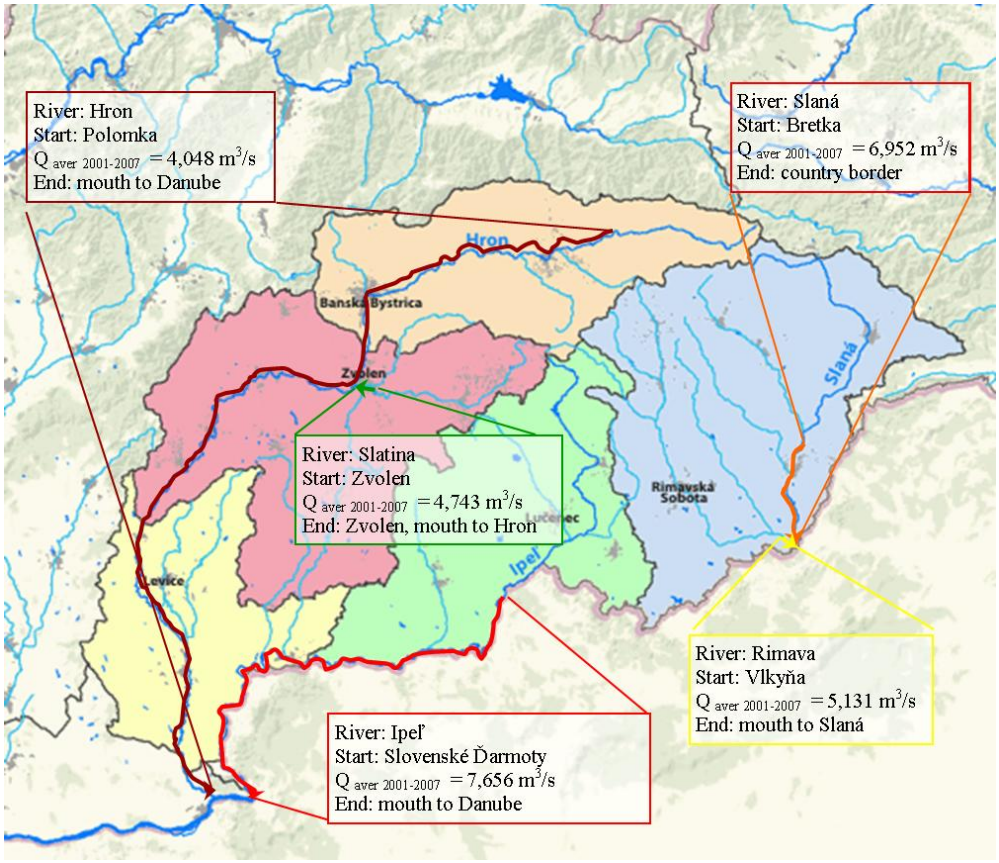



**Figure 5**- The potential river parts in Banská Bystrica region

**Table 23 -** List of perspective rivers and their water flow data in Banská Bystrica region

| River/Monitoring station | Qa | Qmax h | Qmin d |
|---|---|---|---|
| | 2001-2007 average [$m^3/s$] | | |
| ● Rimava/Vlkyňa | 5,131 | 56,64 | 1,120 |
| ● Slaná/Bretka | 6,952 | 53,801 | 1,521 |
| ● Hron/Polomka | 4,048 | 26,131 | 1,059 |
| ● Ipeľ/Slovenské Ďarmoty | 7,657 | 54,749 | 1,222 |
| ● Slatina Zvolen | 4,743 | 84,489 | 0,507 |

After applying the "filter" of protected areas into the maps of perspective rivers some of the river parts must be either excluded from further evaluation or the risk should be considered.

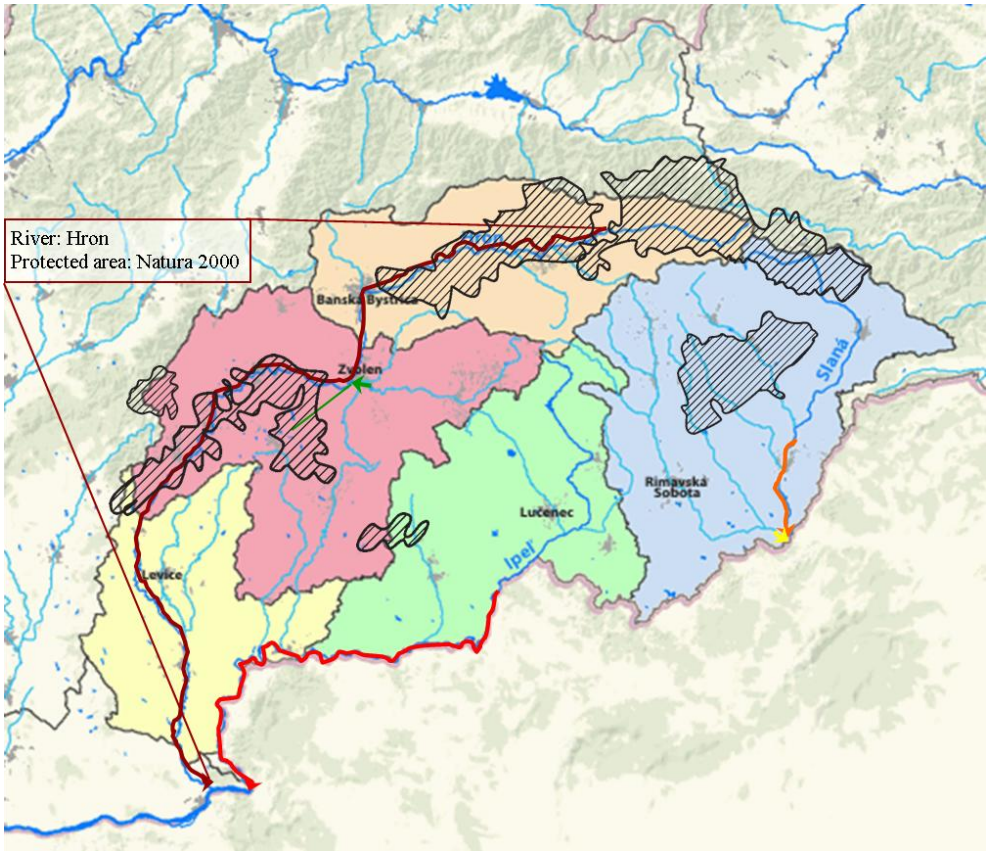



**Figure 6** - Protected areas intersecting the perspective rivers in Banská Bystrica region

As seen on the map there are two rather large sections of river Hron interfering to areas with high level of environmental protection which should be excluded from further evaluation.

### 4.1.3. Piešťany Region

For better overview of the relatively dense water ways the region has been divided into northern and southern part.

## Northern part

The perspective rivers in Northern part of Piešťany region are the right-side tributaries of river Váh – Belá, Polhoranka, Orava, Biela Orava, Bystrica and Kysuca.

