



CURRENT SITUATION OF SMALL HYDROPOWER IN THE EU-15 ACCORDING TO ESHA's MEMBERS

If we look at the objective picture of small hydropower (SHP) in the EU-15 showed by the official available statistics (Eurostat source) the situation is as follows: compared to 1997, year in which the White Paper on renewable energies was passed (Comm(97)599), SHP installed capacity has increased by **2%** from 9 754 MW in 1997 to 9 909 MW in 2001. Similarly, SHP electricity generation has gone up from 37 476 GWh in 1997 to 39 397 GWh in 2001, which represents a **5%** increase. Nevertheless, this slow SHP growth rate compare to the growth of other RES and the EU electricity generation gives as result that the SHP contribution (i) to total electricity generation has decreased from 1.54% in 1997 to 1.47% in 2001, (ii) to RES primary production went down from 4.13% in 1997 to 3.69% in 2001 and (iii) to RES electricity generation fell from 10.5% in 1997 to 9.02% in 2001.

ESHA's Members have described the situation and evolution of the small hydropower in the EU-15 as follows:

Belgium

The Green certificates have boosted the number of potential "projects" but up to now, not many of them have actually been implemented. Past plans are being re-analysed and their power is usually increased. Certain problems appear to slow down the projects. These include environmental constrains - like the "fish problems" (fish ladders, etc.) and the reserved flow- as well as some gaps in the laws, which don't provide sufficient guarantees to the project owners.

Denmark

The pay back rate for hydropower to the grid in Denmark is 0,6 kr kWh. Hydropower is still decreasing in Denmark and there is only few plants left. It looks like only the large hydropower will survive although with restricted water flow. The reason of this downward trend is environmental restrictions related to fish population and ecological status.

Greece

The licensing procedure of private small hydro plants requires consultations of various public services. Authorisations for production licenses are granted by the Ministry of Development following a positive consultation of the newly established RAE (Regularity Authority for Energy), a competent advisory body of the said Ministry. A multitude of other relevant licenses is granted by various other authorities. Another barrier is the multitude of laws and of ministerial orders in particular, which are continuously modified, normally every 6-12 months. The existing legislation is not so clear regarding the allocation of duties among the various public services. The tax legislation is also unfavourable to the small hydropower, by accepting an annual amortization rate for such investments of only 2%. Finally, the

interconnection cost with the public utility networks of a private small hydroplant is normally prohibitive, provided that most of such plants are located within mountainous remote areas. The environmental terms required for the issue of a private SHP license are issued by the Ministry of Environment-Planning & Public Works. The environmental licensing procedure faces frequently various local economic interests. Many SHP plants are located within forested areas, a fact that rather hampers the licensing procedure on behalf of the various services of the Ministry of Agriculture.

The national legislation resulted by said EC Directive has not yet been in force in Greece. As a consequence, no such impacts can be estimated so far. The management of the water resources still belongs to the Ministry of Development, whereas the residual flows are defined by the Ministry of Environment-Planning & Public Works.

Spain

- A- National target: evaluation of progress. Small hydropower only added 107 new MW to the installed power in Spain over the last three years considered (see table below. Source: APPA). This pace is insufficient to achieve its targets (2,380 MW). The small hydro power situation clearly points out how a good support system in terms of economic revenues is not sufficient to overcome the administrative and environmental barriers that prevent small hydro power from developing all its untapped potential

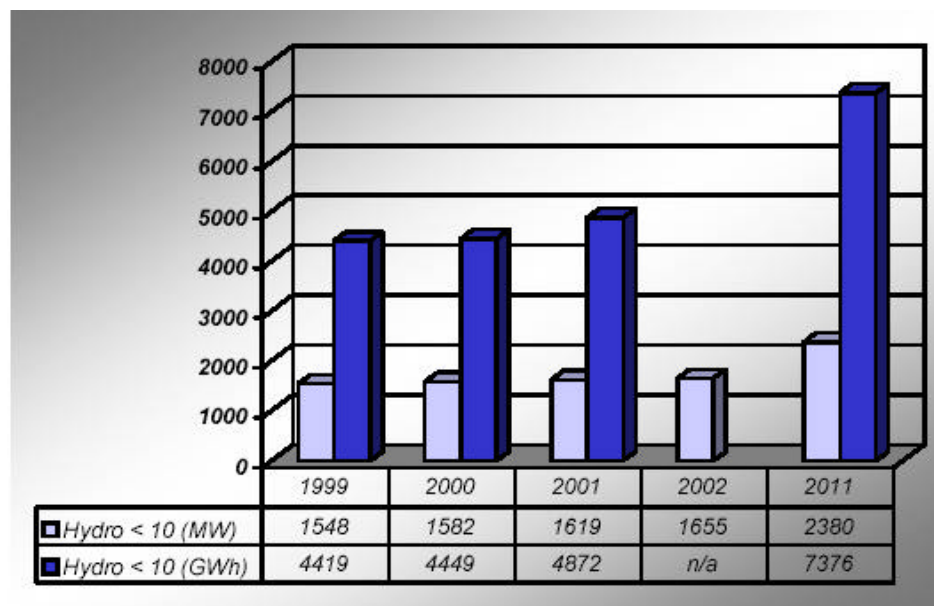


Figure 3: Evolution of small hydropower in Spain compared with its national targets (2011)

