

SMALL HYDROPOWER SITUATION IN THE NEW EU MEMBER STATES AND CANDIDATE COUNTRIES

**Prepared by the Marketing Working Group of the Thematic Network
of Small Hydropower (TNSHP)**

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EXECUTIVE SUMMARY

Methodology of analysis and aims of the study (Chapter 1)

The activities covered in the project were:

- Compilation of a database of key Small Hydropower (SHP) statistics and information in the New EU Member States and Candidate countries,
- Analysis of SHP statistics, existing potential for SHP, technical and environmental aspects, water and energy industries and service capability,
- A review of institutional, economic and regulatory issues of the legislation in force relating to SHP,
- Identification of the preliminary targets of SHP contribution in implementing the EU RES-E Directive,
- Comparison of the SHP sectors both in the new EU Member states and Candidate countries, and the former EU-15.

The approach of this study was mainly focused on a questionnaire which was sent out to SHP experts of 11 countries (8 New EU member states; the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia, Slovenia and 3 Candidate Countries; Bulgaria, Romania and Turkey), Cyprus and Malta, though referred to in this report, were not included in the survey as their hydropower sectors are effectively non-existent.

The questionnaire consists of 63 questions in two main parts: 1) Technical, Environmental and Industrial issues; 2) Institutional, Economic and Strategic issues. It addresses small hydropower which for the purposes of this study refers to hydropower plants of installed capacity less than 10 MW (standard adopted by ESHA).

The information gathered from the questionnaires, mainly related to SHP potential and historical statistics (number of SHP plants, installed capacity and electricity generation), was checked for consistency with other relevant sources of data. In most cases the project's enquiries were deemed reliable. In a very few cases, where the data of surveyed countries was not available or unreliable, other independent information sources have been used. The outputs of 'BlueAGE', the most comprehensive study on small hydropower strategic issues ever carried out in the former EU, considering also Eastern and Southeastern Europe, has been extensively used for comparison to the results of this study.

The reference year for the results of this study is 2002. For some surveyed countries data for 2003 is also available.

General overview of SHP sectors of the former EU-15, the 10 new EU Member States (EU-10) and Candidate Countries (CC) (Chapter 2)

This Chapter presents an overview of SHP sectors of: 1) Former EU-15; 2) 10 New EU Member States (EU-10); and 3) EU Candidate Countries (CC). A Series of indicators are used to assess the sectoral importance, level of development and future prospects for SHP in each of these entities.

SHP potential. The former EU-15 has an estimated economically feasible SHP potential of about 110 000 GWh/year (or 110 TWh/year). The new EU member states (EU-10) and Candidate Countries (CC) have economically feasible potential of 6 775 GWh/year (or 6.8 TWh/year) and 24 216 GWh/year (or 24.2 TWh/year), respectively.

More than 82% of all economically feasible potential has been exploited in the former EU-15 so far. SHP potential exploitation rate is about 36% in the EU-10 and very small in CC (5.8%). The remaining economically feasible potential is some 4 TWh/year in the EU-10 and 22.8 TWh/year in the Candidate Countries. For the latter, the lion's share is located in Turkey.

SHP plants in operation. In the former EU-15 there are about 14 000 SHP plants in operation with average plant size of 0.7 MW. There are around 2 800 SHP plants installed in the EU-10 and some 400 in CC. The average size of plant in these countries is 0.3 and 1.6 MW respectively.

The SHP plants situated in the former EU-15 are also the oldest (almost 70% of plants are older than 40-59 years and nearly a half surpassing 60 years). The surveyed countries (EU-10 and CC) have the highest share of young SHP plants; about 30% of plants in the range 40-59 years and 10% exceeding 60 years old, especially the candidate countries.

The total installed capacity of SHP plants in the surveyed countries, EU-10 and CC, is at least 10 and 15 times lower (822 and 608 MW, respectively) than in the former EU-15.

In terms of electricity quantity the former EU-15 surpasses the EU-10 and CC by factors of almost 17 and 28 respectively.

SHP contribution to gross electricity generation. SHP of the former EU-15 plays a far greater role in the electricity production mix than in surveyed countries. In the latter countries SHP plants contribute only 0.64–0.67% of the total electricity generation, less than half that of the former EU-15. Concerning the total hydropower production (excluding pumped storage plants) SHP shares are almost equal in the former EU-15 and EU-10 (in range of 11% and 13%), but less significant in the CC. In the latter case this is due to the dominance of large hydropower.

SHP manufacturing industry. The former EU-15 has around 70 small-scale water turbine manufacturers. In the surveyed countries, EU-10 and CC, they are less numerous (18 and 3, respectively).

SHP support mechanism. The most widely adopted support mechanism within nearly all countries is that of feed-in tariff – providing a guaranteed price for the electricity sold to a utility. The average buy-back rates are 8.2; 5.4 and 3.7 €cents/kWh in the EU-15, EU-10 and CC, respectively.

Projection of installed capacity and electricity generation into the future. Forecasts of SHP installed capacity and electricity generation have been made for the short (to 2010) and medium (to 2015) terms. Installed capacity and generation are expected to increase from 11% to 30% by the year 2010 and 2015 in the former EU. EU-10 will experience marginally higher rates of growth (11%-49%). SHP Growth is expected to be more significant in the Candidate Countries (34-72%).

General Overview of SHP sectors of the individual 10 new EU members states and 3 Candidate Countries (Chapter 3)

This chapter provides a concise overview and a comparison of the SHP sectors in each of the surveyed countries.

SHP potential. The specific hydropower resources per unit of area are mostly concentrated in Slovenia and Turkey. Romania, Bulgaria, Slovakia and the Czech Republic take an intermediate place. The remaining countries are characterized by relatively low hydropower concentration in their national territories. The huge technically and economically feasible SHP potential is located in Turkey's small and medium streams – 30 000 and 20 000 GWh/year, respectively. Poland and Romania form a second group, having indicated potential 6 to 10 time less than that of Turkey. The

third group is composed of the Czech Republic, Slovenia, Bulgaria and Slovakia. Their technically and economically feasible potential ranges between 755 to 2 800 and 700 and 1 480 GWh/year, respectively. Then follow Latvia and Lithuania. Estonia and Hungary have comparatively limited SHP potential.

In terms of economically feasible sites, many have already been exploited in the Czech Republic, Romania, Slovenia and Bulgaria (around 40-60%). A very insignificant part of this potential has been harnessed in Turkey (3%), while Estonia, Latvia and Lithuania have harnessed around 15 - 20%. The remaining economically feasible potential amounts to some 26 TWh/year in the surveyed countries. The bulk of this potential (roughly 80% or 19 300 GWh/year) is located in Turkey.

SHP plants in operation. The biggest number of SHP plants is located in the Czech Republic (over 1 300), followed by Poland (608), Slovenia (400) and Romania (234). Romania, the Czech Republic, Poland, are distinguished by the largest installed capacities - 275, 273 and 238 MW, respectively.

In most of the analysed countries more than a half of total SHP plants are low head power plants (head <5 m). This fact is especially common in Central and Eastern European countries. The countries located mostly in Southern Europe (Slovenia, Bulgaria, Romania and Turkey) have the highest share of high head SHP plants.

The SHP plants situated in Hungary, Czech Republic and Bulgaria are the oldest, with 100%, 70% and 65% over 40 years old, respectively. Eastern European countries (Estonia, Latvia, Lithuania, Poland and Slovenia), as well as Romania and Turkey have the highest share of young plants.

SHP plants are almost all privately owned in Czech Republic (90%), Estonia (93%), Hungary (100%), Latvia (93%), Lithuania (100%) and Bulgaria (84%). The private ownership of SHP plants in terms of generating capacity is relatively low in Poland and Turkey (6% and 20%, respectively). No SHP plants have been privatised in Romania so far (the privatisation process has only recently started).

SHP contribution to the gross electricity generation. The biggest SHP contribution is concentrated in Slovenia (2%). The contribution is half this (just under 1%) in the Czech Republic, Latvia, Slovakia, Bulgaria and Romania. SHP contribution in Estonia, Hungary and Lithuania is very low. Small hydropower accounts for approximately 4.6 % of total hydro generation in the new EU Member states and Candidate Countries. Currently none of the other renewable energy sources (wind, biomass, etc.) makes as much contribution to the energy mix in the surveyed countries as small hydropower.

SHP manufacturing industry. The Czech Republic and Slovenia are the countries with highest levels of turbine manufacturing industry. Hungary and Romania also have some limited turbine manufacturing capacity, the Polish turbine manufacturing industry, which regained momentum in the 1980's. Turbines with output up to 2.5 MW are manufactured occasionally, but none of the major companies possess both proprietary technology and manufacturing capability. Latvia and Lithuania are countries with low SHP turbine manufacturing capabilities. No SHP turbine industry was reported in Estonia or Slovakia.

SHP support mechanism. The average buy-back rate offered to SHP producers is about 5 €cents/kWh in the analysed countries with the lowest tariff (3.1 €cents/kWh) in Bulgaria and the highest one –(7.3 €cents/kWh) in Hungary

SHP development environmental issues. In some analysed countries the official environmental bodies, usually under pressure from NGO's, do not see small hydro as a green, renewable energy production. Besides existing protected watercourses, i.e. nature conservation areas, lists of forbidden rivers for small hydropower development have been introduced in Latvia, Lithuania and Estonia.

Visual impact related to the intrusion of SHP powerhouse etc on the landscape is a significant barrier for small hydro development in Slovenia. Fish protection is one of the crucial issues in almost all countries with the exceptions of Romania, Turkey and Bulgaria. In Bulgaria no resistance to SHP has been reported.

Forecast of SHP installed capacity and electricity generation. In all the surveyed countries, capacity and electrical output is expected to grow.

SHP situation in the individual new EU Member States and individual Candidate Countries. (Chapter 4)

The Czech Republic. There are 1 330 SHP plants with total installed capacity of 273 MW and electricity generation of 750 GWh/year (2003). The bulk of plants are relatively old (over 40 and 60 years), around a quarter are under 20 years old. Small hydro contributes almost 1% to the electricity mix and is the second largest contributor to RES-E production in the country (after large hydro). So far, nearly a half of economically feasible potential (46%) has been developed. The remaining economically and environmentally feasible potential is evaluated at some 500GWh/year. SHP development is expected to grow at the same pace in the short and medium term. Environmental requirements and various constraints with regard to small hydro are few with the exception of protection of fish life and their reproduction.

SHP manufacturing industry and related service capabilities are highly developed.

The estimated range of investment costs for new plant is between 600 and 2000 €/kW, with average generation costs ranging from 2 to 3 €cents/kWh. A guaranteed power purchase price of about 5 €/kWh exists, this is not sufficient to attract private investments or secure investors confidence.

The main hindrances to the SHP development are: 1) Long licensing process, 2) stringent requirements to protect fish interests, 3) low purchase price of power from SHP.

Cyprus. There is only one SHP plant in operation. SHP thus contributes a negligible proportion (0.06%) to the country's electricity. There are no SHP schemes under construction or planned.

Estonia. There are 27 SHP plants with total installed capacity of 4MW and electricity generation of 24 GWh/year (2003). Most of the plants are young. The same pace of SHP growth is expected in the future. About 18% of the economically feasible potential has been developed so far. The remaining economically feasible potential constitutes 116 GWh/year. Small hydro contributes 0.32% to the electricity mix and is dominant in RES-E generation in Estonia. Environmental requirements and constraints with regard to small hydro are not well balanced.

A list of watercourses of migrating fish prevented from damming has been introduced recently in Estonia, which adversely affects small hydropower potential.

There is no Estonian SHP manufacturing industry. The estimated range of investment costs for new plants is between 1 400 and 1 800 €/kW, and the average generation cost ranges between 1.7 and 1.9 €cents/kWh. The guaranteed power purchase price is fixed at about 5 €/kWh. This price level is not sufficient to attract private investments or secure investors confidence.

The main hindrances to SHP development are: 1) environmental, related to the introduction of forbidden rivers; 2) acquisition of site rights for SHP construction.

Hungary. There are 34 SHP plants with total installed capacity of 8.4 MW and electricity generation of 30 GWh/year (2003). Almost all SHP plants in Hungary are old; almost one third are over 60 years old and the remainder over 40 years old. For more than a decade there has been no new SHP plant development (only refurbishment). A slight growth in the construction of SHP plants is foreseen in the future.

Small hydro contributes only 0.11% to the electricity mix and is the second largest contributor to RES-E production behind large hydro in the country. So far, more than half of the economically feasible potential (53%) has been developed. The remaining economically feasible potential is evaluated at some 32 GWh/year.

The environmental situation and requirements are favourable for SHP development.

Due to the lack of SHP market SHP manufacturing industry is not well developed.

The estimated range of investment costs for new plants is between 1 500 and 4 000 €/kW, and the average generation cost ranges from 3.8 to 4.6 €/cents/kWh. The guaranteed power purchase price depends on the SHP capacity and is in the range of 4.4 to 7.3 €/c/kWh. This price level is neither sufficient to attract private investments or secure investors confidence.

The long authorisation period, relatively low buy-back rate and difficulties related to electricity grid access are the main barriers preventing Hungary's SHP development.

Latvia. There are 150 SHP plants with total installed capacity of 26 MW and annual electricity generation of 58 GWh/year (2003). There has been an impressive upward trend of growth in SHP plants during the last 5-8 years, but this is expected to slow somewhat in future. All Latvian SHP plants are under 20 years old.

So far about 20% of the economically feasible potential has been developed. The remaining economically and environmentally feasible potential is evaluated at some 220GWh/year. Small hydro contributes 0.84% to the electricity mix in Latvia. Small hydro and total hydro contributions to RES-E production are dominant at 100% in Latvia (1.2 and 98.8 %, respectively).

The environmental situation and requirements regarding SHP development is complicated and strict. A list of rivers prevented from hydropower development has been recently established which adversely affects SHP economical potential to be exploited.

SHP manufacturing industry is not developed in Latvia.

The estimated range of investment costs for new plants is between 800 and 1 200 €/kW, and the average generation cost between 2.2 and 2.7 €/cents/kWh. A guaranteed power purchase price is fixed at about 5 €/c/kWh. This price level is sufficient to attract private investments but it does not secure investors confidence.

The main obstacle for SHP development is the list of forbidden rivers (containing 217 watercourses). Another barrier preventing SHP development is the failure of the Ministry of Economy to allocate quotas for power produced in SHP plants.

Lithuania. There are 62 SHP plants with a total installed capacity of 19 MW and annual electricity generation of 41 GWh/year (2003). Recent SHP sector growth has been impressive: there were only 10 plants in operation in 1990. The same pace of SHP development is foreseen for both short and medium terms. Almost all Lithuanian SHP plants can be regarded as young less than 20 years old.

So far, 14% of the economically feasible potential has been exploited. The remaining economically feasible potential is evaluated at 246 GWh/year or 126 GWh/year if environmental constraints are taken into account. Small hydro contributes 0.25% to the electricity mix in Lithuania; its share is second only to large hydro in RES-E generation.

Environmental requirements and various constraints with regard to small hydro are strict. A list of rivers exempted from damming exists.

SHP manufacturing industry is not developed in Lithuania.

The estimated range of investment costs for new plants is between 2 000 and 2 500 €/kW, with an average generation cost of between 2.5 and 3 €cents/kWh. A guaranteed power purchase price is fixed at about 6 €/kWh. This price level is not sufficient to attract private investments and it does not secure investors confidence.

The main hindrances to SHP development are: 1) Environmental constraints; 2) High initial investment costs; 3) Low profitability.

Malta. There is no Hydropower use.

Poland. There are 610 SHP plants with total installed capacity of 233 MW and electricity generation of 962 GWh/year (2002). The majority of plants are less than 20 years old, while about 15% of all plants are older than 60 years. SHP plant growth has followed a constant and impressive upward trend over the past 10 years, though growth of SHP sector is expected to be challenging in the future.

Small hydro contributes almost 0.6% to the electricity mix in Poland. It is the second largest contributor to RES-E production (30%), behind large hydro. About one third of the economically feasible potential has been developed so far. The remaining economically and environmentally feasible potential is evaluated at some 1 500 GWh/year.

Environmental requirements and various constraints with regard to SHP are well balanced.

SHP manufacturing industry and related service capabilities are well developed. However, most units with capacity over 400 kW are purchased from abroad.

Investment costs for new plants are in the range of 500 to 1200 €/kW. The generation cost is between 3 and 4 €cents/kWh. The guaranteed tariff of energy purchase varies from 4 to 6 €/kWh. The price policy does not secure investors confidence.

Economical, legal and administrative and social/public perception issues are the main barriers preventing sound SHP development.

Slovakia. The statistics on SHP in Slovakia supplied by various information sources differ considerably. There are believed to be about 200 SHP plants with total installed capacity of 67 MW and annually electricity generation of 250 GWh/year. A further 35 SHP plants are planned (55 MW,

240 GWh/year). Around a half of all SHP plants in Slovakia have been constructed in the last twenty years. A quarter of SHP plants are in the range of 20–40 years old.

So far 25% of the economically feasible potential has been developed. The remaining economically feasible potential is estimated at some 750 GWh/year. Small hydro contributes 0.71% to the electricity mix in Slovakia. Its share to RES-E generation is also insignificant - some 4%. Notwithstanding this, SHP is the second largest contributor behind large hydro.

Various environmental requirements and other constraints do not favour SHP development. The main barriers for SHP plants construction are fish protection and land acquisition.

There are no SHP turbine manufactures in Slovakia.

The estimated range of investment costs for new plants is between 1 500 and 2 000 €/kW, with the average generation cost around 2-3 €cents/kWh. A guaranteed power purchase price is fixed at 4.25 €/kWh. The current price level is neither sufficient to attract private investments nor secure investors' confidence.

Slovenia. There are 478 SHP plants with total installed capacity of 110 MW and electricity generation of 259 GWh/year (2002). SHP sector growth has followed a constant upward trend over the past 10 years. The bulk of Slovenia's SHP plants are relatively young, built less than 20 years ago.

Small hydro plants contribute 2% to the electricity mix in Slovenia. They are second largest contributors to RES-E production (some 8%) behind large hydro. So far around 40% of the economically feasible potential has been exploited. The remaining economically feasible potential is 417GWh/year. Taking into account environmental constraints the potential falls to some 150 GWh/year.

The environmental requirements and various constraints with regard to SHP are quite stringent. The most important barriers are the quality of visual aspects and compliance with the requirements of the EU Directive promoting the network of protected areas. SHP manufacturing industry and related service capabilities are highly developed. Investment costs for new plants are in the range of 1 500 to 3 000€/kW. The guaranteed tariff of energy purchase exceeds 6 €/kWh. This price level is sufficient to attract private investments but it does not secure investors confidence.

SHP authorisation procedures are the main barrier stopping hydroplants development.

Bulgaria. There are 84 SHP plants with total installed capacity of 166 MW and electricity generation of 348 GWh/year (2003). SHP growth has followed a steady upward trend over the past 10 years. More than a half of all SHP plants are 40-60 years old or above, while slightly more than a quarter are under 20 years old.

Small hydro contributes 0.8% to the electricity mix in Bulgaria. SHP plants are second largest contributors to RES-E production (some 16%) behind large hydro. So far just under half (44%) of the economically feasible potential has been developed. The remaining economically feasible potential is 393 GWh/year.

The environmental requirements and various constraints with regard to SHP are realistic.

SHP manufacturing industry is not well developed; there is one domestic turbine manufacturer.

Investment costs for new plants are in the range of 1 500 to 3 000€/kW, and the average generation cost ranges from 0.3 to 1.0 €cents/kWh. The guaranteed tariff of energy purchase is 3.1 €/kWh, which is enough to attract private investments.

Romania. There are 236 SHP plants with total installed capacity of 278 MW and electricity generation of 430GWh/year (2003). SHP plants construction growth has followed a constant upward trend over the past 10 years. The bulk of all SHP plants in Romania have been constructed within the last 20 years.

Small hydro plants contribute 0.79% to the electricity mix in Romania. They are the second largest contributor to RES-E production (some 3%) behind large hydro. A considerable untapped potential exists for SHP in Romania. 12% of the economically feasible potential has been developed so far. The remaining economically feasible potential is over 3 TWh/year.

The environmental requirements are not overly stringent with regard to SHP development except for some issues arising from river life protection.

SHP manufacturing industry is not well developed: there is one domestic turbine manufacturer.

The average generation cost in high head schemes is 2.8 €cents/kWh. The price for electricity delivered to the grid is about 3.4 €/kWh, which is low to justify investments.

A lack of SHP financing is the main problem hindering their development. There are a large number of unfinished SHP schemes.

Turkey. There are 71 SHP plants with total installed capacity of 177 MW and electricity generation of 67 GWh/year (2002). SHP growth has followed a constant upward trend over the past 10 years. The bulk of all SHP plants were constructed within the past 20 years.

Small hydro contributes 0.52% to the electricity mix in Turkey. SHP plants are second largest contributors to RES-E production (some 2%) behind the first contributor - large hydro. A huge untapped potential exists for SHP in Turkey. Only 3.3% of the economically feasible potential has been developed so far. The remaining economically feasible potential is estimated at 19.3 TWh/year.

The environmental requirements are reasonable, except for relatively high compensation (ecological) flow imposed for SHP plants. There is also strong competition arising from irrigation.

SHP manufacturing industry is not largely developed; there are only a few turbine manufacturers.

Investment costs for new plants are in the range of 300 to 400€/kW, with the average cost of generation ranging from 0.5 to 0.7 €cents/kWh. The price for electricity delivered to the grid depends on the market prices. It is around 4.5 €/kWh.

The bureaucratic, very lengthy administrative procedures hinder the investments for SHP schemes in the country.

INTRODUCTION

On 1 May 2004 eight Eastern European and two Mediterranean countries (the Czech Republic, Cyprus, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia, Slovenia) joined the EU. Bulgaria, Romania and Turkey are expecting to join the EU in the near future. The New EU member states and Candidate countries are shown on the map (Fig.1).

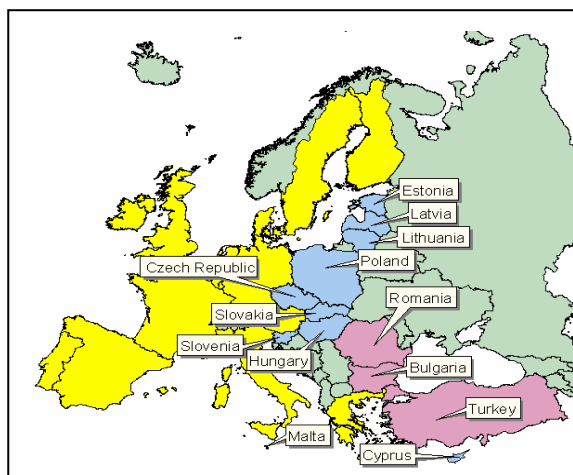


Fig. 1. Map of the EU
Yellow - Pre-May 1, 2004 EU Members;
Blue - May 1, 2004 New Member States;
Lavender - Post-May 1, 2004 Candidate Countries.

The Renewable Electricity Directive (RES-E) is a policy tool to assist the EU in the development of a sustainable energy sector [2]. According to RES-E Directive the renewable generators should provide 21% of electricity by 2010 in the existing states of the EU-25. Reference values for Candidate countries' national indicative targets for the contribution of electricity produced from renewable energy sources to gross electricity consumption by 2010 are presented in Table 1.

Table 1. National indicative targets for the contribution of electricity produced from RES-E of the new Member States and Candidate countries

New Member States and Candidate Countries	RES-E TWh, 1999	RES-E %, 1999	RES-E %, 2010
Czech Republic	2.36	3.8	8
Cyprus	0.002	0.05	6
Estonia	0.02	0.2	5.1
Hungary	0.22	0.7	3.6
Latvia	2.76	42.4	49.3
Lithuania	0.33	3.3	7
Malta	0	0	5
Poland	2.35	1.6	7.5
Slovakia	5.09	17.9	31
Slovenia	3.66	29.9	33.6
EU -15*	338.41	13.9	22
EU - 25**	355.2	12.9	21
Bulgaria***	2.8	7.3	8.7
Romania***	18.3	36.1	n/a
Turkey***	35.0	30.1	n/a

* Data refer to 1999; ** Data refer to 1997–2000, *** IEA and own estimation

For more than 100 years small hydropower has been harnessed in these countries, with the exceptions of Malta and Cyprus. The leading countries are the Czech Republic, Romania, Poland,

Turkey, Bulgaria, Slovenia and Slovakia. As it will be shown hereinafter at present in almost all analysed countries hydropower is a dominant source of energy in RES-E production. Small hydropower is the second largest contributor after large hydro.

1. METHODOLOGY OF ANALYSIS AND AIMS OF THE STUDY

The activities covered in the project were:

- Compilation of a database of key Small Hydropower (SHP) statistics and information in the New EU Member States and Candidate countries,
- Analysis of SHP statistics, existing potential for SHP, technical and environmental aspects, water and energy industries and service capability,
- A review of institutional, economic and regulatory issues of the legislation in force relating to SHP,
- Identification of the preliminary targets of SHP contribution in implementing the EU RES-E Directive,
- Comparison of the SHP sectors both in the new EU Member states and Candidate countries, and the former EU-15.

The project approach largely focused on a questionnaire distributed to key SHP experts in each country. The reason for this approach was that information on the small hydropower sector published in English, French, German and other commonly used languages in Europe is very scarce or non-existent in the new EU Member States and Candidate Countries. To overcome this barrier a detailed questionnaire was prepared to obtain first-hand information regarding the current situation for SHP in these countries (see Annex A1).

The questionnaire consists of two main parts:

- Technical, Environmental and Industrial issues;
- Institutional, Economic and Strategic issues.

It includes a total of 63 questions.

The questionnaire was sent out to the experts of 11 countries (8 New EU member states; the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia, Slovenia and 3 Candidate countries; Bulgaria, Romania and Turkey), except Malta and Cyprus where hydropower sector is non-existent. In the latter country only one SHP plant is operating and there are no hydroplants under construction or planned. The following expert/organisations have answered the questionnaire:

New EU member states:

- Czech Republic (Mr. Martin Exner, HYDROLINK s.r.o),
- Estonia (Mr. Ants Saks, Estonian Waterpower Ltd),
- Hungary (Mr. Gabor Koros, Energy Club Environmental Association),
- Latvia (Dr. Karlis Silke, Latvia University of Agriculture),
- Lithuania (Prof. Juozas Burneikis, Lithuanian Institute of Energy and Petras Punys, Lithuanian Hydropower Association),
- Poland (Dr. Janusz Steller, Institute of Fluid-Flow Machinery of the Polish Academy of Sciences),
- Slovakia (Mr. Peter Breza, ROTOR spol. s.r.o),
- Slovenia (Mr. Marko Gospodjinacki, Association of Small Hydropower Plants Societies),

Accession countries:

- Bulgaria (Dr. Sonya Simeonova, Bulgarian National Committee ICID),
- Romania (Mr. Aurel Mindrican, Freelance consultant of hydropower development),
- Turkey (Mr. N. Nadi Bakir, ERE Hydroelectricity Gen. and Trade Co).

The questionnaire addresses small hydropower, i.e. hydropower plants of installed capacity less than 10 MW (standard adopted by ESHA). In most investigated countries this SHP capacity limit is officially approved. The indicated capacity is lower in Hungary and Poland - 5 MW, in Latvia –2 MW and Estonia – 1 MW. In Turkey the SHP limit is set to 50 MW. It has to be noted that SHP maximum installed capacity is often related to the subsidiary policy of buy-back rate of energy delivered to the grid.

The information gathered from the questionnaires, mainly related to SHP potential and historic statistics (number of SHP plants, installed capacity and electricity generation) was checked for consistency with other relevant sources of data from the hydropower and renewables sectors, notably: ESHA [1,6,9], the International Journal on Hydropower & Dams [10], World Energy Council [11], EBRD, Black and Veatch [7], IEA [4], Eurostat [3] etc. This comparison revealed existing differences in these data (see Table 1.1). In most cases the responses to the project questionnaire were deemed to provide accurate and reliable information. In a very few cases, where the data of surveyed countries was not available or believed to be unreliable, the information sources referred to above have been used.

The enquiry revealed that some countries (e.g. Slovakia, Estonia) are not in possession of SHP databases or their data are not easy accessible.

The enquiry had an ambitious task to evaluate SHP industry capabilities in the analysed countries. Due to the lack of human resources, most of the countries, especially those distinguished by relatively significant SHP industry, have managed to provide only the list of main manufacturers supplying services for the SHP sector. In many cases SHP and large hydro industries are mixed or they overlap. Consequently it was not possible to identify either the turnover or the number of employees operating in SHP industries. Only a qualitative estimate has been made of the SHP turbine manufacturing capability of each surveyed country.

One of the projects tasks was to evaluate the contribution of SHP to the national RES-E targets set up by the EU RES-E directive (relevant only to the new EU member states). The responses of the inquiry show that to date (March-May, 2004) most of the surveyed countries have not yet adopted these targets, in particular for SHP. Only Hungary, Latvia, Lithuania, Poland and Bulgaria have adopted the national targets for RES-E directive so far.