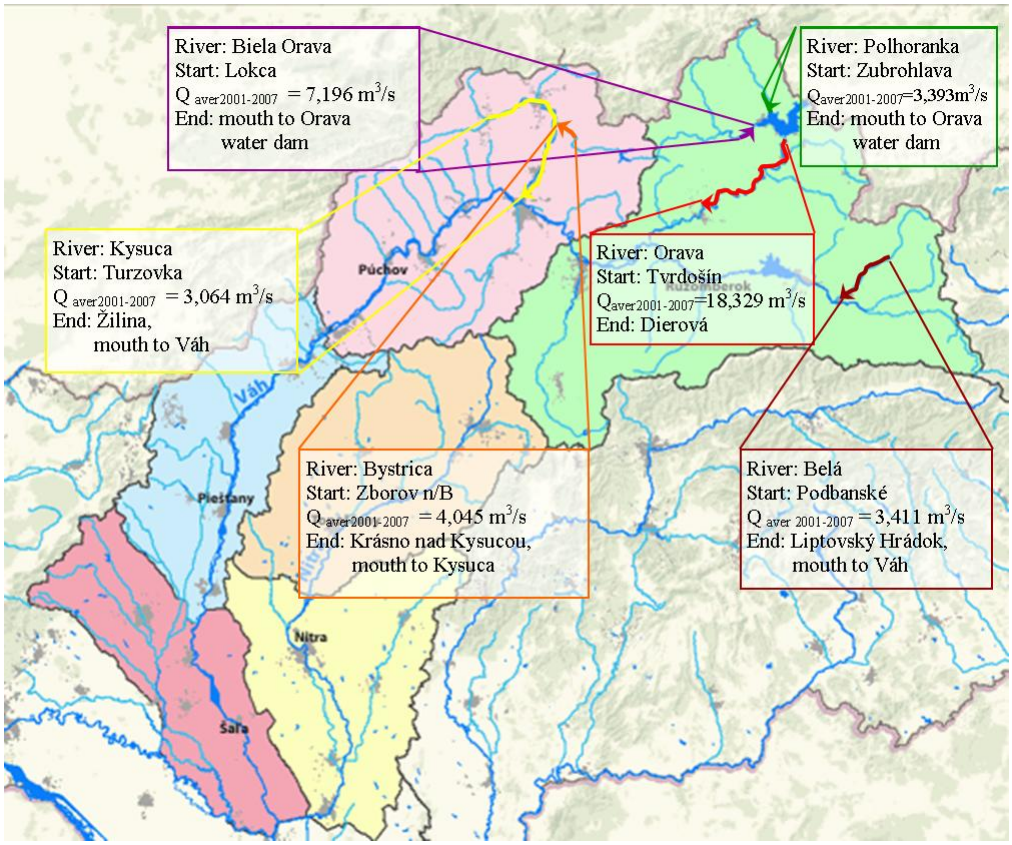



**Figure 7** - The potential river parts in Northern part of Piešťany region

**Table 24** - List of perspective rivers and their water flow data in Northern part of Piešťany region

| River/Monitoring station | Qa | Qmax h | Qmin d |
|---|---|---|---|
| | 2001-2007 average [m³/s] | | |
| ● Belá/Podbanské | 3,411 | 29,984 | 0,771 |
| ● Orava/Tvrdošín | 18,329 | 129,201 | 3,071 |
| ● Polhoranka/Zubrohlava | 3,394 | 95,171 | 0,479 |
| ● Biela Orava/Lokca | 7,196 | 154,757 | 1,138 |
| ● Bystrica/Zboroy n/B | 4,045 | 53,933 | 0,877 |
| ● Kysuca/Turzovka | 3,064 | 60,874 | 0,262 |

## Southern part

The perspective rivers in Southern part of Piešťany region is the Slovakia´s longest river – Váh and its left-side tributaries.

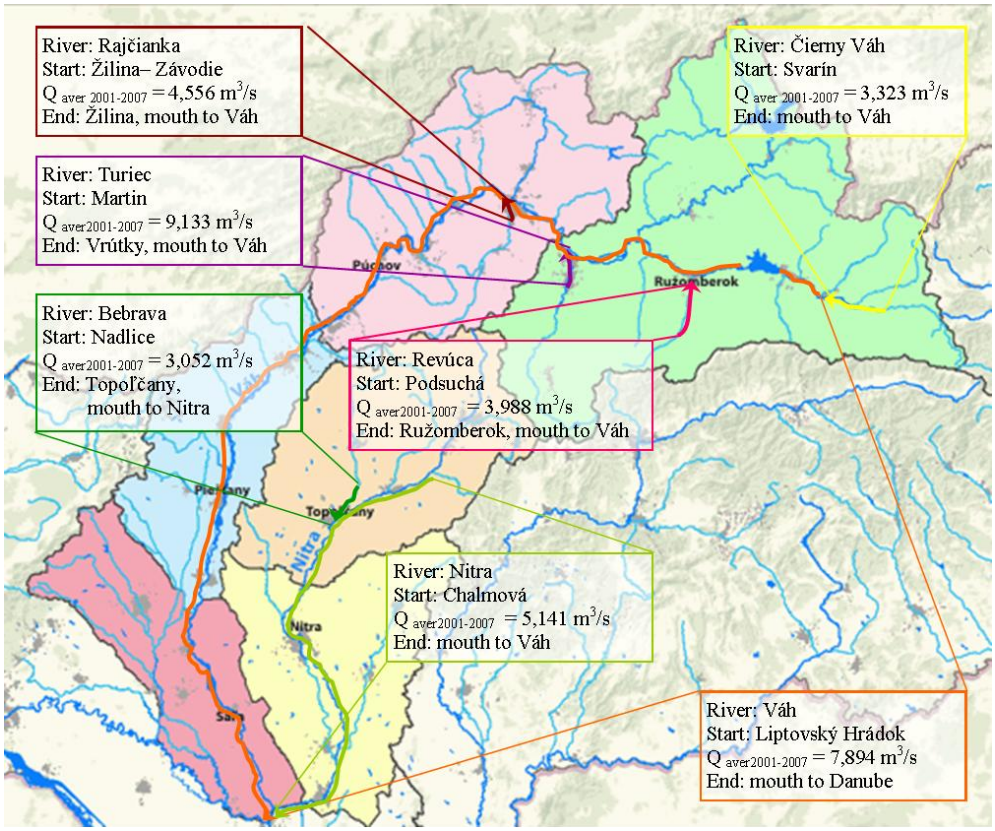



**Figure 8** - The potential river parts in Southern part of Piešťany region

**Table 25** - List of perspective rivers and their water flow data in Southern part of Piešťany region

| River/Monitoring station | Qa | Qmax h | Qmin d |
|---|---|---|---|
| | 2001-2007 average [m3/s] | | |
| ● Čierny Váh/Svarín | 3,328 | 3,239 | 0,922 |
| ● Váh/Liptovský Hrádok | 7,894 | 59,046 | 2,791 |
| ● Revúca/Podsuchá | 3,988 | 27,890 | 1,424 |
| ● Turiec/Martin | 9,133 | 5,954 | 3,576 |
| ● Rajčianka/Žilina-Závodie | 4,556 | 57,790 | 0,980 |
| ● Nitra/Chalmová | 5,141 | 60,631 | 1,604 |
| ● Bebrava/Nadlice | 3,052 | 52,589 | 0,773 |

After applying the "filter" of protected areas into the maps of perspective rivers some of the river parts must be either excluded from further evaluation or the risk should be considered.

