

Green Electricity Products and the Sustainable Use of Water Resources

Dr. Bernhard Truffer

Address of the author
EAWAG - Swiss Federal Institute for Environmental Science and Technology
CH-6047 Kastanienbaum
T: ++41-41-349 2115
F: ++41-41-349 2162
E: truffer@eawag.ch

Abstract

The non-sustainable use of water creates major environmental problems on a world wide scale. It is even an issue in regions with a relative abundance of this resources, like the Alps. Here, major problems are associated with the construction of dams and the operation of hydropower plants. The environmental impact of hydropower has been subjected to a fierce political debate in the eighties, especially in Switzerland. Recently, the discussion has got a new form and direction with the ongoing deregulation, privatization and internationalization of European electricity markets. In the present paper, the development of green hydropower products is discussed as a means to create new incentives for a sustainable use of water resources in a liberalized market environment. The paper is based on the experiences in a recently started research project which aims at developing a certification procedure to identify "green hydropower" plants. This case— although quite remote from traditional water problems in the Mediterranean region — may be used to draw more general insight for the sustainable use of water resources.

1. Sustainable Use of Water Resources in the Alpine regions

The springs of major European streams are located in the Alpine region. The sustainable use of water resources should therefore not be a major issue in this part of the world. Despite the relative abundance of water, an increasing pressure from different uses has build up on aquatic ecosystems, groundwater levels and protected landscapes, in the last few decades. The use of water for the production of electricity has been particularly important in this respect and has gained widespread political attention. In the present paper, we want to show how the issue of sustainable water use has been framed in the case of Alpine hydropower use and in what way “green power” products could promote sustainable management practices in the emerging context of deregulated electricity markets.

The majority of the currently operated hydropower plants in Alpine mountain valleys of Switzerland were build up in the 1950ies and 1960ies. Hydropower was then seen as a clean source which had to be exploited as far as possible in order to meet the exponentially growing demand for electricity. As a result of this expansion, almost all streams in the Alpine region are impacted by hydropower plants and their operation. In the eighties, public opinion turned strongly against any further plans to invest in hydropower. Some spectacular popular movements against new hydropower projects gained widespread support in the population. This situation culminated in a fierce political struggle over the renewal of the Swiss water protection law. This law fixed, among other things, minimal flow requirements for Alpine streams impacted by hydropower plants. In 1991, the revision of the law was accepted in a popular vote and since then the environmental improvement of hydropower has been stated as a legal requirement.

The renewal of the water protection law led to a strong political opposition between several parties: Environmental organizations struggled for the protection of the last untouched water courses in the Alpine mountain valleys. The electric utilities wanted to prevent any cut in their profits because of “unproductive” water running down the river channel. The debate was strongly conditioned by the institutional form of the economic sector which organizes the production, transport and distribution of electricity: It was — and still is — largely constituted by vertically integrated firms and a regional monopoly for the distribution of electricity. In Switzerland, public authorities hold some 75% of the stocks of electric utilities. Therefore, interest conflicts also arouse between the Federal authorities,

supporting the water protection law, and the regional (cantonal) authorities in their role as stockholders and tax receivers of hydropower plants. This conflict is all the more important as it is the cantonal authorities who are responsible for applying the new water protection law.

After the law passed, the political debate about the sustainable management of hydropower came to a stand-still. A major reason was that the deregulation of electricity markets, as it was put into practice in Norway, Great Britain and the US, became inevitable for Switzerland, as well. This new institutional framework puts pressure on hydropower plants to reduce cost and to act as competitive firms. Additional requirements, as those demanded by the revised water protection law, are considered as a kind of a non-payable luxury good. Electric utilities and regional authorities are claiming that the environmental challenge with hydropower is the prevention of closing down existing plants and not so much their sustainable operation.¹

Seen in this way, the deregulation of electricity markets leads to a potentially less sustainable use of water resources, for the sake of other environmental and/or economic goals like the reduction of greenhouse gas emissions or the provision with cheap electricity. Nevertheless, the new institutional setting also opens up new opportunities for promoting sustainable operation modes of hydropower. Experiences from other countries with deregulated electricity markets have shown that consumers place a high utility in getting electricity which is produced in an environmentally benign way. This has made some hydropower plant managers change their minds regarding the relationship between environmental requirements and profitability of their business. "Green electricity" could therefore help to overcome old battle lines: hydropower managers, environmental organizations and public authorities could identify sustainable operation of hydropower as their common goal.