In order to make forecasts of each country's SHP installed capacity and electricity production for the short term (to 2010) and medium term (to 2015) extrapolations were made from recent trends based on historical data. To avoid the complicated descriptions these have been omitted in the text of the report; only the final results are presented for comparison to those of the former EU-15.

The study does not explicitly consider the institutional, economic and regulatory issues of legislation in force relating to the SHP sector of the surveyed countries. Only reported information on the above issues are given without identifying the strengths or weaknesses of a particular country. To describe the support mechanism available for SHP producers a simple indicator - feed-in tariff (buy-back rate) - has been used.

Environmental requirements related to SHP development and exploitation were also considered and quantitative estimates (e.g. losses in electricity production due to maintaining compensation flow) which give a clear picture on the existing restrictions of SHP sector have been identified.

The outputs of 'BlueAGE'[1], the most comprehensive study on small hydropower strategic issues ever carried out in the former EU, considering also Eastern and Southeastern Europe, has been extensively used for comparison to the results of this study.

The reference year for the results of this study is 2002. For some surveyed countries data for 2003 is also available.

Table 1.1 below summarises the main SHP statistics of the EU-10 and Candidate Countries according to a variety of information sources and as revealed by this study (referred to in the Table as TNSHP).

Table 1.1. Small hydropower status of development (according to the different information sources including this TNSHP study)

Country	Number of SHP plants			Installed SHP capacity MW					Generation GWh/year					Technically feasible potential GWh/year			Economically feasible potential					Remaining economically feasible potential GWh/year
	BlueAGE [1]	Hydropower & Dams, [10]	TNSHP	BlueAGE	Hydropower & Dams [10]	WEC [11]	Eurostat, 2002	TNSHP	BlueAGE	Hydropower & Dams [10]	WEC [11]	Eurostat, 2002	TNSHP	BlueAGE	Hydropower & Dams [10]	TNSHP	GWh/year				MW	
																	BlueAGE	Hydropower & Dams [10]	WEC[11]	TNSHP	TNSHP	TNSHP
Czech Republic	1136	1200	1302	250	200	283	238	273	677	680	705	749	750	1148	500?	2800	700	n/a	n/a	1480	465	800
Cyprus	n/a	1	n/a	n/a	0.6	n/a	n/a	n/a	n/a	n/a	n/a		N/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Estonia	10	23	25	1	3.9	n/a	3	3.8	5	n/a	5	6	20	55	210?	210	20	n/a	n/a	130	26	116
Hungary	35	26	34	9	8.8	9	8	8.4	38	n/a	64	28	28	68	n/a	279	68	28.2	n/a	68	22	32
Latvia	57	107	149	2	30	2	19	24.8	14	n/a	15	30	33	150	n/a	900	150	30	150	280	62	225
Lithuania	29	60	50	9	15	9	15	15	30	40	25	37	37	585	854	854	186	185	n/a	287	65	126
Poland	472	~500	610	127	130	32	210	233	705	200	121	847	962	1600	500	5050	1600	n/a	1600	2500	605	1538
Slovakia	180	200	200	31	67	55	7	67	175	250	202	29	250	261	1200?	1200	n/a	n/a	n/a	1000	268	750
Slovenia	413	n/a	478	77	n/a	80	156	110	270	n/a	338	417	259	1300	n/a	1000	780	n/a	1115	700	180	417
Bulgaria	n/a	64	84	n/a	141	n/a	133	156	n/a	412	n/a	17	355	n/a	n/a	755	n/a	n/a	n/a	706	319	393
Romania	9	278	234	44	279	273	346	275	n/a	n/a	433	436	416	n/a	821?	3630	n/a	n/a	600	3510	1060	3080
Turkey	67	70	71	138	176	138	201	177	500	651	331	411	673	n/a	n/a	30000	n/a	n/a	555	20000	6500	19336

Notes: Data refer to: BlueAge –1999; Hydropower & Dams –2002 or 2003; WEC –1999; Eurostat –2002 (for Turkey 2001), TNSHP (current report) -2002

n/a –data are not available

? -Indicates data might also be attributed to the economically feasible potential

2. GENERAL OVERVIEW OF SHP SECTORS OF THE FORMER EU-15, THE 10 NEW EU (EU-10) AND CANDIDATE COUNTRIES (CC)

This Chapter presents an overview of SHP sectors of: 1) Former EU-15, 2) EU-10 and 3) CC. The main indicators that have been used to describe the SHP sector in concise way are: SHP potential (percentage of developed so far economically feasible potential and remaining potential given in absolute units); SHP plants in operation (number, installed capacity and electricity generation); SHP contribution to gross electricity generation; SHP support mechanisms (mainly referring to the electricity selling price); forecasts for the future (installed capacity and power generation). By comparing these indicators of each entity's SHP sector, their importance, level of development and future prospects are shown. Legal, institutional, technical economical and other SHP development or operation issues are out of scope of this study.

2.1 SHP potential

Figure 2.1 clearly shows the part of economically feasible potential that has been developed in the international entities so far. More than 82% of all economically feasible potential has been exploited in the former EU-15 so far. This SHP resource exploitation rate in the EU-10 is less than half of that in the EU-15 and very small in the CC (5.8%). For the latter, the lion's share is due to SHP potential of Turkey.

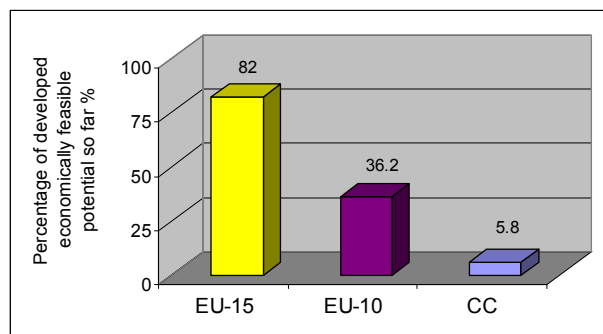


Fig. 2.1 Percentage of developed economically feasible potential so far. Source for EU-15: [1]

Figure 2.2 illustrates the remaining SHP potential, expressed in absolute units, to be developed in the future. The figures represented do not take into account the extra potential that can be exploited by upgrading existing SHP plants or recovery of abandoned plants. This average extra potential ranges between 10 and 15% of the remaining potential in the former EU-15 [1]. The remaining SHP potential is similar between the former EU-15 and CC. In the latter entity the largest contribution is due to Turkey (more than 80%). By comparison the EU-10 shows considerably less developed potential at around a fifth of the EU-15 and CC's.

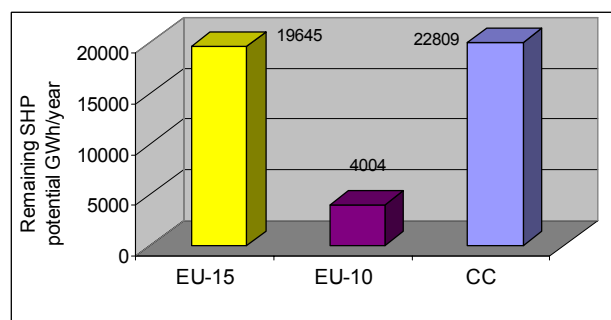


Fig. 2.2 Remaining small hydropower potential (upgrading existing SHP plants is not taken into account). Source for EU-15: [1].

2.2 SHP plants in operation

In the former EU-15 there operates about 14 000 SHP plants with an average plant size of 0.7 MW (figure 2.3). There are around 2 770 and 390 SHP plants installed in EU-10 and CC respectively. The average plant size these categories is 0.3 and 1.6 MW. Unlike the former EU-15 considerably smaller plants (less than half) are prevalent in the new members states. Conversely, the situation in the CC's is the opposite in that most schemes are approximately twice than the EU-15.

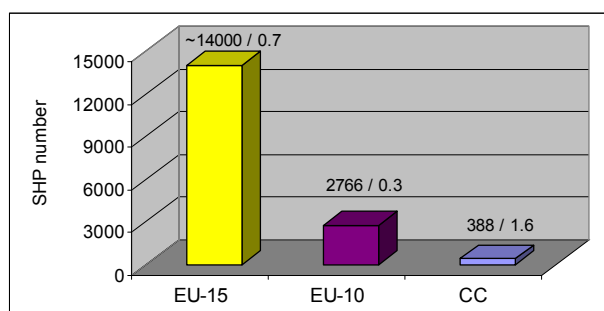


Fig. 2.3 Total number of operating SHP plants. Figures above the columns indicate the total SHP plants number and the average size of the plant. Source for EU-15: [1,6].

The SHP plants situated in the former EU-15 are also the oldest (figure 2.4). The surveyed countries have the highest share of young SHP plants, especially the candidate countries.

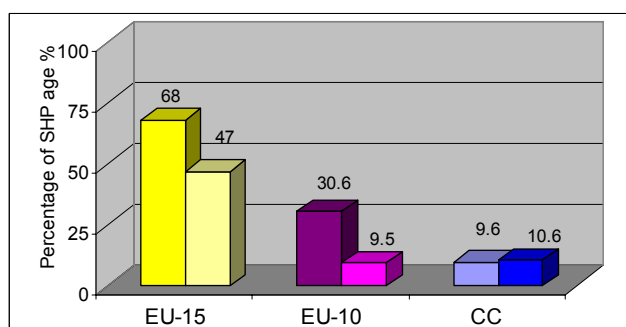


Fig. 2.4 SHP age distribution. First column indicates the percentage of plants in range of 40 and 59 years old and the second one the plants over 60 years old. Source for EU-15: [1].

The total installed capacity of SHP plants in the surveyed countries is at least 10 times smaller than in the former EU-15 (figure 2.5).

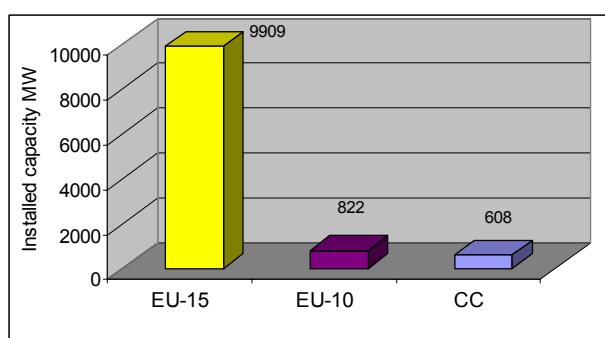


Fig.2.5 Installed capacity (MW). Source for EU-15:[6].

Figure 2.6 illustrates SHP production, which is a real economic value that provides SHP sector in each category. Electricity generation by SHP in the former EU-15 is considerably higher by

comparison to the EU-10 and the CC's; production is nearly 15 times that of the EU-10 and 30 times that generated in the CC's.

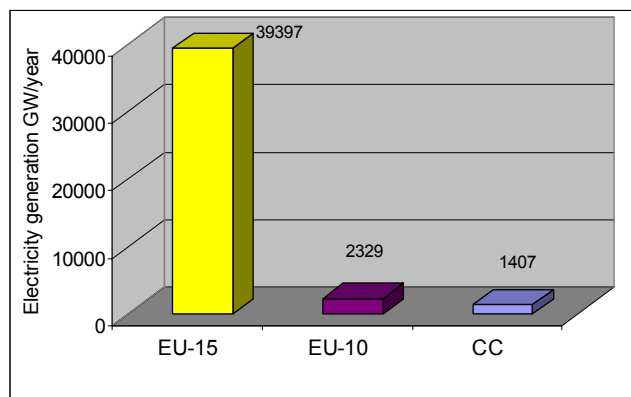


Fig.2.6 Electricity generation (GWh/year). Source for EU-15: [6].

2.3 SHP contribution to gross electricity generation

Figure 2.7 shows that SHP in the former EU-15 plays a significantly greater role in the electricity production mix than in surveyed countries. In the latter countries SHP plants contribute only 0.64 - 0.67% of the total electricity generation. These figures reveal that this share is less than half than in the former EU-15.

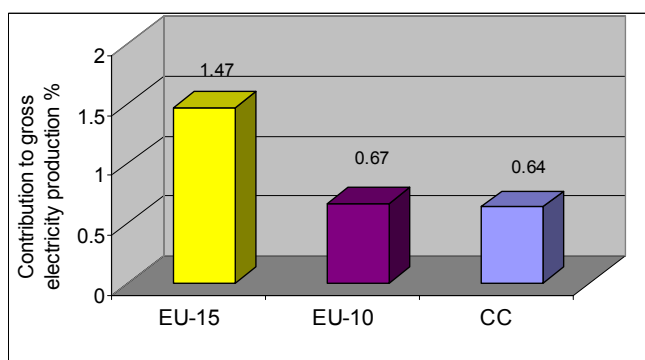


Fig.2.7 SHP contribution to gross electricity generation. Source for EU-15: [6].

It is interesting to compare the SHP share in the total hydropower production (fig. 2.8). The share of SHP in the former EU-15 and EU-10 is very similar, however the figure is significantly less in the CCs. In the latter case it indicates that large hydropower is totally dominant.

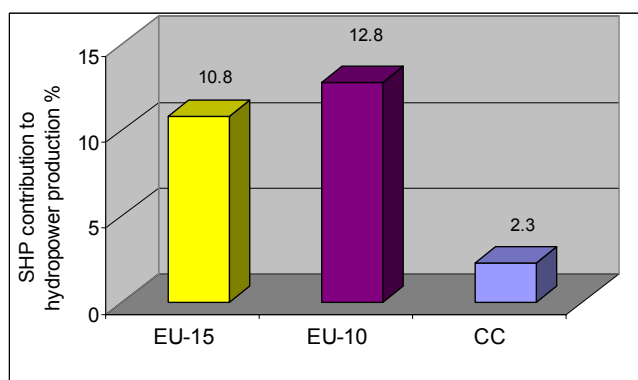


Fig.2.8 SHP contribution to hydropower production (only pure hydro)

2.4 SHP manufacturing industry

The former EU-15 has around 70 small-scale water turbine manufacturers [1]. In the surveyed countries – EU-10 and CCs, they are less numerous with 18 and 3, respectively.

2.5 SHP support mechanisms

There was no intention to present various SHP support mechanisms existing in different countries, a complex task in its self, but to present in summary the main differences in the common theme of buy-back rates. The most widely adopted support mechanism in most countries is that of a feed-in tariff, which gives SHP generator a guaranteed price for their electricity (fig. 2.9). The difference between the buy-back rates between the EU-15 and EU-10 is less than the EU-15 and the CCs.

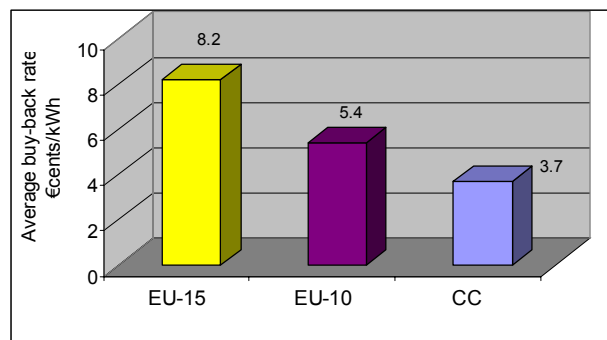


Fig. 2.9 Average buy back rate (price level 2003 and 2004) Source for EU-15: [9]

2.6 Projection of installed capacity and electricity generation into the future

In order to carry out the forecast of SHP installed capacity and electricity generation the short and medium terms (2010 and 2015) have been used. The figures below (2.10, 2.11, 2.12 and 2.13) clearly show a rising trend when compared with the with reference year (2002). Installed capacity and corresponding generation is expected to increase from 11% to 30% by the year 2010 and 2015 in the former EU. About the same rate of increase will be kept for EU-10 (11-49%). The candidate countries are expected to achieve a more significant growth of SHP sector (34-72%).

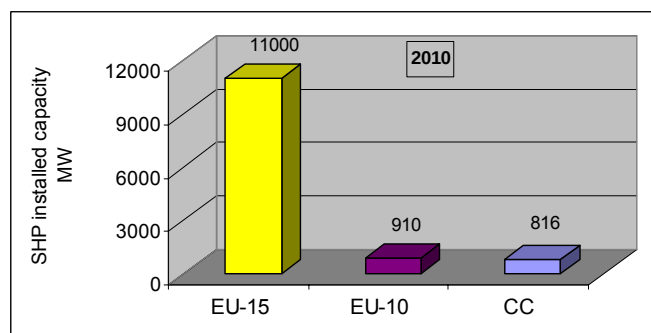


Fig. 2.10 Installed capacity by 2010. Source for EU-15: [8].

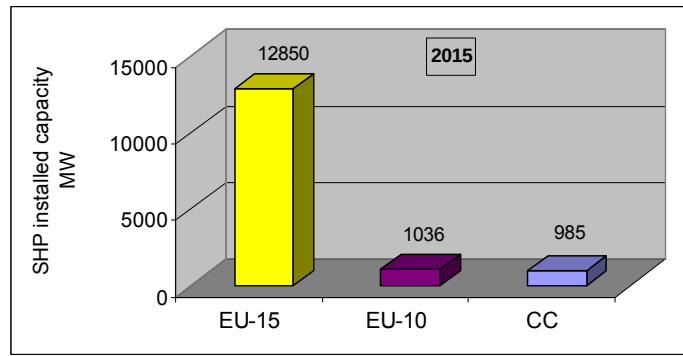


Fig.2.11 Installed capacity by 2015. Source for EU-15: [1].

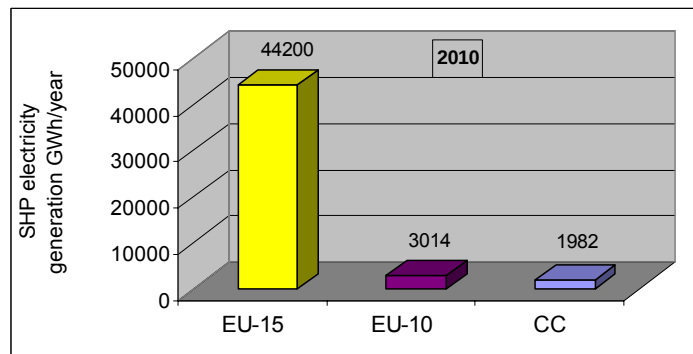


Fig.2.12 Electricity generation by 2010

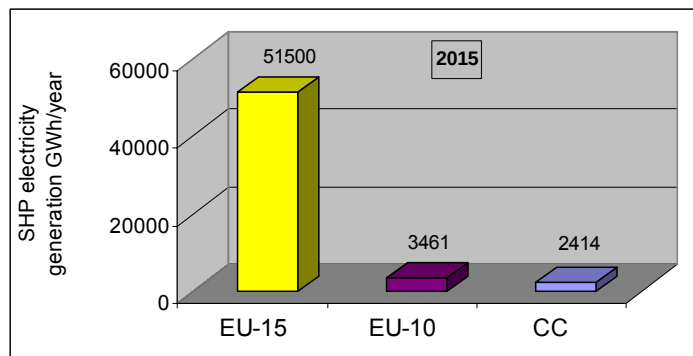


Fig. 2.13 Electricity generation by 2015. Source for EU-15: [1].

3. GENERAL OVERVIEW OF SHP SECTORS OF THE INDIVIDUAL 10 NEW EU MEMBERS STATES AND 3 CANDIDATE COUNTRIES

This chapter provides a concise overview and a comparison of each country's SHP sector by comparison. The outcomes are mainly based on the questionnaires filled in by the experts of each country. There are no given references to the former EU-15 SHP sector. Legal, institutional and others SHP related issues are not treated here. More detailed information on each country is given in Chapter 4.

3.1 SHP potential

Figure 3.1 gives an overview of the concentration of hydropower potential per unit of area (1 km^2) called specific energy in the surveyed countries. The specific energy is expressed as the gross theoretical, technically and economically feasible potential divided by the total area of a country and is expressed in the units - GWh/year/km^2 . It can be seen that specific hydropower resources per unit of area are mostly concentrated in Slovenia and Turkey; Romania, Bulgaria, Slovakia and the Czech Republic follow on form a second group. The remaining countries are characterized by relatively low hydropower concentration.

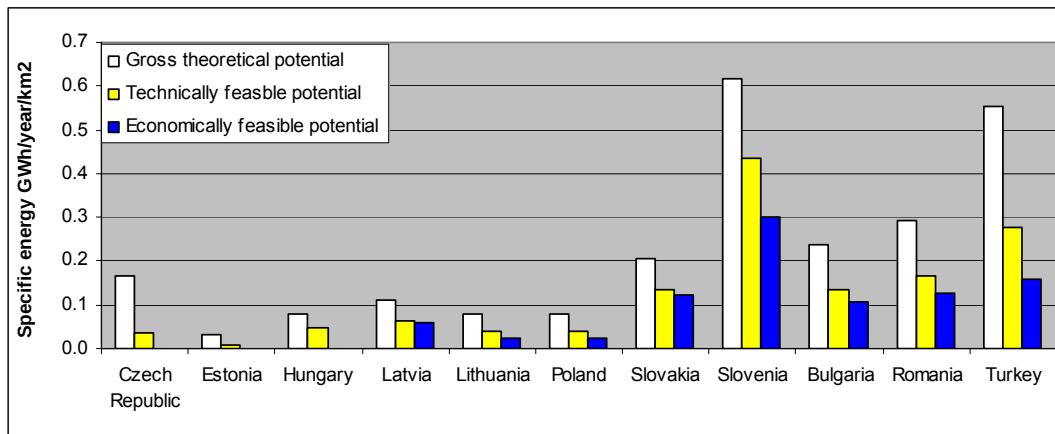


Fig. 3.1. Hydropower specific energy (gross theoretical, technically and economically feasible potential) in GWh/year/km^2 . Data source: [10].

Figure 3.2 represents small hydropower potential and developed potential so far in absolute units of the surveyed countries. From practical point of view the most important aspects are technically and economically feasible potentials, these give the real picture of SHP capability of an individual country. The potential that has been developed so far, i.e. the actual electricity production by SHP plants, reflects the level of harnessing of economically feasible potential. Its importance is further revealed in figure 3.3, where the reciprocal is shown i.e. the potential remaining to be developed. The main, and very large, technical and economically feasible SHP potential is located in Turkey's small and medium streams – 30 000 and 20 000 GWh/year , respectively. Poland and Romania form a second group, having indicated potential 6 to 10 times lower than that of Turkey. The third group is composed of the Czech Republic, Slovenia, Bulgaria and Slovakia. Their technical and economically feasible potential ranges between 755 to 2 800 and 700 and 1 480 GWh/year , respectively. Then follow Latvia and Lithuania and finally Estonia and Hungary where comparatively little SHP potential exists.

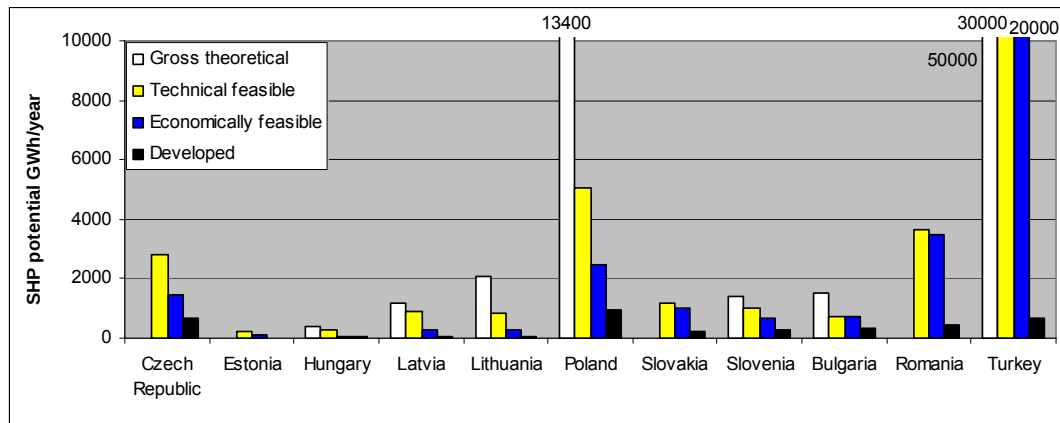


Fig. 3.2 Small hydropower potential (gross theoretical, technically and economically feasible potential) in absolute units - GWh/year.

Estimates have been made to understand the economically feasible potential due to existing environmental constraints (for example, protected territories and rivers exempted from hydropower development). Only a few countries approached though this study were able to supply this very important information, which reflects the real SHP potential to be harnessed. Due to the lack of sufficient data it has not been possible to compare the individual countries in this regard. SHP experts of Sweden estimate this share to be in the range of some 20 to 30% of the natural (gross theoretical) potential [1]. In Lithuania this percentage amounts to about 5-6%, which reveals very strict environmental constraints in force.

The economically feasible potential that has not been developed so far is given in figure 3.3. The biggest share of economically feasible potential has been exploited in the Czech Republic, Romania, Slovenia and Bulgaria (between 40-60%). A very small part of this potential has been harnessed in Turkey (only 3%), Estonia, Latvia and Lithuania (around 15 - 20%). The remaining economically feasible potential amounts to some 26 TWh/year in the surveyed countries. The majority of this potential (roughly 80% or 19 300 GWh/year) is located in Turkey.

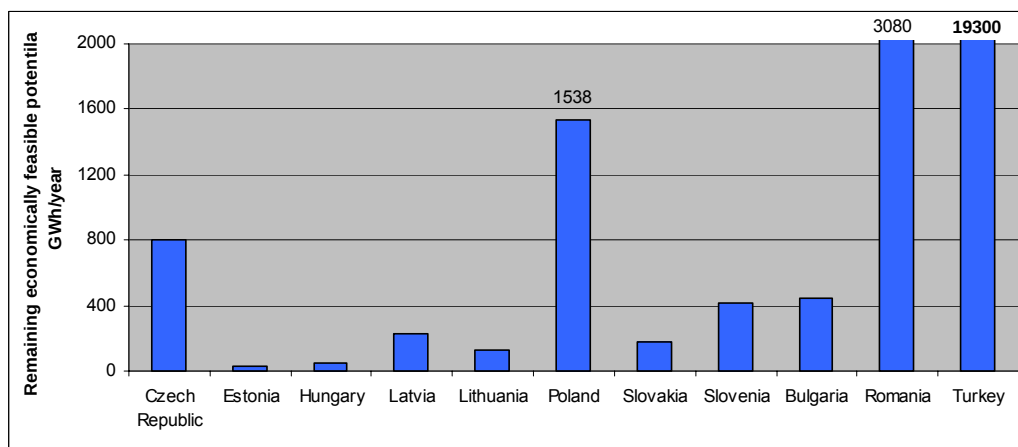


Fig.3.3. SHP remaining economically feasible potential

3.2 SHP plants in operation

Since the 1960's, SHP has been in decline in some of the analysed countries. Many SHP plants have been shut down because of old age and competition from newer, larger plants mostly using fossil fuel.

There are approximately 3200 plants installed in the 12 countries mentioned, corresponding to a capacity of about 1430 MW of SHP. The average size of a SHP plant is about 0.44 MW (0.70 MW in EU-15). Figure 3.4 shows that the biggest number of SHP plants is located in the Czech Republic (1 302) then follows Poland (608), Slovenia (400) and Romania (234). Hydropower is not used in Malta with almost the same situation is in Cyprus - there is only one SHP plant in operation. Romania, Czech Republic, Poland, are characterized by the largest installed capacities - 275, 273 and 238 MW respectively.

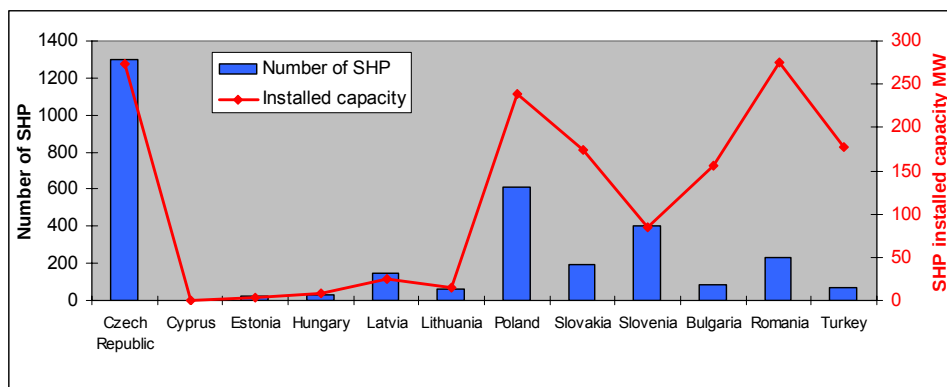


Fig.3.4. Number of SHP and installed capacity

Figure 3.5 illustrates the distribution of SHP plants according to their gross head. In most of surveyed countries more than a half of total SHP plants are low head power plants (head <5 m). This fact is especially common in Central and Eastern European countries. The countries located mostly in Southern Europe (Slovenia, Bulgaria, Romania and Turkey) have the highest share of high head SHP plants.