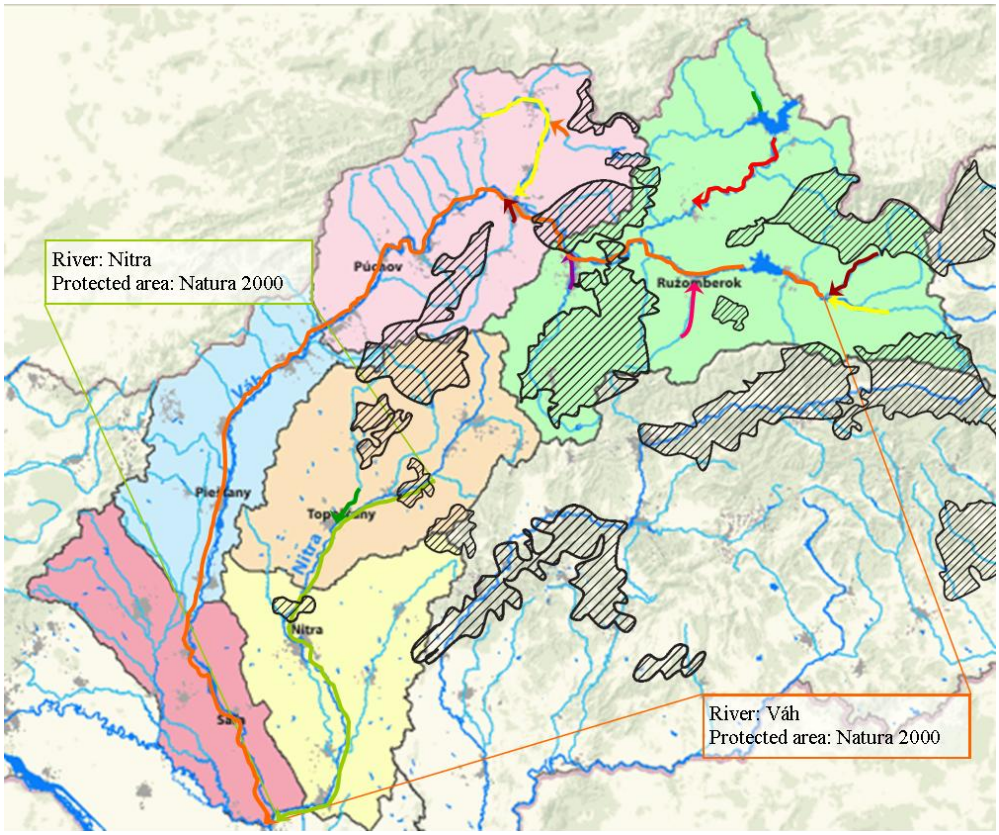



**Figure 9** - Protected areas intersecting the perspective rivers in Piešťany region

As seen on the map there are two sections of river Váh in its upper course and two sections of river Nitra which must be excluded from further evaluation due to interfering to areas with high level of environmental protection.

### 4.1.4. Bratislava Region

The perspective rivers in this region are Dunaj (Danube), Malý Dunaj, short parts of Dunaj channels, border river Morava and lower parts of rivers Váh, Nitra, Hron and Ipeľ noted above.

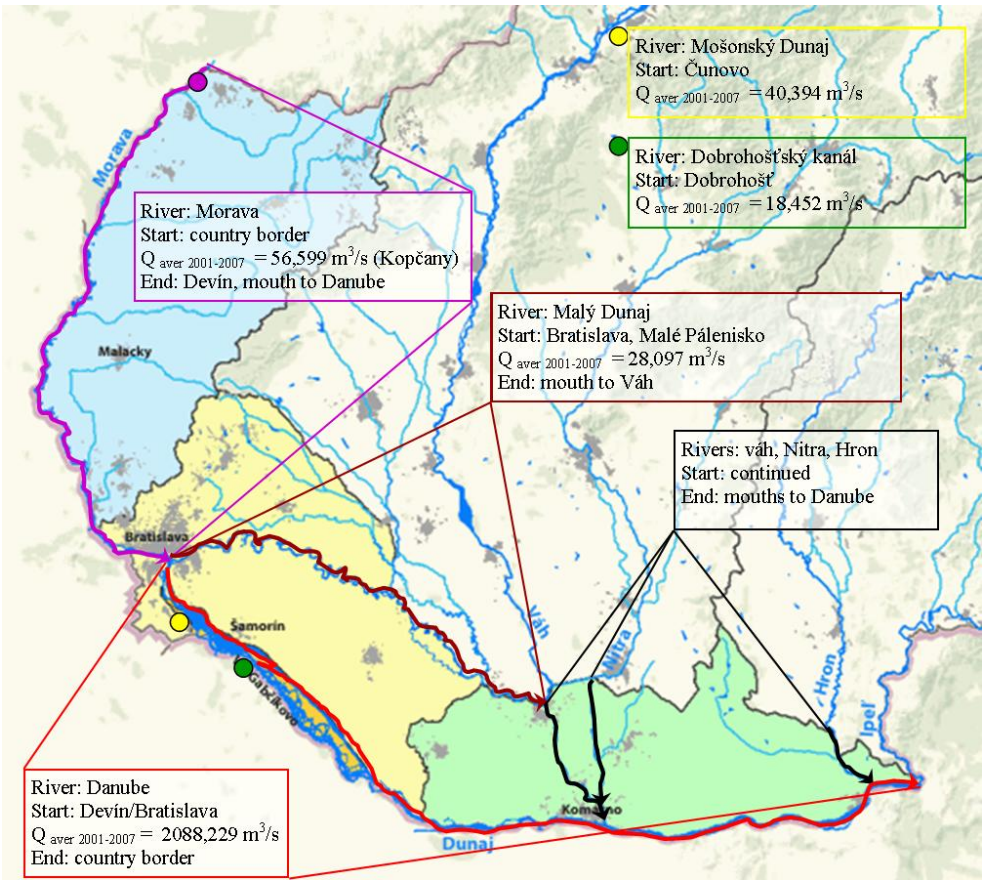



**Figure 10** - The potential river parts in Bratislava region

**Table 26** - List of perspective rivers and their water flow data in Bratislava region

| River/Monitoring station | Qa | Qmax h | Qmin d |
|---|---|---|---|
| | 2001-2007 average [$m^3/s$] | | |
| ● Malý Dunaj/Malé Pálenisko | 28,097 | 38,094 | 17,087 |
| ● Dunaj/Devín-Bratislava | 2 088,229 | 6 800,714 | 928,371 |
| ● Morava/Kopčany | 56,599 | 415,457 | 10,921 |
| ● Mošonský Dunaj/Čunovo | 40,394 | 52,330 | 13,278 |
| ● Dobrohošťský kanál | 18,452 | 50,643 | 7,531 |

After applying the "filter" of protected areas into the maps of perspective rivers some of the river parts must be either excluded from further evaluation or the risk should be considered.

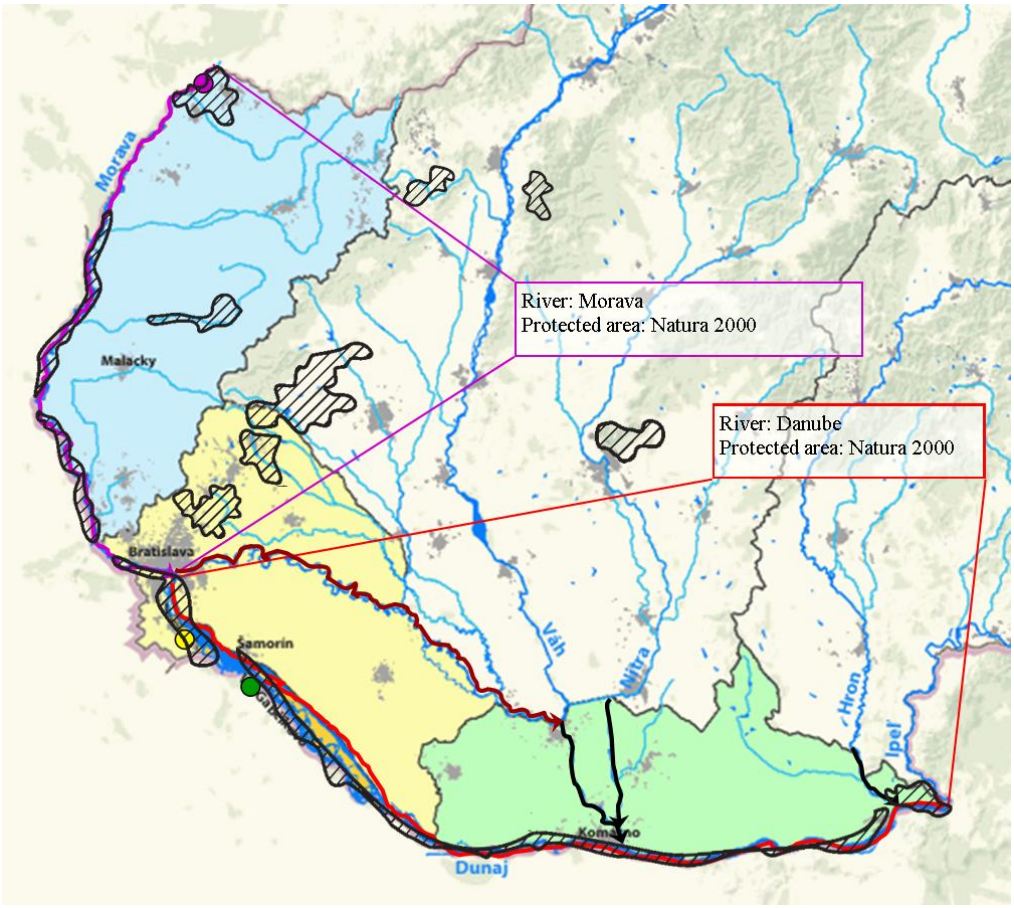



**Figure 11** - Protected areas intersecting the perspective rivers in Bratislava region

As seen on the map the whole area of river Dunaj (Danube) and most of Morava river must be excluded from further evaluation due to interfering to areas with high level of environmental protection.