- B- Administrative procedures. Authorisation procedures applicable to RES-E plants as electric installations often overlap those regarding water concessions (in small hydro plants), connection to the grid and environmental assessment leading to a real confusion of procedures. Authorisation procedures for the assignment of the connection point to the distribution or transmission grid are a permanent source of confusion and conflict. Co-ordination between different administrative authorities is not working successfully as regards deadlines, reception and treatment of applications for authorisations. Time limits for responses from the Administration are not usually respected. Developers have to undergo successive public consultations on the same project. There are no real “fast track” procedures, especially for smaller projects. For example, the Royal Decree 916/1985 of 25th May – amended by the Royal Decree 242/1988 – which settles a short procedure to get licences (concessions and authorisations) for installing, refurbishing or upgrading small hydropower resources

(nominal potential of less than 5000 KVA) has in practice made more complicated the licensing process.

France

Since the end of the eighties, there has been no more development of SHP in France: 3 or 4 new plants per year were built in our country and the activities of the French turbine manufacturers were from 80 % to 90 % applying to projects in foreign countries. The projects in France were mainly concerning refurbishment and maintenance.

There were several reasons for that, mainly:

- Best sites have already been equipped
- The cost of environmental constraints on the one hand, and the low pay-back tariff on the other hand were making the projects too expensive to meet an economic balance
- There was a strong opposition of fishermen organisations and various environmentalist associations
- Numerous rivers and river sections are forbidden to make hydroelectricity.
- The administrative procedures were very heavy

The e-RES Directive gave a new hope in the development of RES and states of mind have begun to change:

- The pay-back tariff has been raised for new plants and for power increases of existing plants
- The dialog between the protagonists concerned by SHP: public authorities, independent producers, fishermen, etc...has improved;
- Two ministerial working groups have discussed on the simplification of procedures, and on the problems of hydroelectricity and the environment, and in particular it was agreed that the authorization procedure should not last more than 2 years.

Through these measures and discussions, it seems that it has become clearer at the national level that France had commitments to meet in the development of RES, and that SHP is the second potential RES after wind to be developed.

Nevertheless, it takes time between summit meetings and concrete results, and there is still much to do in order to have really more generation of electricity from SHP:

- Probably, the most important point is to re-discuss the classification of sites forbidden to hydropower
- Concrete measures have to be taken for a real simplification of procedures and in particular to have authorization procedures which don't last more than 2 years;
- Regulation aspects also have to be improved; in particular the rules to be used for the calculation of the residual flow.

Please find below a more concrete explanation (in original language) of the main points:

- Forbidden Rivers: “La France connaît des obstacles législatifs. Le principal obstacle provient d'un classement non fondé visant à interdire toute nouvelle installation hydroélectrique sur des cours d'eau dont la liste est fixé en Conseil d'Etat par décrets, en application de l'article 2 de la loi du 16 octobre 1919(modifiée en 1980) relative à l'utilisation de l'énergie hydraulique. Ces rivières sont ainsi réservées. Sur le fond, le classement souffre d'une erreur d'appréciation ; il n'y a pas d'appréciation en fonction de critères objectifs et

rationnels scientifiquement établis. Cette disposition serait vraisemblablement discriminatoire, au sens du droit européen.”