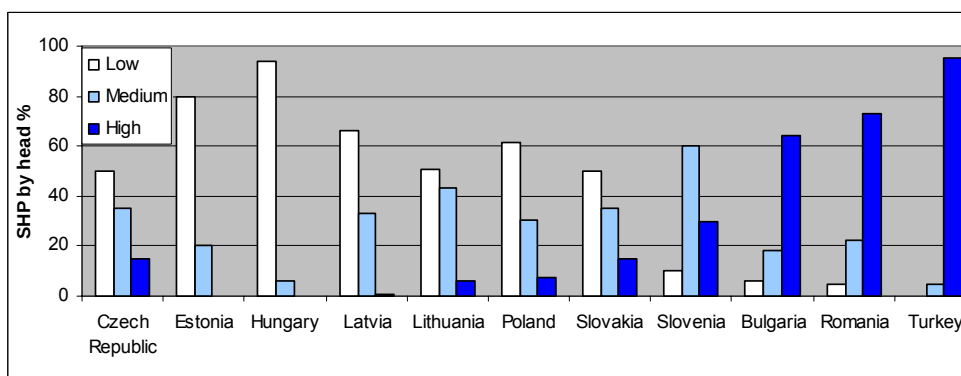


Fig.3.5. Percentage of small hydropower plants by head (low head <5m, medium head 5-15m, high head >15m)

The SHP plants situated in Hungary, Czech Republic and Bulgaria are the oldest, with 100, 70 and 65% respectively being over 40 years old (Fig.3.6). Eastern European countries (Estonia, Latvia, Lithuania, Poland, Slovenia), Romania and Turkey have the highest share of newer plants.

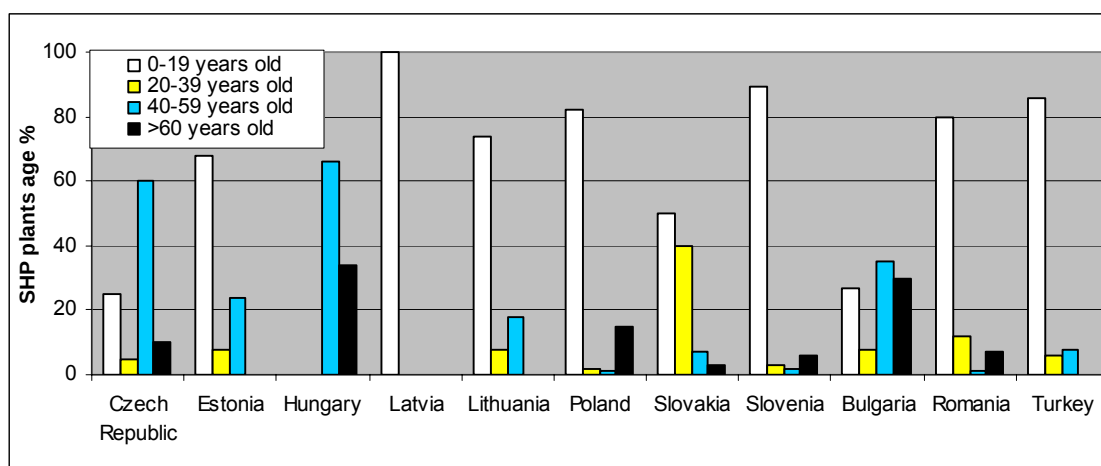


Fig.3.6 SHP plants age distribution

SHP plants are almost all privately owned in Czech Republic (90%), Estonia (93%), Hungary (100%), Latvia (93%), Lithuania (100%), Bulgaria (84%). The private ownership of SHP plants in the terms of generating capacity is relatively low in Poland and Turkey (6% and 20%, respectively). No SHP plants have been privatised in Romania so far (the privatisation process has only recently started).

3.3 SHP contribution to the gross electricity generation

Small hydropower contributes some 0.7% to production of electrical energy in the new EU Member states and Candidate Countries. The biggest SHP contribution is concentrated in Slovenia at 2% (Fig. 3.7). The contribution is half (just under 1%) in the Czech Republic, Latvia, Slovakia, Bulgaria and Romania. SHP contribution in Estonia, Hungary and Lithuania is very low.

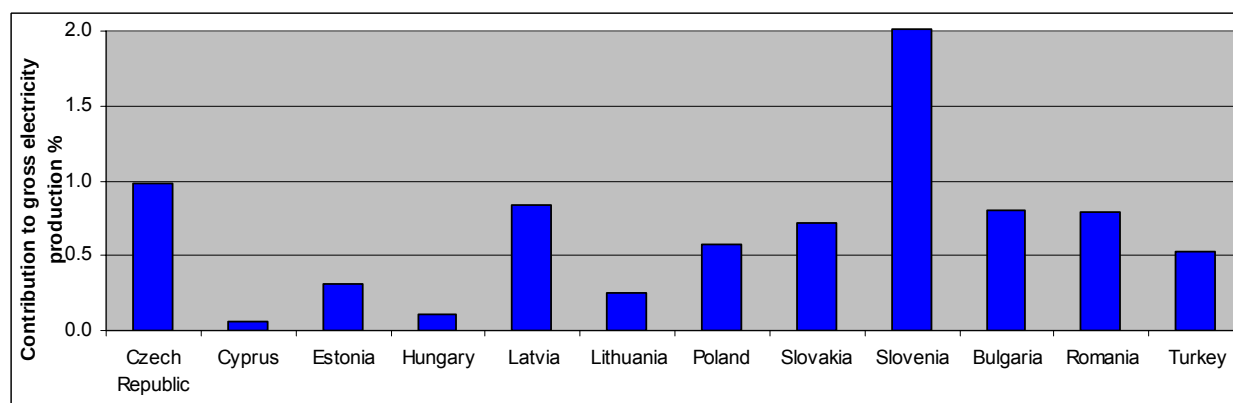


Fig.3.7. SHP contribution to gross electricity generation

It is interesting to compare the hydropower share to renewable electricity production in the analyzed countries. In almost all surveyed countries hydropower is the dominant source of energy in RES-E production (Fig. 3.8). Small hydropower accounts for approximately 4.6 % of total hydro generation in the new EU Member states and Candidate Countries. Currently, none of the other renewable energy sources (wind, biomass etc) makes as much contribution to the energy mix in the surveyed countries as small hydropower.

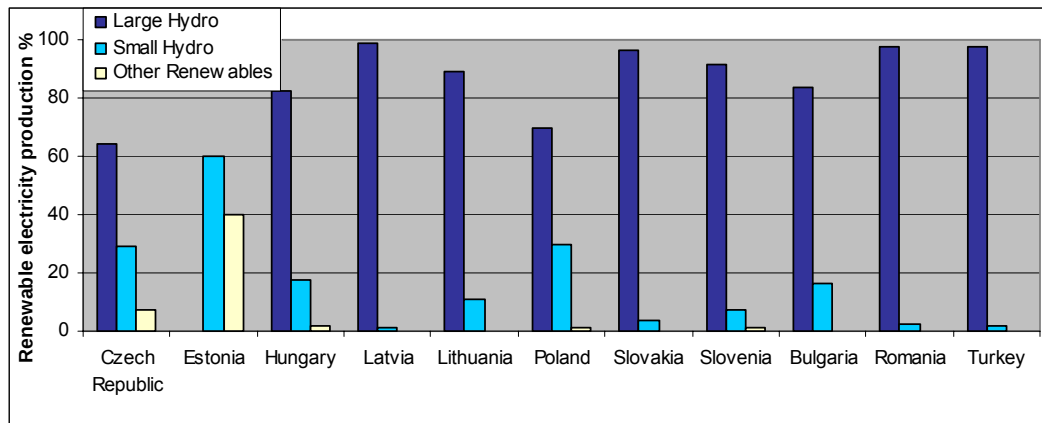


Fig. 3.8. Share of large and small hydro, and other renewable energy sources in the total renewable electricity generation

3.4 SHP manufacturing industry

The following main categories of players can be distinguished in the small hydropower industry market:

- 1) Manufactures of: a) turbines, b) generators, c) electrical equipment, d) control and monitoring, e) valves and gates f) penstocks g) other mechanical equipment.
- 2) Civil works contractors,
- 3) Consulting services, project developers.

To obtain the comprehensive information on the above hydropower market players was out of the project scope. Only general picture, giving the main ideas on SHP manufacturing industry, related mainly with small turbine production, is given here. In surveying countries it was even difficult to identify the manufacturers acting purely in small hydropower sector ($P < 10\text{MW}$). There was an attempt to make an estimation of the individual company's turnover, but it failed. The number of employees involved in the surveying countries' SHP manufacturing industry was not determined either. The survey revealed that some 18 and 3 small-scale water turbine manufacturers exist in EU-10 and CC, respectively.

In order to compare the position of manufacturers of turbines of individual countries the following categories have been distinguished:

1. No turbine manufacturers,
2. Turbine manufactures exist, but they are not able to cover domestic demand,
3. Turbine manufactures exist; they are able to cover domestic demand with limited export capacities,
4. Turbine manufactures exist; they are able to cover domestic demand with some export capacities,
5. Turbine manufacturing industry well developed, with high export capacities.

Referring to the survey results the following graph has been produced (fig.3.9).

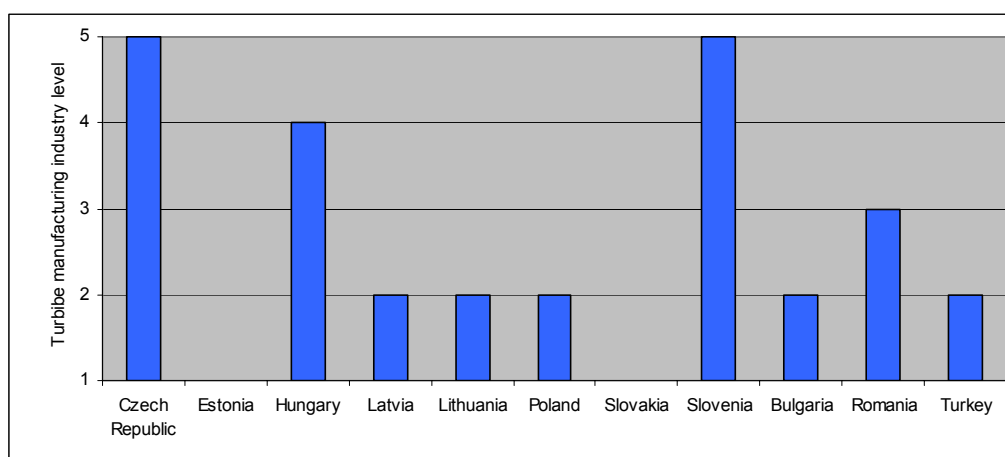


Fig. 3.9 SHP turbine manufacturing industry capabilities (1= no turbine manufacturers, 5- high capability of turbine manufacturing industry)

The Czech Republic and Slovenia are the main countries with highest levels of turbine manufacturing industry. Hungary and Romania also have some limited turbine manufacturing capacity. Internationally recognised manufacturers exist in all of the above mentioned countries. The Polish turbine manufacturing industry, which regained momentum in the 1980's has numerous small enterprises manufacturing highly simplified equipment for low head micro power plants. Turbines with an output up to 2.5 MW are manufactured occasionally, but none of the major companies possess both the proprietary technology and manufacturing capability. Latvia and Lithuania are countries with the low SHP turbine manufacturing capabilities. No SHP turbine industry was reported in Estonia or Slovakia.

3.5 SHP support mechanism

To facilitate accelerated SHP development programs Governments have a range of policy options at their disposal. The support they provide can either be targeted at power production or investment costs. The answers from the questionnaire show that the most widely adopted support mechanism within the analysed countries are feed-in tariffs, which give the SHP generators a guaranteed price for their electricity.

The average buy-back rate offered to SHP producers is about 5 €cents/kWh in the analysed countries with the lowest tariff (3.1 €cents/kWh) in Bulgaria and the highest one – (7.3 €cents/kWh) in Hungary (Fig. 3.10). In some countries the price for sale to the grid depends on SHP installed capacity, voltage level (low or high).

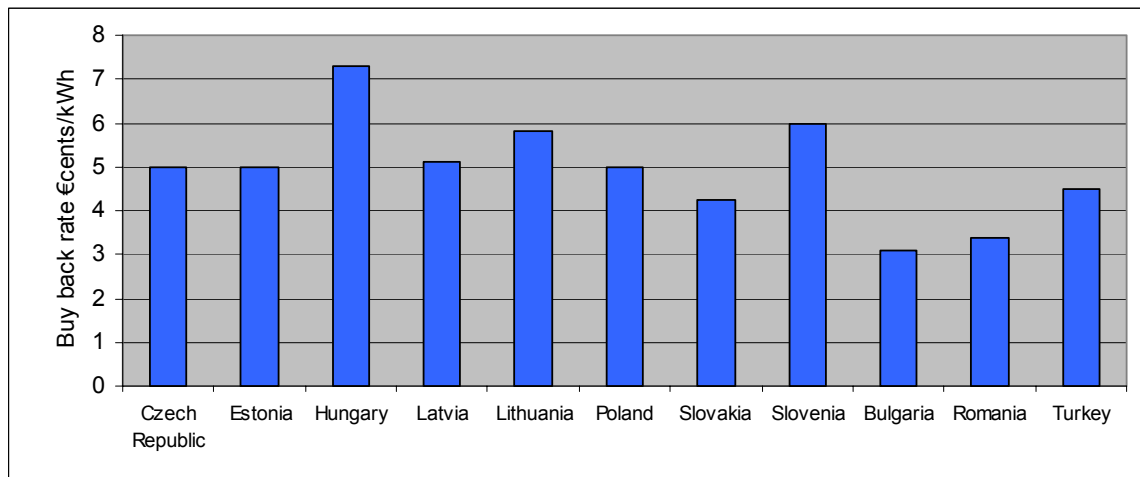


Fig. 3.10. Buy-back rates in the surveyed countries (price level 2003 or 2004)

The survey results clearly show that in almost all analysed countries the indicated buy-back rates are not enough to attract private investment and secure investors confidence. There is no one country to have introduced extra prices based on the green prices schemes.

3.6 SHP development environmental issues

In some analysed countries the official environmental bodies, usually under pressure from Non-Governmental Organisations (NGOs), do not see small hydro as a green, renewable energy. Besides existing protected watercourses e.g. nature conservation areas, lists of forbidden rivers for small hydropower development have been recently introduced in Latvia, Lithuania and Estonia. Figure 3.11 summarizes the existing resistances to small hydropower development.

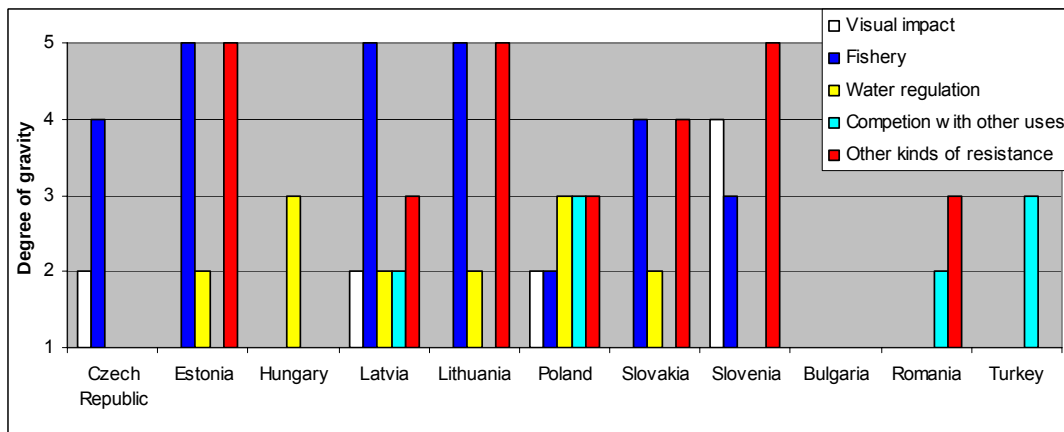


Fig 3.11. Resistances to SHP development (1-no impact, 5- severe impact)

Visual impacts related to the intrusion of SHP powerhouses and infrastructure etc on the landscape is a significant barrier for small hydro development in Slovenia. Fish protection is one of the crucial issues to almost all countries with the exceptions being Romania, Turkey and Bulgaria. In Romania no resistance to SHP has been reported. Other kinds of resistance constitute the enlargement of protected areas including watercourses under NATURA 2000 (EU network of protected areas), land ownership, water quality degradation due to creation of a small impoundment.

3.7 Forecast of SHP installed capacity and electricity generation

Figures 3.12 and 3.13 indicate forecasted values of SHP installed capacity and power generation for the short (2010) and medium terms (2015). In all surveyed countries, capacity and electrical output is expected to grow.

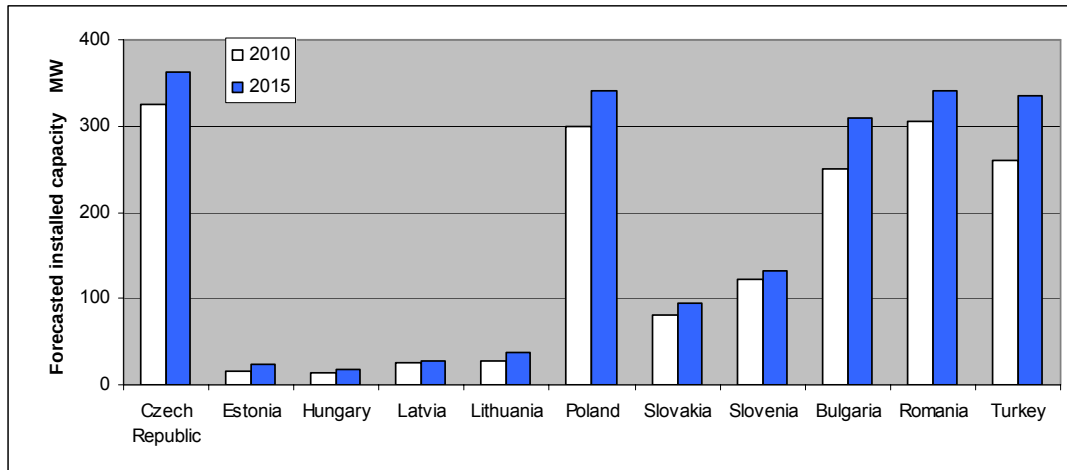


Fig.3.12 Forecasted SHP installed capacity (MW) by 2010 and 2015

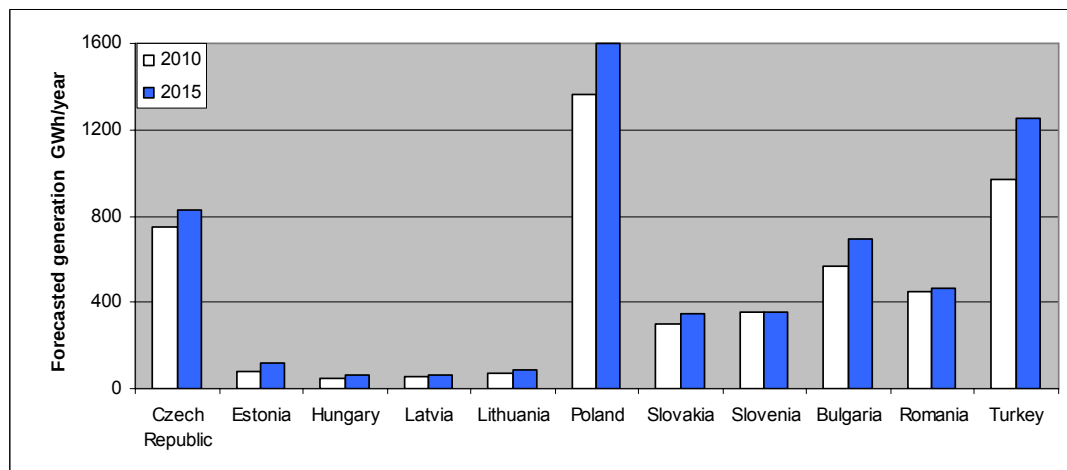


Fig.3.13 Forecasted SHP electricity generation (GWh/year) by 2010 and 2015

4. SHP SITUATION IN THE INDIVIDUAL NEW EU MEMBER STATES AND INDIVIDUAL CANDIDATE COUNTRIES

4.1 Czech Republic

Small hydro power (SHP) <10 MW in operation

The main statistics regarding SHP number, installed capacity and electricity generation during the last 8 years in the Czech Republic are shown Table 4.1.1 and Figure 4.1.1. There is a clear upward trend of these SHP characteristics over the reference period and the forecasted figures for SHP growth show good annual increase of over 2% to 2015.

Table 4.1.1 *Small hydro power (<10 MW) evolution and forecast in the Czech Republic*

	1996	1997	1998	1999	2000	2001	2002	2003	Forecast*	
									2010	2015
Total number of SHP	837	1090	1136	1193	1244	1273	1302	1330	n/a	n/a
Capacity MW	125	263	250	267	269	271	273	275	325	362
Generation GWh	318	737	676	659	508	516	750	580	751	862

* Forecast is based on extrapolation of the existing trend

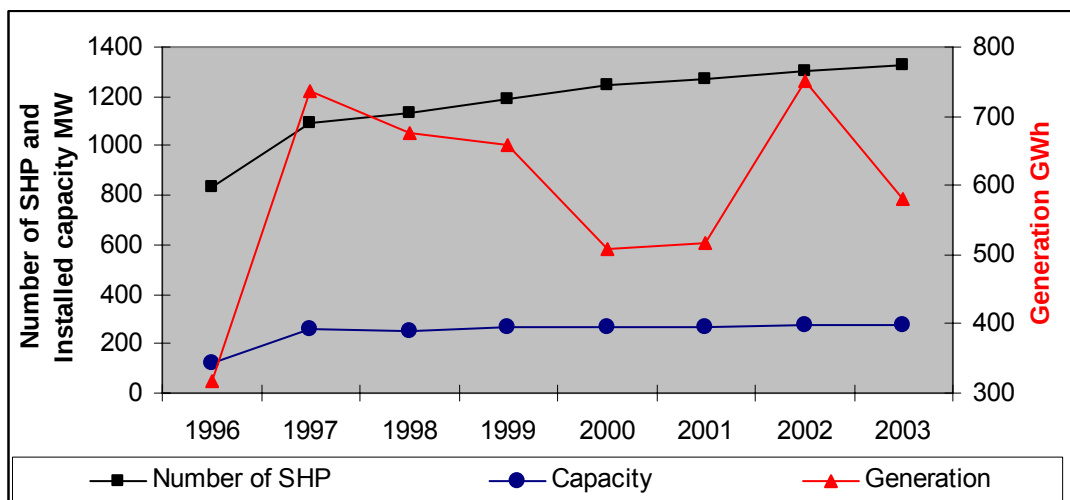


Fig. 4.1.1 *Trends in the SHP plants number, installed capacity (MW) and electricity generation (GWh) in the Czech Republic*

The majority of SHP plants are relatively old in the Czech Republic, generally built 40-60 years ago and only one quarter of SHP plants can be considered as recently built (0-19 years), as the Table below shows. Around 90% of all SHP generating capacity (MW) are privately owned.

Table 4.1.2 *Age structure of SHP plants*

Age	0-19 years old	20-39 years old	40-59 years old	>60 years old	Total
Percentage of number of SHP	25	5	60	10	100%

Low head power plants followed by medium head are prevailing in the Czech Republic. The percentage of SHP plants according to their gross head is as follows: Low head (up to 5 m) – 50%; Medium head (5-15 m) – 35% and High head (more than 15 m) – 15%.

SHP contribution to gross electricity generation and renewable electricity mix

Small hydro amounts to almost 1% of the electricity capacity in the Czech Republic but for electricity generation the total hydro contribution is three times bigger – at around 3% of the total generation. With respect to contribution of the renewable energy-based electricity supply, small and total hydro production are dominant in the Czech Republic, at 29% and 64 % respectively.

Potential for SHP

The gross theoretical small hydropower potential is unknown in the Czech Republic (see Table 4.1.3). but the technically and economically feasible potential is 2800 and 1480 GWh/year, respectively. So far, nearly a half of economically feasible potential (or 46%) has been developed.

Table 4.1.3 *Small hydropower potential*

Potential	Generation		Capacity MW
	GWh/year	%	
Gross theoretical	n/a	n/a	n/a
Technically feasible	2800	n/a	1134
Economically feasible	1480	n/a	465
Economically feasible potential that has been developed:	680	46	275
Remaining economically feasible potential	800	54	190
Remaining economically feasible potential taking into account environmental constraints (for example, rivers exempted from damming)	n/a	n/a	n/a

New techniques of SHP implemented during the last decade

None

RD&D programmes for SHP

There are not any RD&D programmes supporting SHP recently carried out in the Czech Republic.

Environmental aspects

Tables 4.1.4 and 4.1.5 show the existing resistances to small hydropower development and other environmental restrictions in the Czech Republic. The protection of fish life and their reproduction are the main issues when developing SHP plants.

Table 4.1.4 *Resistances to SHP development*

Impact	Degree of gravity (1= no impact, 5=severe impact)
Visual impact	2
Fishery	4
Water regulation	1
Competition with other uses of water (irrigation, recreation ect.)	1
Other kinds of resistance	1

Other environmental requirements or constraints indicated in the Table below are indicative for small hydro in Czech Republic at present.

Table 4.1.5. *Effect on SHP development and operation of the forbidden rivers, EIA, compensation flow, EU Water Framework Directive and other specific EU environmental regulations*

Forbidden rivers for hydropower construction*	Environmental impact assessment (EIA)	Compensation flow (CF)	EU WFD and other specific EU environmental regulations
There are no forbidden rivers for hydropower projects	EIA must be carried out for hydropower projects in protected areas, national parks etc.	When setting CF flow the long term average flow and hydro-biological parameters are taken into account. The losses in SHP electricity production resulting from maintaining CF are in the range of 5% to 10%.	There is no information available with SHP developers and producers related to the implementation of the WFD.

*Except conventional protected areas – strict nature reservations or protected areas with overall restricted economic regime

Position of local NGO's (green movement, ecologists, anglers), general public and official environmental bodies with regard to SHP development

NGO's unfortunately do not see hydro power as green renewable energy, but as a threat to the natural environment. Public accepts hydro power either positively or with low interest.

SHP manufacturing industry

Water and energy industries and service capabilities related to SHP are highly developed in the Czech Republic. There are 5 main turbine manufactures (HYDROHROM s.r.o., MAVEL a.s., Cink vodni elektrarny a.s., CKD Blansko Engineering a.s. Hydrolink s.r.o.) producing Kaplan, Francis, Pelton and other types of turbines. They have extensive markets in the European countries and outside it.

Economic issues

Investment costs for new plants vary between 600 and 2000€/kW. High head schemes are less expensive to develop and exploit than low head schemes.

Table 4.1.6 *Investment and electricity production costs*

Estimated range of investment costs for new plants €/kW			Range of investment costs* €/kW	Average cost of producing a unit of electricity generated by SHP scheme in Czech Rep. (€cents/kWh)			Financing schemes
Low head	Medium head	High head		Low head	Medium head	High head	
1200-2000	800-1400	600-1000	-	3.0	2.5	2.0	Private finance, equity, loans, third party, project finance, corporate finance,

* Alternatively to previous columns

The existing price level is not that effective to attract private investments and secure investors' confidence (Table 4.1.7) but there is some support available for SHP developers and producers.

Table 4.1.7 *Buy- back rates and support mechanisms*

Structure of prices of selling electricity	Other support mechanisms for SHP development
The feed-in tariff system is used for producing renewable electricity. Guaranteed purchase price is fixed at about 5 €/kWh. This price level is not very effective to attract private investments and secure investors confidence. There is no extra price based on the green prices scheme.	Soft loans for 80% costs with 5% interest rate are offered for SHP developers. Income tax exemptions for a period of 5 years beginning from the date of SHP commissioning are in force.

SHP regulatory issues

Small scale hydro plants are defined as those of less than 10MW capacity in the Czech Republic.

Table 4.1.8 *Water and sites rights and administrative procedures*

SHP definition	Legal conditions for SHP	Licence for water use, power production	Fees for the use of water
<10 MW	There is no one-stop shop for SHP developers. Planning permits are granted by the Construction Authority, Water Authority and Ministry of Environment	Energy Regulation Authority is responsible for granting a licence for power generation for a period of time up to 25 years. It can be extended.	There are no water fees SHP producer.

Table 4.1.9 *SHP planning, process to get new licence, technical specifications*

SHP master, regional or local/regional spatial plans	Process to get a new licence for SHP exploitation	Connection to the grid, cost for the use of the grid
There is not a master plan for SHP development. There is no intention to develop local spatial plans to guide the development of SHP project in suitable areas	Energy Regulation Authority grants licence for power generation. The whole process to get license takes 1-2 years.	There is no cost to connect to the grid. The connection itself is not regulated. SHP operators are given access to the grid at reasonable prices. But they are responsible for covering the costs of extensions and of strengthening the grid.