## 4.2. Artificial and Industrial Water Channels

The list of water channels which is kept by SVP contains records of totally 966 water bodies classified as channels in Slovakia. Their total length is 3224,053 km.

**Table 27** - Overview of the water channels

| Channel manager | Number of channels | Total length [km] |
|---|---|---|
| Melioration (HM) | 338 | 508,243 |
| Water management (SVP) | 621 | 2701,197 |
| Forest management | 1 | 0,976 |
| Other | 5 | 12,395 |
| Not assigned | 1 | 1,242 |
| ***total*** | ***966*** | ***3224,053*** |

Melioration channels have been excluded from the further evaluation due to reasons explained above. For further processing and evaluation 628 channels are left with total length 2715,81 km. These water channels have been sorted according to the connection to individual rivers that have been selected as perspective ones. There are 507 channels with total length 2553,33 km connected to 8 of the perspective rivers.

**Table 28** - Overview of water channels connected to perspective rivers

| Region | River | Number of channels | Total length [km] |
|---|---|---|---|
| Košice | Bodrog | 146 | 721,0451 |
| | Hornád | 24 | 35,4933 |
| Banská Bystrica | Hron | 6 | 72,1840 |
| | Ipeľ | 8 | 12,7444 |
| | Slaná | 1 | 4,0576 |
| Piešťany | Váh | 232 | 1260,1200 |
| Bratislava | Morava | 42 | 176,8731 |
| | Dunaj | 48 | 270,8125 |
| | **total** | **507** | **2553,3300** |

The list of water channels contains data of very detailed position of the channel. It is indicated by the number enabling to "zoom in" from the international level river basin to national level river basin to partial river basin and to river part between two orientation points – usually tributaries of the river or the mouth of the river to another water body. According to these specific codes the exact positions of the water channels have been found and compared to the perspective river parts as described in chapter 4.1. Water channels localized out of the perspective areas have been filtered out. There are altogether 190 water channels with total length 1111,245 km.

**Table 29** – Important water channels connected to the perspective river parts not situated in protected areas

| Region | River | Number of channels | Total length [km] |
|---|---|---|---|
| Košice | Bodrog | 13 | 98,3223 |
| | Hornád | 2 | 13,8916 |
| Banská Bystrica | Hron | 4 | 60,5036 |
| | Ipeľ | 7 | 12,4078 |
| Piešťany | Váh | 159 | 835,6247 |
| Bratislava | Morava | 5 | 29,4874 |
| | **total** | **190** | **1111,2450** |

The water channels connected to Malý Dunaj ("Small Danube") belong to the river basin of Váh.
Due to the data contained in the water channels documentation it is not possible to filter the resulted numbers of channels any further. No information of the water volumes and flows was available. Neither information on the technical aspects of the channels – the cross cut shapes and dimensions. Because of the general situation of the channels in Southern Slovakia the channels on river Morava should be excluded, mainly because:

- The land of Southern Slovakia is rather flat so the water in the channels doesn't flow fast enough most probably. Although the operator is not the HM (Hydromeliorácie (Hydro Meliorations)), most of the channels are used for watering the agricultural land, anyway.
- The most of the channels are very small. The network of the channels is rather dense in this region and most of the lands are supplied by the channels.

For the other channels further evaluation and filter mean could be the "political" situation in the individual regions such as general attitude or contacts to the regional and local authorities which could contribute to the acquiring the permission.

### 4.3. Water Consumers

The summarized record of water use permissions for surface water use and discharge of waste water into the surface water bodies acquired from SHMU has been evaluated in aim to make a list of large industrial cooling & process water consumers. The documentation contains information on the subject (name, seat, location of the plant), basic kind of water use and the amounts of water (volumes per year). The actual water flow in $m^3/s$ has been calculated and the subjects taking in or discharging "more than 3 $m^3/s$" have been selected and then the way of water transport (underground pipeline or open channel) has been identified. As seen in the table below there is only one subject taking in surface waters for industrial purpose in amount higher than the limit set for this study. It is actually one of the existing SHPs. The SHP is using open water channel for water transport, naturally.

**Table 30** - List of subjects taking in the surface waters

| Purpose of water use | Name of the subject | Name of the plant | Plant location | Name of the river | River km | Water volume [$m^3/s$] |
|---|---|---|---|---|---|---|
| Use of hydro power and hydro potential of the water flow | Železiarne Podbrezová a.s. | SHP HC Dubová | Podbrezová | Hron | 208,300 | 4,4123 |
| Cooling | Slovnaft a.s. | Slovnaft a.s. Bratislava, P-4.2 | Bratislava | Dunaj | 1863,000 | 1,4882 |
| Use of hydro power and hydro potential of the water flow | Železiarne Podbrezová a.s. | Malá vodná elektráreň Predajná | Podbrezová | Jasenica -1 | 1,550 | 1,2105 |
| Breeding of fishes, water birds or other aquatic animals | Slovryb a.s. | Pstruhárstvo Biely Potok<br>MO Slovryb | Ružomberok | Revúca | 9,850 | 1,0599 |
| Cooling | Slovenské elektrárne a.s. | Nuclear power plant Bohunice | Jaslovské Bohunice | VN Sĺňava (Váh) | 115,000 | 1,0508 |

As seen in the table below there is no subject discharging wastewaters into the surface waters in amount higher than the limit set for this study.

**Table 31** - List of subjects discharging waste waters into the surface waters

| Type of water discharged | Name of the subject | Name of the plant | Plant location | Name of the river | River kilometer | Water volume [$m^3/s$] |
|---|---|---|---|---|---|---|
| Cooling waters | Slovnaft a.s. | Slovnaft a.s. Bratislava, P-4.2 | Bratislava | Malý Dunaj | 124,000 | 1,736 |
| Municipal waste waters | BVS a.s. - Bratislavská vodárenská spoločnosť | Bratislavská vodárenská spoločnosť a.s. ČOV Vrakuňa | Bratislava | Malý Dunaj | 123,400 | 1,188 |
| Fish breeding waste waters | Slovryb a.s. | Pstruhárstvo Biely Potok | Ružomberok | Revúca | 9,850 | 1,131 |
| Industrial waste waters | Mondi Business Paper SCP a.s. | Mondi Business Paper SCP a.s. ČOV | Ružomberok Hrboltová | Váh | 314,800 | 1,061 |

The lack of subjects was much unexpected when taking into account information from other countries, such as Austria. The reason could be that there are no really large industrial facilities or they do not use natural surface waters and/or they do not discharge their waste waters to the surface waters.

## 5. Chances for Project Development of SHP´s

### 5.1 SWOT Analysis

SWOT Analysis is a strategic planning method used to evaluate the Strengths, Weaknesses, Opportunities, and Threats involved in a project or in a business venture. It involves specifying the objective of the business venture or project and identifying the internal and external factors that are favourable and unfavourable to achieving that objective.[26]

This SWOT analysis highlights the important aspects of the idea of constructing new SHPs in Slovakia. It should shows all pro and contras for investments in small hydroelectric in Slovakia.