- Reserved flow: “Le second obstacle provient de la loi sur la pêche de 1984. La loi sur la pêche demande à l'exploitant de laisser passer directement, dans le tronçon court-circuité, un débit d'eau minimum qui puisse garantir la vie aquatique. Ce débit biologique est fixé par la loi à 10% du débit moyen interannuel ou module du cours d'eau. Cette disposition devait faire l'objet d'une évaluation par le Gouvernement au Parlement, dans un délai de 5 ans à partir de la date de publication de la loi sur la pêche, soit en 1989. Ce bilan a été rédigé conjointement par les Ministère de l'Industrie et de l'Environnement dans les délais requis. Or à ce jour, le rapport n'a toujours pas été publié ! L'Administration impose souvent des débits réservés arbitraires, pouvant aller jusqu'à 20% du module. Pour Electricité de France (EDF), les débits réservés conduisent à une perte de 4 TWh/an de production.”
- Licenses process: “Le nombre d'autorisations (autorizations = puissance maximale brute PMB inférieure ou égale à 4500 kW ; concessions de l'Etat = PMB > 4500 kW) délivrée est ainsi passée d'une cinquantaine en 1987 à quelques unes en 1999, alors que dans le même laps de temps, certaines d'entre elles n'ont pas été renouvelées. Les obstacles au niveau des services instructeurs de l'Administration conduisent à un blocage des demandes d'autorisations ou un allongement des durées d'instruction des renouvellements d'autorisation. Il faut maintenant de 5 à 7 ans pour instruire un dossier ! GPAE demande à ce que le délai soit limité à 2 ans (instruction du droit d'eau et instruction du permis de construire)”
- Connection to the grid: La petite hydraulique fait face à des obstacles liés aux conditions d'accès aux réseaux publics de distribution concédé à EDF (réseau HTA). Certains producteurs demandent à raccorder des petites centrales hydroélectriques (PCH) et n'y parviennent pas, par manque de transparence au niveau du gestionnaire du réseau public de distribution (EDF), en raison des coûts parfois prohibitifs et abusifs des devis de raccordement, des délais de raccordement parfois trop longs (3 ans dans certains cas), des frais de renforcement du réseau qui obèrent la rentabilité des projets de PCH. Le raccordement nécessite de prendre rang dans une file d'attente qui, actuellement, est engorgée par les projets éoliens.
- Support systems: “La programmation pluriannuelle des investissements de production électrique (PPI) fixe les orientations de la France en matière de nouvelles capacités de production. Le Ministère de l'Industrie a arrêté le 7 mars 2003 les objectifs de développement de l'hydraulique : 200 à 1000 MW d'ici 2007 (hors pompage). Le système de l'obligation d'achat (seuil de 12 MW) nous paraît suffisant pour permettre les investissements dans la petite hydraulique ; nous sommes tout à fait réservés sur les appels d'offres qui sont mal adaptés à la petite hydraulique et sommes réservés quant au système de certificats verts qui doit encore faire ses preuves. Les tarifs d'achat de l'électricité produite sont garantis sur 20 ans (arrêté du 25 juin 2001): ils permettent aux investisseurs d'avoir une visibilité à long terme et d'envisager d'optimiser par exemple leurs installations, comme l'autorise l'arrêté.
- Water Framework Directive: “Depuis 2003, le Gouvernement a lancé deux débats: l'un sur l'énergie, afin de présenter un projet de loi d'orientation énergétique, l'autre sur la réforme de la politique de l'eau, comprenant une première phase qui consiste à présenter une loi transposant la directive cadre sur l'eau. Nous avons des craintes quant à l'avenir de l'hydroélectricité en France, quant on considère les propositions du projet de loi d'orientation énergétique trop insuffisantes, et la réforme de la politique de l'eau (réforme de la loi sur l'eau de 1992) qui est régressive concernant l'hydroélectricité. Le

document de communication ci-joint (format pdf) traduit bien la position des principaux acteurs de l'hydroélectricité en France sur ces sujets (grande et petite hydraulique)".

Ireland

Development of small hydro in Ireland is currently in a state of flux. A couple of relatively large projects ($\geq 300\text{kW}$), with government sponsored AER Power Purchase Agreements have been initiated, however most other types of small hydro development have stalled. This is due to the large amount of uncertainty, which exists in three areas:

- Government Support. The current support levels provided by government are considered quite low, providing for a very low return on capital invested. These supports are currently under review, but would need to reflect market realities in they are to act as a driver rather than a barrier.
- Electricity market and trading conditions. As deregulation continues, it is difficult to predict how renewables will be treated, weather green credits will be available and at what valuation. This makes estimating the financial prospects of a project very difficult. The trading system has also been described as very cumbersome for the small generator creating a further barrier to entry.
- Environmental Concerns. There appears to be almost conflicting requirements lay down from different agencies. Also some of these agencies are undergoing a fundamental review of some of their policies. This has raised the possibility of having to apply again for permissions making developers reluctant to proceed with projects.

There is a significant small hydro resource in Ireland, (30 to 70MW, Total RE resource of Ireland, ESBI, 1997) which will be easier to exploit when the regulatory situation normalizes.

Italy

The development of SHP in Italy is influenced by the energy policy of the Government.

SHP in Italy refers to run-of-rivers hydroplants with installed capacity not exceeding 3 MW: this limit will have influence on SHP development in Italy because a large part of hydroplants (ranging from 3 to 10 MW installed capacity) are not considered as "small", such as in several Countries in Europe. This could be considered a barrier for those power plants, which exceed 3 MW.