Small Hydropower Association

There is a national association representing the interests of SHP sector called the Union of Entrepreneurs for Utilisation of Energy Resources with approx. 700 members. Its activities are to support the interests of renewable energy producers, mainly from the SHP sector. The Chairman is Mr. Pavel Sedivy. E-mail: spvez@spvez.cz, Web: www.spvez.cz.

Main hindrances to the SHP development and description of non-technical barriers to SHP growth

1) Licensing process, 2) protection of environment, 3) low purchase price of power from SHP.

Recommendations to overcome the current obstacles

1) Simplifying of the licensing process, 2) Support of SHP as a green source of power, one of the cleanest power generations, 3) Advertising of positive issues of SHP to the public.

National Indicative targets for RES-E (Renewable Energy Sources - Electricity) Directive

N/a

New arrangements enforced after the EU RES-E Directive (2001/77/EC) affecting SHP production: new opportunities (green prices and green certificate systems), constraints, legal changes to be adopted.

N/a

References on national SHP issues

www.mve.hydroenergetika.cz, www.ceacr.cz, www.hydrolink.cz,
www.mavel.cz, www.cink-turbiny.cz, www.spvez.cz

4.2 Estonia

Small hydropower (SHP) <10 MW in operation

Table 4.2.1 shows the main statistics regarding SHP number, installed capacity, SHP electricity generation in the last 7 years in Estonia. The installed capacity and electricity generation increased

considerably over the reference period and the same pace of growth in SHP is expected in the future.

Table 4.2.1 *Small hydro power (<10 MW) evolution and forecast in Estonia*

	1997	1998	1999	2000	2001	2002	2003	Forecast	
								2010	2015
Total number of SHP	5	n/a	n/a	n/a	10	25	27	100	150
Capacity MW	0.8	n/a	1.0	n/a	1.8	3.8	4.0	16	24
Generation GWh	n/a	n/a	5.0	n/a	n/a	20	24	80	120

The bulk of SHP plants in Estonia have been constructed in the last few years (see Table 4.2.2). Around 93% of all generating capacity of SHP plants are in private hands.

Table 4.2.2. Age structure of SHP plants

Age	0-19 years old	20-39 years old	40-59 years old	>60 years old	Total
Number of SHP	17	2	6	0	25

Low head hydropower plants are the most common in Estonia. According to the gross head of SHP plants their percentage is as follows: Low head (up to 5 m) – 80%; Medium head (5-15 m) – 20% and High head (more than 15 m) – 0%.

SHP contribution to gross electricity generation and renewable electricity mix

Small hydro contributes only 0.32% to the electricity mix in Estonia and there are no large hydropower plants. Total hydro proportion of the renewable energy-based electricity production is dominant in Estonia at over 60%.

Potential for SHP.

Estonia's small hydropower potential is not large (Table 4.2.3) and about 18% of economically feasible potential has been developed so far.

Table 4.2.3 *Small hydropower potential*

Potential	Generation		Capacity MW
	GWh/year	%	
Gross theoretical	n/a	n/a	n/a
Technically feasible	210	n/a	n/a
Economically feasible	130	n/a	26
Economically feasible potential that has been developed:	24	18.4	4.0
Remaining economically feasible potential	116	81.6	22.0
Remaining economically feasible potential taking into account environmental constraints (for example, rivers exempted from damming)	n/a	n/a	n/a

New techniques of SHP implemented during the last decade.

New fully-automatic compact turbines from Waterpumps Ltd (Finland), and Kaplan turbines from the Czech Republic have been used.

RD&D programmes for SHP

None

Environmental aspects

Table 4.2.4. and 4.2.5 shows the existing resistances to small hydropower development and other environmental restrictions in Estonia. Fish protection is one of the crucial challenges in promoting small hydropower.

Table 4.2.4. Resistances to SHP development

Impact	Degree of gravity (1= no impact, 5=severe impact)
Visual impact	1
Fishery	5
Water regulation	2
Competition with other uses of water (irrigation, recreation ect.)	1
Other kinds of resistance: NATURA 2000, salmon habitat areas	5

The list of watercourses prevented from damming due to migrating fish has been introduced recently in Estonia. It adversely affects small hydropower potential.

Table 4.2.5. Effect on SHP development and operation of the forbidden rivers, EIA, compensation flow, EU Water Framework Directive and other specific EU environmental regulations

Forbidden rivers for hydropower construction*	Environmental impact assessment (EIA)	Compensation flow (CF)	EU WFD and other specific EU environmental regulations
The list of watercourses of migrating fish preventing from damming has been introduced recently. It adversely affects small hydropower potential.	EIA is required for SHP licensing process hydropower plants	Compensation flow value is fixed in the water use licensing procedure. Its value depends on minimum mean flow. The losses in SHP electricity production can reach 5% to 10%	Implementation of WFD requirements could result in a total prohibition of new SHP construction.

**Except conventional protected areas – strict nature reservations or protected areas with overall restricted economic regime*

Position of the local NGO's (green movement, ecologists, anglers), general public and official environmental bodies with regard to SHP development

There is a very strong opposition from ecologists against the restoration of SHP in salmonids and cyprinids rivers. The environmental bodies do not trust the effectiveness of fish pass for migrating fish.

SHP manufacturing industry

There are neither turbine nor generator and other mechanical/electrical equipment manufactures in Estonia. The main domestic civil works contractors are AS MARU Ltd and FKSM Ltd. For the local market consulting services, project development is provided by MERIN AS, Estonian Waterpower Ltd and Tallinn Technical University.

Economic issues

Investment costs for new plants vary between 1400 and 1800€/kW (see Table 4.2.6). The cost of 1 kWh electricity produced is between 1.7 and 1.9 €cents.

Table 4.2.6 Investment and electricity production costs

Estimated range of investment costs for new plants €/kW			Range of investment costs* €/kW	Average cost of producing a unit of electricity generated by SHP scheme in Estonia (€cents/kWh)			Financing schemes
Low head	Medium head	High head		Low head	Medium head	High head	
1400	1800	-	-	1.9	1.7	-	Loans about 70-80%. Private finance around 20-30%. BOOT model is often used.

* Alternatively to previous columns

This price level is not sufficient to attract private investments neither secure investors confidence in Estonia (Table 4.2.7). Some support for environmental improvement exists.

Table 4.2.7 Buy- back rates and support mechanisms

Structure of prices of selling electricity	Other support mechanisms for SHP development
The feed-in tariff system is used for producing renewable electricity. The price is around 5 €cents/kWh. This price level is not sufficient to attract private investments neither secure investors confidence.	There is 0% Value Added Tax level for electricity purchased from SHP. Green certificate system exists. Investment support for fish ladders construction is available.

SHP regulatory issues

Small-scale hydro plants are defined as those of less than 1 MW capacities in Estonia.

Table 4.2.8 Water/sites rights and administrative procedures

SHP definition	Legal conditions for SHP	Licence for water use, power production	Fees for the use of water
<1 MW	There is a one-stop shop for SHP developers. County or city council is responsible for granting planning permits. Water use licence from local department of MoE. Actual commissioning is carried out	Licence for operation is given by Estonian Energy Inspection. It is granted for 5 years and can be extended	No fees are charged for SHP.

Table 4.2.9 SHP planning, process to get new licence, technical specifications

SHP master, regional or local/regional spatial plans	Process to get a new license for SHP exploitation	Connection to the grid, cost for the use of the grid
Study "Hydropower in Estonia" carried out by Drive Tech Int. (Sweden) and Estonian Waterpower Ltd in 1977. There is intention to develop local spatial plans to guide the development of SHP project in suitable areas	Length of authoritative procedures to get a license is 2-5 months (the time for performing EIA is not included)	Connection cost is charged according to SHP construction project. It costs around €160/year. The rules of grid access are transparent and non-discriminatory. There are no charges for the use of the grid (in case the grid owner is Estonian energy Ltd)

Small Hydropower Associations

There is no small hydropower association in Estonia.

Main hindrances to the SHP development and description of non-technical barriers to SHP growth

There is a strong opposition from ecologists against dam construction and proclamation of numerous rivers as fish migrating zones. Private ownership of land around water impoundments is often a problem to build a SHP.

Recommendations to overcome the current obstacles

Achieve a complete evaluation of rivers including:

- Importance of rivers to collect flood waters in order to stabilise groundwater level
- Promotion of recreational activities around created small impoundments
- Revision of the role of NATURA 2000 projects that importance is overestimated

National Indicative targets for RES-E (Renewable Energy Sources - Electricity) Directive

In 2010 the SHP's installed capacity it is planned to be 16 MW and total RES 150 MW.

References on national SHP issues.

1. H.-A. Velner and H. Ericsson. Hydropower in Estonia, 1997, 91 p.
2. H.-A. Velner. Small hydropower in Estonia. Proceedings of International Conference on Small Hydro, 23 –25 May, 2001, Kaunas, Lithuania, pp.1/37-1/40.
3. H.-A. Velner, M. Pärnapuu and T. Kark. The Fish Passes in Estonia. "Environmental Impact and Water Management in a Catchment Area Perspective". Proceedings of Symposium, 24-26 September, 2001, Tallinn, Estonia, pp 165-166.
4. The engineering solutions for fish-gates on Estonian small rivers. Estonian Science Foundation Grant. Tallinn University of Technology, manuscript, 2001, 52 p.
5. Renewable energy sources in Estonia, Latvia and Lithuania. Strategy and policy targets, current experiences and future perspectives. Riga, Latvia, Baltic Environmental Forum, 2003

4.3 Hungary

Small hydropower (SHP) <10 MW in operation

The main statistics regarding SHP number, installed capacity, SHP electricity generation during the last decade and beginning this decade in Hungary are shown in Table 4.3.1 and Figure 4.3.1. There have not been any SHP developments over the reference period. A slight growth of SHP is foreseen in the future.

Table 4.3.1 *Small hydro power (<10 MW) evolution and forecast in Hungary*

	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003	Forecast	
											2010	2015
Total number of SHP	35	35	35	35	35	35	35	34	34	34	38	40
Capacity MW	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.4	8.4	8.4	13	18
Generation GWh	38	38	38	38	38	38	45.2	34	28.2	30.0	45	60

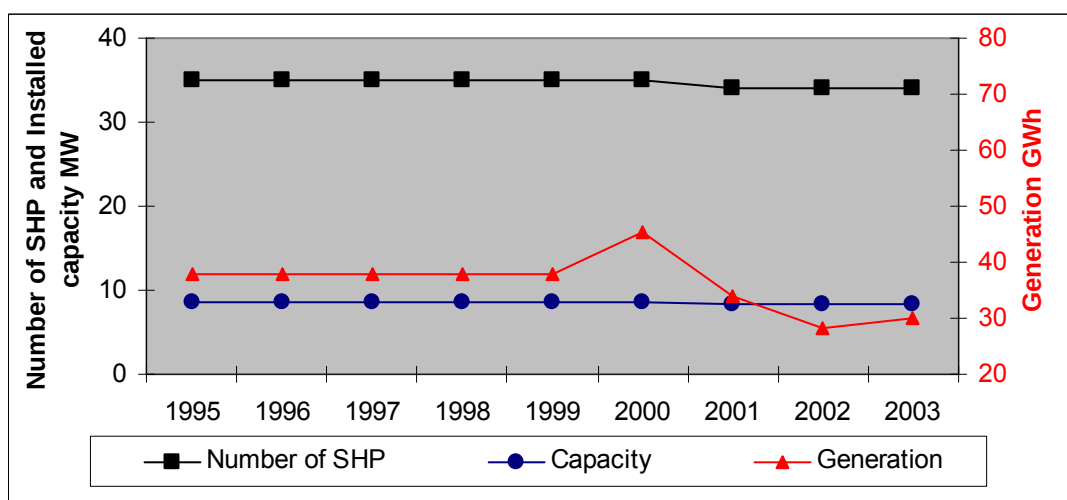


Fig. 4.3.1. Trends in the SHP plants number, installed capacity (MW) and electricity generation (GWh) in Hungary

Almost all SHP plants in Hungary can be regarded as old ones (Table 4.3.2). No new SHP plants, except refurbishment, have been constructed during the last 40 years. All SHP plants are privately owned (100%).

Table 4.3.2 Age structure of SHP plants

Age	0-19 years old	20-39 years old	40-59 years old	>60 years old	Total
Number of SHP	-	-	23	11	34

Low head SHP plants are the most developed in Hungary. According to the gross head of SHP plants their percentage is as follows: Low head (up to 5 m) – 94%; Medium head (5-15 m) – 6% and High head (more than 15 m) – 0%.

SHP contribution to gross electricity generation and renewable electricity mix

Small hydro contributes only 0.11% to the electricity mix in Hungary and total hydro contribution is also insignificant at around 0.5% of total electricity generation. Small hydro and total hydro contributions in the renewable energy-based electricity production are dominant in Hungary (17.3% and 82.2 % respectively).

Potential for SHP

The last RES potential evaluation, including small hydro, took place in 2004. The gross theoretical small hydropower potential of Hungary is 420 GWh/year. The technically and economically feasible potential is 279 and 68 GWh/year, respectively. So far, slightly more than a half of economically feasible potential (or 53%) has been developed.

Table 4.3.3 Small hydropower potential

Potential	Generation		Capacity MW
	GWh/year	%	
Gross theoretical	420	100	100-130
Technically feasible	279	66	90
Economically feasible	68	16	22
Economically feasible potential that has been developed:	36	53	8
Remaining economically feasible potential	32	47	14
Remaining economically feasible potential taking into account environmental constraints (for example, rivers exempted from damming)	n/a	n/a	n/a

New techniques of SHP implemented during the last decade.

There has been no SHP development for a long time, only renewal. Consequently, no new techniques have been implemented.

RD&D programmes for SHP

There is a countrywide hydropower potential estimation initiated by the Ministry of Economy and Transport.

Environmental aspects

Tables 4.3.4 and 4.3.5 show the existing resistances to small hydropower development and other environmental restrictions in Hungary. The environmental situation and requirements are favourable for SHP development.

Table 4.3.4 Resistances to SHP development

Impact	Degree of gravity (1= no impact, 5=severe impact)
Visual impact	1
Fishery	1
Water regulation	3
Competition with other uses of water (irrigation, recreation ect.)	1
Other kinds of resistance	1

Table 4.3.5 Effect on SHP development and operation of the forbidden rivers, EIA, compensation flow, EU Water Framework Directive and other specific EU environmental regulations

Forbidden rivers for hydropower construction*	Environmental impact assessment (EIA)	Compensation flow (CF)	EU WFD and other specific EU environmental regulations
There are the rivers forbidden for damming. Their small hydropower potential is relatively low.	EIA must be carried out hydropower projects larger than 20 MW or alternatively, for reservoirs which volume exceed 10^6 m^3 . It is obligatory for any hydroplant regardless its scale if this is planned to be developed in the nature protected areas or on waterbase protected belt.	Compensation flow is set as a fraction of the long-term average flow. The losses in SHP electricity production resulting from maintaining RF are negligible.	WFD is in course of implementation. WFD will not be a problem for SHP development.

**Except conventional protected areas – strict nature reservations or protected areas with overall restricted economic regime*

Position of the local NGO's (green movement, ecologists, anglers), general public and official environmental bodies with regard to SHP development.

N/a

SHP manufacturing industry

There is one turbine manufacturer (Ganz Energetics Co Ltd) producing Kaplan, Francis, Pelton and other turbines types (capacity up to 50 MW), and associated equipment. Its potential markets are Greece, Turkey, Peru, India, Romania, Italy, Canada, Iran, Puerto Rico and other countries. There are also generator and associated electrical and control equipment manufacturers having market outside Hungary.

Economic issues

Investment costs for new plants are expected to vary between 1500 and 4000€/kW. The cost of 1 kWh electricity produced in a SHP plants is between 3.8 and 4.6 €cents.

Table 4.3.6 *Investment and electricity production costs*

Estimated range of investment costs for new plants €/kW			Range of investment costs* €/kW	Average cost of producing a unit of electricity generated by SHP scheme in Hungary (€/cents/kWh)			Financing schemes
Low head	Medium head	High head		Low head	Medium head	High head	No new developments in the past 10 years
1500-4000	2500-4000	Not applicable	-	3.8-4.6	3.8-4.6	Not applicable	

* Alternatively to previous columns

The electricity selling price is neither sufficient to attract private investments nor secure investors confidence.

Table 4.3.7 *Buy- back rates and support mechanisms*

Structure of prices of selling electricity	Other support mechanisms for SHP development
The feed-in tariff system is used for producing renewable electricity. The price paid to SHP producer depend on the capacity: 7.3 €/kWh for SHP which capacity is lower than 5MW and 4.4 €/kWh for SHP larger than 5MW. This price level is neither sufficient to attract private investments nor secure investors confidence. There is no extra price based on the green price scheme.	There are investment supports from the EU structural funds.

SHP regulatory issues

Small scale hydro plants are defined as those of less than 5MW capacity in Hungary.

Table 4.3.8. *Water/sites rights and administrative procedures*

SHP definition	Legal conditions for SHP	Licence for water use, power production	Fees for the use of water
<5 MW	Law No III. of 1964 on “Construction” regulates the utilization of all type types of area stipulating a license issued by the authorities for the cases of area utilization, construction, reconstruction, extension and demolition of buildings, physical planning etc. The authorities may function within the licensing procedures as licensing authorities or special authorities. In the latter case they submit their expertise of special authority for another authority empowered to licensing. The Hungarian laws prescribe for various licensing authorities into consideration. Licensing tasks and competencies related to power plants are governed by the Act on Generation, transmission and supply of electric energy. The guaranteed feed in tariffs are implemented in the decree of the Minister of Economy. The official licenses related to the power plant issued by the Hungarian Energy Office. These licenses do not replace other necessary official licenses.	Water abstractions are authorised by Water Authority (VIZIG). They must be renewed every 2 years.	n/a

Table 4.3.9. SHP planning, process to get new licence, technical specifications

SHP master, regional or local/regional spatial plans	Process to get a new license for SHP exploitation	Connection to the grid, cost for the use of the grid
There is not any master plan. There is no intention to develop local spatial plans to guide the development of SHP project in suitable areas	Three main permissions are needed for a new development: Construction permission (local governmental) Environmental permission (regional competent environmental protection inspectorate) Permission for the grid connection (regional competent utilities) For the construction and environmental permissions, the developers need to provide additional permissions from other authorities, like national parks (nature protection permission), water authority (water uses permission) etc. The whole permission process takes over 12-15 month.	The technical details of the connection are regulated by the regional electricity suppliers. There is no available data about the cost for connection. SHP operators are not given access to the grid at reasonable prices. They are responsible for covering the costs of extensions and strengthening the grid. The cost for the use of grid is planned to be introduced in 2005.

Small hydropower association.

There is no SHP Association, but there is Hungarian Hydrology Association:

<http://www.mht.mtesz.hu>. The Association for Renewable Energy Sources is likely to be established in the near future.

Main hindrances to the SHP development and description of non –technical barriers to SHP growth

- Difficulty of the authorization process.
- The existence of 0.1 MW nominal capacity level in the Electricity Act.
- Few and not sufficient investment supports.
- Low guaranteed tariff.
- Short guaranteed period.
- Compulsory of the schedule for the utilities
- Difficult requirements of the grid connection

Recommendations to overcome the current obstacles

For further steps, the most important issue would be repeal of the level of 0.1MW in the Act on electricity, CX/2001. This fact is holding up additional SHP developments. The guaranteed feed-in tariff must be harmonised to the certain renewable energy sources.

National Indicative targets for RES-E (Renewable Energy Sources - Electricity) Directive.**Table 4.3.10 National indicative targets for small and large hydro, and total RES.**

	Unit	2003	2004	2005	2006	2007	2008	2009	2010
Small Hydro-power (<10MW)	MW	8.4	9	9	10	11	12	13	13
	GWh/year	28	34	34	36	37	40	45	45
Large Hydro-power	MW	39.5	39.5	39.5	39.5	39.5	50	60	60
	GWh/year	166	166	166	166	166	200	240	240
Total RES	MW	84	120	200	300	350	400	450	500
	GWh/year	197	300	550	700	850	1000	1150	1350

New arrangements enforced after the EU RES-E Directive (2001/77/EC) affecting SHP production: new opportunities (green prices and green certificate systems), constraints, legal changes to be adopted

The new Electricity Act came into force January 1st 2003 and implemented the feed-in tariff system, under the German experiences. Unfortunately there is no differentiated guaranteed feed-in prices for the certain renewable energy sources.

References on national SHP issues

www.energiakozpont.hu

www.tiszavizvizeromu.hu

www.gkm.hu

www.kvvm.hu

www.vizugy.hu

<http://www.ganz-holding.hu/>

www.aweconsulting.com

4.4 Latvia

Small hydropower (SHP) <10 MW in operation

The main statistics regarding SHP number, installed capacity, SHP electricity generation during the last decade in Latvia are shown in Table 4.4.1 and Figure 4.4.1. There is a very impressive upward trend of number of SHP plants. However, the forecasted figures for 2010 and 2015 are not as remarkable as previous years.

Table 4.4.1 *Small hydro power (<10 MW) evolution and forecast in Latvia*

	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003	Forecast	
											2010	2015
Total number of SHP	0	7	16	21	33	52	72	106	149	150	160	170
Capacity MW	0	2.2	3.8	4.3	6.0	8.1	10.6	15.0	24.8	24.8	26	28
Generation GWh	0	4.4	4.1	9.0	18.1	17.7	25.3	37.1	32.6	54.5	58	62

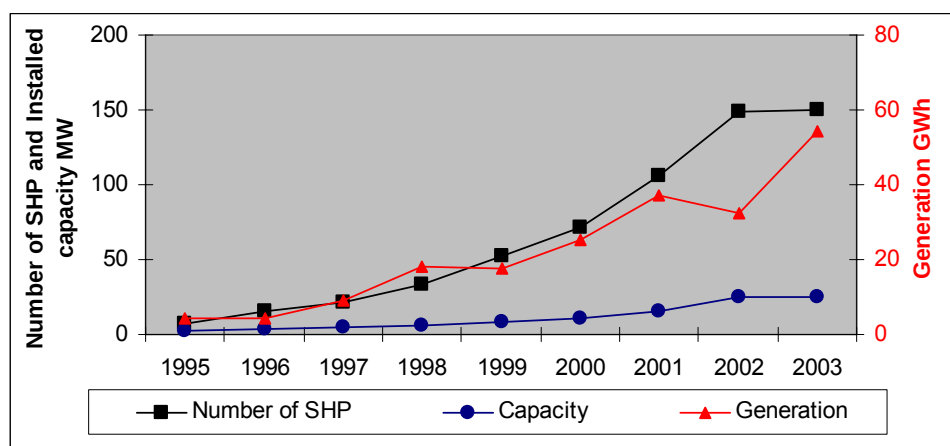


Fig. 4.4.1 *Trends in the SHP plants number, installed capacity (MW) and electricity generation (GWh) in Latvia*

All Latvian SHP plants are regarded as recently built (See Figure above and Table below). The percentage of generating capacity (MW) privately owned for SHP plants in Latvia is 93.2 %.

Table 4.4.2 Age structure of SHP plants

Age	0-19 years old	20-39 years old	40-59 years old	>60 years old	Total
Number of SHP	150	0	0	0	150

Low head SHP schemes are prevailing in Latvia. According to the gross head of SHP plants their percentage is as follows: Low head (up to 5 m) – 66%; Medium head (5-15 m) – 33% and High head (more than 15 m) – <1%.

SHP contribution to gross electricity generation and renewable electricity mix

Small hydro contributes only 0.84% to the electricity mix in Latvia but total hydro contribution is very significant at more than 70% of total electricity generation. Small hydro and total hydro contributions to renewable energy-based electricity production are dominant in Latvia (1.2% and 98.8 % respectively).

Potential for SHP

The gross theoretical small hydropower potential of Latvia is 1160 GWh/year. The technically and economically feasible potential is 900 and 280 GWh/year, respectively. So far, 20% of economically feasible potential has been exploited.

Table 4.4.3 Small hydropower potential

Potential	Generation		Capacity MW
	GWh/year	%	
Gross theoretical	1160	100	132
Technically feasible	900	78	103
Economically feasible	280	24	62
Economically feasible potential that has been developed:	55	20	25
Remaining economically feasible potential	225	80	37
Remaining economically feasible potential taking into account environmental constraints (for example, rivers exempted from damming)	220	78	N/a

New techniques of SHP implemented during the last decade

Double regulated Kaplan turbines have started to be manufactured in Latvia.

RD&D programmes for SHP

In 1999 a comprehensive research report on SHP potential in Latvia was carried out by researchers of Latvia University of Agriculture.

Environmental aspects

Tables 4.4.4. and 4.4.5 show the existing resistances to small hydropower development and other environmental constraints in Latvia. The most severe impact impeding SHP promotion is fish protection. The EU environmental directives and other regulation related to the river fauna and flora protection is going to adversely affect small hydropower development.

Table 4.4.4. Resistances to SHP development

Impact	Degree of gravity (1= no impact, 5=severe impact)
Visual impact	2
Fishery	5
Water regulation	2
Competition with other uses of water (irrigation, recreation ect.)	2
Other kinds of resistance*	3

* Land drainage systems are influenced negatively; pollution is stored in the water reservoirs; during the summer water temperature is higher in the reservoir and the level of eutrophication is rising.

Table 4.4.5. *Effect on SHP development and operation of the forbidden rivers, EIA, compensation flow, EU Water Framework Directive and other specific EU environmental regulations*

Forbidden rivers for hydropower construction*	Environmental impact assessment (EIA)	Compensation flow (CF)	EU WFD and other specific EU environmental regulations
In 2002 Latvian Ministry of Environmental Protection and Regional Development, together with Latvian Fishery Board elaborated the list of 214 rivers which are prevented from hydropower development for ever. These forbidden rivers adversely affect SHP economical potential to be exploited.	There is Law on EIA. However it does not treat SHP plants directly. An EIA must be carried out for reservoir plants where the reservoir volume exceeds 10 millions m ³ .	An officially approved compensation flow (CF) setting methodology exists. CF is set as a mean monthly (30 consecutive days) low flow (return period of 20 years). The losses in SHP electricity production resulting from maintaining CF can reach up to 5%	WFD is in the course of implementation. and its requirements will result in a prohibition of new SHP construction and complication in authorisation issuing.

*Except conventional protected areas – strict nature reservations or protected areas with overall restricted economic regime

Position of the local NGO's (green movement, ecologists, anglers), general public and official environmental bodies with regard to SHP development

Some international and local NGOs, namely Coalition Clean Baltic and association of anglers were very active during the period of 2001-2002 resulting in a big amount of propaganda against SHP launched in the mass media. Even the country's politicians debated SHP issues. Under their pressure a list of forbidden rivers for hydropower development and rehabilitation of old mills has been promulgated. Although public opinion with regard to SHP is more or less positive, the Latvian Government is not eager to support SHP development in the future, so it is difficult to forecast the SHP prospects.

SHP manufacturing industry

There are 4 local turbine manufactures producing only Kaplan turbines. The main SHP civil works contractor is LATVENERGO.

Economic issues

Investment costs for new plants vary between 800 and 1 200€/kW. The cost of 1 kWh electricity produced in SHP plants is between 2.2 and 2.7 €cents.

Table 4.4.6 *Investment and electricity production costs*

Estimated range of investment costs for new plants €/kW			Range of investment costs* €/kW	Average cost of producing a unit of electricity generated by SHP scheme in Latvia (€cents/kWh)			Financing schemes
Low head	Medium head	High head		Low head	Medium head	High head	
1200	800	-	-	2.7	2.2	-	Private finance –6% Equity- 10% Loans –80% Third party –2%, Project finance- 2%

* Alternatively to previous columns

The price level is sufficient to attract private investments but it does not secure investors confidence. Unlike the past few years there is no double electricity purchase tariff in force for the new SHP schemes exploited for the first 8 years.

Table 4.4.7 Buy- back rates and support mechanisms

Structure of prices of selling electricity	Other support mechanisms for SHP development
The feed-in tariff system is used for producing renewable electricity. The Law of Energy (1998) obliges Latvian State utility LATVENERGO to purchase the electricity produced by SHP at double consumer tariff for 8 years after commissioning of SHP (9.96 €/kWh in 2004). After 2004 the new commissioned SHP will sell the electricity produced at ordinary consumer tariff (4.98 €/kWh) This price level is sufficient to attract private investments but it does not secure investors confidence. There is no extra price based on green prices scheme.	There are no fiscal aids for SHP development.

SHP regulatory issues

SHP limit in Latvia is fixed at 2 MW.