**Strengths**

- long life time of SHP´s
- proven and scalability and flexibility of various technologies
- low operation costs
- clean technology with high efficiency

**Weaknesses**

- Questionable outputs/yields in comparison with other technologies of renewable energy
- High investments

**Opportunities**

- Reduction of investment and installation costs by using existing water constructions
- Realization on artificial waterways may simplify and quicken the EIA and permission acquiring process

**Threats**

There is a lack of Slovak politics in a clear line in terms of responsibilities for renewable energy as well as the necessary resources available from institutions such as the Slovak Energy Agency, which must be financed privately.[27]

- Lack of natural rivers and artificial water channels available
- Complicated information collection
- Regulatory constraints
- Ownership of the premises (could be unsettled)

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[26] www.wikipedia.org
[27] dena – Deutsche Energie Agentur (2004)

## 5.2 Potential of SHP´s in Slovakia

The question is: *´How big is the potential for new small hydro power plants in Slovakia which could be realized quickly?´*

The statistical data on SHPs (electrical power above 10 MW) in Slovakia vary significantly according to source very major differences. Even national agencies have only little reliable data on the SHP Inventory. Essential cause this is the fact that the performance limits for various SHPs be defined.[28]

There are currently around 200 SHPs with an average electrical power of around 0,5 MW in operation. This should be only 25% of the technical hydroelectrical potential of Slovakia, but in reality there are a limited figure of new potential locations. In the masterplan of the ministery is an expectation of hydroelectrical production through SHPs of 450 GWh in 2015. This could just be reach with the planned SHPs in Slovakia.

The water channels of industrial factories in Slovakia do not have sufficient water flows for installation of the SHP as the primary layout of the masterthesis assumed. The research results show that there are very few subjects taking in or discharging water in amount higher than 1 $m^3/s$ only.

In the registry of the water intakes and discharges there is only one subject passed the selection criteria and it is the SHP of the steel mill Železiarne Podbrezová with water flow ca. 4,4 $m^3/s$. This SHP is not the biggest one in Slovakia, actually. The other SHPs are obviously not registered for official surface water utilization. This fact opens potential question of search for the sites next to existing SHP. Using the existing channel, transforming station and grid connection may decrease the investment costs. The environmental impact assessment may be easier, as well.
It is expected that in the large industrial plants are still some existing potentials for modern small hydropower investments, if the potential be availed of water from the process (cooling water, waste water, drinking water[29]). However, it has still to be done a stronger awareness created to the respective management for using process waters.

Private investors have a good legislative background for new projects now, but have to calculate with uncertainties in the EIA-process.

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[28] Pelikan B. (2005)
[29] Papp J. (2008)

## 5.3 Slovakian National Energy Strategy for Development of SHP

The question is: *´Does Slovakia have a strategy for electricity of small hydro power?´*

Slovakia plans to solve its bottleneck of energy through nuclear power and natural gas. The government does not believe in a bigger potential of renewable energy. By the way the European programs of $CO_2$-reductions and renewable energy will even be used for other things, like waste incineration. So they give feed-in tariffs for co-firing of wood waste, etc.

However, the Slovak government currently promotes its expansion of hydropower. The reason is EU funding. Hydro electrical power is in fact eligible for EU structural funds in 2007-2013. Therefore Slovakia is to receive funds from Brussels. However it is feared that these EU funds will not be taken, because of missing further investments in new SHP´s.

It is the strategy of Slovakia to fullfill all the administrative requirements of European Union, like new acts. On the other side they will not push small hydro power, but believe in bigger solutions like natural gas and nuclear power.

Slovakia fullfill all European requirements for safe investments in the field of renewable energy. The future will show, if this is enough to reach their national targets for $CO_2$-neutral electricity.

## 5.4 Hydro Power in Relation to other Renewable Solutions

The question is: *´Does the eligibility requirements of the state match to the free potential of hydro power?´*

Actually it seems clear, that the Slovakian government have made a token gesture for feed-in tariffs into new investments in hydro electric. Even the new law with fixed tariffs will not push forward hydro power very much. In Slovakia the free potential in geothermal, photovoltaic, wind and biomass are much higher than in development of new hydro power. *(see table 6)*

The EBRD gave additional 60 million Euros for private investments in sustainable energy in 2008, but less than 5% went into hydro power projects. In the EBRD-Report they came to the opinion, that Slovakia needs additional promotion of alternative energy sources, greater energy efficiency and

development of renewable energy, which lag behind regional standards. ´It is not clear that the government's interventions in the energy sector have been helpful in this regard.´[30]

In the last years the government were accused that they protect the interests of the existing producers of hydro electric who have a strong lobby with big influence into politics. On the other hand it seems interesting that new laws and grants for investments in hydro power could be misplaced because of the low potential of hydro power.

Anyway there is enough space for new technologies, especially for micro hydro power plants (from 10 kW up to 100 kW) in Slovakia and everywhere in Europe, but this must be recognized by politicans and decision-makers.

[30] EBRD - European Bank For Reconstruction And Development (2009)

## 6. Summary

This study has focused on search for potential sites for installation of small hydro power plants with an electric power under 250 kW and overview of the general conditions of energy sector, market, legislation and economy.

The energy sector in Slovakia is characterized by strong dependence on fossil fuels (over 28% of electricity production) and nuclear (over 50% of electricity production). Almost 15% of annual electricity production is covered by 25 large hydro power plants.

There are over 200 SHPs with installed capacity under 5 MW in operation in Slovakia. 192 of them with total capacity ca 64 MWe are registered for feed-in tariffs. The major operator/owner of SHPs is ENEL-Slovenské elektrárne (28% of installed capacity).

Hydro power has relatively favourable position in terms of the bureaucracy and prejudices. It can be seen in the growth of the SHPs projects within last years and numbers of planned installations in the future (19 in 2009, 11 in 2010 or later).

The main regulatory body for energy sector is "URSO" – Regulatory Office for Network Industries which is approving all energy sources and energy prices.
The feed-in tariffs for "green energy" from small SHP is fixed for 15 years on 74,69 –109,08 €/MWh depending on the date of beginning of operation, the highest one being paid for refurbished existing SHP.

All SHPs are subject to the environmental impact assessment procedure which must be considered by project preparation and planning.
For the list of the potential sites the primary search has been focused on the artificial water ways and channels where easy environment impact assessment and favourable technical status (already built walls of the channel).

The study revealed lack of potential sites. The water flows in rivers are in major part of the country relatively small because of the geographical and geomorphologic conditions. Due to historic development of water management there are very few industrial water channels. Majority of the channels serve agricultural and/or flood prevention purposes and have very small flows.

The masterthesis has shown that the information on the water channels is hardly available and the

channels´ operators do not keep the records in a way and detail needed for this study.

The natural rivers have been analyzed with the aim to obtain potential areas where the water channel connected to the river has the potential to have sufficient flow. Afterwards the areas with strict nature protection rules have been sorted out. The resulting list consists of 190 water channels. However, there are no detailed data on water flows and cross cut shapes of these channels and further selection was not possible.

The records of surface water consumption and discharges proved that the water consumers in Slovakia there are not large enough to be considered as potential sites for SHP installation. Even the largest industrial factories as the steel mills and oil refinery discharge water slightly above 1,7 $m^3/s$ only. Only one subject has a discharge over 3,3 $m^3/s$ which has been set as the minimum flow necessary.

The Slovak government currently promotes its expansion of hydropower. The reason is EU funding. Hydro electrical power is in fact eligible for EU structural funds in 2007-2013. Therefore Slovakia is to receive funds from Brussels. However it is feared that these EU funds will not be taken, because of missing further investments in new SHP´s.

In Slovakia the free potentials in geothermal, photovoltaic, wind and biomass are much higher than in development of new hydro power. It is the strategy of Slovakia to fullfill all the administrative requirements of European Union, like new acts. On the other side they will not push small hydro power, but believe in bigger solutions like natural gas and nuclear power.