A second remark refers to the electricity tariff to SHPs, which feed electricity to the System Operator grid: actually a progressive tariff is established (*Delibera 62/02 AEEG*), whereas the price of electricity to the SHP producers decreases with an increasing yearly production of electricity:

Every cluster of 1.000 MWh is related to a determined electricity price, so that the overall price is the weighted average with the yearly electricity production:

Progressive cluster of yearly electricity production	Electricity price recognized for every cluster of electricity production	Average yearly electricity price (effective price)
From 1.000 to 2.000 MWh	82,30 €/MWh	82,30 €/MWh
From 2.000 to 3.000 MWh	63,20 €/MWh	72,75 €/MWh
From 3.000 to 4.000 MWh	57,80 €/MWh	67,76 €/MWh
...

So a SHP producer will receive 82,30 €/MWh should produce 1.000 MWh/y, will receive 72,75 €/MWh should produce 2.000 MWh/y, will receive 67,76 €/MWh should produce 1.000 MWh/y and so on.

After the introduction of the new Decree (*Decreto 29 dicembre 2003, n.387*) which adopt the Directive 77/2001/CE, the regulatory Authority for electricity and Gas (AEEG) should implement a new tariff system for those RE plants which have no power exchange right: as a consequence is not clear if this feed in system reserved to SHP will be maintained or not, generating confusion over the SHP producers. Nevertheless, the Green Certification system is boosting the rehabilitation of many hundreds of old existing small hydroelectric plants, giving them new life and increasing - in many cases in a remarkable way - the energy produced.

In addition, several Regional Authorities are implementing new *Rules for water use Documents* (including use of water for hydropower purposes), where the production of electricity is not encouraged as a consequence of several measures (Determination of lower *Reserved flow* rate, time reduction of the permit for water use with hydropower purpose, etc.), despite the Directive 77/2001/CE and the Water Framework Directive guidelines. In fact, the development and implementation of new small hydroelectric plants in Italy is highly hindered by more and more environmental constraints. The actual legislation is de facto made to create as much obstacles as possible to new plants. This legislation is clearly environment protection oriented so that the general approach provided by the Water Framework Directive (not yet implemented in Italy) is already in force.

The Netherlands

In the Netherlands, the development of SHP has stopped due to the lobby of fishermen (recreational and professional). This lobby has resulted in questions in our parliament and the Minister of State has ordered to start a study in order to determine which actions are necessary for the existing SHP. First results show that SHP has to install fish guidance systems, which will require investments around €15 mln for a 10 MWe SHP. Based on this study, we expect that a discussion will start between the Department responsible for the Nature and Fishery and the Department of Economics (responsible for the Energy policy). If

the Parliament will decide in favour of the Department of Nature and Fishery this might result in the situation that we have to shut down all SHP in the Netherlands. Therefore, administrative barriers are not really a problem in the Netherlands because the environmental barriers are dominating the development of SHP. Besides, lobby of fishermen are using the Water Framework Directive for their purposes.

Austria

Until the end of 2002 the situation was very uncertain - nobody knows or could foresee what will happen with the tariffs. It was the period of the Austrian green certificates, which were applied just on SHP instead of all renewables. The system failed more or less and that WAS foreseen by us. 2003 brought the new legislation and the so-called "Ökostromverordnung" (a tariff legislation), which brings unique tariffs for the whole country replacing 9 different tariffs, individual to all nine federal countries of Austria. That was an advantage for some federal countries having very low tariffs before (like Tyrol). It was no or very little advantage for the eastern countries, which stay more or less on the same level. However the system was invented to promote the further exploitation, but it did NOT because the tariffs are still too low to serve as a promotion tool. The decision how much money was dedicated to SHP and to other RE was a political one and did not focus on real demands. It was effective for wind (for example) but not for SHP. Now the situation got even worse because the industry opposes the tariff system and asks for reduction. The SHP-sector asks for some increase to meet the real demands better and on more reality. A lot of projects are waiting for better conditions. Already running projects have to fight against economics complications.

Due to the WFD implementation it has become a difficult game to carry out any project. A clear statement on that problem by the commission is urgently needed to continue even a slow and very environmentally sound SHP exploitation in the future.

Portugal

After 1996/7 only around 30 MW have been put in operation because the licensing process is very slow, around 9 to 12 years to get a license, specially due to environmental reasons. The process is "a never ending story" because the authorities keep on asking for more studies and imposing more obligations, many of them incompatible with this type of projects

Sweden

The development of SHP in Sweden has slowed down during the last years. In 2003 less than 5 new SHP plants were commissioned except some very small (below 100 kW) plants, which were re-commissioned after earlier shut down. The reason is a combination of low buy-back rates and legal barriers. Since the Green Certificates were introduced (May 2003) buy-back rates have become better and the legal barriers are now the main reasons preventing development of SHP.

