

Small hydropower has considerable potential for electricity generation in Europe. **Petras Punys** and **Maria Laguna** report on a recent survey of small plants in the European Union's new Member States and those wishing to join

# Small hydropower has much to offer

## The situation in the new Member States and candidate countries

**S**mall hydropower (SHP) has a key role to play in the development of Europe's renewable energy resources, particularly in view of the new enlarged European Union and its increasing electricity demand, international agreements to reduce greenhouse gases such as the Kyoto Protocol, and the adverse environmental impact of fossil fuel extraction and use. Also, interest is increasing in developing SHP because large hydro sites are generally already being exploited in many European countries.

**Small hydropower has a key role to play in the development of Europe's renewable energy resources**

This article gives an overview of the SHP sector in the new EU Member States and candidate countries. It is based on the results of a study carried out by the Lithuanian Hydropower Association (LHA) and the European Small Hydropower Association (ESHA) as part of an EU-funded project known as the Thematic Network on Small Hydropower (TNSHP). However, the lack of readily available statistical information on SHP makes it difficult to analyse the real status of the SHP sector in the new Member States and candidate countries.

As in the 15 Member States, no consensus exists about the definition of SHP in the new Member States. In Poland it is schemes producing less than 5 MW, in Latvia it is those whose

output is under 2 MW, and in Estonia, under 1 MW. This article uses the European definition: any small scheme with an installed capacity up to 10 MW, a definition adopted by ESHA, the European Commission and the International Union of Producers and Distributors of Electricity (UNIPED).

### RENEWABLE ELECTRICITY DIRECTIVE TARGETS

The trend towards SHP has been enhanced by the European Commission's White Paper on renewable energy and by the EU Renewable Electricity Directive (RES-e Directive). Both give a clear signal that greater use of renewable energy is necessary to reduce environmental impacts, ensure security of supply and create a sustainable energy system.

The RES-e Directive sets national targets for consumption of electricity from renewable energy sources, promotes national support schemes and calls on Member States to simplify national administrative procedures for authorization and to guarantee access to transmission and distribution of electricity from renewable sources. The White Paper establishes sub-targets for various sectors, preserves flexibility in how these targets are to be met in view of EU enlargement, and introduces a tri-annual review process. Its action plan includes internal market measures, reinforcement of EU policies and improved co-ordination between Member States.

According to the RES-e Directive, renewable generators in the first 15 Member States of the EU should provide 22% of electricity by 2010. However, eight eastern European and two Mediterranean countries joined the EU on 1 May 2004: the Czech Republic, Cyprus, Estonia, Hungary, Latvia, Lithuania,



A large chalet-style hydropower plant in Poland POLISH ACADEMY OF SCIENCES

**TABLE 1. National indicative targets for the contribution of electricity produced from renewables**

	1999 (TWh)	1999 (%)	2010 (%)
EU15a	338.41	13.9	22
EU25b	355.2	12.9	21
New Member States			
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
Candidate countries			
Bulgariac	2.8	7.3	8.7
Romaniac	18.3	36.1	n/a
Turkeyc	35.0	30.1	n/a