Slovakia fullfill all European requirements for safe investments in the field of renewable energy. The future will show, if this is enough to reach their national targets for $CO_2$-neutral electricity. Anyway there is enough space for new technologies, especially for micro hydro power plants (from 10 kW up to 100 kW) in Slovakia and everywhere in Europe, but this must be recognized by politicans and decision-makers.

So there could be more detailed works on a focus of of micro hydro power plants with less than 100 kW in the future.

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## 8. Attachment – List of SHPs with total installed capacity < 5 MW in SR with the certificate of proof of origin for RES (Source: Regulatory Office for Network Industries)

| | Name of SHP | Nr. of turbines and capacity | Type of Turbine | Installed capacity total in MW | 2009 exp. yearly production in MWh | Operator/ Owner |
|---|---|---|---|---|---|---|
| 1 | MVE Gočovo | | | 0,070 | 160 | Hydrokov s.r.o. |
| 2 | MVE Nováły | 0,075 + 0, 011 | | 0,086 | 185 | Hydro-Gen, a.s. |
| 3 | MVE Preseľany | 0,4 + 0,4 | | 0,800 | 2 971 | Hydro-Gen, a.s. |
| 4 | HC Jasenie | 1,6 + 0,8 | | 2,400 | 11 600 | Železiarne Podbrezová, a.s. |
| 5 | HC Dubová | 1,01 + 0,4 | | 1,410 | 7 900 | Železiarne Podbrezová, a.s. |
| 6 | HC Piesok | 0,8 + 0,4 | | 1,200 | 4 200 | Železiarne Podbrezová, a.s. |
| 7 | MVE Predajná | 0,16 + 0,08 | | 0,240 | 700 | Železiarne Podbrezová, a.s. |
| 8 | MVE Jasenie | 0,09 | | 0,090 | 240 | Železiarne Podbrezová, a.s. |
| 9 | HPP Bešeňová | 2,32 + 2,32 | Kaplan | 4,640 | 19 250 | Slovenské elektrárne, a.s. |
| 10 | VE Dobšiá 2 | 2 | Kaplan | 2,000 | 5 284 | Slovenské elektrárne, a.s. |
| 11 | VE Ružín 2 | 1,8 | Kaplan | 1,800 | 4 670 | Slovenské elektrárne, a.s. |
| 12 | VE Krompachy | 0,33 | Kaplan | 0,330 | 560 | Slovenské elektrárne, a.s. |
| 13 | MVE Švedlár | 0,045 + 0,045 | Francis | 0,090 | 77 | Slovenské elektrárne, a.s. |
| 14 | VE Bešeňová | 2 x 2,32 | | 4,640 | 18 625 | Slovenské elektrárne, a.s. |
| 15 | VE Dobšiná 2 | | | 2,000 | 5 284 | Slovenské elektrárne, a.s. |
| 16 | VE Ružín 2 | | | 1,800 | 4 670 | Slovenské elektrárne, a.s. |
| 17 | VE Krompachy | | | 0,330 | 560 | Slovenské elektrárne, a.s. |
| 18 | MVE Švedlár | 2 x 0,045 | | 0,090 | 78 | Slovenské elektrárne, a.s. |
| 19 | MVE Blatnica | | | 0,060 | 50 | Poľnohospodárske družstvo Gader Blatnica |
| 20 | MVE Stránske | | | 0,049 | 240 | Kostka Ľubomír |
| 21 | MVE Necpaly | | | 0,011 | 700 | Turčianska vodárenská spoločnosť, a.s. |
| 22 | MVE Krupina | | | 0,022 | 30 | Nádej, a.s. |
| 23 | MVE Nová Bystrica | 2 x 0,055 | | 0,110 | 430 | Severoslovenské vodárne a kanalizácie, a.s. |
| 24 | MVE Krásno nad Kysucou | | | 0,110 | 375 | Severoslovenské vodárne a kanalizácie, a.s. |

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| 25 | MVE Kysucké Nové Mesto | | | 0,050 | 155 | Severoslovenské vodárne a kanalizácie, a.s. |
| 26 | MVE Spišská Nová Ves | | | 0,030 | 185 | Viliam Králik |
| 27 | MVE Čirč | | | 0,100 | 650 | Milan Roba |
| 28 | MVE Harmanec - Tunel a Čierno | 0,09 + 0,022 | | 0,112 | 1 600 | FINEZ, a.s. |
| 29 | MVE Staré Hory - Mor ho | | | 0,132 | | |
| 30 | MVE - T0 Košice | | | 0,135 | 590 | CES BETA s.r.o. |
| 31 | MVE - T2 Košice | | | 0,135 | 600 | CES BETA s.r.o. |
| 32 | MVE - Brezovica | | | 0,111 | 500 | CES BETA s.r.o. |
| 33 | MVE Ťahanovce | 2 x 0,22 | | 0,440 | 2 200 | CES BETA s.r.o. |
| 34 | MVE Vyšná Rybnica | | | 0,075 | 210 | CES BETA s.r.o. |
| 35 | MVE Kremnica | 0,71 + 1,12 + 2,16 | | 3,990 | 10 000 | Kremnická banská spoločnosť s.r.o. |
| 36 | MVE Uhorská Ves | | | 0,992 | 4 199 | MVE Váh, s.r.o. |
| 37 | MVE Kalná 1 | | | 0,496 | 2 199 | MVE Váh, s.r.o. |
| 38 | MVE Kalná 2 | | | 0,992 | 3 999 | MVE Váh, s.r.o. |
| 39 | MVE Boboty | 0,03 + 0,03 | | 0,060 | 100 | Milan Čilík, Helena Makovníková |
| 40 | MVE Liptovská Teplička | | | 0,400 | 1 898 | Prvá Oravská Energetická |
| 41 | MVE Spišské Bystré | | | 0,110 | 700 | Prvá Oravská Energetická |
| 42 | MVE Heľpa | 0,09 + 0,09 | | 0,180 | 800 | MAJK s.r.o. |
| 43 | MVE Huncovce | 0,25 + 0,25 | | 0,500 | 1 400 | DREVOMAT, s.r.o. |
| 44 | MVE Podbreh | 0,315 + 2x0,09 | | 0,495 | 1 500 | EPIOR |
| 45 | MVE Demänovská Dolina | 0,045 | | 0,045 | 110 | Liptovská vodárenská spoločnosť, a.s. |
| 46 | MVE Nová Dedinka | 0,492 + 0,492 | | 0,984 | 4 900 | Slovenský vodohospodársky podnik, š.p. |
| 47 | MVE Malé Pálenisko | 0,4945 + 0,4945 | | 0,989 | 2 800 | Slovenský vodohospodársky podnik, š.p. |
| 48 | MVE Veľké Blahovo | 0,4985 + 0,4985 | | 0,997 | 4 700 | Slovenský vodohospodársky podnik, š.p. |