Table 4.4.8 Water/sites rights and administrative procedures

SHP definition	Legal conditions for SHP	Licence for water use, power production	Fees for the use of water
<2 MW	There is no one-stop shop for SHP developers. The situation for SHP development was favourable until 2002. It has changed dramatically when the list of forbidden rivers was introduced. A quota is needed for selling power produced from SHP to state owned utility LATVENERGO. This quota is to be authorised by the Ministry of Economy. During the period of 2003-2004 there was no any quota given.	There is no water use licensing in Latvia. SHP, which capacity exceeds 1MW must get the licence for power production. The licence lasts 10 years and it can be extended (at the moment there is no available information). The smaller hydroplants are not required to get it.	SHPs are not entitled to pay the fees for use of water. But this position can be changed since the new regulations are under process of elaboration.

Table 4.4.9 SHP planning, process to get new licence, technical specifications

SHP master, regional or local/regional spatial plans	Process to get a new license for SHP exploitation	Connection to the grid, cost for the use of the grid
No master plan for SHP development exists. There is no intention to develop local spatial plans to guide the development of SHP project in suitable areas.	In total 8 authorisations issued by different authorities are needed. It could take up to 1- 2 years for developer to start building a SHP.	SHP developers are responsible for covering the costs of extensions and of strengthening the grid. The cost of construction of power line of 1 km long is between €12 000 and €15 000. The transformer 0.4 –20 kV (if needed) costs around €4000. The rules of grid access are not transparent. For the moment there are no charges for the use of grid.

Small Hydropower Association

There is the national Small Hydropower Association (Mazas hidroenergetikas asociacija – MHEA). Email: orvils.henins@rcc.lv. Chairman – **Orvils Henins**. Number of members and SHP plants is 40 and 58, respectively. Main activities are: acting as NGO in legislative procedures, development of green power schemes and technical, legal and administrative support for members.

Main hindrances to the SHP development and description of non –technical barriers to SHP growth

The main obstacle for SHP development is the list of forbidden rivers (containing 214 watercourses). Another barrier preventing SHP from its sustainable development is non-willingness of the Ministry of Economy to allocate quotas for power produced in SHP plants.

Recommendations to overcome the current obstacles

The list of forbidden rivers must be revised. Green certificate system should be introduced for RES development.

National Indicative targets for RES-E (Renewable Energy Sources - Electricity) Directive

Table 4.4.10. National indicative targets for small and large hydro, and total RES.

	Unit	2003	2004	2005	2006	2007	2008	2009	2010
Small Hydro-power (<10MW)	MW	24.8	24.8	25.0	25.2	25.4	25.6	25.8	26.0
	GWh/year	54.5	54.9	55.4	55.9	56.4	57.0	57.6	58.1
Large Hydro-power	MW	1547	1547	1547	1547	1547	1547	1547	1547
	GWh/year	2760	2760	2760	2760	2760	2760	2760	2760
Total RES	MW	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	GWh/year	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

New arrangements enforced after the EU RES-E Directive (2001/77/EC) affecting SHP production: new opportunities (green prices and green certificate systems), constraints, legal changes to be adopted

Green certificate system should be introduced for RES. We hope this will take place after new Parliament elections.

References on national SHP issues

1. K. Silke. and Y. Strubergs. Small hydropower in Latvia. Proceedings of International Conference on Small Hydro, 23 –25 May, 2001, Kaunas, Lithuania, pp.1/59-1/64 (in Russian).
2. Renewable energy sources in Estonia, Latvia and Lithuania. Strategy and policy targets, current experiences and future perspectives. Riga, Latvia, Baltic Environmental Forum, 2003

4.5 Lithuania

Small hydropower (SHP) <10 MW in operation

The main statistics regarding SHP number, installed capacity, SHP electricity generation during the last 10 years in Lithuania are shown Table 4.5.1 and Figure 4.5.1. There is clear upward trend for these SHP characteristics over the reference period. More remarkable are the forecasted figures for SHP growth to 2010 and 2015.

Table 4.5.1 Small hydro power (<10 MW) evolution and forecast in Lithuania

	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003	Forecast*	
											2010	2015
Total number of SHP	10	15	15	15	19	24	35	42	50	62	100	130
Capacity MW	6	6	6	7	8	9	13	14	15	19	28	36
Generation GWh	18	16	11	17	26	25	27	41	37	41	68	87

* Forecast is based on an extrapolation of the existing trend. The electricity generation for 2010 is almost two times lower than foreseen in the adopted national target to comply with the requirements of the EU RES-E directive (134.2 GWh for 2010).

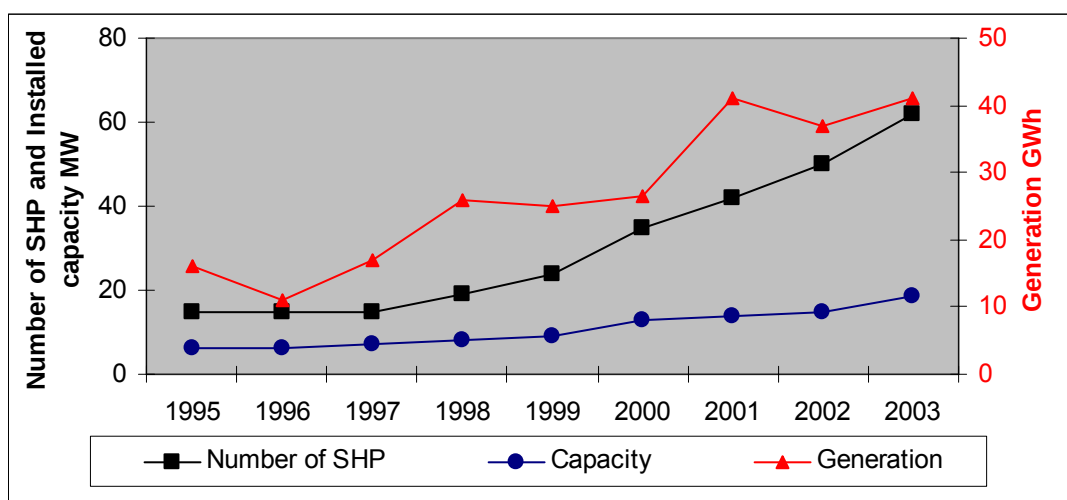


Fig. 4.5.1 Trends in the SHP plants number, installed capacity (MW) and electricity generation (GWh) in Lithuania

Almost all Lithuanian SHP plants can be regarded as recent developments (see Figure above and Table below). All SHP plants are in private hands (100%).

Table 4.5.2 Age structure of SHP plants

Age	0-19 years old	20-39 years old	40-59 years old	>60 years old	Total
Number of SHP	37	4	9	0	50

Low head SHP schemes are prevailing in Lithuania. According to the gross head of SHP plants their percentage is as follows: Low head (up to 5 m) – 51%; Medium head (5-15 m) – 43% and High head (more than 15 m) – 6%.

SHP contribution to gross electricity generation and renewable electricity mix

Small hydro contributes 0.25% to the electricity mix in Lithuania and the total hydro contribution is not significant – about 3% of total electricity generation. Small hydro and total hydro contributions to renewable energy-based electricity production are dominant in Lithuania (11.2% and 88.9 % respectively).

Potential for SHP

The gross theoretical small hydropower potential of Lithuania is 2094 GWh/year. The technically and economically feasible potential is 854 and 287 GWh/year, respectively. So far, 14% of economically feasible potential has been exploited.

Table 4.5.3 Small hydropower potential

Potential	Generation		Capacity MW
	GWh/year	%	
Gross theoretical	2094*	100	239
Technically feasible	854	41	195
Economically feasible	287	13.7	65
Economically feasible potential that has been developed:	41	14	15
Remaining economically feasible potential	246	86	50
Remaining economically feasible potential taking into account environmental constraints (for example, rivers exempted from damming)	126**	44	29

* The annual energy potentially available in the country if all natural flows were turbinised down to sea level or to the water level of the border of the country with 100% efficiency.

** Taking into the consequences of the order of the Ministries of Environment and Agriculture (of 16 January 2003 No 27/3D-13) related to the list of forbidden rivers for damming or hydropower development.

New techniques of SHP implemented during the last decade

Only conventional techniques have been used in Lithuania so far.

RD&D programmes for SHP

In 1996-1999 a research programme entitled "Solar energy and other renewables" including small hydro, supported by the Lithuanian State Science and Studies Foundation has been carried out. This research programme has been extended for another 3 years (2001-2004). It mainly deals with environmental issues when developing small scale hydropower resources.

A project proposal “ Sustainable small hydropower development” for PHARE funding has been submitted recently jointly by SERO (Sweden) and the Lithuanian Hydropower Association (in association of Water & Land Management faculty of Lithuanian University of Agriculture).

Since 1996 a number of studies related to technical, environmental, legislative small hydro issues with funding from the Ministries of Economy and Environment have been prepared. The Lithuanian Hydropower Association has performed all above indicated studies.

Environmental aspects

Tables 4.5.4. and 4.5.5 show the existing resistances to small hydropower development and other environmental restrictions in Latvia. The most severe impact impeding SHP promotion is fish protection. The EU environmental directives and other regulation related to the river fauna and flora protection are going to adversely affect small hydropower development.

Table 4.5.4 Resistances to SHP development

Impact	Degree of gravity (1= no impact, 5=severe impact)
Visual impact	2
Fishery	5
Water regulation	2
Competition with other uses of water (irrigation, recreation ect.)	1
Other kinds of resistance*	5

** Requirements of the specific EU environmental legislation, which according to the specialists of environmental protection entirely forbids river damming: NATURA 2000, Water Framework directive, Habitat directive and other conventions protecting the nature of Baltic Sea region.*

The list of rivers required to protect fish and prevented from damming has been introduced recently in Lithuania (2003). It adversely affects small hydropower potential. Before introducing this list SHP economically feasible potential was estimated at 30% of natural potential and after introducing this percentage was reduced up to 6%.

Table 4.5.5. *Effect on SHP development and operation of the forbidden rivers, EIA, compensation flow, EU Water Framework Directive and other specific EU environmental regulations*

Forbidden rivers for hydropower construction*	Environmental impact assessment (EIA)	Compensation flow (CF)	EU WFD and other specific EU environmental regulations
In 2003 Lithuanian Ministries of Environment and Agriculture together published the list of 147 rivers which have been prevented from hydropower development for ever. Currently this list is under approval by the Government. These forbidden rivers adversely affect SHP economical potential to be exploited.	Lithuania like most industrialized countries has a generalized EIA legislation aimed at all types of development projects. Depending on a particular project size there are two options: mandatory requirement or screening. Hydropower is not directly included in the mandatory list for the EIA. However the screening is needed for hydropower projects larger than 100 kW or alternatively for reservoir volume exceeding 0.2 millions m ³	An officially approved compensation flow (CF) setting methodology exists. CF is set as a mean monthly (30 consecutive days) low flow (return period of 20 years). The losses in SHP electricity production resulting from maintaining CF are negligible (diversions schemes are rare in Lithuania).	WFD is in the course of implementation. Implementation of WFD requirements will result in a prohibition of new SHP construction and complication in authorisation issuing. Referring to the WFD, a project of a list of rivers prevented from being dammed is under consideration of Lithuanian Government.

**Except conventional protected areas – strict nature reservations or protected areas with overall restricted economic regime*

Position of the local NGO's (green movement, ecologists, anglers), general public and official environmental bodies with regard to SHP development.

The official environmental bodies do not see small hydro as a clean energy source. They are against any dam construction. A local NGO (Green movement) and international NGO, namely Coalition Clean Baltic have been very active during the period of 2001-2002. Under their pressure a list of forbidden rivers for hydropower development and rehabilitation of old mills has been promulgated. However, the general public accepts SHP development positively and the Lithuanian Ministry of Economy support actively RES promotion including SHP development.

SHP manufacturing industry

There is only one local turbine manufacture producing small Kaplan type turbines for the domestic market.

Economic issues

Investment costs for new plants vary between 2 200 and 2 500€/kW. The cost of 1 kWh electricity produced in SHP plants is between 2.5 and 3 €cents.

Table 4.5.6 *Investment and electricity production costs*

Estimated range of investment costs for new plants €/kW			Range of investment costs* €/kW	Average cost of producing a unit of electricity generated by SHP scheme in Lithuania (€cents/kWh)			Financing schemes
Low head	Medium head	High head		Low head	Medium head	High head	
2500	2200	-	-	3	2.5	-	Private finance ~90% Loans –10%

** Alternatively to previous columns*

Table 4.5.7 Buy- back rates and support mechanisms

Structure of prices of selling electricity	Other support mechanisms for SHP development
The feed-in tariff system is used for producing renewable electricity. The Law of Energy obliges the utilities to purchase the electricity. Currently the buy-back rate for SHP produced power is fixed at 6 €c /kWh (2004). Neither hourly nor seasonal variations are applicable to this tariff. However there are night-time and day-time differentiated tariffs. No SHP supplies produced power to the grid at night/day time tariffs, since they are less attractive. There is no extra price based on green prices scheme.	Income tax exemptions for a period of 4 years beginning from the date of SHP commissioning are in force.

The price level is sufficient to attract private investments on the construction SHP at existing conventional dams, but not in the cases where they do not exist. In the latter case the price paid to the producer does not secure investors confidence.

SHP regulatory issues

SHP limit in Lithuania is fixed at 10 MW

Table 4.5.8 Water/sites rights and administrative procedures

SHP definition	Legal conditions for SHP	Licence for water use, power production	Fees for the use of water
<10 MW	There is no one-stop shop for SHP developers. There is no specific hydropower legislation in Lithuania. Small hydro is regulated by the laws, decrees, orders published by the Government, Ministries of Economy, Environment and Agriculture. The State Commission for Pricing and Control Energy (a regulatory under supervision of President's administration) fixes the energy price to be paid by an utility for a SHP producer.	Water or site rights are granted for a period of 50 to 99 years. The licence (permit) for power production must be obtained independently from SHP size. It is authorised forever. However, every 5 years it must be registered. In certain cases the permission can be granted for 1 year trial period. The license can be stopped or even revoked if SHP do not comply with the requirements.	According to the Government Decision (No 190 of May 13,1991), there are no charges imposed on water use for small hydropower.

Table 4.5.9 SHP planning, process to get new licence, technical specifications

SHP master, regional or local/regional spatial plans	Process to get a new license for SHP exploitation	Connection to the grid, cost for the use of the grid
The master plan for SHP development (at national level) is under establishment. There is intention to develop local spatial plans to guide the development of SHP project in suitable areas	In total 10 authorisations issued by different authorities are needed. It could take up to 2 years for a developer to start building a SHP.	SHP developers are responsible for covering the costs of extensions and of strengthening the grid. The technical requirements for the connection to the grid SHP plants are provided by regional/local grid authorities. The requirements depend on the grid particularities and the power plant local conditions. There has been no discriminatory policy to connect hydropower producer to the grid so far. The line between the powerhouse and the grid has to be built at the expense of SHP producer. A 1 km of line costs around 25 000 Euros. The cost of transformer depends on SHP capacity. A 50 to100 kW costs about 8 000 Euros, 1 MW about 50 000 Euros. There is an overall regulation dealing with the technical specifications for the connection to the grid electricity generators.

Small Hydropower Association

There is the Lithuanian Hydropower Association (Lietuvos hidroenergetiku asociacija). Email: punys@eko.lzua.lt, <http://www.hydrogis.lt/hydropower/> Chairman – Petras Punys. Director - Dainius Tirunas

The main goal of the Lithuanian Hydropower Association is to increase the use of hydropower in Lithuania, particularly that produced by independent power producers. The association has about 80 members, 20 percent of which are hydropower producers. These individual members represent independent power producers, utilities, environmental groups, research institutions and universities related to the hydro sector. One general assembly is held each year and the governing board meets at least six times a year.

The association advises its members on technical and political matters, represents their interests in debates on energy- and environmental-related laws and regulation and arranges seminars and technical tours to study new hydro technologies. A number of studies related to hydropower technical, environmental and legal issues are produced each year for relevant ministries and research institutions in Lithuania. The association cooperates with international, local governmental, and nongovernmental organizations on matters likely to contribute to hydropower development. Members maintain active contact with the mass media.

Main hindrances to the SHP development and description of non –technical barriers to SHP growth

1. Environmental constraints (a list of watercourses where damming is prohibited was recently introduced by the order of the Ministry of Environment. It concerns about 90% of all small hydropower potential).
2. High initial investment costs.
3. Buy-back prices are relatively low to implement new hydro projects (until now the existing dams have been used for building hydro plants).

Recommendations to overcome the current obstacles

- To reconcile the opposite requirements of the EU directives and other legal documents: on the one hand – Environmental (Water Framework, Habitat directive, Natura 2000, Bern Convention etc.), on the other hand - RES (White paper, RES-E, Kyoto Protocol).
- Assure financial returns and commercial security of RES-E.
- Internalization of external costs of electricity generation from RES.
- National framework of support schemes of RES-E should be elaborated as soon as possible. It should be based on normal accounting practices using the profitability index method and incorporating the external costs of conventional generation.

Table 4.5.10. National indicative targets for small and large hydro, and total RES.

	Unit	2003	2004	2005	2006	2007	2008	2009	2010
Small Hydro-power (<10MW)	MW	-	16	21	25	28	29	30	31
	GWh/year	-	53	80.4	99.8	114.8	125.6	132.0	134.2
Large Hydro-power	MW	-	101	101	101	101	101	101	101
	GWh/year	-	350	350	350	350	350	350	350
Total RES	MW	-	117	404.5	409.7	414.4	423	416.2	406.2
	GWh/year	-	n/a	439.9	521.9	579.4	659.1	784.2	931.8

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4.6 Poland

Small hydropower (SHP) <10 MW in operation

The main statistics regarding SHP number, installed capacity, SHP electricity generation during the last decade in Poland are shown in Table 4.6.1 and Figure 4.6.1. SHP has followed a constant and an impressive upward trend over the reference period and the SHP sector will continue to grow in the future.

Table 4.6.1 *Small hydro power (<10 MW) evolution and forecast in Poland*

	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003	Forecast*	
											2010	2015
Total number of SHP	194	347	389	406	439	474	514	572	610	n/a	n/a	n/a
Capacity MW	157	175	179	189	206	214	216	225	233	242	300	340
Generation GWh		578	675	670	n/a	705	872	894	962	998	1360	1600

* Forecast is based on an extrapolation of the existing trend

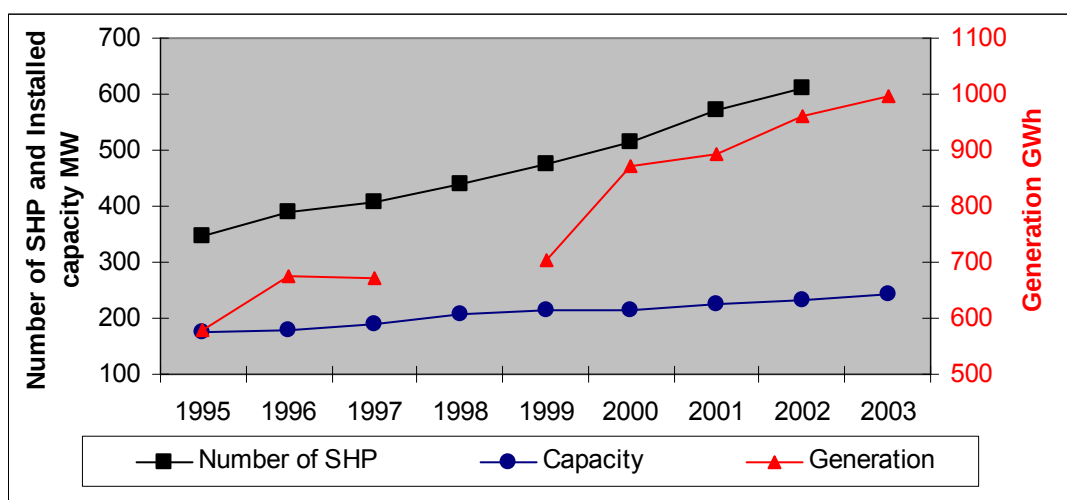


Fig. 4.6.1. Trends in the SHP plants number, installed capacity (MW) and electricity generation (GWh) in Poland

A lion's share of the total number of SHP are recently built plants (Table 4.6.2). About 15% of all plants are older than 60 years. The percentage of privately owned SHP generating capacity (MW) in Poland is about 6 % (about 500 mini and micro hydro plants).

Table 4.6.2 Age structure of SHP plants

Age	0-19 years old	20-39 years old	40-59 years old	>60 years old	Total
Number of SHP	499	13	6	90	608

The percentage of SHP plants according to their gross head is as follows: Low head (up to 5 m) – 61.8%; Medium head (5-15 m) – 30.6% and High head (more than 15 m) – 7.6%. Low head schemes are most common followed by medium head ones.

SHP contribution to gross electricity generation and renewable electricity mix

Small hydro contributes almost 0.6% to the electricity mix in Poland and total hydro contribution is not very significant either at only 2 % of total electricity generation. Small hydro and total hydro contribution in the renewable energy-based electricity production in Poland are dominant (30% and 69 % respectively).

Potential for SHP

The gross theoretical small hydropower potential of Poland is 13 400 GWh/year. The technically and economically feasible potential is 5 050 and 2 500 GWh/year, respectively. More than a third of economically feasible potential is developed so far.

Table 4.6.3 Small hydropower potential

Potential	Generation		Capacity MW
	GWh/year	%	
Gross theoretical	13400	100	n/a
Technically feasible	5050	37.7	n/a
Economically feasible	2500	26.1	605
Economically feasible potential that has been developed:	962	38.5	233
Remaining economically feasible potential	1538	61.5	372
Remaining economically feasible potential taking into account environmental constraints (for example, rivers exempted from damming)	1500	60.0	310

New techniques of SHP implemented during the last decade.

The following new techniques have been implemented for SHP sector during the last 10-15 years:

- horizontal siphon turbines are often installed in micro power plants erected at existing weirs;
- tubular turbines of compact design are now widely installed in numerous low head mini hydropower plants;
- in numerous micro power plants Francis runners are being replaced by propeller types.

RD&D programmes for SHP

A large number of programmes regarding research and development of SHP in Poland were carried out in the last two decades. Their list and a brief outline are included in Annex A2.

Environmental aspects

Tables 4.6.4 and 4.6.5 show the existing resistances to small hydropower development and other environmental requirements and restrictions in Poland. These can be seen as well balanced with regard to SHP.

Table 4.6.4 Resistances to SHP development

Impact	Degree of gravity (1= no impact, 5=severe impact)
Visual impact	2
Fishery	3
Water regulation	2
Competition with other uses of water (irrigation)	3
Other kinds of resistance	3

Table 4.6.5 Effect on SHP development and operation of the forbidden rivers, EIA, compensation flow, EU Water Framework Directive and other specific EU environmental regulations

Forbidden rivers for hydropower construction*	Environmental impact assessment (EIA)	Compensation flow (CF)	EU WFD and other specific EU environmental regulations
There are no forbidden rivers for damming except conventional protected areas (national parks, reservations)	EIA is required for water use licensing for all new dams, reservoirs and hydropower plants.	Compensation flow (CF) value is fixed in the water use licensing procedure. The losses in electricity production with regard to maintaining CF are negligible.	n/a

*Except conventional protected areas – strict nature reservations or protected areas with overall restricted economic regime

Position of the local NGO's (green movement, ecologists, anglers), general public and official environmental bodies with regard to SHP development

Ecologists are generally opposed to any water regulation projects, especially damming and creation of artificial reservoirs. Most of these projects are conducted by the Water Management Authorities as a part of flood protection activities. The attitude of local communities is generally positive although it depends on the expected profits (protests are possible in case the local area is flooded and profits concern only the regions located downstream of the erected dam).

Most of SHP investments are located at already existing dams or those under construction by the Water Management Authorities. Therefore the conflicts do not directly affect the SHP investor. However, in some cases (micro plants) the abandoned weir has to be reconstructed by the investor himself. Fears due to the need of the investor to minimise investment costs and maximise water levelling may occur. In some cases this had lead to dam rupture (e.g. 2 cases from the 1990s are known). Headwater level fluctuations are sometimes the reason of conflicts with local agricultural communities.

SHP manufacturing industry

The turbine manufacturing industry is dispersed and only in the initial stage of development. There are a number of small enterprises producing turbines with capacity below 100 kW and 7 turbine manufactures producing Kaplan and Francis turbines with capacity of several hundred kilowatts. Occasionally Kaplan turbines with power up to 2.5 MW are manufactured. Some of the companies have limited markets outside Poland (e.g. Germany, Norway). A complete list of turbine, generator and other mechanical equipment manufacturers is given in Annex A2.

Economic issues

Investment costs for new plants are in the range of 500 and 1200€/kW. The cost of 1 kWh electricity produced in SHP plants is about 3- 4 €cents. By comparing it to power purchase price (4- 6 €cents), it is too high.

Table 4.6.6 *Investment and electricity production costs*

Estimated range of investment costs for new plants €/kW			Range of investment costs* €/kW	Average cost of producing a unit of electricity generated by SHP scheme in your country (€cents/kWh)			Financing schemes
Low head	Medium head	High head		Low head	Medium head	High head	Generally bank credits are taken. Some institutions are granting loans at preferential conditions while monitoring the progress of the project.
800-1200	700-1000	500-800	-	3-4	n/a	n/a	

* Alternatively to previous columns

Table 4.6.7 *Buy- back rates and support mechanisms*

Structure of prices of selling electricity	Other support mechanisms for SHP development
The system of guaranteed tariffs for producing renewable electricity is introduced step-by-step. The price varies from 4 to 6 (€cents/kWh). It is negotiable. The prices are high enough to attract private investment, but they do not secure investors confidence. There is no extra price based on green prices scheme.	No direct fiscal aid is available

SHP regulatory issues

SHP limit is fixed at 5 MW in Poland.

Table 4.6.8 *Water/sites rights and administrative procedures*

SHP definition	Legal conditions for SHP	Licence for water use, power production	Fees for the use of water
<5 MW	There are a large number of laws and acts (at least 10) which govern SHP development: e.g, Water law, Construction law, Power generation law, Environmental protection law. There is also the Development strategy of RES adopted by the Parliament in 2001. The legal framework is favourable for SHP promotion in Poland. The basic document needed to develop an SHP project is the Water-Legal Consent. Tariff system is regulated by Energy regulation board. There is no one-stop shop for SHP project developers.	According to the Water Law the licence for water abstractions can be granted for a fixed period of time, but not shorter than 10 years. An applicant can apply for a longer term. Water rights (Water Legal Consent) is issued by the relevant government administration authority based on the following documents: Water-Legal Action Plan (“operat wodnoprawny”) It can be obtained during 3-6 months. The license is required for power generation in SHP plants regardless of their size. According to the Power Generation Law the licence for SHP operation is issued for a period no shorter than 10 years and no longer than 50 years.	Generally no fees are charged for SHP. However, some fees can be taken for the state-owned area covered by water used for energy production.

Table 4.6.9. *SHP planning, process to get new licence, technical specifications*

SHP master, regional or local/regional spatial plans	Process to get a new licence for SHP exploitation	Connection to the grid, cost for the use of the grid
At the beginning of the 90s the SHP Master plan for refurbishment or erection of new hydropants (total capacity of 204 MW and generation 1-1.2 TWh/year) was established. Currently a pilot SHP local spatial plan is carried out within EU funded SPLASH project	EIA, Water abstraction permit, Construction permit, Commissioning and operation permit, The licence is issued by the Energy Regulatory Authority.	These costs depend essentially on the voltage at the grid connection point. The rules are regulated by the tariffs established independently for each Power Distribution Utility by the Energy Regulatory Authority. Typical costs are €3 000 for a 250 kVA transformer station, €10 000 per 1 km of overhead transmission line and €1 000 per one support (without an isolating switch). There is no any fee for using the grid. SHP operators given access to the grid at reasonable prices but the rules of grid access are transparent.

Small Hydropower Associations

There are 2 Hydropower Associations in the country:

- 1) Society for Development of Small Hydropower Plants (TRMEW, Towarzystwo Rozwoju Małych Elektrowni Wodnych) e-mail: biuro@trmew.pl, website: www.trmew.pl
- 2) The Polish Hydropower Plant Association (TEW, Towarzystwo Elektrowni Wodnych), e-mail: biuro@tew.pl, website: www.tew.pl.

The first association was established in 1988 in Gdansk, in result of an initiative put forward by the first and long-time President, Mr Marian Hoffmann. The activities of the TRMEW concentrate in three fields: representation of small hydro power interests at the political arena by active participation in the legislative processes, integration of the SHP sector by organising sector meetings, conferences, schoolings and educational activity on small hydro and other renewable sources of energy.

The second association mainly deals with large hydropower plants. However the interests of state owned small hydropower sector (of about 100 SHP) are represented here also. More detailed information is given in Annex A2.

Main hindrances to the SHP development. Description of non –technical barriers to SHP growth.