<sup>a</sup> Data refer to 1999

<sup>b</sup> Data refer to 1997–2000

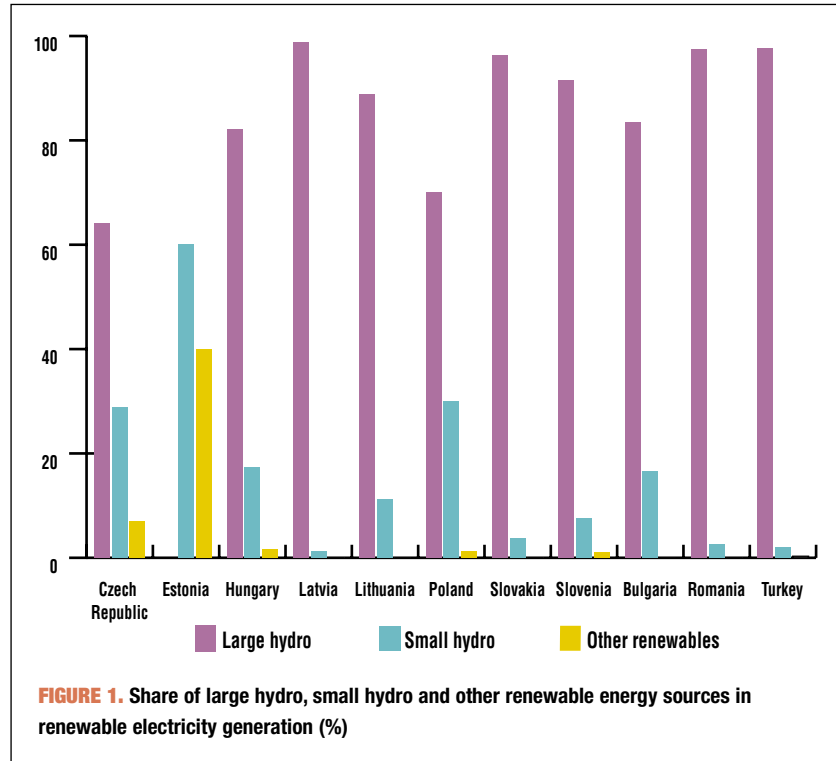
<sup>c</sup> International Energy Agency (IEA) and authors' own estimation

Malta, Poland, Slovakia, Slovenia. The candidate countries of Bulgaria, Romania and Turkey are expecting to join the EU in the near future.

Table 1 presents indicative targets for the new Member States (the new Member States) and the candidate countries for the contribution of electricity produced from renewable energy sources to gross electricity consumption required by 2010. Latvia and Slovenia have the highest targets of the individual countries.

### STATUS OF SHP IN THE NEW MEMBER STATES AND CANDIDATE COUNTRIES

Hydropower is currently a dominant source of renewable energy in electricity production in most of the new Member States and candidate countries (with the exception of Malta and Cyprus), with small hydropower the second largest contributor after large hydropower (Figure 1). Small hydropower accounts for about 4.6% of total hydro generation in these countries, where none of the other renewable energy sources (wind, biomass, PV, etc) are able to compete with it. The leading countries are Bulgaria, the Czech Republic, Poland, Romania, Slovenia, Slovakia and Turkey,



They are followed by Latvia and Lithuania and, finally, Estonia and Hungary, where comparatively little SHP exists.

**PLANT PROFILE**

The oldest SHP plants are in the former 15 countries of the EU. The new Member States and, especially, the candidate countries, have the highest share of new SHP plants. Those in Hungary, the Czech Republic and Bulgaria are the oldest (respectively 100%, 70% and 65% over 40 years old), while the eastern European countries (Estonia, Latvia, Lithuania, Poland and Slovenia), Romania and Turkey have the highest share of newer plants.

About 14,000 SHP plants, with an average size of 0.7 MW, operate in the former 15 countries of the EU. There are around 2770 plants in the 10 new Member States and some 390 plants in the three candidate countries. The average size of the plants in the new Member States is 0.3 MW, considerably smaller than in the former 15, but 1.6 MW, much larger, in the candidate countries.

The new Member States and candidate countries have at least 10 times less total installed capacity than the former 15 countries. Electricity generation by SHP plants in the latter is much higher; production is nearly 15 times greater in the former 15 than in the 10 new Member