United Kingdom

There is a lot of interest in the development of hydro projects in the UK. Currently there are 39 project proposals in the range up to 10MW and some 50+ micro hydro (up to 100kw) applications being prepared and/or already submitted for planning approval. The main reason for this interest is the creation of a market through the renewables obligation providing an economic return and for micro hydro the introduction of the "Clear Skies Funding Programme".

However the planning process is long winded and some applicants have experienced problems getting license consent from the environmental protection agencies.

The dreaded or dreadful "Water Framework Directive" is only being applied in Scotland at the moment and the BHA (British Hydropower Association) is in discussion with the various regulatory bodies on the effect of this on hydropower. Although in principle they do not see it affecting further new development, indications are it will be extremely difficult as the regulatory bodies have no idea what good water status or potential is.

Suffice to say that existing hydro is going to see an increase in cost through mitigation and monitoring and loss of revenue through reduced water availability.

The danger is that the benefits from market trading will be wiped out through increased operational and development costs and reduced production.

We need to get the balance right because the perception in the UK is that most sensitive areas such as National Parks would welcome hydropower development but frown on Wind, which the EU and UK are hell bent on doing.

The British hydropower Association is expecting their first refusal of a hydro planning proposal due to the application of the WFD (Water Framework Directive).

Additional information:

Text box 1: The Water Framework Directive and SHP

On 23 October 2000, “Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for Community action in the field of water policy” – the Water Framework Directive – was adopted. It was amended by Decision 2455/2001/CE. The Water Framework Directive aims to prevent pollution at source and sets out a control mechanism to ensure that all pollution sources are managed in a sustainable way. It sets clear objectives: (i) Expanding the scope of water protection to all waters, surface waters and groundwater, (ii) Achieving "good status" for all waters by a set deadline, (iii) Water management based on river basins, (iv) "Combined approach" of emission limit values and quality standards, (v) Getting the prices right, (vi) Getting the citizen involved more closely and (vi) Streamlining legislation.

The schedule for implementation

2000	Directive entered into force
2003	Transpose it into national legislation
2004	Characterisation of river basin: pressures, impacts and economic analysis
2006	Establishment of monitoring network
2008	Present draft river basin management plan
2009	Finalise river basin management plan including programme of measures
2010	Introduce pricing policies
2012	Make operational programmes of measures
2015	Meet environmental objectives (good ecological status or good ecological potential)
2021	First management cycle ends
2027	Second management cycle ends, final deadline for meeting objectives

The **implementation of the Water Framework Directive** raises a number of shared technical challenges for the Member States, the Commission, the Candidate Countries and other stakeholders. In addition, many of the European river basins are international, crossing administrative and territorial borders and therefore a common understanding and approach is crucial to the successful and effective implementation of the Directive. In order to address the challenges in a co-operative and co-ordinated way, the Member States, Norway and the Commission agreed on a **Common Implementation Strategy (CIS)** for the Water Framework Directive. The key activities of this strategy are: (i) Information sharing, (ii) Developing guidance on technical issues, (iii) Information and data management and (iii) Application, testing and validation.

The WFD focuses on alterations of quantity and dynamics of water flow, connection to groundwater bodies, river continuity, depth and width variation, substrate and structure of riverbed and structure of riparian zone. The case studies should focus on *important pressures* on these elements, which appear at least in *three Member States*. **Hydropower generation has been identified as an important pressure on the morphology and on the physical alteration of the water bodies**. Why? Because Hydro-power generation has the following impacts: (i) Disruption of the river continuum (dams/weirs), (ii) Disruption of sediment transport (dams/weirs), (iii) Change in river profile, (iv) Canalisation and engineering activities, (v) Reduced flow in the river bed (cross-catchments transfers), (vi) Change in flow regime, (vii) Mechanical damage of aquatic fauna caused by turbines, (viii) Artificial discharge regime, (ix) Bank reinforcement/fixation/embankments and (x) Detach ox-bow lakes/wetlands.