They can be divided into the following groups:

- Economical. Hydropower has been always considered a costly investment requiring long redemption period and low interest rates. Potential owners of micro power plants invest often the whole off their life earnings into their installation. There is a general feeling that the existing state support (preferential credits from some sources) is insufficient. This is due both to lacking fiscal aid and to unstable price/tax policy.
- Legal and Administrative. The TRMEW (national SHP association) representatives used to criticize the legal conditions of small hydropower plants. The main reason are lacking clear and uniform ownership regulations in the water management sector, unclear regulation of problems related to the spatial economy and landscape protection and a lack of clear and uniform guidelines on specifying conditions for connecting the SHPs to the power grid.
- Social/Mental. The potential significance of hydropower is generally underestimated in Poland. While large hydro has its sworn enemies in form of ecological movements, the SHP sector is hardly tolerated. Officially, the ecologists admit positive effects of SHP installations. However, in practice they protest against introducing any changes in the ecological balance conditions, which are inevitably linked with erection of dams and other water management structures. This means that only plants at already existing weirs are accepted. Such a position is often supported by the media which generally promote only micro hydro power plants. Unfortunately, the agencies advising the government on RES policy and responsible for the final form of official documents, are generally against development of large hydro and show strong inclination to marginalize the role of SHPs. On the other hand they support very strongly the biomass based energy production as a chance for Polish agriculture.

Recommendations to overcome the current obstacles

- The system of guaranteed prices should be introduced for the mini, and perhaps, micro hydro power plants in addition to the negotiation practice. The green certificate system may be an alternative in Poland as long as a deficit of “green” energy exists.
- All sectors of RES should be treated on equal conditions and full costs should be taken into account (e.g. grid investment in case of wind energy, technological costs in case of biomass).
- Proper attention should be paid to the water management problems with due but reasonable account of ecological problems. “Green energy” out of hydropower installations is just one of numerous profits following from construction of civil engineering structures.

New arrangements enforced after the EU RES-E Directive (2001/77/EC) affecting SHP production: new opportunities (green prices and green certificate systems), constraints, legal changes to be adopted

According to the Power Generation Law of 1997, the electrical energy trade enterprises should be able to prove that a certain portion of the total energy acquired (and sold) stems from renewable sources. In December 2000, the Minister of Economy issued a Directive putting on energy trade enterprises the obligation to purchase a specified percentage of energy from RES-E. This Directive was transposed into National legislation in 2003.

National Indicative targets for RES-E (Renewable Energy Sources - Electricity) Directive

Table 4.6.10 National indicative targets for small and large hydro, and total RES.

	Unit	2003	2004	2005	2006	2007	2008	2009	2010
Small Hydro-Power* (<10MW)	MW	280 (242)	300 (250)	320 (258)	340 (266)	360 (274)	380 (282)	400 (290)	420 (298)
	GWh/year	935 (998)	953 (1049)	972 (1100)	990 (1151)	1009 (1203)	1027 (1254)	1046 (1305)	1 064 (1 356)
Large Hydro-Power**	MW	664	664	664	664	664	664	664	675
	GWh/year	1150	1150	1150	1150	1150	1150	1150	1 200
Total RES	MW	1363	1560	1755	1950	2144	2340	2535	2 730
	GWh/year	25 861	4 230	5 870	7 515	9 155	10 800	12 440	14 080

* Linear interpolation of the national target according to the document "Strategy for Development of Renewable Power Industry" (Strategia rozwoju energetyki odnawialnej), Ministry of Environment, Warsaw 2000, and expected annual production of 6 power plants with capacity between 5 and 10 MW. Predictions of the Contributor (based on extrapolation of a multiyear trend) are given in brackets. Contributor's energy production prognosis for 2005 is more optimistic than the Strategy and consistent with the document "Short-term prognosis of the power industry sector development in Poland" (Krótkoterminowa prognoza rozwoju sektora energetycznego kraju), Ministry of Economy, Warsaw 2002.

** Classic pumped storage schemes and energy from pumped water have been excluded

References on national SHP issues.

A large number of references have been published in Poland. Only a few of them are presented here, the remaining are annexed (A2).

1. Kulagowski W. Hydropower engineering in Poland – present state and development perspectives. Gospodarka wodna (Water management) (in Polish). No3, 2001.
2. Reymann Z., Steller K., Litorowicz J. Activities of the Polish Academy of Sciences' Institute of Fluid-Flow Machinery concerning development of small water power plants. Trans. IF-FM, 1989, vol.90-91, pp.149-171
3. Hoffmann M. (editor.). Małe elektrownie wodne. Poradnik, Nabba Sp. z O.O., Warszawa 1991
4. Steller K., Steller J.: Research and development activity on small hydropower in Poland. Energy Sources, 1993, vol. 15, pp.37-49
5. Development strategy of renewable energy sector. Presentation of major topics. Ministry of Environment. 2002.

4.7 Slovakia

Small hydropower (SHP) <10 MW in operation.

The statistics on SHP in Slovakia supplied by various information sources (International Journal on Hydropower & Dams, WEC, IEA etc.) differ considerably. Even the domestic energy data holders (Ministry of Economy, Energy Centre of Bratislava) are not in possession of reliable SHP data of capacity less than 10 MW. This is mainly due to the different approach of scaling small hydropower plants according to their installed capacity (up to 60 kW and up to 30MW).

At the end of 2002 there were about 200 SHP plants operating with totaled installed capacity of 67 MW and power generation of 250 GWh/year. A further 35 SHP are planned (55 MW, 240 GWh/year). Around a half of the total number of SHP plants in Slovakia has been constructed in the last twenty years (see Table 4.7.1). Nearly a half of SHP generating capacity (30MW) is in private hands (45%).

Table 4.7.1 Age structure of SHP plants

Age	0-19 years old	20-39 years old	40-59 years old	>60 years old	Total
Number of SHP	90	72	13	5	180

According to the gross head of SHP plants their percentage is as follows: Low head (up to 5 m) – 50%; Medium head (5-15 m) – 35% and High head (more than 15 m) – 15%. Low head power plants followed by medium head are prevailing in Slovenia and high head SHP plants are relatively rare.

SHP contribution to gross electricity generation and renewable electricity mix

Small hydro contributes 0.71% to the electricity mix in Slovakia but total hydro contribution is more remarkable – around 17% of total electricity generation. Small hydro and total hydro contribution in the renewable energy-based electricity production is dominant in Slovakia (3.7% and 96.0 % respectively).

Potential for SHP

The gross theoretical small hydropower potential is unknown in Slovakia (Table 4.7.2). The technically and economically feasible potential is 1 200 and 1 000 GWh/year, respectively. So far, about a quarter of the economically feasible potential has been developed.

Table 4.7.2 *Small hydropower potential*

Potential	Generation		Capacity MW
	GWh/year	%	
Gross theoretical	n/a	n/a	n/a
Technically feasible	1 200	n/a	n/a
Economically feasible	1 000	n/a	268
Economically feasible potential that has been developed:	250	25	67
Remaining economically feasible potential	750	75	201
Remaining economically feasible potential taking into account environmental constraints (for example, rivers exempted from damming)	n/a	n/a	n/a

New techniques of SHP implemented during the last decade

N/a

RD&D programmes for SHP.

There are not any RD&D programme regarding SHP recently carried out in Slovakia

Environmental aspects

Tables 4.7.3 and 4.7.4 show the existing resistances to small hydropower development and other environmental requirements and restrictions in Slovakia. The main barriers for SHP plants construction are fish protection and land acquisition.

Table 4.7.3 *Resistances to SHP development*

Impact	Degree of gravity (1= no impact, 5=severe impact)
Visual impact	1
Fishery	5
Water regulation	2
Competition with other uses of water (irrigation, recreation ect.)	2
Other kinds of resistance*	5

* Related with land acquisition for SHP construction.

Table 4.7.4 *Effect on SHP development and operation of the forbidden rivers, EIA, compensation flow, EU Water Framework Directive and other specific EU environmental regulations*

Forbidden rivers for hydropower construction*	Environmental impact assessment (EIA)	Compensation flow (CF)	EU WFD and other specific EU environmental regulations
SHP construction is forbidden in national parks and country reservations.	An EIA is applicable to all hydropower projects larger than 20 kW.	Compensation flow depends on river hydrological and hydraulic parameters. The methodology is site specific. The losses in SHP electricity production resulting from maintaining CF can reach 5% to 10%	n/a

*Except conventional protected areas – strict nature reservations or protected areas with overall restricted economic regime

Position of the local NGO's (green movement, ecologists, anglers), general public and official environmental bodies with regard to SHP development

NGOs need more information about positive role of SHPs. They fight against something about which they do not have enough information.

SHP manufacturing industry

There are no turbine manufactures for SHP in Slovakia. Manufacturers of generator, electrical and other mechanical and control equipment designed for SHP plants exist. Main countries of export activities for national manufactures are in the EU.

Economic issues

Investment costs for new plants is in between 1500 and 2000€/kW (Table 4.7.5).

Table 4.7.5 *Investment and electricity production costs*

Estimated range of investment costs for new plants €/kW			Range of investment costs* €/kW	Average cost of producing a unit of electricity generated by SHP scheme in your country (€cents/kWh)			Financing schemes
Low head	Medium head	High head		Low head	Medium head	High head	
n/a	n/a	n/a	1500-2000	n/a			All financing schemes are used

* Alternatively to previous columns

Table 4.7.6 *Buy- back rates and support mechanisms*

Structure of prices of selling electricity	Other support mechanisms for SHP development
The feed-in tariff system is used for producing renewable electricity. For SHP the price of selling of electricity is 4.25€/kWh (2004). It is intended to apply market prices for next year. The current price level is neither sufficient to attract private investments nor secure investors confidence.	There are no fiscal aids for SHP development.

SHP regulatory issues

Small-scale hydro plants are defined as those of less than 10 MW capacities in Slovakia.

Table 4.7.7 *Water/sites rights and administrative procedures*

SHP definition	Legal conditions for SHP	Licence for water use, power production	Fees for the use of water
<10MW	There is no one-stop shop for SHP developers.	Water abstractions are authorised for a period of time up to 30 years. License for SHP power production is not time specified.	According to the new Water Law the fees for the use of water depend on electricity production.

Table 4.7.8 *SHP planning, process to get new licence, technical specifications*

SHP master, regional or local/regional spatial plans	Process to get a new license for SHP exploitation	Connection to the grid, cost for the use of the grid
The master plan for SHP development exists. There is intention to develop local spatial plans to guide the development of SHP project in suitable areas	List of authorisations depends on specific conditions of SHP site. Requested time to get the new license for SHP exploitation can go up to 2 years.	There is neither cost for SHP connection to the grid nor for its use.

Small Hydropower Association

There is a National Association of owners of SHP with around 150 members. Its chairman is Eng. Ladislav Dvoran. The Association's main activity is cooperation with Ministry of Economy.

References on national SHP issues.

1. Breza P. Realised and prepared Slovak small hydropower. International conference on small and medium hydropower 11-13 October 1999, Vienna, Austria, HIDOENERGIA 99 (CD)
2. Energy sector of Slovakia. January 2001. European commission/Energy centre Bratisla

4.8 Slovenia

Small hydropower (SHP) <10 MW in operation

The main statistics regarding SHP number, installed capacity, SHP electricity generation since 1990 in Slovenia are shown in Table 4.8.1 and Figure 4.8.1. There is an upward growth trend for SHP over the reference period and the forecasted figures show a similar pace of SHP growth.

Table 4.8.1 *Small hydro power (<10 MW) evolution and forecast in Slovenia*

	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003	Forecast*	
											2010	2015
Total number of SHP	276	429	237	449	460	469	476	477	478	n/a	-	-
Capacity MW	80.8	97.8	99.5	101	105.5	108.5	109.4	109.5	109.7	n/a	122	132
Generation GWh	127.1	216.2	267.9	209.8	257.5	275.6	260	279.4	258.8	n/a	352	356

*Forecast is based on an extrapolation of the existing trend

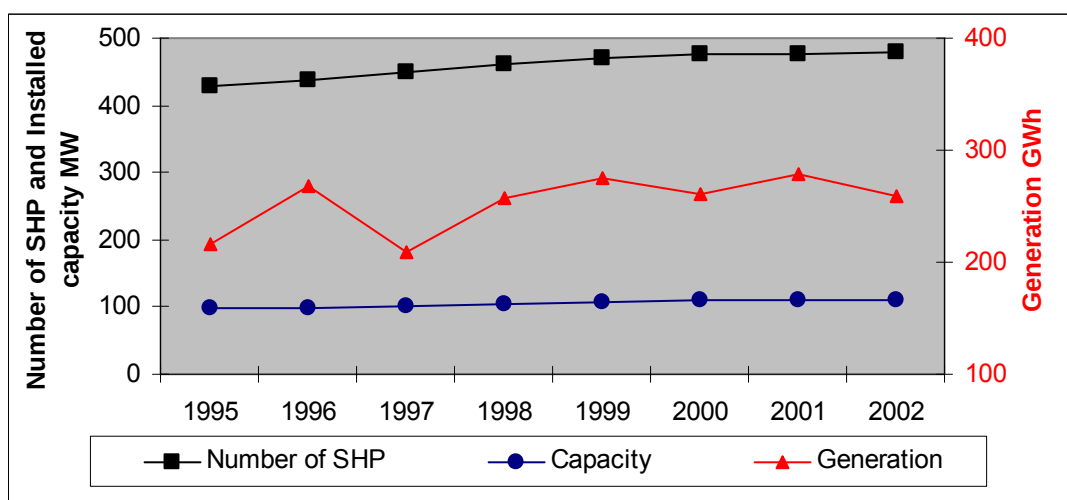


Fig. 4.8.1 Trends in the SHP plants number, installed capacity (MW) and electricity generation (GWh) in Slovenia

The bulk of Slovenia's SHP plants are relatively recently built, less than 20 years ago (see Table below). Nearly a half of SHP generating capacity (MW) is in private hands (47.2 %).

Table 4.8.2 Age structure of SHP plants

Age	0-19 years old	20-39 years old	40-59 years old	>60 years old	Total
Number of SHP	353	14	9	23	400

The percentage of SHP plants according to their gross head is as follows: Low head (up to 5 m) – 10%; Medium head (5-15 m) – 60% and High head (more than 15 m) – 30%. Medium head power plants followed by high head are prevailing in Slovenia. Low head SHP plants are less common.

SHP contribution to gross electricity generation and renewable electricity mix

Small hydro contributes 2.01% to the electricity mix in Slovenia but total hydro contribution is ten times bigger (23.8%) of total electricity generation. Small hydro and total hydro contribution in the renewable energy-based electricity production is dominant in Slovenia (7.5% and 91.5 %, respectively).

Potential for SHP

The gross theoretical small hydropower potential of Slovenia is 1400 GWh/year. The technically and economically feasible potential is 1000 and 700 GWh/year, respectively. So far, around 40% of economically feasible potential has been exploited.

Table 4.8.3 Small hydropower potential

Potential	Generation		Capacity MW
	GWh/year	%	
Gross theoretical	1400	100	365
Technically feasible	1000	71	250
Economically feasible	700	50	180
Economically feasible potential that has been developed:	283	40.4	110
Remaining economically feasible potential	417	59.6	170
Remaining economically feasible potential taking into account environmental constraints (for example, rivers exempted from damming)	150	21.4	40

New techniques of SHP implemented during the last decade

Only electrical, control and monitoring equipment of new generation (computers, radio and telephone connection etc.) have been widely implemented during the last 10-15 years

RD&D programmes for SHP

There are not any RD&D programme regarding SHP recently carried out in Slovenia.

Environmental aspects

Tables 4.8.4 and 4.8.5 show the existing resistances to small hydropower development and other environmental requirements and restrictions in Slovenia. The most important barriers are the quality of visual aspects and compliance with the requirements of the EU network of protected areas.

Table 4.8.4 Resistances to SHP development

Impact	Degree of gravity (1= no impact, 5=severe impact)
Visual impact	4
Fishery	3
Water regulation	1
Competition with other uses of water (irrigation, recreation ect.)	1
Other kinds of resistance: NATURA 2000*	5

* Almost all Slovenia's SHPs are run-of-river type with relatively small water stocking basin.

Table 4.8.5 Effect on SHP development and operation of the forbidden rivers, EIA, compensation flow, EU Water Framework Directive and other specific EU environmental regulations

Forbidden rivers for hydropower construction*	Environmental impact assessment (EIA)	Compensation flow (CF)	EU WFD and other specific EU environmental regulations
The rivers are categorised in 4 categories. 1 st and 1-2 nd are regarded as preserved (non-regulated or used for any economic activity) and are not intended for power production. These forbidden rivers considerably affect SHP economical potential to be exploited.	An EIA must be carried out for reservoir plants where the reservoir volume exceeds 10,000 m ³ , or for run-of-river stations larger than 500 kW.	There is no officially approved compensation flow (CF) setting methodology. CF is set as a fraction of the average low flow (around 0.95). The losses in SHP electricity production resulting from maintaining CF can reach 5% to 10%	WFD is in course of implementation. Implementation of WFD requirements will result in a prohibition of new SHP construction and complication in issuing authorisation.

*Except conventional protected areas – strict nature reservations or protected areas with overall restricted economic regime

Position of the local NGO's (green movement, ecologists, anglers), general public and official environmental bodies with regard to SHP development

Some NGO's and especially biologists believe any energy production is harmful for nature. Others support RES as the only energy alternative but still SHP is regarded as having the major environmental impact. The statement "SHP destroys the valley" often made by environmentalists is very popular. Nevertheless, there is no strong environmental movement like WWF, Friends of the Earth or Greenpeace in Slovenia and one local NGO is "Slovenian Ecological Movement" in which the leadership is in favour of SHP.

SHP manufacturing industry

Water and energy industries, and service capabilities related to SHP are well developed in Slovenia. There are 3 turbine manufactures producing Kaplan, Francis, Pelton and other types of turbines. They have markets in the EU, USA, Canada, Central and Eastern Europe (CEE), African and Asian countries. A complete list of turbine, generator, and other mechanical equipment manufacturers is given in Annex A3.

Economic issues

Investment costs for new plants vary between 1 500 and 3 000€/kW. High head schemes are less expensive to develop and exploit than low head schemes.

Table 4.8.6 *Investment and electricity production costs*

Estimated range of investment costs for new plants €/kW			Range of investment costs* €/kW	Average cost of producing a unit of electricity generated by SHP scheme in your country (€cents/kWh)			Financing schemes
Low head	Medium head	High head		Low head	Medium head	High head	
3000	2500	1500	-	n/a	n/a	n/a	n/a

* Alternatively to previous columns

The price level is sufficient to attract private investments but it still does not secure investors confidence.

Table 4.8.7 *Buy- back rates and support mechanisms*

Structure of prices of selling electricity	Other support mechanisms for SHP development
The feed-in tariff system is used for producing renewable electricity. The price is based on the "predicted long-term electricity price" (3.35 €/kWh). If the producer gets the status of qualified producer (QP) – which is not too hard – he is eligible for additional premium of 2.8 €/kWh for new plant (<5 years old), 2.68 €/kWh for SHP old 5-10 years (= -5%) and 2.54 €/kWh for SHP>10 years (= -10 %). This price level is sufficient to attract private investments but it does not secure investors confidence.	There are no fiscal aids for SHP development.

SHP regulatory issues

SHP limit is fixed at 10 MW in Slovenia.

Table 4.8.8 *Water/sites rights and administrative procedures*

SHP definition	Legal conditions for SHP	Licence for water use, power production	Fees for the use of water
<10MW	There is no one-stop shop for SHP developers. Planning permits are granted by the Ministry of the Environment, Spatial Planning and Energy (MOPE). SHP developer are bound to fulfil their obligations based on several different laws (acts): Energy Act, Water Act, Spatial Planning Act, Construction of Facilities Act etc.	Water abstractions are authorised for a period of time up to 30 years. Construction permit of the scheme is not time specified.	There are two types of fees to be paid by SHP producer: 1) Water concession fees – 3% of T (were T is buy-back rate for 1 kWh) and 2) extra fees -0.3% of T)

Table 4.8.9 *SHP planning, process to get new licence, technical specifications*

SHP master, regional or local/regional spatial plans	Process to get a new license for SHP exploitation	Connection to the grid, cost for the use of the grid
Local spatial plans are being produced in which SHP have to be included to apply for the concession. There is no intention to develop local spatial plans to guide the development of SHP project in suitable areas	In total 11 authorisations issued by different authorities are needed. It takes at least 2 years for developer to commission a SHP.	The costs to connection to the grid are not transparent. They are responsible for covering the costs of extensions and of strengthening the grid. The rules of grid access are discriminatory and not transparent.

Small Hydropower Association

The Slovenian SHP Association's name is Zveza društev lastnikov in graditeljev malih hidroelektrarn; Zveza društev MHE Slovenije (short) (ZDMHE) or in English, Association of Small Hydro Power Plants Societies. President: Marko Gospodjinackie- e-mail: zdmhe@ekowatt.si. It was established in 1988, developed from single association (society) to 5 regional societies in which 335 members (SHP owners and investors) are united. Its main activities are: acting as NGO in legislative procedures; development of green power schemes; technical, legal and administrative support for members.

Main hindrances to the SHP development and description of non –technical barriers to SHP growth.

SHP has experienced fast growth from 1985-1991 and even faster in years 1992-1994, due to government financial programme, by which the state offered to investors financial credits with (at that time) low interest rates. Without good inspectorate service, allowing innovators cheap approach to the investments, taking into account also much lower environmental demands at the time, SHP hit the wall of public disagreements, started by several journalists and biologists.

In the past 9 years SHP has suffered from poor public support and very arbitrary approach from state officials. It became clear that even the Minister is not immune to public opinion.

The biggest flaw was when officials did not respond to applications for concessions or responded that the area is intended for preservation (not yet protected) and thus not possible for power production. In that way almost all of potential investors lost hope in their SHP.

In the last few years the biggest obstacle represents local spatial plans in which SHPs have to be included in order to be able to apply for concession. Local authorities are not against SHP, but they have to give the proposal of spatial plan to the Ministry of the Environment, Spatial Planning and Energy (MOPE) for approval. It has been seen on few occasions that MOPE demanded exclusion of SHP from spatial plan in order to confirm it. A major problem lies in fact that these procedures are very hard to overcome and that technical (or legislative) aspects of MOPE's decisions are not transparent.

Recommendations to overcome the current obstacles

Regulatory and technical conditions should be transparent for all players and put in hands of local authorities. Authorisation procedures should be simple, one-level, with basic possible stop signs visible at the very beginning of investment (at the information stage). Reasonable concession fee should be put into law, otherwise the government can change it (technically) every week. That does not contribute to investor's confidence. The same goes for energy sector, where the feed-in tariff hasn't been changed for 2 years, despite written obligation that the government will adjust the prices with the inflation at least once a year. Law for RES should be prepared and put into parliament procedure.

National Indicative targets for RES-E (Renewable Energy Sources - Electricity) Directive

N/a

New arrangements enforced after the EU RES-E Directive (2001/77/EC) affecting SHP production: new opportunities (green prices and green certificate systems), constraints, legal changes to be adopted.

MOPE, Agency for Energy Efficiency (AEE) and Fund for Ecology Development (FED) are also managing some support schemes for RES but SHP is sometimes excluded. Both have several programmes for financial aid for new power plants, mainly with suitable financial credits (low interest rate on €; 1-2 %).

Regarding green certificates, the major power producer (HSE) is a member of RECS and Energy Agency is the issuing body (all in 2004). The Energy Act allows that also tariff users (not eligible) can choose power from qualified producer (e.g. green power) and in addition have rights to lower grid costs. In 2004, the private company Ekowatt d.o.o. managed to sign the contracts (Balance group contract + Contract for grid access) with 1 of 5 public utilities (PU's). Based on that, the first consumer was able to buy green power directly from the producer (via representative). First fault of the system is that any new power supplier has to ask the PU to grant him grid access under reasonable conditions, but PUs, supplying certain consumer, are at that time already a competition. SHP are incompetent to comply to system rigid conditions regarding announcements and deviations (balancing), but without special approach the consumers can only get green power from big HP.

References on national SHP issues.

1. Jerkovic, B., Mravljak J. and Plavcak V. Male hidroelektrarne (Small hydropower stations), Ministry for Economic Affairs, Maribor 1996
2. Maksic R. and Gospodinjacki M. The programme of using renewable energy sources – I part – Hydroenergy, report No: 1486, EIMV Hajdrihova 2, Ljubljana

4.9 Bulgaria

Small hydropower (SHP) <10 MW in operation.

The main statistics regarding SHP number, installed capacity, SHP electricity generation during the last and beginning this decade in Bulgaria are shown in Table 4.9.1 and Figure 4.9.1. The number of SHP plants and installed capacity has grown steadily over the reference period and the same pace is to be kept in the future.

Table 4.9.1 *Small hydro power (<10 MW) evolution and forecast in Bulgaria*

	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003	Forecast	
											2010	2015
Total number of SHP	61	63	67	67	69	72	77	79	83	84	128	249
Capacity MW	139.0	143.1	144.7	144.7	145.7	147.5	149.0	150.1	156.3	166.3	251	310
Generation GWh	304.9	307.9	309.9	310.0	311.8	313.5	316.4	318.1	354.6	347.7	564	697

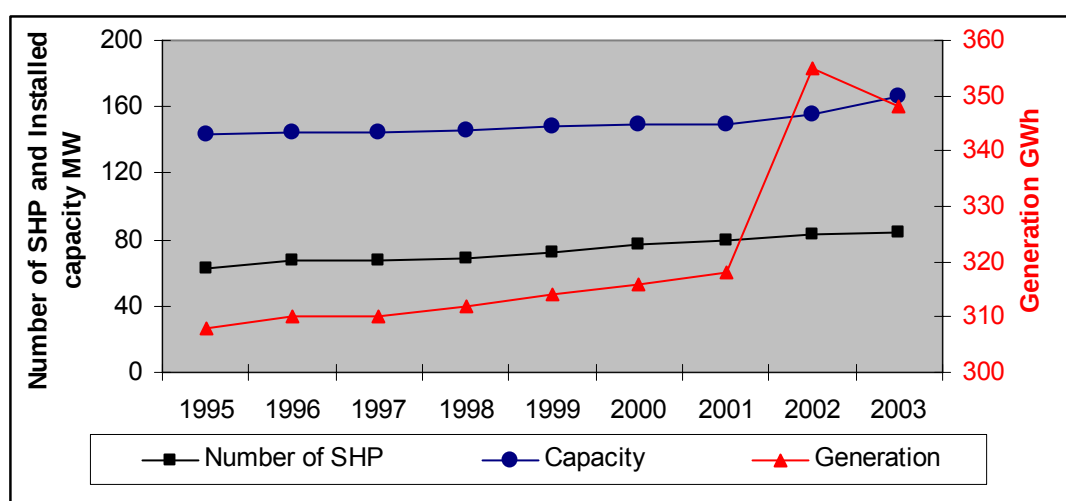


Fig. 4.9.1 *Trends in the SHP plants number, installed capacity (MW) and electricity generation (GWh) in Bulgaria*

More than a half of all SHP plants in Bulgaria can be regarded as old ones, exceeding 40-60 years (see Table below). Most SHP plants, according to their generating capacity, are privately owned at 84 %.

Table 4.9.2 *Age structure of SHP plants*

Age	0-19 years old	20-39 years old	40-59 years old	>60 years old	Total
Number of SHP	22	7	29	25	83

The percentage of SHP plants according to their gross head is as follows: Low head (up to 5 m) – 18%; Medium head (5-15 m) – 18% and High head (more than 15 m) – 64%. Low head SHP plants are mostly exploited in Hungary.

SHP contribution to gross electricity generation and renewable electricity mix

Small hydro contributes 0.81% to the electricity mix in Bulgaria. Total hydro contribution is about 3.6% of total electricity generation. Small hydro and total hydro contributions in the renewable energy-based electricity production is dominant in Bulgaria (16.5% and 83.5 %, respectively).

Potential for SHP

The last SHP potential evaluation took place in 1998-2000, calculating that the gross theoretical small hydropower potential of Bulgaria is 1 527 GWh/year. The technically and economically feasible potential is 755 and 706 GWh/year, respectively. So far about a half of economically feasible potential (or 44.3%) has been developed.

Table 4.9.3 *Small hydropower potential*

Potential	Generation		Capacity MW
	GWh/year	%	
Gross theoretical	1527	100	305
Technically feasible	755	49.4	240
Economically feasible	706	46.2	319
Economically feasible potential that has been developed	313	44.3	166
Remaining economically feasible potential	393	55.7	153
Remaining economically feasible potential taking into account environmental constraints (for example, rivers exempted from damming)	n/a	n/a	n/a

New techniques of SHP implemented during the last decade

There have been used the new type penstock pipes made of fibreglass impregnated with polyester resins. The Bulgarian company 'HYDRO-M' has its own specialised design software for small water turbines (such as Pelton, Francis and Cross-flow) and also for the modernisation of the stream part of the existing water turbines.