The development of "green hydropower" products is therefore an interesting field for analyzing the relationship between different institutional settings and incentive structures to promote sustainable modes of water use. In the following, we will report on the recent history of the environmental differentiation of electricity as a marketed product. Then we will discuss the approach of determining

¹ The debate of whether or not environmental legislation leads to the non-profitability of hydropower has not yet been settled. From the data available, it seems that even hydropower plants which use the water resources without any environmental restrictions will be confronted with high production costs. This is especially the case

the sustainable use of hydropower use as it is currently developed in a major research project in Switzerland.² Finally, we try to draw conclusions for the sustainable use of water resources on a more general level transcending the specific situation of hydropower use in the Alpine regions.

2. Differentiating a homogeneous product — Green electricity

In the past few years, deregulation of electricity markets has been a major topic in energy policy. After public transport, and telecommunications, the energy sector is going to be deregulated and privatized all over the world (Loskow 1998). The new market order is intended to bring a number of advantages to the customers. The major effect should be a lowering in price. As electricity is a basic input to most commodities and services, a major increase in societal welfare should result from this endeavor. From an environmental point of view, these positive effects are impaired by the risk of giving advantage to energy forms with less attractive environmental characteristics. An increase in the environmental impact of the electricity sector may be expected if cheap energy from low standard power plants will compete against high standard plants with higher production costs. The overall effect of deregulation on welfare could then become largely negative.³

The protection and support of environmentally less polluting energy forms has therefore become a major concern in the context of market liberalization. The EU's guidelines for the liberalization opens the possibility for prioritizing renewable energy. Besides, new promotional instruments which are more compatible with a liberalized market order have been developed, in the last few years. "Green electricity"⁴ products have gained a lot of interest as a means to promote environmentally benign electricity production.

when substantial technical upgradings have to be made or when the concessions have to be renewed. A one-to-one opposition between sustainable management and survival of hydropower seems not to be given.

² Research leading to this paper was funded in the context of a transdisciplinary research project on the topic of "Ökostrom" (eco-power) regarding the relationship between green electricity and hydropower conducted at EAWAG (Swiss Federal Institute for Environmental Science and Technology). A more detailed description of the overall project is given by Truffer, et al. (1998).

³ The overall environmental impact is, however, not clear. For further discussions see Fouquet (1998) and Schelling (1998).

⁴ Throughout this paper, we will use "green electricity", "green power" and "green pricing" as synonyms.

The idea of offering customers the choice over their electricity mix was for the first time formulated by Moskovitz (1993). With the unfolding debate on deregulation, green pricing received more and more attention. Originally conventional electric utilities, with regional monopolies, were at the forefront of promoting green power products. Recently, a number of newly founded firms have emerged both in the US and Europe (Markard and Truffer 1998). Several studies evaluated the first experiments with regard to market potentials and conditions for success (see Markard 1998, Holt 1997a, Farhar and Ashley 1996). Major lessons from these studies are that green power products are successful in the market if they are conceived as competitive products, if they are marketed professionally, if the surplus-payments are invested transparently and if the electric utility is able to position itself as a trustworthy promoter of environmentally profitable technologies.

In the last few years, green pricing experiments received a lot of attention and were in general quite successful. However, current sales cover only a tiny share of the actual electricity market. In Switzerland, market shares in regions where green power is supplied are below 1% (Wüstenhagen 1998). Studies of the market potential for green power show that about 20% of the private households would be ready to pay a price premium of 20% or more over the current electricity prices (Wortmann 1998). If firms and communities are included as potential market segments, market shares of 20% of the total electricity delivered may be achieved (Truffer 1998).⁵

Most offers of green power products concentrate today on some sort of mix of "new" renewables. These technologies have in common that production costs are in general quite high and quantities produced are negligibly small in the overall mix of the respective countries. On the other hand, prospects for achieving substantial economies of learning (through research and development) and economies of scale are widely discussed in the media and should in the long run lead to a competitive market position of these technologies.