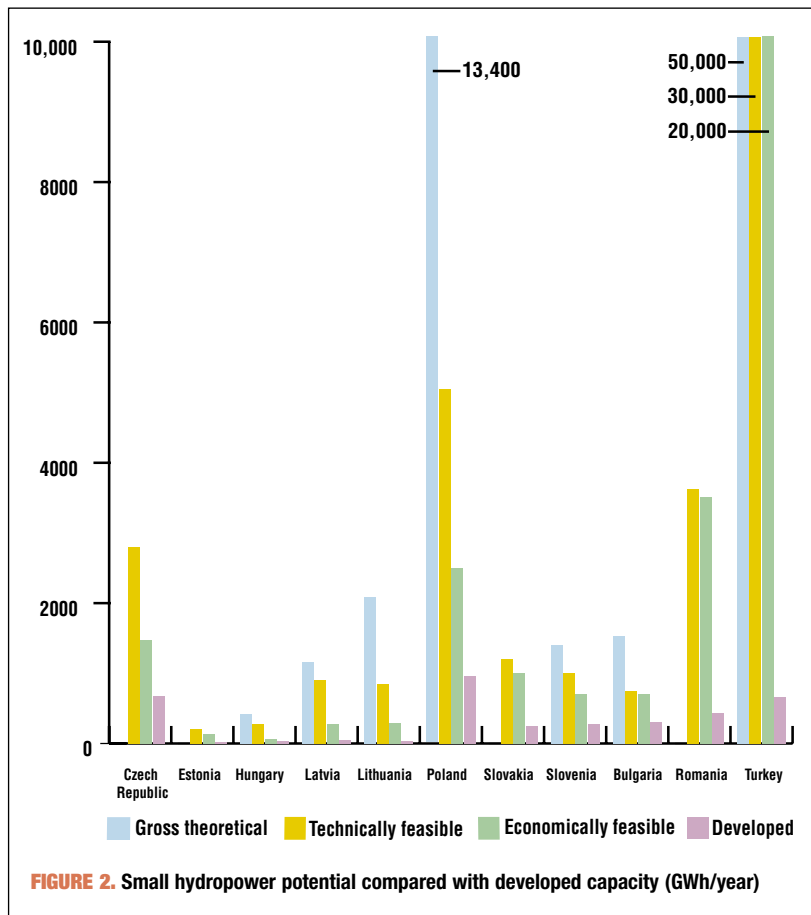
**SHP POTENTIAL**

More than 82% of all economically feasible potential has so far been exploited in the former 15 countries of the EU. The SHP exploitation rate in the 10 new Member States is less than half of that in the former 15 and very small, only 5.8%, in the candidate countries. The Czech Republic, Romania, Slovenia and Bulgaria have the biggest share (40-60%) of economically feasible potential SHP. Only 3%, a very small part of this potential, has been harnessed in Turkey,

and it in Estonia, Latvia and Lithuania it is between 15 and 20%. The remaining economically feasible potential in the new Member States and candidate countries amounts to some 26 TWh/year.

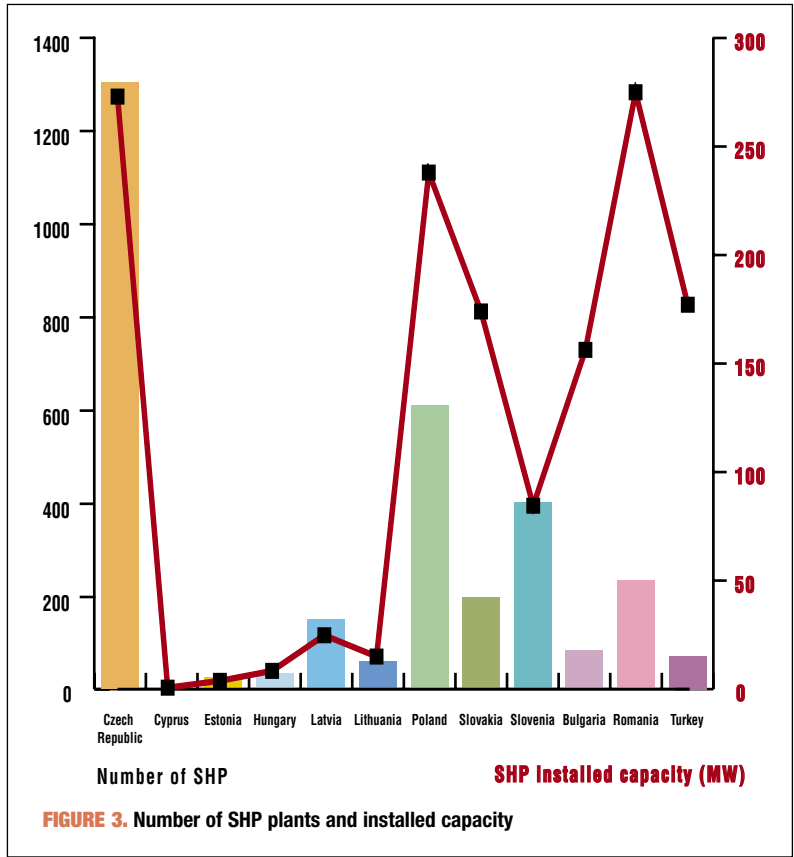
**New Member States in the European Union and candidate countries have harnessed small hydropower for more than 100 years**

Most of this potential, roughly 80%, or 19,300 GWh/year, is located in Turkey (Figure 2). Poland and Romania rank second, having a potential some six to 10 times lower than that of Turkey. The third group consists of the Czech Republic, Bulgaria, Slovenia and Slovakia, whose technically feasible potential ranges from 755 to 2800 GWh/year and economically feasible potential ranges from 700 to 1480 GWh/year (Figure 2).