RD&D programmes for SHP

The following RD&D have been recently carried out:

- 1) Building of Small Hydro-electric Power Stations in the Smolyan Region. Providing technical assistance, development and publication of materials for supporting entrepreneurs in building small hydroelectric power stations. Project funded by PHARE Partnership Program.
- 2) Pre-feasibility study of the hydro potential in Bulgaria and investment opportunities. Fifth Framework Programme: Energy Environment and Sustainable Development. Partners: ESD Bulgaria Ltd and the British Know-How Fund (1998-1999).
- 3) National programme on RES development (NPPRES).

Environmental aspects

Tables 4.9.4. and 4.9.5 show the existing resistances to small hydropower development and other environmental requirements and restrictions in Bulgaria. These can be seen as realistic with regard to SHP.

Table 4.9.4. Resistances to SHP development

Impact	Degree of gravity (1= no impact, 5=severe impact)
Visual impact	1
Fishery	1
Water regulation	1
Competition with other uses of water (irrigation, recreation ect.)	1
Other kinds of resistance	1

Table 4.9.5 Effect on SHP development and operation of the forbidden rivers, EIA, compensation flow, EU Water Framework Directive and other specific EU environmental regulations

Forbidden rivers for hydropower construction*	Environmental impact assessment (EIA)	Compensation flow (CF)	EU WFD and other specific EU environmental regulations
There are no rivers forbidden for damming.	EIA must be carried out for all hydropower projects and for reservoirs which volume exceed 10^6 m^3 . EIA is demanded in SHP licensing process.	Compensation flow is set as a fraction of the long-term average flow or alternatively minimum mean flow. The losses in SHP electricity production resulting from maintaining CF are important (>10%).	WFD is in course of implementation. Its implementation might cause higher residual flow for SHP and increase in their operating costs.

*Except conventional protected areas – strict nature reservations or protected areas with overall restricted economic regime

Position of the local NGO's (green movement, ecologists, anglers), general public and official environmental bodies with regard to SHP development

The Ministry of Environment and Water has funds and supports the construction of new SHP with fiscal aids. "Green people" are against for developing the Struma River for power generation (project "Kresna") and there are objections for the cascade building.

SHP manufacturing industry

There is one domestic turbine manufacturer (Vaptsarov JSC–Pleven) producing Francis (0.1-216 MW), Pelton (0.11-136 MW) and mini turbines (4 kW-200kW) and satisfying the needs of local market. There are a number of consulting companies dealing mainly with larger hydropower projects.

Economic issues

Investment costs for new plants vary between 1100 and 1500€/kW. The cost of producing of a unit of electricity in Bulgaria is relatively low.

Table 4.9.6 Investment and electricity production costs

Estimated range of investment costs for new plants €/kW			Range of investment costs* €/kW	Average cost of producing a unit of electricity generated by SHP scheme in your country (€cents/kWh)			Financing schemes
Low head	Medium head	High head		Low head	Medium head	High head	Generally private, project finance.
n/a	1100-1500	700**	-	n/a	0.3-1.0	0.4-0.6**	

* Alternatively to previous columns

** SHP associated to a drinking water supply systems.

The buy back rate is enough to attract private investment (see Table 4.9.7).

Table 4.9.7 Buy- back rates and support mechanisms

Structure of prices of selling electricity	Other support mechanisms for SHP development
The feed-in tariff system is used for producing renewable electricity. The guaranteed tariff is 3.07 €cents/kWh (for SHP up to 10MW). The price of the electricity is subject of annual update by the State Commission for Energy Regulation (DKER). This buy back rate is enough to attract private investment. The mandatory buying out of electricity pursuant to Article 159 from Law on Energy shall be applied until the time of setting up a system for issuing and trade in green certificates. There is no extra price based on the green price scheme.	1. Loans for building of SHP – up to €766 000 - 5 year paying up period, counted from the date when the SHP put in operation 2. Cost per installed kW – €1 278

SHP regulatory issues

Small-scale hydro plants are defined as those of less than 10 MW capacities in Bulgaria.

Table 4.9.8. Water/sites rights and administrative procedures

SHP definition	Legal conditions for SHP	Licence for water use, power production	Fees for the use of water
<10 MW	There is no one-stop shop for SHP project developers. The following dossiers and administrative procedures are needed to develop a small hydropower site: Pre-investment project (approved by municipality expert council, coordinated by Chief architecture in compliance with the Law on Territory structure, positive decision on EIA, approved by Regional Inspectorate of Environment according to the provisions of the Law on Water Environment Protection), Approval of Chief Architecture Technical project Construction permission, issued in a period of 7 days and valid for 2 years, Commissioning and operation of the plant Contract for the connection to the grid.	For larger water abstractions concession regime is applied. In the case of SHP simplified permit for water use issued. Basin Directorate is charged to issue a permit for water use. It could take 100 to 160 days. The permit for water use is granted for a time of 10 years. Licence for power generation is granted up to 35 years. They both can be extended for an undetermined period.	There are annual fees paid by SHP producer.

Table 4.9.9 SHP planning, process to get new licence, technical specifications

SHP master, regional or local/regional spatial plans	Process to get a new license for SHP exploitation	Connection to the grid, cost for the use of the grid
There is a National Programme on renewable energy sources established by the Energy Efficiency Agency. There is an intention to develop local spatial plans to guide the development of SHP project in suitable areas	Two main permissions are needed for a new development: Permit for water use (from Basin Directorate), Licence for production of electricity (from State Energy Regulatory Commission – SERC)	The transmission and the distribution companies are obliged to connect by priority all power plants generating electricity from RES, including hydroelectric plants, with total installed capacity up to 10 MW. SHP operator covers the cost for connection to the grid. Utility purchasing power covers all expenses related to the construction of connection installations up to SHP property border. SHP operators are given access to the grid at reasonable prices. They are not responsible for covering the costs of extensions and strengthening the grid. The rules of grid access are transparent and non-discriminatory

Small Hydropower Association.

There is National Union of Independent Energy Producers “ECOENERGY” in which SHP interests are presented. The President is Dimiter Socolov. <http://www.ecoenergy-bg.org>. Email: president@ecoenergy-bg.org.

The main goals of the Association are: to defend the rights and interests of its members; to raise the authority and qualification of its members; to facilitate the contacts of its members with one another, as well as with the state and public organizations in national and international aspect; to introduce its members' activities to the society; to formulate a strategy for stimulation of energy production.

Main hindrances to the SHP development. Description of non –technical barriers to SHP growth

N/a

Recommendations to overcome the current obstacles

N/a

National Indicative targets for RES-E (Renewable Energy Sources - Electricity) Directive.**Table 4.9.10 National indicative targets for small and large hydro, and total RES.**

	Unit	2003	2004	2005	2006	2007	2008	2009	2010
Small Hydro-power (<10MW)	MW	166	166.26	170.34	170.5	171	N/a	251	309.8
	GWh/year	347	348	383	383	386	N/a	564	697
Large Hydro-power	MW	2333	2333	2725	2725	2725	N/a	2985	2985
	GWh/year	2100	2166	2608	2608	2608	N/a	3075	3075
Total RES	MW	2499	2499	2895	2895	2896	N/a	3236	3294
	GWh/year	2447	2514	2991	2991	2993	N/a	3639	3772

References on national SHP sector

N/a

4.10 Romania

Small hydropower (SHP) <10 MW in operation

The main statistics regarding SHP number, installed capacity, SHP electricity generation over the last 13 years in Romania are shown in Table 4.10.1 and Figure 4.10.1. There is a clear trend of growth of SHP plants and continued growth in the forecasted figures.

Table 4.10.1 *Small hydro power (<10 MW) evolution and forecast in Romania*

	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003	Forecast	
											2010	2015
Total number of SHP	194	223	225	225	226	227	230	233	234	236	245	257
Capacity MW	229.4	258.5	259.4	260.0	265.4	266.7	269.2	274.2	275.0	278	305	340
Generation GWh	322	380	385	401	457	403	415	450	415.5	430	450	467

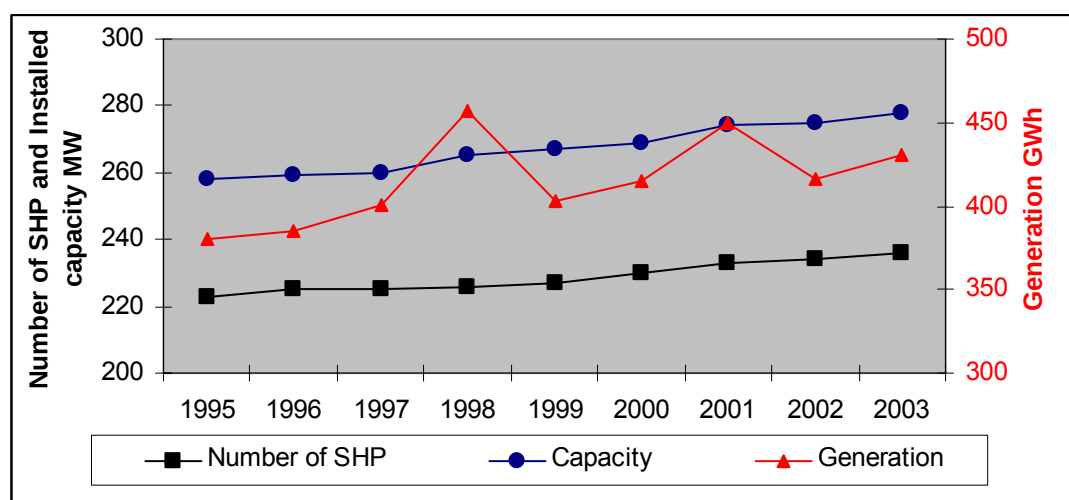


Fig. 4.10.1 *Trends in the SHP plants number, installed capacity (MW) and electricity generation (GWh) in Romania*

The bulk of all SHP in Romania are recently built plants (see Table 4.10.2). They were constructed 20 years ago. The largest SHP owner is state utility HIDROELECTRICA SA. Until 2002 there were no privately owned SHP plants but their privatisation has recently started.

Table 4.10.2 *Age structure of SHP plants*

Age	0-19 years old	20-39 years old	40-59 years old	>60 years old	Total
Number of SHP	189	29	2	16	236

According to SHP plants gross head their percentage is as follows: Low head (up to 5 m) – 4.5%; Medium head (5-15 m) – 22.55% and High head (more than 15 m) – 73%. High head SHP plants are mostly exploited in Romania.

SHP contribution to gross electricity generation and renewable electricity mix

Small hydro contributes only 0.79% to the electricity mix in Romania but total hydro contribution is more remarkable – around 30% of total electricity generation. Small hydro and total hydro contributions in the renewable energy-based electricity production are dominant in Romania (2.6% and 97.4 % respectively).

Potential for SHP

The gross theoretical small hydropower potential of Romania is unknown. The technically and economically feasible potential is 3 630 and 3 510 GWh/year, respectively. Considerable untapped potential exists for SHP in Romania. Slightly more than ten percent (12.2%) of economically feasible potential is developed so far.

Table 4.10.3 *Small hydropower potential*

Potential	Generation		Capacity MW
	GWh/year	%	
Gross theoretical	n/a	n/a	n/a
Technically feasible	3 630	n/a	n/a
Economically feasible	3 510	n/a	1 060
Economically feasible potential that has been developed:	430	12.2	278
Remaining economically feasible potential	3 080	87.8	782
Remaining economically feasible potential taking into account environmental constraints (for example, rivers exempted from damming)	n/a	n/a	n/a

New techniques of SHP implemented during the last decade

- Axial double control turbines for low head plants have been used.
- Remote control and computer assisted management of stations and units.
- Adequate treatment, in line with regulation in effect, of stations on measurement of electric energy exchange so as to establish best seller-to- buyer relationship.

RD&D programmes for SHP

None

Environmental aspects

Tables 4.10.4 and 4.10.5 show the existing resistances to small hydropower development and other environmental requirements and restrictions in Romania. Only the river life protection is a frequent problem when SHP plants are constructed. Other environmental requirements are well balanced with regard to SHP.

Table 4.10.4. *Resistances to SHP development*

Impact	Degree of gravity (1= no impact, 5=severe impact)
Visual impact	1
Fishery	1
Water regulation	1
Competition with other uses of water (irrigation)	2
Other kinds of resistance (river life protection)	3

Table 4.10.5. *Effect on SHP development and operation of the forbidden rivers, EIA, compensation flow, EU Water Framework Directive and other specific EU environmental regulations*

Forbidden rivers for hydropower construction*	Environmental impact assessment (EIA)	Compensation flow (CF)	EU WFD and other specific EU environmental regulations
There are no rivers forbidden for damming.	EIA must be carried out for all hydropower projects which reservoir volumes exceed 10 ⁶ m ³ .	Compensation flow is set depending on hydrological and hydro-biological parameters. The losses in SHP electricity production resulting from maintaining CF are negligible.	Not applicable

*Except conventional protected areas – strict nature reservations or protected areas with overall restricted economic regime

Position of the local NGO's (green movement, ecologists, anglers), general public and official environmental bodies with regard to SHP development

Local NGO's and general public have no firm determination regarding SHP development. Official environmental bodies encourage the development of SHP. The only important ecologist protest was regarding the 'Romanichthys valsanicola', a valuable fish that live on Valsan river who's habitat was reduced by a large dam (Vidraru) construction.

SHP manufacturing industry

There is one domestic turbine manufacturer, UCM Resita SA, producing various kind and sizes of water turbines, a few of manufacturers of mechanical equipment (UCM Resita, IMGB Kverner, SC Fibrec Campina, Hidrotim SA), generator, electrical and control equipment. Main countries of export activities for national manufactures are Serbia, China, Iraq and Iran.

Economic issues

The cost of producing a unit of electricity in Romania is relatively high for medium head hydroplants.

Table 4.10.6 *Investment and electricity production costs*

Estimated range of investment costs for new plants €/kW			Range of investment costs* €/kW	Average cost of producing a unit of electricity generated by SHP scheme in your country (€cents/kWh)			Financing schemes
Low head	Medium head	High head		Low head	Medium head	High head	
n/a	n/a	n/a	n/a	n/a	n/a	2.8	Equity, project finance, BOT, BOOT are common.

* Alternatively to previous columns

Table 4.10.7 *Buy- back rates and support mechanisms*

Structure of prices of selling electricity	Other support mechanisms for SHP development
Price for electricity delivered to the grid is about 3.4 €/kWh. This price level is sufficient to attract private investments and secure investors confidence. There is no extra price based on the green price scheme.	No

SHP regulatory issues

Small-scale hydro plants are defined as those of less than 10 MW capacities in Romania (until December 2003 this limit was fixed at 3.6 MW).

Table 4.10.8 *Water/sites rights and administrative procedures*

SHP definition	Legal conditions for SHP	Licence for water use, power production	Fees for the use of water
<10MW	There is no one-stop shop for SHP project developers. The Ministry of Economy and Industry is responsible for granting planning permits.	National Water Authority. (ANAR) grants water abstraction authorisation within 2 weeks if all requirements are respected. In receiving this authorisation Ministry of Agriculture, Food and Forests also gives their opinion. Licence for power production is needed also.	There are no fees for water use in SHP plants. fee is collected by ANAR (National Water Authority).

Table 4.10.9 SHP planning, process to get new licence, technical specifications

SHP master, regional or local/regional spatial plans	Process to get a new license for SHP exploitation	Connection to the grid, cost for the use of the grid
There is not any master plan. There is no intention to develop local spatial plans to guide the development of SHP project in suitable areas	The main authorisations that must be obtained are: Authorisation from ANRE (National Energy Authority). For this a large number of technical and economical documents should be submitted. The answer will be given in 1- 2 months. Authorisation for water use from ANAR. Subscription at OpCom (Romanian energy market operator); Authorisation from Transelectrica or Electrica to access to the grid (depends on the grid, distribution or transport); Environmental authorisation from Ministry of Environment and Water, Ministry of Agriculture. Each procedure requires from two weeks to two month.	It is a case specific and regulated by ANRE (National Energy Authority). There is a formula depending on type of grid (distribution or transport) and voltage. The cost for the use of grid is about 0.4 €/kWh (transport grid). The SHP operators are responsible for covering the cost of extensions and of strengthening the grid. They are given access to the grid at reasonable prices and the rules of grid access are transparent.

Small Hydropower Association

There is no SHP Association in Romania

Main hindrances to the SHP development. Description of non –technical barriers to SHP growth

Lack of SHP financing is the main problem. There are a large number of unfinished SHP schemes.

Recommendations to overcome the current obstacles

Feed-in tariff should be higher.

National Indicative targets for RES-E (Renewable Energy Sources - Electricity) Directive

Not applicable

References on national SHP issues

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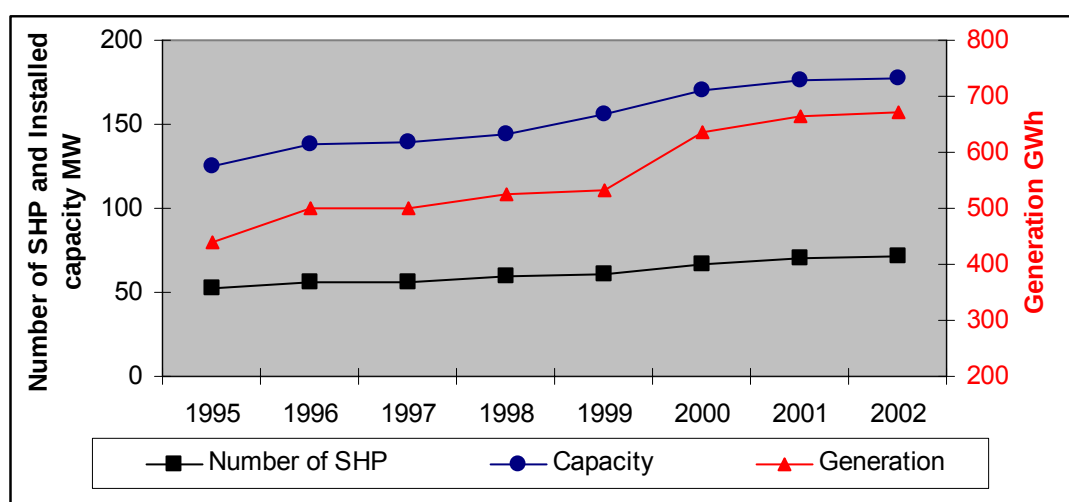
4.11 Turkey

Small hydropower (SHP) <10 MW in operation

The main statistics regarding SHP number, installed capacity, SHP electricity generation over the past 13 years in Turkey are shown in Table 4.11.1 and Figure 4.11.1. There is clear growth trend for these SHP and good forecasted figures for SHP in the future.

Table 4.11.1 *Small hydro power (<10 MW) evolution and forecast in Turkey*

	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003	Forecast	
											2010	2015
Total number of SHP	33	52	55	56	59	61	67	70	71	n/a	100	130
Capacity MW	84.4	124.9	137.7	138.6	144.1	146.3	170.2	175.5	177.1	n/a	260	335
Generation GWh	283	439	499	500	524	533	636	664	673	n/a	968	1250

**Fig. 4.11.1.** *Trends in the SHP plants number, installed capacity (MW) and electricity generation (GWh) in Turkey*

The bulk of all SHP plants are constructed recently in Turkey, within a period of 20 years (table 4.11.2). Around 20% of generating capacity of SHP plants are in private hands.

Table 4.11.2 *Age structure of SHP plants*

Age	0-19 years old	20-39 years old	40-59 years old	>60 years old	Total
Number of SHP	61	4	6	0	71

According to their gross head the percentage of SHP plants is as follows: Low head (up to 5 m) – 0%; Medium head (5-15 m) – 5% and High head (more than 15 m) – 95%. High head SHP plants are mostly exploited in Turkey.

SHP contribution to gross electricity generation and renewable electricity mix

Small hydro contributes 0.52% to the electricity mix in Turkey but total hydro contribution is more remarkable – around 34% of total electricity generation. Small hydro and total hydro contribution in the renewable energy-based electricity production is dominant in Turkey (2% and 97.7 %, respectively).

Potential for SHP

There is a proposal of the project called “HYDROPOT” submitted for FP6 funding in order re-evaluate hydropower potential. Only estimates on SHP potential can be given (see Table 4.11.3). The gross theoretical small hydropower potential of Turkey is 50000 GWh/year. The technically and economically feasible potential is 30000 and 20000 GWh/year, respectively. A huge untapped potential exists for SHP in Turkey. Only 3.3% of economically feasible potential is developed so far.

Table 4.11.3 Small hydropower potential

Potential	Generation		Capacity MW
	GWh/year	%	
Gross theoretical	50 000	100	16 500
Technically feasible	30 000	60	10 000
Economically feasible	20 000	40	6 500
Economically feasible potential that has been developed:	664	3.3	175
Remaining economically feasible potential	19 336	96.7	6 325
Remaining economically feasible potential taking into account environmental constraints (for example, rivers exempted from damming)	~19 300	96.7	6 325

New techniques of SHP implemented during the last decade

None

RD&D programmes for SHP

There is a study underway by Government Agencies (EIE and DSI) to assess the potential of SHP. ERE Holding has also proposed “HYDROPOT” within the 6th Framework Programme, to investigate the hydropower potential of Turkey and Greece.

Environmental aspects

Tables 4.11.4. and 4.11.5 show the existing resistances to small hydropower development and other environmental restrictions in Turkey. These can be viewed as very liberal by comparing with those in other analysed countries except existing relatively tough competitor irrigation and relatively high compensation flow for SHP plants. The latter incurs significant losses in electricity production.

Table 4.11.4 Resistances to SHP development

Impact	Degree of gravity (1= no impact, 5=severe impact)
Visual impact	1
Fishery	1
Water regulation	1
Competition with other uses of water (irrigation)	3
Other kinds of resistance	1

Table 4.11.5 Effect on SHP development and operation of the forbidden rivers, EIA, compensation flow, EU Water Framework Directive and other specific EU environmental regulations

Forbidden rivers for hydropower construction*	Environmental impact assessment (EIA)	Compensation flow (CF)	EU WFD and other specific EU environmental regulations
There are no rivers forbidden for damming.	EIA must be carried out for hydropower projects larger than 10 MW. Between 10 MW and 50 MW a preliminary IEA is required. Full EIAs are required for storage facilities having reservoir surface more than 15 km ² and reservoir volumes of more than 100 x 10 ⁶ m ³ .	Compensation flow is set depending on flow duration curve and hydro-biological parameters. The losses in SHP electricity production resulting from maintaining CF could be estimated between 5 and 10%	Not applicable

*Except conventional protected areas – strict nature reservations or protected areas with overall restricted economic regime

Position of the local NGO's (green movement, ecologists, anglers), general public and official environmental bodies with regard to SHP development

There are some resistances to SHP development at some specific locations.

SHP manufacturing industry

There are a few turbine manufacturers (for example Tamsan producing turbines under Neyrpic license), manufacturers of mechanical equipment (Ciltug Machinery, Rona Machinery, Isik Machinery), plenty of electrical, control equipment, engineering consultancy companies, civil works contractors. Domestic producers of electrical equipment have market in the Europe.

Economic issues

Investment costs for new plants vary between 300 and 450€/kW. High head schemes are less expensive to develop and exploit than medium head schemes.

Table 4.11.6 *Investment and electricity production costs*

Estimated range of investment costs for new plants €/kW			Range of investment costs* €/kW	Average cost of producing a unit of electricity generated by SHP scheme in your country (€cents/kWh)			Financing schemes
Low head	Medium head	High head		Low head	Medium head	High head	
Not applicable	350-450	300-400	-	Not applicable	0.6-0.7	0.5-0.6	BOT and BOOT are not used any more. Private finance, equity, loans and project finance are common.

* Alternatively to previous columns

Table 4.11.7 *Buy- back rates and support mechanisms*

Structure of prices of selling electricity	Other support mechanisms for SHP development
Price for electricity delivered to the grid depend on the market prices. It is around 4.5 €/kWh This price level is neither sufficient to attract private investments nor secure investors confidence. There is no extra price based on the green price scheme.	There is no any other support

SHP regulatory issues

Small-scale hydro plants are defined as those of less than 50 MW capacities in Turkey.

Table 4.11.8 *Water/sites rights and administrative procedures*

SHP definition	Legal conditions for SHP	Licence for water use, power production	Fees for the use of water
<50MW	Licensing is granted through Electricity Market Regulatory Authority, Water Rights are obtained through State Hydraulic Works.	Licences are valid for 20-40 years, renewal is possible.	There are fees up to 5% of investment cost. If an investor develops itself the project the fees can be much smaller

Table 4.11.9 *SHP planning, process to get new licence, technical specifications*

SHP master, regional or local/regional spatial plans	Process to get a new license for SHP exploitation	Connection to the grid, cost for the use of the grid
There is no any master plan. There is no intention to develop local spatial plans to guide the development of SHP project in suitable areas	Three main permissions needed for a new development: 1) EMRA issues licence, 2) DSI issues Water Rights Contract, 3) Ministry of Forestry and other Agencies authorise Land use and require Environmental Impact Assessment.	There are no any advantages for SHP to connection to the grid. The connection fees depend on installed capacity. They differentiate one from another region. SHP operators are given access to the grid at reasonable prices and the rules of grid access are transparent.

Small Hydropower Association

There is no SHP Association, but there is the Association for Hydropower in general.

Main hindrances to the SHP development. Description of non –technical barriers to SHP growth

The bureaucratic administrative procedures that are very lengthy hinder the investments for SHP schemes.

Recommendations to overcome the current obstacles

The long administrative procedures must be accelerated for the investments. The attractive tariff system must be applied to facilitate and promote investments for SHP plants. Besides the investments of SHP plants the local SHP manufacturing capability, especially electrical and control equipment, should be promoted.

National Indicative targets for RES-E (Renewable Energy Sources - Electricity) Directive

Not applicable

New arrangements enforced after the EU RES-E Directive (2001/77/EC) affecting SHP production: new opportunities (green prices and green certificate systems), constraints, legal changes to be adopted

There is a proposed law in the parliament to promote the use of Renewable Energy.

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6. GLOSSARY

ACC or CC	3 Candidate countries for EU membership (EU Accession countries)
BlueAGE	Strategic study for the development of SHP in the European Union (ESHA, Brussels, 2001)
CF	Compensation flow (reserved, residual, ecological, instream flow) - the minimum flow legally required to be released to the watercourse below an intake, dam or weir, to ensure adequate flow downstream for environmental, abstraction or fisheries purposes.
EIA	Environmental impact assessment
ESHA	European Small Hydropower Association
EU-10	10 new EU member states
EU-15	EU before enlargement (before 1 May 2004)
EU-25	EU after enlargement (after 1 May 2004)
Gross theoretical SHP potential	The annual energy potentially available in the country if all natural flows were turbinised down to sea level or to the water level of the border of the country (if the water course extends into another country) with 100% efficiency.
Technically feasible SHP potential	The amount within the gross theoretical potential that could be exploited within the limits of current technology (includes output from currently installed capacity)
Economically feasible SHP potential	The amount within the gross theoretical potential that could be exploited within the limits of current technology and under present and expected local economic conditions (includes output from currently installed capacity)
Remaining economically feasible SHP potential	The amount of economically feasible potential likely to be developed in the future
HP	Hydropower: potential or kinetic energy of water converted into electricity in hydroelectric plants
RES	Renewable energy sources
RES-E	Directive 2001/77/EC of the European Parliament and of the Council on the promotion of electricity from renewable energy sources in the internal electricity market (Official Journal L 283 of 27.10.2001).
RES-E	Renewable energy sources for electricity generation
SHP	Small hydropower
SHP database	The main characteristics of SHP sector, namely: potential (theoretical, technically and economically feasible), historic statistics (number of SHP plants, installed capacity and electricity generation)
SHPP	Small hydropower plant
TNSHP	Thematic network on Small Hydropower
WFD	Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for the Community action in the field of water policy (Official Journal L 327 of 22.12.2000).