As far as SHP is concerned and the potential consequences of this Directive, ESHA would like to point out that:

- A careful **interpretation** of the above paragraph should be done when considering SHP since it states nothing on the intensity of the alterations. It should be notice that not all hydropower plants exert the same pressure on the water bodies. No difference between large and small hydro is ever mentioned.
- The Cardiff Summit in 1998 set off a process aiming at a better **integration of environment objectives and sustainable development into Community policy sectors**. The Gothenburg Summit confirmed this attitude in 2001. Therefore, DG Environment in the context of the Common Implementation Strategy pursues a further integration of the WFD into other Community Policies, in particular Energy. Small Hydropower is considered as a renewable energy source and is being promoted by DG TREN actions and programmes. In this sense, the WFD does only not **integrate** into Energy policy but act as a **contradiction** to Renewable Energy targets set in RES -E Directive and the White Paper.

TABLE 1: Support schemes in force in the EU-15 – SHP, 2003

Member State	Compensation Scheme	Price for sale to the grid (€cents/kWh)
Belgium	Wallonia: Green certificates since 1 st October 2002	Wallonia: 12.3 = 3.3 (market price) + 9 (green certificate)
	Flanders: Green certificates since 1 st January 2003	Flanders: 12.8 = 3.3 (market price) + 9.5 (green certificate)
Denmark	Transition period from fixed price to green certificates.	8.48
Germany	Feed-in tariff	7.67 (< 500 kW)
		6.65 (500 kW - 5 MW)
Greece	Feed-in tariff	<u>Interconnected system</u>
		6.29 + 113/month
		<u>Non-interconnected islands</u>
		7.78
Spain	Fixed price (feed-in tariff) and premium payment adjusted annually by government.	6.49 = 3.54 (pool price) + 2.95 (premium)
France	Feed-in tariffs applicable only to renewable plants up to 12 MW. Price paid to SHP plants depends on their construction date. Winter tariff for SHP plants commissioned after 2001 is guaranteed for 20 years.	<u>Operating before 2001</u> : 7.32 + bonus for regularity of 0.75 (winter) and 2.94 (summer)
		<u>Commissioned after 2001</u>
		<i>SHP < 500 kW</i> : 8.55 + regulatory premium up to 1.52 (winter) and 4.52 (summer) <i>SHP > 500 kW</i> : 7.69 + + regulatory premium up to 1.52 (winter) and 4.07 (summer)
Ireland	Public tender: Alternative Energy Requirement (AER) competitions. The Irish Government launched in February 2003 the AER VI.	6.41 (weighted average price)
Italy	Quota + tradable green certificates: The quota should increase by 0.3% each year starting from 2005. The grid authority fixes a cap (upper) price for green certificates every year. Certificates are issued only for the first eight years of operation.	4.6 (spot electricity price) + 10.0 (green certificates)
Luxembourg	Feed-in tariff. Premium is guaranteed for 10 years.	3.1 (electricity price) + 2.5 (premium only for plants under 3 MW)
Netherlands	New support system as from 1 st July 2003. Wholesale electricity market and feed-in premium. Hydropower does not receive green certificates.	3.3 (market price) + 6.8 (premium)
Austria	Feed-in tariff: a) Old plants: Plants which obtained planning permission before January 1 st 2003, including all those currently operating, are entitled to receive the guaranteed feed-in tariff for the first 10 years of operation. b) New plants: Plants obtaining all planning permissions between January 1 st 2003 and December 31 st 2005 and which start generating by the end of 2006 are entitled to receive the feed-in tariff for the first 13 years of operation.	<u>Old plants</u>
		1 st GWh: 5.68
		1 – 4 GWh: 4.36
		4- 14 GWh: 3.63
		14-24 GWh: 3.28
		+ 24 GWh: 3.15
		<u>New plants</u>
		<i>Rebuilt plants with a production increase per year > 15%</i>
		1 st GWh: 5.96
		1 – 4 GWh: 4.58
4- 14 GWh: 3.81		
14-24 GWh: 3.44		
+ 24 GWh: 3.31		
<i>New plants or Rebuilt plants with a production increase per year > 50%</i>		
1 st GWh: 6.25		
1 – 4 GWh: 5.01		
4- 14 GWh: 4.17		
14-24 GWh: 3.94		
+ 24 GWh: 3.78		
Portugal	Feed-in tariff	7.2
Finland	Nordpool market plus premium	2.6 (market price) + 0.42 premium if < 1 MW + subsidy covering 30% of the investment cost
Sweden	Green certificates: This system was started May 1 2003.	4.9 = 2.3 (certificate level) + 2.6 (Nordpool price)
United Kingdom	Market price (energy market – NETA) and Renewable Energy Obligation Certificates – ROC's (only available for Hydropower up to 20MW when they have been built since 1990 or if built before 1990 have been refurbished with new turbine runners and control equipment. Also hydro plants commissioned since 2000 are also eligible for ROC's	2 (Average price for electricity in the energy market) + 0.38 (exemption to the Climate Change Levy)
		4.2 (value of ROC's). When an electrical supply company provide renewable energy to 10% of its costumers it gets the 4.2 but if it fails to provide that percentage it has to pay 4.2 to the government.