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| 49 | MVE Kunov | | | 0,037 | 62 | Slovenský vodohospodársky podnik, š.p. |
| 50 | MVE Buková | | | 0,011 | 2 | Slovenský vodohospodársky podnik, š.p. |
| 51 | MVE Drahovce | | | 0,375 | 2 000 | Slovenský vodohospodársky podnik, š.p. |
| 52 | MVE Bošany | | | 0,440 | 550 | Slovenský vodohospodársky podnik, š.p. |
| 53 | MVE Ondrochov | | | 0,011 | 35 | Slovenský vodohospodársky podnik, š.p. |
| 54 | MVE Selice | | | 0,264 | 550 | Slovenský vodohospodársky podnik, š.p. |
| 55 | MVE Ružomberok | | | 0,200 | 550 | Slovenský vodohospodársky podnik, š.p. |
| 56 | MVE Krpeľany | | | 0,500 | 2 200 | Slovenský vodohospodársky podnik, š.p. |
| 57 | MVE Turček Ia II | | | 0,217 | 760 | Slovenský vodohospodársky podnik, š.p. |
| 58 | MVE Turček III | | | 0,110 | 360 | Slovenský vodohospodársky podnik, š.p. |
| 59 | MVE Nová Bystrica I a II | | | 0,290 | 1 240 | Slovenský vodohospodársky podnik, š.p. |
| 60 | MVE Nosice | | | 0,400 | 1 500 | Slovenský vodohospodársky podnik, š.p. |
| 61 | MVE Nitrianske Rudno | | | 0,074 | 130 | Slovenský vodohospodársky podnik, š.p. |
| 62 | MVE Nováky II | | | 0,214 | 75 | Slovenský vodohospodársky podnik, š.p. |
| 63 | MVE Hriňová Ia II | | | 0,364 | 625 | Slovenský vodohospodársky podnik, š.p. |
| 64 | MVE Klenovec Ia II | | | 0,157 | 250 | Slovenský vodohospodársky podnik, š.p. |
| 65 | MVE Rimavská Sobota | | | 0,013 | 23 | Slovenský vodohospodársky podnik, š.p. |
| 66 | MVE MálinecI, II, III | | | 0,322 | 810 | Slovenský vodohospodársky podnik, š.p. |
| 67 | MVE Ružiná | | | 0,080 | 45 | Slovenský vodohospodársky podnik, š.p. |
| 68 | MVE Teplý Vrch | | | 0,049 | 65 | Slovenský vodohospodársky podnik, š.p. |
| 69 | MVE Zvolen | | | 0,800 | 2 200 | Slovenský vodohospodársky |

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| | | | | | | podnik, š.p. |
| 70 | MVE Starina | | | 0,112 | 600 | Slovenský vodohospodársky podnik, š.p. |
| 71 | MVE Krompachy | | | 0,110 | 330 | Slovenský vodohospodársky podnik, š.p. |
| 72 | MVE Pružina | | | 0,040 | 170 | Považská vodárenská spoločnosť, a.s. |
| 73 | MVE Visolaje | 0,045 + 0,037 | | 0,082 | 250 | Považská vodárenská spoločnosť, a.s. |
| 74 | MVE Malé Kršteňany | | | 0,053 | 170 | Milan Mlynarčík |
| 75 | MVE Boboty | 0,04 + 0,04 | | 0,080 | 140 | František Záruba |
| 76 | MVE Cenovo | 0,055 + 0,055 | | 0,110 | 422 | František Záruba |
| 77 | MVE Horná Streda | 0,02 + 0,02 | | 0,040 | 200 | Pravoslavná akademie Vilémov |
| 78 | MVE Svit | | | 0,015 | 65 | Viera Tatranská |
| 79 | MVE Torysa | | | 0,062 | 450 | ENERGO Bzenica s.r.o. |
| 80 | MVE Družstevná pri Hornáde | 0,4 + 0,4 | | 0,800 | 3 980 | MVE Družstevná pri Hornáde s.r.o. |
| 81 | MVE Drnava | | | 0,051 | 75 | Július Cmorík |
| 82 | MVE Veľké Bielice | | | 0,012 | 10 | DUKAS, s.r.o. |
| 83 | MVE Machulince | | | 0,008 | 30 | Ondrej Hvišč |
| 84 | MVE Obyce | | | 0,030 | 60 | Jozef Mlynár |
| 85 | MVE Humenné | | | 0,055 | 55 | Východoslovenská vodárenská spoločnosť, a.s. |
| 86 | MVE Stakčín | 0,2 + 0,2 | | 0,400 | 405 | Východoslovenská vodárenská spoločnosť, a.s. |
| 87 | MVE Bukovec | 0,037 + 0,075 | | 0,112 | 70 | Východoslovenská vodárenská spoločnosť, a.s. |
| 88 | MVE Mníšek nad Hnilcom | 0,075 + 0,075 | | 0,150 | 690 | ENERGO-AQUA, a.s. |
| 89 | MVE Trenčianske Biskupice | | | 0,400 | 3 180 | ENERGO-AQUA, a.s. |
| 90 | MVE Chvojnica | 0,03 + 0,015 | | 0,045 | 123 | Mendel Jozef |
| 91 | MVE Bánovce nad Brebravou | | | 0,008 | 20 | Paulech Anton |
| 92 | MVE Liptovská Osada | | | 0,075 | 393 | Vodárenská spoločnosť Ružomberok, a.s. |

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| 93 | MVE Kosovo | | | 0,075 | 246 | Vodárenská spoločnosť Ružomberok, a.s. |
| 94 | MVE Motyčky | | | 0,055 | 40 | Stredoslovenská vodárenská spoločnosť, a.s. |
| 95 | MVE Svrčková | | | 0,132 | 620 | Anna Chorvátová ALFA |
| 96 | MVE Podlužany I | | | 0,055 | 130 | Ondrej Števanka ZPMS ENEKO |
| 97 | MVE Podulžany II | | | 0,500 | 2 365 | Ondrej Števanka ZPMS ENEKO |
| 98 | MVE Jaklovce | | | 0,008 | 15 | Ján Šmída |
| 99 | MVE Sokolovce | | | 0,075 | 21 | František Oboňa |
| 100 | MVE Vígľaš | 0,022 + 0,022 + 0,007 | | 0,051 | 140 | Fáberová Jana |
| 101 | MVE Mýtne Ludany | 0,01 + 0,0025 + 0,0025 | | 0,015 | 100 | Ivan Reider |
| 102 | MVE Starý Tekov | | | 0,075 | 485 | Arpád Reider |
| 103 | MVE Habovka | 0,015 + 0,015 | | 0,030 | 180 | Peter Tekeľ |
| 104 | MVE Sečovská Polianka | | | 0,075 | 236 | Darina Tkáčová |
| 105 | MVE Huncovce pri hati | | | 0,030 | 220 | Anton Kornaj |
| 106 | MVE Stará Voda | | | 0,050 | 220 | Oto Vavra |
| 107 | MVE Dolný Jelenec | 0,7 + 0,35 | | 1,050 | 984 | Stredoslovenská energetika, a.s. |
| 108 | MVE Staré Hory | 0,7 + 0,35 | | 1,050 | 1 976 | Stredoslovenská energetika, a.s. |
| 109 | MVE Union Zvolen | | | 0,500 | 2 465 | Stredoslovenská energetika, a.s. |
| 110 | MVE Bobrovec | 0,015 + 0,007 + 0,011 | | 0,033 | 134 | Blaščík Eduard |
| 111 | MVE Jerguška | 0,022 + 0,03 | | 0,052 | 82 | Holík Ondrej |
| 112 | MVE Očová Rovne | 0,022 + 0,03 | | 0,052 | 90 | Holík Ondrej |
| 113 | MVE Roveň | | | 0,300 | 1 500 | RODACH s.r.o. |
| 114 | MVE Kočkovce | | | 0,450 | 2 697 | Dmi TRADE, a.s. |
| 115 | MVE Hričov | | | 0,750 | 4 396 | Dmi TRADE, a.s. |
| 116 | MVE Beňuš | 0,12 + 0,12 | | 0,240 | 799 | RENOST, s.r.o. |