ANNEXES

A1. Questionnaire

Thematic Network on Small Hydropower (TNSHP). Contract No NNE5/2001/886. European Small Hydropower Association (ESHA). Report on SHP situation in the Accession Countries

ENQUIRY ON SMALL HYDROPOWER (SHP) IN THE ACCESSION COUNTRIES (Small Hydro-Plants up to 10 MW)

Part A - Technical, Environmental and Industrial Issues

A1. Electrical power in total (in 2002)												
01	Total installed capacity of powerplants OF ALL TYPES in operation (MW)											
02	Average annual electricity generation (GWh/year)											
03	Average electricity price per kWh for households (€cents/kWh)											
04	Total installed hydropower capacity (MW)											
05	Average annual hydro power generation (GWh/year)											
06	Total number of hydro power plants											
A2. Small hydropower (SHP) <10 MW in operation												
01	Installed SHP capacity in 2002 (MW)											
02	Actual generation of SHP in 2002 (GWh/year)											
03	Average annual SHP generation (GWh/year)											
04	SHP statistics:											
	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003	Forecast	
											2010	2015
Total number of SHP												
MW												
GWh/year												
<i>(Note: The figures (MW and GWh/year) for 2010 should equal your answer to B4.01)</i>												

05	Age of SHP plants in 2002:		
	0-19 years:	20-39 years:	40-59 years: >60 years:
	Total number:		
06	Percentage (%) of:		
	Low head (up to 5m)	Medium head (5-15m)	High head (more than 15m)
07	What percentage (%) of generating capacity (MW) is now privately owned for SHP plants?		
A3. Potential for SHP			
01	Has the small hydropower potential of your country been re-evaluated? If so, state when it was re-evaluated. Give the figures for:		
	a) gross theoretical potential	(GWh/year):	(MW):
	b) technically feasible potential	(GWh/year):	(MW):
	c) economically feasible potential	(GWh/year):	(MW):
<i>Note: These should be TOTALS, including the potential of the SHP sites already developed (A2.03). If figure also exist for potential capacities in MW, please include these as well</i>			
02	Percentage (%) of economically feasible potential that has been developed: <i>Note: This should be equal your answer to (A2.03) divided by A3.01 (c) x100</i>		
03	Remaining economically feasible potential taking into account environmental constraints (for example, rivers exempted from damming) (GWh/year and MW):		

A4. Technical aspects SHP																																																																	
01	Have any new techniques been implemented during the last 10-15 years. Please describe shortly.																																																																
02	Has any programme regarding research and development of SHP in your country been recently carried out? If so, please state when and describe shortly.																																																																
A5. Environmental aspects																																																																	
01	Are there any kinds of resistance against SHP according to: Visual impact: <table> <tr> <td></td> <td>1</td> <td>2</td> <td>3</td> <td>4</td> <td>5</td> </tr> <tr> <td></td> <td>☐</td> <td>☐</td> <td>☐</td> <td>☐</td> <td>☐</td> </tr> </table> Fishing <table> <tr> <td></td> <td>1</td> <td>2</td> <td>3</td> <td>4</td> <td>5</td> </tr> <tr> <td></td> <td>☐</td> <td>☐</td> <td>☐</td> <td>☐</td> <td>☐</td> </tr> </table> Water regulation <table> <tr> <td></td> <td>1</td> <td>2</td> <td>3</td> <td>4</td> <td>5</td> </tr> <tr> <td></td> <td>☐</td> <td>☐</td> <td>☐</td> <td>☐</td> <td>☐</td> </tr> </table> Competition with other kinds of water utilization (irrigation, navigation, recreation) <table> <tr> <td></td> <td>1</td> <td>2</td> <td>3</td> <td>4</td> <td>5</td> </tr> <tr> <td></td> <td>☐</td> <td>☐</td> <td>☐</td> <td>☐</td> <td>☐</td> </tr> </table> Other kinds of resistance (please specify) <table> <tr> <td></td> <td>1</td> <td>2</td> <td>3</td> <td>4</td> <td>5</td> </tr> <tr> <td></td> <td>☐</td> <td>☐</td> <td>☐</td> <td>☐</td> <td>☐</td> </tr> </table> <i>Degree of gravity: 1=no impact,..... 5 –severe impact</i>						1	2	3	4	5		☐	☐	☐	☐	☐		1	2	3	4	5		☐	☐	☐	☐	☐		1	2	3	4	5		☐	☐	☐	☐	☐		1	2	3	4	5		☐	☐	☐	☐	☐		1	2	3	4	5		☐	☐	☐	☐	☐
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02	Please describe briefly the position of the local NGO's (green movement, ecologists, anglers), general public and official environmental bodies with regard to SHP development in your country.																																																																

A6. Water and energy industries, service capability				
Please list reasonable-sized manufacturers of equipment (SHP) > 0.5M€ turnover				
01	Turbine manufacturers	Approximate turnover M€	Turbine type	Primary market country (ies)
<i>(Francis –F, Kaplan –K, Pelton – P, Other –O)</i>				
02	Manufacturers of other mechanical equipment as gates, penstocks, gearboxes etc	Approximate turnover M€	Primary market country (ies)	
03	Generator manufacturers	Approximate turnover M€	Primary market country (ies)	

04	Electrical equipment manufacturers	Approximate turnover M€	Primary market country (ies)
05	Control equipment manufacturers	Approximate turnover M€	Primary market country (ies)
06	Civil works contractors	Approximate turnover M€	Primary market country (ies)
07	Consulting services, Project development	Approximate turnover M€	Primary market country (ies)

08	Is there a market in the EU, outside the EU and outside Europe for the above manufactures ?																																																															
	<table border="0"> <tr> <td></td> <td colspan="2">EU</td> <td colspan="2">Europe (excluding the EU)</td> <td colspan="2">Outside Europe</td> </tr> <tr> <td></td> <td>Yes</td> <td>No</td> <td>Yes</td> <td>No</td> <td>Yes</td> <td>No</td> </tr> <tr> <td>Turbines</td> <td>☐</td> <td>☐</td> <td>☐</td> <td>☐</td> <td>☐</td> <td>☐</td> </tr> <tr> <td>Other mechan. equipment</td> <td>☐</td> <td>☐</td> <td>☐</td> <td>☐</td> <td>☐</td> <td>☐</td> </tr> <tr> <td>Generators</td> <td>☐</td> <td>☐</td> <td>☐</td> <td>☐</td> <td>☐</td> <td>☐</td> </tr> <tr> <td>Electrical equipment</td> <td>☐</td> <td>☐</td> <td>☐</td> <td>☐</td> <td>☐</td> <td>☐</td> </tr> <tr> <td>Control equipment</td> <td>☐</td> <td>☐</td> <td>☐</td> <td>☐</td> <td>☐</td> <td>☐</td> </tr> <tr> <td>Civil works contractors</td> <td>☐</td> <td>☐</td> <td>☐</td> <td>☐</td> <td>☐</td> <td>☐</td> </tr> <tr> <td>Consulting services</td> <td>☐</td> <td>☐</td> <td>☐</td> <td>☐</td> <td>☐</td> <td>☐</td> </tr> </table>		EU		Europe (excluding the EU)		Outside Europe			Yes	No	Yes	No	Yes	No	Turbines	☐	☐	☐	☐	☐	☐	Other mechan. equipment	☐	☐	☐	☐	☐	☐	Generators	☐	☐	☐	☐	☐	☐	Electrical equipment	☐	☐	☐	☐	☐	☐	Control equipment	☐	☐	☐	☐	☐	☐	Civil works contractors	☐	☐	☐	☐	☐	☐	Consulting services	☐	☐	☐	☐	☐	☐
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09	Main countries of export activities for national manufacturers.																																																															

Part B - Institutional, Economic and Strategic issues

B1 Institutional issues	
01	Please describe the principal legal conditions for SHP Is there a one-stop shop for SHP project developers? Who is responsible for granting planning permits?
02	Concession fees for <u>the use of water</u> : please describe specifying the list of the fees, the length of the authorisation procedure, who is issuing the concession and the time requested to obtain them.
03	Process to get a new licence for <u>SHP exploitation</u> . Please describe specifying the list of authorizations and who is issuing them, the time requested to have them.
04	How long does a licence last; how can it be renewed?
05	Is there any Small Hydropower Association in your country? Please give details: Name of Association, Chairman/President, E-mail ; WWW, Overview, Membership, Activities.
B2 Economic issues	
01	Estimated range of investment costs for new plants €/kW Low head (up to 5m) - Medium head (5-15m) - High head (more than 15m) -
02	Average cost of producing a unit of electricity generated by SHP scheme in your country (€/cents/kWh) Low head (up to 5m) - Medium head (5-15m) - High head (more than 15m) -
04	Financing schemes: private finance, equity, loans, third party, project finance, corporate finance, BOT (Build, Operate, Transfer); BOOT (Build, Own, Operate, Transfer) etc.

B3 Regulatory section	
01	SHP definition in your country: <1 MW; 1-5 MW; <10 MW; (or give your country's definition if different):
02	Does any master plan for SHP development in your country exist? ☐ Yes, ☐ No Is there any intention to develop regional and local spatial plans to guide the development of SHP projects in the suitable areas? ☐ Yes, ☐ No
03	Structure of prices (Guaranteed Tariffs, Buy-back rates) for the sale of SHP to the grid (which options, which prices), (€cents/kWh) Are they high enough to attract private investment? ☐ Yes, ☐ No Are they long enough to secure investors confidence? ☐ Yes, ☐ No Is there any extra price based on the green prices scheme? ☐ Yes, ☐ No
04	Cost for the connection to the grid. How is it regulated and how much it costs? Are the SHP operators given access to the grid at reasonable prices? ☐ Yes, ☐ No Are the SHP operators responsible for covering the cost of extensions and of strengthening the grid? ☐ Yes, ☐ No Are the rules of grid access transparent and non-discriminatory? ☐ Yes, ☐ No
05	Cost for the use of the grid (€/kW or €/kWh)
06	Fiscal aids to SHP. Please give details if any.

07	Do you have the forbidden rivers for hydropower construction (exempted from damming) in your country? ☐ Yes, ☐ No Please indicate the main reasons to protect them from hydropower. If yes, please indicate how these forbidden rivers affect small hydropower economical potential to be exploited? <table style="width: 100%; text-align: center;"> <tr> <td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr> <tr> <td>☐</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td></tr> </table> <i>1=no impact,..... 5 –severe impact</i>	1	2	3	4	5	☐	☐	☐	☐	☐
1	2	3	4	5							
☐	☐	☐	☐	☐							
08	Is an EIA (Environmental Impact Assessment) demanded in SHP licensing process. Please give some details. EIA have to be carried: 1) For all hydropower projects ☐ Yes, ☐ No 2) For hydropower projects bigger than kW (orMW), dam height.....m; reservoir storage volume 10⁶ m³, reservoir area.....km² 3) For hydropower projects in the protected areas, national parks etc.... 4) Please specify other.....										
09	How is the Residual (Reserved, Ecological) Flow (RF) regulated? RF is set depending on: ☐ long term average flow ☐ minimum mean flow ☐ flow duration curve ☐ specific discharge or catchment area ☐ water depth, flow velocity, wetted area ☐ hydro-biological (habitat) parameters ☐ Please specify other										
10	Average percentage of losses in SHP electricity production with regard to Residual Flow regulation ☐ Negligible ☐ < 5% ☐ 5-10% ☐ please other specify										
11	Please describe the status of national implementation of the EU Water Framework Directive (2000/60/EC)? ☐ Already implemented ☐ In discussion including the interests/representatives of SHP ☐ In discussion excluding the interests/ representatives of SHP ☐ No information										
12	Which are the main fears connected to the EU Water Framework Directive? ☐ No fears ☐ Fish by-pass systems ☐ Higher residual flow ☐ No new hydroelectric sites ☐ Complication in authorisations issuing ☐ Increase in operating costs ☐ Please specify other										
13	Which are the activities of SHP associations concerning the EU Water Framework Directive? ☐ Participation in decision/discussion process ☐ Intervention on political level ☐ Information of SHP operators ☐ No activities										

B4 Strategic issues																																																													
01	National Indicative targets for RES-E (Renewable Energy Sources - Electricity) Directive																																																												
Please give the contribution of SHP (≤ 10 MW), large hydro (>10 MW) and total RES-E to the indicative target.																																																													
	Unit	2003	2004	2005	2006	2007	2008	2009	2010																																																				
Small Hydro-power (<10MW)	MW																																																												
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Large Hydro-power	MW																																																												
	GWh/year																																																												
Total RES	MW																																																												
	GWh/year																																																												
<i>(Note: Energy/Environmental authorities of your countries are currently breaking down the contribution of each RES sector according to the national indicative target (RES-E % in 2010). Please contact them in order to fill in the above table. When completing please refer to the table below. The total RES-E in 2010 should be consistent with the RES-E % in 2010).</i> <u>National indicative targets for the contribution of electricity produced from RES of the Accession countries (source: Treaty of Accession to the European Union 2003)</u> <table border="1"> <thead> <tr> <th></th> <th>RES-E TWh, 1999</th> <th>RES-E %, 1999</th> <th>RES-E %, 2010</th> </tr> </thead> <tbody> <tr> <td>Czech Republic</td> <td>2.36</td> <td>3.8</td> <td>8</td> </tr> <tr> <td>Estonia</td> <td>0.02</td> <td>0.2</td> <td>5.1</td> </tr> <tr> <td>Cyprus</td> <td>0.002</td> <td>0.05</td> <td>6</td> </tr> <tr> <td>Latvia</td> <td>2.76</td> <td>42.4</td> <td>49.3</td> </tr> <tr> <td>Lithuania</td> <td>0.33</td> <td>3.3</td> <td>7</td> </tr> <tr> <td>Hungary</td> <td>0.22</td> <td>0.7</td> <td>3.6</td> </tr> <tr> <td>Malta</td> <td>0</td> <td>0</td> <td>5</td> </tr> <tr> <td>Poland</td> <td>2.35</td> <td>1.6</td> <td>7.5</td> </tr> <tr> <td>Slovenia</td> <td>3.66</td> <td>29.9</td> <td>33.6</td> </tr> <tr> <td>Slovakia</td> <td>5.09</td> <td>17.9</td> <td>31</td> </tr> <tr> <td>EU-15</td> <td>338.41</td> <td>13.9</td> <td>22</td> </tr> <tr> <td>EU-25</td> <td>355.2</td> <td>12.9</td> <td>21</td> </tr> </tbody> </table>											RES-E TWh, 1999	RES-E %, 1999	RES-E %, 2010	Czech Republic	2.36	3.8	8	Estonia	0.02	0.2	5.1	Cyprus	0.002	0.05	6	Latvia	2.76	42.4	49.3	Lithuania	0.33	3.3	7	Hungary	0.22	0.7	3.6	Malta	0	0	5	Poland	2.35	1.6	7.5	Slovenia	3.66	29.9	33.6	Slovakia	5.09	17.9	31	EU-15	338.41	13.9	22	EU-25	355.2	12.9	21
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02	Main hindrances to the development of SHP. Please describe the non technical barriers to SHP growth																																																												
03	What recommendations do you have to policy makers on the priority policy and regulatory reforms which must taken to overcome the current obstacles?																																																												

04	New arrangements enforced after the EU RES-E Directive (2001/77/EC) affecting SHP production: new opportunities (green prices and green certificate systems), constraints, legal changes to be adopted.
05	Description of existing support programmes for SHP (subsidised process, investment support, fiscal credits, innovative investments).
06	Please indicate any references (WWW sites, technical papers, brochures, books, reports) on SHP issues in your country.

Please supply the information requested, taking due account of the definitions and notes provided for data items. Where data are not available, please write **“Not available”**, where the question is not applicable, write **“Not applicable”**, where the answer is zero put **“0”**, Please do not leave answer boxes empty or put -, since this is unclear.

The Questionnaire should be completed using the units of measurement shown on the form. Where the unit is not printed on the form, please specify the unit used.

Where appropriate, please specify in the notes the local terminology corresponding to the questions. Please attach separate sheets if necessary.

A period (.) should be used to indicate a decimal point.

SHP – Small Hydropower, Small scale hydro plants with installed capacity less than 10 MW.

Water Framework Directive - Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for the Community action in the field of water policy (Official Journal L 327 of 22.12.2000).

RES-E - Directive 2001/77/EC of the European Parliament and of the Council on the promotion of electricity from renewable energy sources in the internal electricity market (Official Journal L 283 of 27.10.2001).

Please fill in your name, full address and contact details at the end of the form. Thank you.

Completed by:

Position, Department

Organization:

Full address

Tel:

Fax:

Email:

Please return this Questionnaire by email, fax (or airmail/courier) to reach us by 15 March 2004.

Our email address is: punys@eko.lzua.lt and our mailing address is: Lithuanian Hydropower Association, Universiteto 10, University of Agriculture, Kaunas-Akademija, LT-4324, Lithuania

If there are any questions concerning the Questionnaire please contact Petras Punys (Mr.) at the above address.

For general TNSHP project activities please contact Gema Sanbruno (Mrs), TNSHP project manager at the ESHA, email: gema_sanbruno@esha.be, Rue de Trône 26 B-1000 Bruxelles, Telephone: +32 2 546.19.45 Fax : +32 2 546.19.47

We encourage you and your colleagues acting in small hydropower sector to join the Thematic Network on Small Hydropower. Please visit the Network Website <http://www.esha.be/ukthematic.htm> for more information and access to the online discussion. You will need a user name and password to enter the site. Please contact Mrs Gema Sanbruno to be registered.

A2. Poland

RD&D programmes for SHP.

- 1981÷85 PR-8 Governmental Programme *Complex development of power industry*
- 1986÷90 CPBR 5.1 Central Research and Development Programme
Complex development of power industry
Direction 7: *Renewable energy sources*
- 1991-94 *Development of small hydro power*, a package of KBN (Polish Committee on Scientific Research) research projects (ref. no. 9 0534 91 01/p3). The following projects were involved:
- a) *Investigation of prototype governors of small power hydraulic turbines and development of electro-hydraulic governors for double-regulated tubular turbines and single-regulated open-flume turbines* (ref. no. 9 0534 91 01/p1)
 - b) *Tubular vertical hydraulic turbine* (ref. no. 9 0534 91 01/p2)
 - c) *Investigation of prototype small power water turbines installed in test plants and development of double-regulated horizontal tubular turbines and single-regulated open flume turbines* (ref. no. 9 0534 91 01/p4)
- 1991÷94 *Recovery of energy lost in various technological processes by means of hydraulic turbomachines* (KBN research project no. 9 0412 91 01)
- 1996÷98 *Experimental analysis of design modifications in impeller pumps aimed at their implementation to turbine operation* (KBN research project no. 7 T07B 005 10)
- 2000÷02 *Analysis of selected performance properties of cross-flow hydraulic turbines* (KBN research project no. 7T07C 032 17);
- 2003÷05 *CLEANERPAS*
Centre of Excellence of Clean and Safe Technologies in Power Engineering
European Commission project no. NNE 5 / 2002

A6. Water and energy industries, service capability

Please list reasonable-sized manufacturers of equipment (SHP) > 0.5M€ turnover

01	<i>Turbine manufacturers</i>	Approximate turnover M€	Turbine type	Primary market country (ies)
	Gajek ENGINEERING sp. Z o.o. ul. Fiszera 14; 80-952 Gdańsk phone: ++ (58) 520 31 75; ++ (58) 520 31 76 e-mail: geg@geg.miasto.pl, <i>MADEx Sp. z O.O.</i> <i>Al. Wojska Polskiego 33, 65_077 Zielona Góra</i> phone/fax: +(68) 452 76 60 e-mail: madex@ekoenergia.pl PPDU DR ZĄBER ul. Magazynowa 1; 33-300 Nowy Sącz phone ++ (18) 547 41 00 phone ++ (18) 547 41 01, fax ext. 102 e-mail: biuro@zaber.com.pl <i>Przedsiębiorstwo Wielobranżowe „WTÓRMEX” S.C.</i> <i>ul. Św. Rozalii 11, 97-500 Radomsko</i> phone: ++ (44) 683 54 00 phone/fax ++ (44) 683 54 31 e-mail: wtormex@wtormex.com.pl P.P.H.U. „FENIX” Mieczysław Wesółowski ul. Ciepeliowska 9; 67-100 Nowa Sól phone/fax: ++(68) 387 24 44 mobile: + 604 326 787 <i>ZRE Gdańsk Sp. z O.O.</i> <i>ul. Litewska 14a, 80-719 Gdańsk</i> phone: ++ (58) 320 77 00 fax: ++ (58) 320 77 31 <i>BE&K Europe Sp. z o.o.</i> ul. A. Hoffmanna 4; 86-140 Drzycim phone. ++(52) 331 68 06; 331 81-24 fax ++(52) 331 68 66 e-mail: zre_grodek@post.pl		K, F, O K O F K K, O K,F,O	Poland, Germany, Norway
	<i>(Francis –F, Kaplan –K, Pelton – P, Other –O)</i>			

02	Manufacturers of other mechanical equipment as gates, penstocks, gearboxes etc	Approximate turnover M€	Primary market country (ies)
	TBHYDRO POZNAŃ ul. Czernika 4, 60-194 Poznań, tel. + 48 61 8679312 fax. + 48 61 8679315 e-mail: tbh@tbhydro.com.pl Fabryka Reduktorów i Motoreduktorów "BEFARED" S.A. ul. Grażyńskiego 71, 43-300 Bielsko-Biała, tel. (033) 812-60-31 fax. (033) 815-93-63 e-mail: befared@befared.com.pl Dolnośląskie Zakłady Artykułów Technicznych Sp. z o.o. ul. Sienkiewicza 73A, 58-340 Głuszyca, phone: ++ (74) 845-63-71÷73, fax ++ (74) 845-63-70, 845-64-21 www.nortech.com.pl		
03	Generator manufacturers	Approximate turnover M€	Primary market country (ies)
	ALSTOM Power Sp. z o.o. w Elblągu, Oddział we Wrocławiu ul. Fabryczna 10, 53-609 Wrocław tel.: +48 71 356 52 00 fax: +48 71 355 17 42 www.alstom.pl/generators Zakład Okrętowych Urządzeń Elektrycznych i Automatyki ELMOR ul. Wałowa 63, 80-858 Gdańsk phone: +(58) 301 36 41 Zakłady Wytwórcze Maszyn Elektrycznych i Transformatorów "Emit" S.A. ul. Narutowicza 72, 99-320 Żychlin phone: ++(24) 285-10-14 fax. ++(24) 285-20-05 e-mail: emitsa@pl.onet.pl Fabryka Maszyn Elektrycznych Indukta S.A. ul. Grażyńskiego 22, 43-300 Bielsko-Biała tel. +48 33 822-82-01 fax +48 33 822-01-85 e-mail: indukta@cantonimotor.com.pl Maszyny Elektryczne Celma S.A. ul. 3 Maja 19, 43-400 Cieszyn tel. +48 33 852-29-76 fax +48 33 852-27-76 e-mail: celma@cantonimotor.com.pl		

04	Electrical equipment manufacturers	Approximate turnover M€	Primary market country (ies)
	ELEKTROBUDOWA SA ul. Porcelanowa 12, 40-246 Katowice phone: ++(32) 259 01 00, fax ++(32) 205 27 60 e-mail: elbudowa@elbudowa.com.pl <i>Elektromontaż-Poznań SA</i> <i>ul. Wieruszowska 12/16, 60-166 Poznań</i> <i>phone: +48 61 86-55-800, +48 61 86-55-870</i> <i>fax: +48 61 86-55-871</i> <i>e-mail: elmont@elektromontaz.poznan.pl</i> PHU "Gawlikowski" 97-500 Radomsko, ul. Fabianiego 5 tel./fax (0 prefix 44) 683 28 35 mobile 0 602 46 37 43		
05	Control equipment manufacturers	Approximate turnover M€	Primary market country (ies)
	ENERGOEFEKT Południowy Zakład Automatyki i Zabezpieczeń ul. Kokotek 6, 41-700 Ruda Śląska phone. ++(32) 248 06 78; 248 06 79 fax ++(32) 248 00 71 e-mail: info@energoeffekt.com.pl Institute of Power Engineering, Gdansk Division ul. Mikołaja Reja 27, 80-870 Gdansk phone: +(58) 349 81 21 fax: +(58) 349 76 87 e-mail: ien@ien.gda.pl		
06	Civil works contractors	Approximate turnover M€	Primary market country (ies)
	HYDROBUDOWA SA ul. Grunwaldzka 135, 80-264 Gdańsk tel. +48 58 / 3407 100 fax. +48 58 / 341 56 30 e-mail: sekretariat@hydrobudowa.com.pl Skanska S.A. ul. Generała J. Zajączka 9, 01-518 Warszawa tel. +48 22 561 30 00 fax +48 22 561 30 01 www.skanska.pl e-mail: info@skanska.pl Skanska S.A., Oddział Hydrotrest ul. Tyniecka 18, 0-323 Kraków tel. + 48 12 261 49 00 fax + 48 12 261 48 02 e-mail: info@hydrotrest.skanska.pl INTOP Ltd ul. Łużycka 3A, 81-537 Gdynia phone: ++ (58) 622 30 46, 622 42 92 Budownictwo Hydro-Energetyka Dychów phone: ++ (68) 383 87 89 fax ++ (68) 383 00 70 e-mail: poczta@energoprojekt.pl		

07	Consulting services, Project development	Approximate turnover M€	Primary market country (ies)
	BSiPE <i>ENERGOPROJEKT</i> S.A. ul. Krucza 6/14, 00-950 Warszawa P.O.Box 184, phone: + (22) 621 02 81 fax + (22) 629 32 40 e-mail: poczta@energoprojekt.pl HYDROPROJEKT Warszawa Sp. z O.O> Design and Consulting Office ul.Dubois 9, 00-182 Warszawa phone: +(22) 625 48 84, 635 57 08 fax: +(22) 635 00 20, 831 00 22 e-mail: hydrowar@pol.pl MADEX Sp. z O.O. Al.Wojska Polskiego 33, 65_077 Zielona Góra phone/fax: +(68) 452 76 60 e-mail: madex@ekoenergia.pl Elektrownie Wodne Słupsk Sp. z O.O. ul.Rybacka 4a, 76-200 Słupsk phone: +(59) 841 69 00 fax: +(22) 841 69 16 e-mail: enwod@ze.slupsk.pl Biuro Inżynierii Wodnej i Ochrony Środowiska M & I GAJDA ul. Wałowa 19, 80-858 Gdansk phone: +(58) 301 33 05 fax: +(22) 305 29 82 Zakład Usług Techniczno-Informatycznych, ul.Rewolucjonistów 3/12, 42-500 Będzin phone: +(32) 761 27 78 fax: +(32) 267 76 27 e-mail: inform@inform.com.pl website: www.inform.com.pl Narodowa Agencja Poszanowania Energii ul.Filtrowa 1, 00-611 Warszawa phone: +(22) 8255285, 8251977 fax: +(22) 8258670 e-mail: napeneca@hbz.com.pl Instytut Maszyn Przepływowych PAN ul.Fiszera 14, 80-231 Gdańsk phone: +(58) 3411271 fax: +(58) 3416144 e-mail: hadam!@imp.gda.pl website: www.imp.gda.pl Towarzystwo Rozwoju Małych Elektrowni Wodnych ul.Królowej Jadwigi 1, 86-300 Grudziądz phone:+48 (56) 46 49 644; fax:+48 (56) 46 49 643, e-mail: biuro@trmew.pl, website: www.trmew.pl		

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22. Stowarzyszenie Energetyki Odnawialnej (*Renewable Energy Association*), www.seo.org.pl
23. Centrum Alternatywnych Źródeł Energii (*Centre of Alternative Energy Sources*), Vortal Eko: www.ecoenergia.pl

A3. Slovenia

01	Turbine manufacturers	Approximate turnover M€	Turbine type	Primary market country (ies)
	ANDINO HYDROPOWER ENGINEERING d.o.o.	5	F+P+K	EU, CEE , Africa, Norway, USA, Dominican Republic
	LITOSTROJ E.I.	<i>Not available.</i>	F+P+K+ Tubular	Europe, Africa, India, Meadle East, USA
	TURBOINSTITUT d.o.o.	<i>Not available.</i>	F+P+K	EU, CEE
<i>(Francis –F, Kaplan –K, Pelton – P, Other –O)</i>				
02	Manufacturers of other mechanical equipment as gates, penstocks, gearboxes etc	Approximate turnover M€		Primary market country (ies)
	LITOSTROJ E.I.	<i>Not available.</i>		Europe, Africa, India, Meadle East, USA
	ANDINO HYDROPOWER ENGINEERING d.o.o.	5		EU, CEE , Africa, Norway, USA, Dominican Republic
03	Generator manufacturers	Approximate turnover M€		Primary market country (ies)
	none			
04	Electrical equipment manufacturers	Approximate turnover M€		Primary market country (ies)
	ANDINO HYDROPOWER ENGINEERING d.o.o.	5		EU, CEE , Africa, Norway, USA, Dominican Republic
	TURBOINSTITUT d.o.o. ISKRA d.d.	<i>Not available.</i> <i>Not available.</i>		EU, CEE <i>Not available.</i>
05	Control equipment manufacturers	Approximate turnover M€		Primary market country (ies)
	ANDINO HYDROPOWER ENGINEERING d.o.o.	5		EU, CEE, Africa
	LITOSTROJ E.I. TURBOINSTITUT d.o.o.	<i>Not available.</i> <i>Not available.</i>		Europe, Africa, India, Meadle East, USA EU, CEE
06	Civil works contractors	Approximate turnover M€		Primary market country (ies)
	GRADIS INŽENIRING d.d.	10		EU, CEE
	NIVO, gradnje in ekologija d.d.	<i>Not available.</i>		Slovenia
	SCT d.d. PRIMORJE d.d.	200 173		EU, CEE EU, CEE
07	Consulting services, Project development	Approximate turnover M€		Primary market country (ies)
	IBE d.o.o. EKOWATT d.o.o.	12		EU, CEE EU, CEE
	HIDRO ELEKTRO BOHINJ d.o.o. ANDINO HYDROPOWER ENGINEERING d.o.o.	5		EU, CEE EU, CEE , Africa, Norway, USA, Dominican Republic