States and 30 times more than in the three candidate countries. These figures indicate the considerable potential for increased electricity generation by SHP plants in the new Member States and candidate countries through more efficient operation and maintenance.

SHP has been in decline in some of the new Member States since 1960. Many plants have been shut down due to old age and competition from newer, larger power plants mostly using fossil fuel. There are approximately 3200 plants installed in the 12 countries featured in Figure 3, which includes Cyprus. Malta does not use hydropower and there is only one SHP plant in operation in Cyprus. This total corresponds to a capacity of about 1430 MW and an average size of about 0.44 MW. The largest number of SHP plants is in the Czech Republic, 1302, followed by Poland, 608, Slovenia, 400, and Romania, 234 (Figure 3). Romania, the Czech Republic and Poland have the largest installed capacities, respectively 275, 273 and 238 MW. In most of these countries and particularly in the states of central and eastern Europe, over half the SHP plants are low-head types, where the head is less than 5 m. The southern European countries of Slovenia, Bulgaria, Romania and Turkey have the highest share of high-head SHP plants.



Many SHP plants are privately owned in the new Member States and candidate countries: Hungary 100%; Lithuania 100%; Estonia 93%; Latvia 93%; Czech Republic 90%; and Bulgaria 84%. Private ownership of SHP plants in terms of generating capacity is low in Poland and Turkey: 6% and 20% respectively. Romania has privatized no SHP plants so far.

same rate of increase is expected in the new Member States: 11% by 2010 and 49% by 2015. However, the candidate countries are expected to achieve greater growth: 34% by 2010 and 72% by 2015. Figure 4 shows the forecast installed capacity by 2010 and 2015 for the new Member States and candidate countries (except for Cyprus and Malta).