TABLE 2: Additional support to SHP in the EU-15

Member State	Policy	Description
Belgium	Grants Business Users	Incentive for investments in renewable energy by industry. It provides capital grants of up to 15% of the eligible investments by industry.
Greece	Grants Renewable Energy Industry	The Operational Programme for Energy (OPE) provides capital cost grants for the promotion of renewable energies.
Ireland	Demonstration project, R&D	Under the National Development Plan, a programme of support for research, development and demonstration on renewable sources is available.
Austria	Portfolio Standard	Trading of small hydro certificate
United Kingdom	R&D	DTI's New and Renewable Energy Programme supporting renewables for improving the economic attractiveness.
	Fossil fuel Taxes	Climate Change Levy to promote energy efficiency and stimulate investment in new energy technology

TABLE 3: Investment and production costs of small hydropower plants in the EU

Member State	Average SHP production costs €cents/kWh	Range of investment costs €kW
Belgium	1.8	3,700 – 4,960
Germany	5	4,000 – 6,000
Greece	2.4 – 4.2	1,000 – 2,000
Spain	3.5 - 7	1,000 – 1,500
France	-	1,200 – 3,000
Ireland	3.75 – 9.1	1,500 – 3,750
Italy	5 – 10	1,500 – 3,000
Austria	3.6 – 14.5	2,900 – 4,300
Portugal	-	1,300 – 2,500
Finland	3 – 3.5	2,200
Sweden	4 – 5	1,500 – 2,500
UK	5 – 7	2,000 – 4,800

TABLE 4: Technical SHP development in the EU

Current Improvements	Current & Future RD&D Priorities
DESIGN	GENERAL TOPICS
Integration of environmental and safety issues: - Water discharges, remote control and monitoring, upgrading and refurbishment of dams, overflow dams.	Setting correct minimum residual flow and/or appropriate flow regimes Maps, hydrology and residual flow
BUILDING STRUCTURES	Improvement of hydrological assessment methods.
Tunnelling methods of full-race boring.	CIVIL ENGINEERING WORKS
MECHANICAL EQUIPMENT	Head enhancement techniques for very low heads
<i>Turbines</i>	Reduction of penstocks installation costs
Application of advanced computer techniques to improve the turbine efficiency. Use of new composite materials, exploitation of low heads, environmental friendly runner blades.	Development of appropriate screening systems for downstream migrating fish. Avoiding the use of cofferdams during installation
<i>Gear boxes</i>	Development of efficient desilters with high head intakes, of proper water intakes, and of trash racks.
High speed generator gearbox Low noise gearboxes and generators	ELECTROMECHANICAL EQUIPMENT
<i>Penstocks</i>	<i>Turbines</i> Development of turbines according to the Systemisation method and of CAD tools to calculate and draw them.
Underground penstocks Glass fibre reinforced plastic penstocks	Tests of new construction materials. Development of submersible turbo-generators.
<i>Gates, trash racks</i>	<i>Electrical equipment</i>
Rubber gates for low dams, intake trash racks manufactured from composite material	Adapting high pole permanent magnet excitation (PME) generators to SHP
ELECTRICAL EQUIPMENT	Development of low speed generators
<i>Generators</i>	Development of variable speed operation
Use of permanent rotors Development of new generators like the “powerformer”	CONTROL & MONITORING
<i>Power and control equipment</i>	Develop full software support for site-specific digital control, for the control of operational specifications, and for generalised control modules Development of a graphical user interface, and of improved monitoring and data analysis.
Computer based control equipment Modern monitoring and control remote technology like web-cameras or microphones	Development of standardised hardware packages
<i>Variable speed equipment for turbines and generator</i>	ENVIRONMENTAL INTEGRATION
	Bioengineering techniques applied to a wider range of works. Standard and objective methods for environmental impact assessment of SHP plants