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| 117 | MVE Bujakovo | 0,151 + 0,151 | | 0,302 | 779 | MVE s.r.o. |
| 118 | MVE Utekáč-Salajka | 0,03 + 0,015 | | 0,045 | 65 | Ladislav Beňuš |
| 119 | MVE Remata I | | | 0,160 | 1 460 | Lahky Design Consulting |
| 120 | MVE Nová Ľubovňa | | | 0,015 | 45 | Miroslav Arendáč |
| 121 | MVE Kovo Bohunka | 3 x 0,04 | | 0,120 | 240 | KOVO BOHUNKA VD |
| 122 | MVE Studenec 1 | | | 0,011 | 40 | Líška Milan |
| 123 | MVE Studenec II | | | 0,014 | 40 | Líška Milan |
| 124 | MVE Černík | | | 0,075 | 30 | Líška Milan |
| 125 | MVE Podbiel | | | 0,040 | 360 | Anna Krupová KRUP |
| 126 | MVE Trnovec na Váhu | 0,45 + 0,45 | | 0,900 | 3 600 | MVE Slovakia s.r.o. |
| 127 | MVE Turá na Hrone | 4 x 0,55 | | 2,200 | 7 000 | MVE Slovakia s.r.o. |
| 128 | MVE Krasňany | | | 0,045 | 125 | Bečár Boris BELEN |
| 129 | MVE Liptovská Osada | 0,03 + 0,03 | | 0,060 | 250 | Ján Haluška - MVE |
| 130 | MVE Dúbrava | | | 0,240 | 850 | BADOS s.r.o. |
| 131 | MVE Závadka nad Hronom | | | 0,027 | 128 | Vojtech Brucháč |
| 132 | MVE Liptovská Kokava | | | 0,018 | 80 | Otto Drenka |
| 133 | MVE Dovalovo | 0,166 + 0,166 | | 0,332 | 1 300 | Jurčo Ján |
| 134 | MVE Prenčín | | | 0,007 | 30 | Andel Vojtech |
| 135 | MVE Nováky I | 0,075 + 0,011 | | 0,086 | 185 | Hydro-Gen, a.s. |
| 136 | MVE Preseľany | 0,4 + 0,4 | | 0,800 | 2 971 | Hydro-Gen, a.s. |
| 137 | MVE Turiec-Bystrička | 0,08 + 0,08 | | 0,160 | 250 | AMIKUS, s.r.o. |
| 138 | MVE Dolný Harmanec | | | 0,018 | 80 | Šimon Vajs |
| 139 | MVE Tatranská kotlina | | | 0,030 | 160 | TGM INVEST, s.r.o. |
| 140 | MVE Nadlice | 0,018 + 0,018 | | 0,036 | 120 | František Kováč |
| 141 | MVE Handlovka | 0,018 + 0,005 | | 0,023 | 35 | František Kováč |

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| 142 | MVE Važec | | | 0,030 | 140 | Vladimír Lehotský |
| 143 | MVE Ryveja | | | 0,019 | 52 | Jozef Rybár |
| 144 | MVE Lopej | | | 0,120 | 220 | MVE - Lopej s.r.o. |
| 145 | MVE Kunerád | | | 0,040 | 130 | Závodský Anton |
| 146 | MVE CHS Oravice | 0,132 + 0,090 | | 0,222 | 710 | Oravská vodárenská spoločnosť, a.s. |
| 147 | MVE Liptovská Kokava | 0,011 + 0,015 | | 0,026 | 85 | Július Poruban |
| 148 | MVE Mokrá Lúka | | | 0,030 | 150 | Július Dvorčák |
| 149 | MVE Vyšné Opátske | 0,315 + 0,315 | | 0,630 | 1 500 | MVE Opátske s.r.o. |
| 150 | MVE Pribylina | | | 0,036 | 120 | Štecko Pavel |
| 151 | MVE Ďanová | 0,0185 + 0,0055 + 0,0055 | | 0,030 | 105 | Milan Achimský |
| 152 | MVE Sulín | 3 x 0,315 | | 0,945 | 3 600 | RIMY s.r.o. |
| 153 | MVE Jakubany | 2 x 0,015 + 0,0075 | | 0,038 | 130 | Ladislav Myttnik |
| 154 | MVE Batizovce | | | 0,018 | 100 | Gašperová Mária |
| 155 | MVE Košecké Podhradie | 2 x 0,015 | | 0,030 | 130 | Františe kPolák |
| 156 | MVE Udiča | | | 0,011 | 95 | Mado František |
| 157 | MVE Huncovce | | | 0,055 | 95 | TATRAFAT s.r.o. |
| 158 | MVE Ruskovce | 0,007 + 0,018 | | 0,025 | 41 | Pavol Basanda |
| 159 | MVE Richnava | 2 x 0,105 | | 0,210 | 780 | Cyril Filo |
| 160 | MVE Vidová | 0,016 + 0,048 | | 0,064 | 1 232 | 1. energetická s.r.o. |
| 161 | MVE Veľká Lomnica | 0,015 + 0,011 | | 0,026 | 100 | Hubač Ladislav |
| 162 | MVE Jenisejská | 0,0185 + 0,006 | | 0,025 | 75 | Marcin Michal |
| 163 | MVE Nitra Sever | 2 x 0,3 | | 0,600 | 1 763 | ZSE Energia, a.s. |
| 164 | MVE Jelšovce | | | 1,200 | 4 498 | ZSE Energia, a.s. |
| 165 | MVE Žehrica | 0,017 + 0,013 | | 0,030 | 125 | Dušan olejník |
| 166 | MVE Poruba | | | 0,005 | 20 | Čavojský Róbert |
| 167 | MVE Okoličné | 2 x 0,4 | | 0,800 | 4 050 | KFK, s.r.o. |
| 168 | MVE Nálepkovo | | | 0,057 | 60 | Šahin Štefan |
| 169 | MVE Prečín | | | 0,008 | 36 | Andel Vojtech |

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|---|---|---|---|---|---|---|
| 170 | MVE Lomná | | | 0,096 | 300 | Obec Lomná |
| 171 | MVE Čierna Lehota | 0,008 + 0,012 | | 0,020 | 35 | Emil Pukanský |
| 172 | MVE Plešivec | 0,04 + 0,08 | | 0,120 | 259 | ENERGIA s.r.o. |
| 173 | MVE Jakub | 3 x 0,011 | | 0,033 | 30 | Ingrid Ridene Ciencalová |
| 174 | MVE Turiec | 0,008 + 0,018 +0 ,018 | | 0,044 | 320 | BELKAM s.r.o. |
| 175 | MVE Hranovica | | | 0,055 | 290 | LATNER s.r.o. |
| 176 | MVE Levice | | | 0,045 | 160 | STOLANA - Polakovič Milan |
| 177 | MVE Liptovská Kokava - mlyn | | | 0,015 | 70 | Možiešiková Katarína |
| 178 | MVE Veľký Folkmár | 0,08 + 0,12 | | 0,200 | 40 | Plast s.r.o. |
| 179 | MVE Krajná Poľana | 0,023 + 0,016 | | 0,039 | 90 | Peter Ivančo - ENERGOALTERNATÍV |
| 180 | MVE Biely Potok | | | 0,240 | 586 | REPOX s.r.o. |
| 181 | MVE Svit Podskalka | 2 x 0,03 | | 0,060 | 180 | RADIX s.r.o. |
| 182 | MVE Nová Ľubovňa | | | 0,015 | 55 | Miroslav Arendáč |
| 183 | MVE Nižná Rybnica | | | 0,030 | 120 | Eugen Komár |
| 184 | MVE Lukov | | | 0,030 | 110 | VATMEX s.r.o. |
| 185 | MVE Brežný riadok | | | 0,035 | 60 | ERKON Poprad s.r.o. |
| 186 | MVE Ružomberok - Biely Potok | | | 0,015 | 89 | Vodárenská spoločnosť Ružomberok, a.s. |
| 187 | MVE Gelnica | 2 x 0,09 | | 0,180 | 750 | KreditConsult s.r.o. |
| 188 | MVE Horné Orešany | 0,015 + 0,055 | | 0,070 | 194 | VP Trans s.r.o. |
| 189 | MVE Pružina II | | | 0,045 | 160 | Považská vodárenská spoločnosť, a.s. |
| 190 | MVE Biely Potok | | | 0,240 | 586 | PP LAND s.r.o. |
| 191 | MVE Ľubochňa | 2 x 0,35 | | 0,700 | 1 400 | ELEKTRIK BOBÁK s.r.o. |
| 192 | MVE Malužiná | 2 x 0,075 | | 0,150 | 700 | ELEKTRIK BOBÁK s.r.o. |
| | TOTAL | | | 63,977 | 227 843 | |