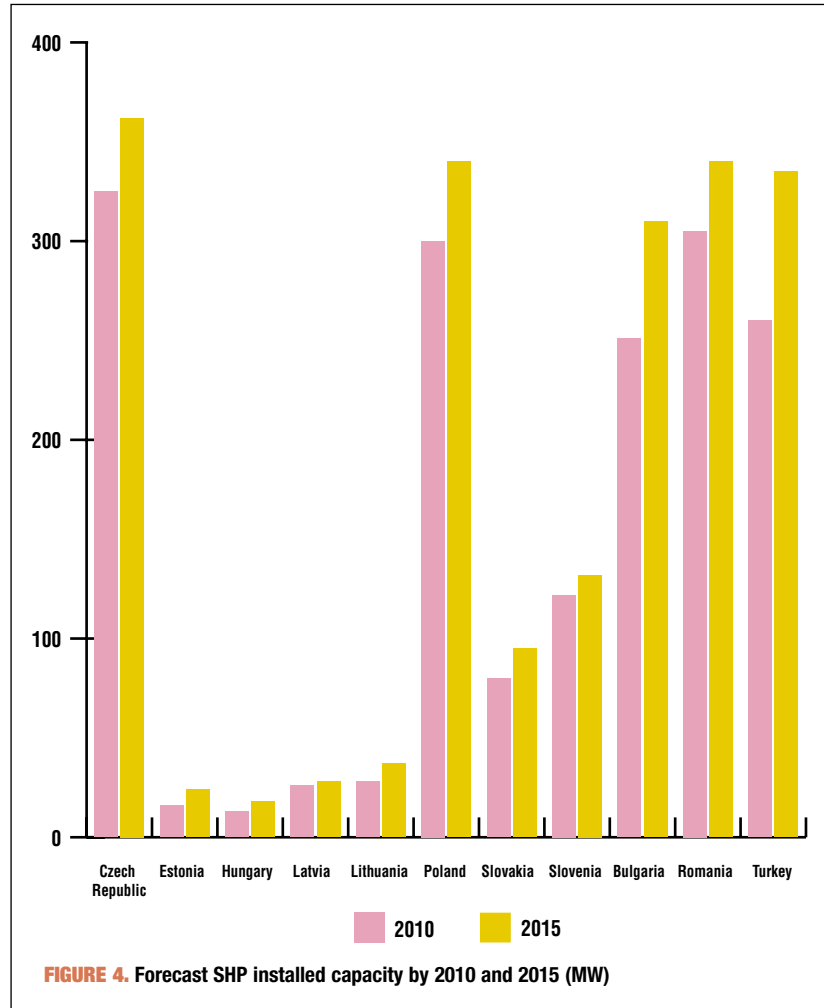
**GREATER CAPACITY IN THE PIPELINE**

Installed capacity in the former 15 is expected to increase by 11% by 2010 and 30% by 2015 compared with 2002. About the

The Czech Republic and Slovenia have the biggest turbine-manufacturing industries and Hungary and Romania have

A new privately owned SHP plant in Lithuania Lithuania Hydropower Association





these countries. Bulgaria's tariff of 3.1 eurocents/kWh is the lowest and Hungary's 7.3 Eurocents/kWh the highest. In almost all the countries, the buy-back rates are not enough to attract private investment and secure investors' confidence. None of the countries has introduced prices based on green schemes.

There is some opposition to SHP in some of the new Member States and candidate countries but it is often related to specific cases. For example, the visual impact of the SHP powerhouse and infrastructure on a landscape is a barrier for its development in Slovenia. Fish protection is a crucial issue to almost all the countries, with the exception of Bulgaria, Romania and Turkey. No resistance to SHP has been reported in Bulgaria. Other issues include the enlargement of protected areas including watercourses under EU network of protected areas NATURA 2000, land ownership and water quality degradation due to creation of a small impoundment.

**BARRIERS TO HYDROPOWER**

Hydropower is the main source of renewable energy in the new Member States and candidate countries. It is a proven technology with a large potential from the economic and technological points of view. However, numerous administrative, economic and environmental barriers still stand in its way throughout the enlarged EU and the three candidate countries.

In the new Member States and candidate countries, the initial strategic requirement is for small hydro to feature more prominently in national and EU energy planning, with a view to its stronger promotion. Experiences from the former 15 can be transferred to its new members in areas such as:

some limited turbine-manufacturing capacity. Internationally recognised manufacturers exist in all four countries. The Polish turbine manufacturing industry, which regained momentum in the 1980s, has numerous small enterprises making 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 possesses both the proprietary technology and the manufacturing capability. Latvia and Lithuania have low SHP turbine manufacturing capability, while no SHP turbine industry is reported in Estonia and Slovakia.

Governments have a range of policy options at their disposal to accelerate the development of SHP. Support can either be targeted at power production or at investment costs. As in the former 15, the most widely adopted support mechanism within the new Member States and candidate 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 eurocents/kWh in

**RIGHT** Many SHPs are located in areas of natural beauty yet cause minimum environmental impact, such as this plant in the Czech Republic **HYDROLINK** **FACING PAGE** Maintenance of an old Pelton turbine driven by the water supply system at a 103 kW SHP plant near Bled, Slovenia **EKOWATT**



**Governments have a range of policy options at their disposal to accelerate the development of SHP**

- the EU policy framework for renewables with a particular focus on SHP issues (RES-e Directive, Water Framework Directive, etc)
- technological issues, ie the mechanical, civil and electrical engineering



- national research, development and demonstration projects
- licensing procedures
- financing possibilities
- retrofitting of existing SHP sites.

The cooperation between key SHP stakeholders within all Member States will help to overcome barriers for the development of SHP in the new Member States. Sharing a common EU approach will also help to improve their managerial capabilities, especially with respect to overcoming technological, financial and administrative barriers.

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**FURTHER READING**

European Small Hydropower Association website at [www.esha.be](http://www.esha.be). This site may need visitors to adjust screen resolution to 1024 x 760 pixels to view  
 Lithuanian Hydropower Association. *Small hydropower situation in new Member States and candidate countries*. Thematic Network on Small Hydropower (TNSHP), 2004. <http://www.energiaklub.hu/doc/hirek/h-20041511081543-272.pdf> [accessed 22 March 2005]  
 European Renewable Energy Council. *Renewable energy in Europe. Building markets and capacity*. ISBN 1 84407 124 3. James & James (Science) Publishers, 2004.