FIGURE 1: Administrative procedure in Portugal

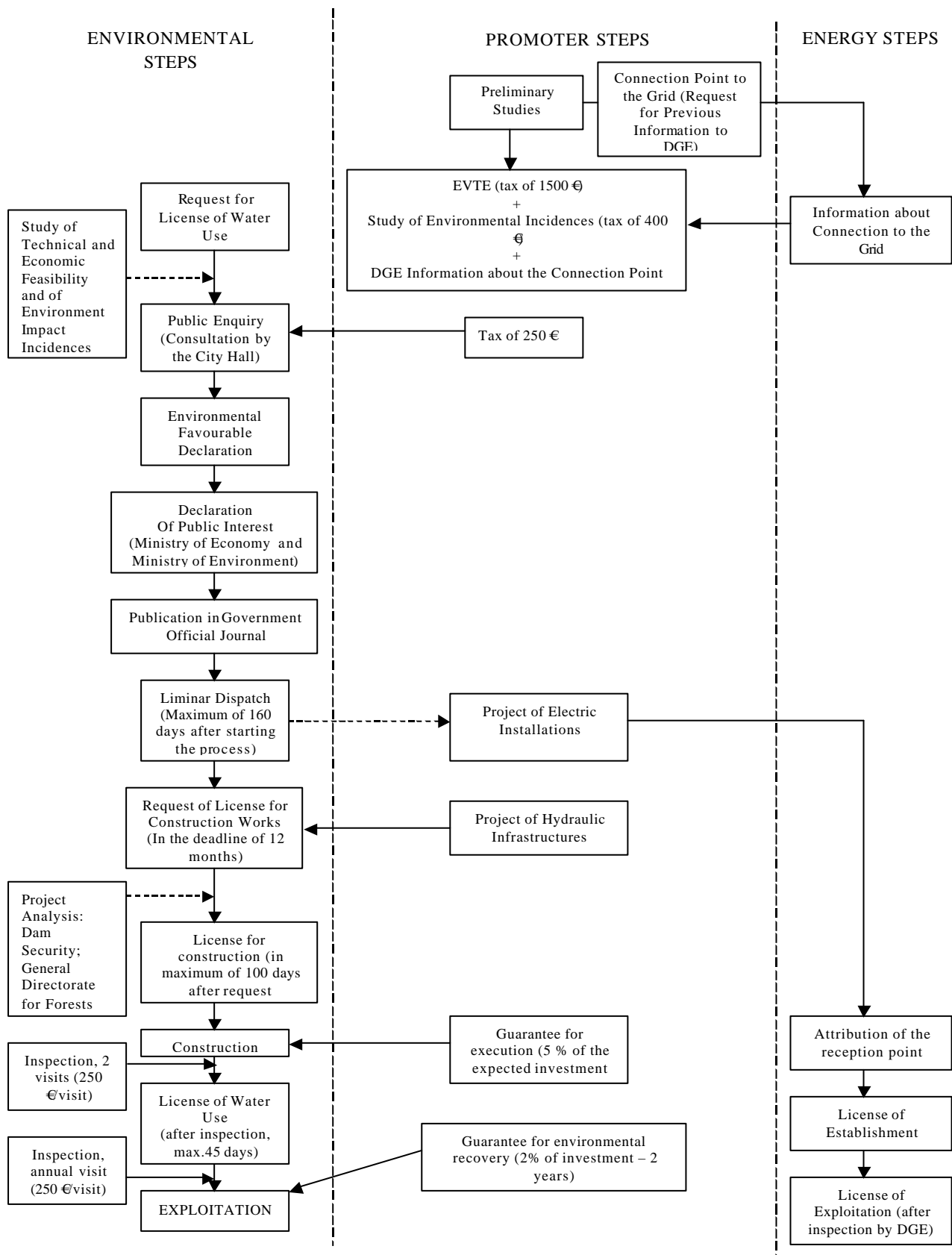


TABLE 5: SHP environmental impacts and feasible solutions

SHP IMPACTS	FEASIBLE SOLUTIONS*
<i>Landscape – visual intrusion</i>	Painting the water intake pipe
	Embedding the water intake pipe in a “geotextile”
	Burying the water intake pipe
	Integrate the powerhouse in the landscape by using local materials and architecture
	Underground works for outdoors power station and transmission line connecting the plant to the grid
	Disturbed ground can be replanted with appropriate vegetation
<i>Water resources, including impacts on other water uses</i>	Maintaining an appropriate minimum reserve flow
	Design and construction techniques to maintain or replace local drainage channels
	Retention or detention structures to avoid increase of runoff
<i>Flora and fauna, and especially on aquatic ecosystems</i>	Fish passes
	Installing grids or other diversion methods across water intakes and tailraces to prevent the entry of fish into the turbine
<i>River water quality</i>	Clearing of biomass
	Installation of multilevel water intake pipes
	Re-aeration of deeper waters and
	Aspiration turbines
	Sluice gates that can be opened and closed, pumping sediments slurries over the dam crest or removing sediments from the river by conventional dredging or pumping out the slurry elsewhere
<i>Other impacts</i>	Noise can be minimized by proper noise abatement measures or underground works

* These are some examples to illustrate the availability of solutions. A full description of this issue can be found in the ESHA publication “Guide to the Environmental Approach and Impact Assessment”, Studio Frosio 2000.

*ESHA Secretariat
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