The "old renewable" energy form of hydropower is fundamentally different in all these respects: there are considerable production capacities at competitive price all over Europe. Economies of scale and

⁵ For sure, this statement depends on the actual mix of renewables that are offered, the price of these products, the quality of the marketing strategies, the trustworthiness of the supplier, political framework conditions, and so on.

learning effects have been reaped throughout the last century. The construction of new facilities is confronted with often fierce political opposition. Because of these difficulties, hydropower is often excluded from the green power mix or else it is treated in a most arbitrary way which defies any transparent and credible communication about the ecological benefits of the product (Markard and Truffer, 1998).

In some cases, power from big dams has been sold as green power without any qualification.⁶ Most schemes set a limit on installed capacity, i.e. those plants which are below a certain installed capacity are considered as environmentally benign the others are not.⁷ Another criterion is related to construction date. Some ecolabeling schemes only consider already existing power plants, others restrict themselves to new plants.⁸ Only in a few exceptions green payments are used to achieve specific environmental improvements for the plants.⁹ This great variety of approaches is due to a lack of a clear analysis what green power products have to sell and communicate, as well as a lack of a scientifically grounded method for assessing the environmental impacts of hydropower (Truffer and Bratrich 1998).

An encompassing assessment of green hydropower should proceed along the following lines: Hydropower is almost emission free in its use. It is therefore considered as a very favorable energy form, from a global environmental point of view. Locally, however, the storage and diversion of waters may cause a wide number of negative environmental impacts which are irreversible and which endanger the survival of natural ecosystems and indigenous people (IUCN and World Bank 1997). An environmental balance sheet of this energy form has to take both sides, the local and the global,

⁶ Several initiatives are reported in Holt (1997a).

⁷ This follows the idea that "small is environmentally sound". Despite of the fact that this claim is in general not true, there is an impressive variety of approaches to define what "small" means: In California the "green-e" label sets a limit at 30 MW. In Canada a limit of 20 MW has been chosen (Buhl et al. 1998). A recently founded ecolabel for electricity has set the limit at 10 MW (Photon 1999). Finally in the Swiss city of Berne the level has been set at 100 kW (EWB 1998).

⁸ The certification scheme which is under preparation by the TÜV (Technischer Überprüfungsverein) in Southern Germany demands that only newly constructed plants should be entitled to sell green power. Sweden is following an opposite course as they only certify hydropower plants that went into operation before 1995 (Buhl et al., 1998).

⁹ Bonneville Power Administration in Portland has commissioned the Environmental Resource Trust to develop and market green power products which aim at restoring salmon in rivers (ERT 1998). Somewhat more encompassing is the Californian green-e label which demands that hydropower stations should get into contact with local environmental groups in order to define and establish concrete improvements in the catchment area. However, the framework for these negotiations has not yet been spelled out sufficiently (green-e, 1998).

into account. Furthermore, an overall assessment may not stop at assembling “objective” information. It also has to consider the arguments and fears of concerned local interest groups.

As the new construction of hydropower facilities is confronted with political opposition, and the intrinsic value of remaining “untouched” ecosystems has to be attributed a high value, green power payments should not promote the massive expansion of new power plants. Rather, green pricing schemes should create incentives for the sustainable operation of existing power stations (Truffer et al. 1998). If hydropower is treated in such a way, a mix of new and old renewables may be consistently built up and communicated to the customers. New renewables would then profit from being part of a competitive product. Hydropower would profit from a positive image transfer and could achieve a higher price in the market.

3. Sustainable use of hydropower

It has been shown by the green pricing experiments all over the world that credibility and transparency of the products and the suppliers are key factors for success. As electricity is a homogeneous product on the side of the end-user but a highly complex commodity at the level of production, transport and distribution, a credible and transparent system of quality control becomes very important. This kind of information problem between producer and consumer may be reduced by third party certification procedures. Eco-certification of production systems has been a field of growing interest in several product sectors like food, wood, marine fishery and cloth. Eco-certification of electricity is only in its beginnings.¹⁰ One of the major challenges is the development of a certification procedure for hydropower plants. A recently started research project of EAWAG aims at developing an eco-certification procedure for hydropower plants.¹¹

The certification or labeling of green hydropower plants should meet the following three major criteria: first, a base line or minimum quality of a green hydropower plant should be guaranteed, second additional payments from green power customers have to be invested in environmental

¹⁰ In Switzerland, a private association will be founded which includes major stakeholders of an ecolabel for electricity, namely producers of renewables, electric utilities, environmental organizations and consumer organizations. For further details, see Grasser and Kiefer (1999).

¹¹ This project is called Ökostrom (Green electricity) and is run by the Swiss Federal Institute for Environmental Science and Technology (EAWAG).

improvements in a transparent way, and third support from local stakeholders active in the catchment area should be sought. These requirements have been translated into the following four-step procedure for attributing an ecolabel to hydropower plants.

First, baseline requirements for green hydropower are related to the notion of “ecosystem integrity” and implies for instance the potential for natural reproduction of fish and invertebrates, the maintenance of groundwater levels and the ecological integrity of protected landscapes, such as wetlands. By defining minimum criteria, comparability of the environmental quality between different hydropower plants in different regions may be achieved. Furthermore, it guarantees that no “black sheep” invade the market and create negative publicity for the product. The basic requirements shall be applied in a very rough procedure carried out by a small team of experts in a short time.

Second, transparency of the use of additional payments from green consumers is achieved by determining a locally adapted set of environmental upgrading measures. These upgrading measures should achieve an optimal environmental benefit for a given amount of money. The upgrading measures are identified on the basis of a systems overview in the catchment area. Here, sites for potentially profitable measures will be identified. In the end, a list of upgrading measures will be developed and each measure will be valued by its contribution to various measures of the ecosystems’ integrity and the cost of the measure. Potential measures are: dynamically adapted minimum flow regimes, restoration of natural river beds, controlled reservoir flushing, damped forms of hydropeaking, but may also imply the protection of some not yet used rivers.

Third, the selection of an optimal set of measures shall be carried out in the context of a participatory decision process, involving the major local stakeholders of the area impacted by the hydropower plant. The decision board could be constituted of hydropower plant operators, environmental organizations, government officials, local communities, fishery associations and the like. They will decide on the basis of the list of measures and may determine a priority ranking with which measures should be realized in the context of a green power certification. The number of measures to be realized will be constrained by a determined amount of money which could be given as a fixed mark up for the kWh produced. By following such a participatory decision process, the local acceptance

of the investment could be achieved and a broader set of valuation criteria may be taken into consideration. By this, the social and economic dimension of sustainability will be taken into account besides the environmental dimension.

Fourth, the certification, i.e. control of whether the above three steps have been executed in the required way, should be carried out by an independent certifier. He reports back to the board of directors of the association who owns the ecolabel and the latter decides about the attribution of the ecolabel to the plant.

This four step certification procedure forms the core of the project on *Ökostrom* (green hydropower) which was started by EAWAG this year. *Ökostrom* is an interdisciplinary research project which aims at developing a certification procedure for hydropower plants and which wants to estimate the effectiveness of this instrument as an environmental “policy tool”. The project encompasses about 20 individual research projects in four working areas. The research groups work on the following topics:

- minimal flow requirements at the level of the catchment area,
- the impact of a changed hydrological regime on the flood plain ecosystems and on ground water
- the establishment of the certification procedure
- the analysis of market and policy aspects of green hydropower products.

The individual research projects are from the social and the natural sciences. The project is developed in close interaction with major stakeholders in the problem area of environmental impacts from electricity, both at a national and a local level. Furthermore, the research project is run in cooperation with private consultants and other research institutes.

The project is planned to be run in two rough phases: From April 1998 until April 2000 a prototype of the certification procedure will be developed. The research projects are concentrated in a specific case study area: the catchment of the Brenno river, i.e. the Blenio valley in the canton of Ticino in the Italian speaking part of Switzerland. The Blenio valley is located some 50 km from Como in the southern part of the Alps. In a second phase (2000-2002) a generalization of the procedure to other plant types will be endeavored. First hydropower plants should be certified by the beginning of the year 2000. At the same time first green electricity products with hydropower shall be on the market.

4. Lessons for the sustainable use of water resources

Given the current state of the project it is premature to draw any firm conclusion about the effectiveness of green electricity products for promoting sustainable hydropower use. Time will tell what the actual size of a green power market segment will be and how the supply of green power will promote sustainable use of water resources in the particular case of the Swiss Alps. Nevertheless, our experience in setting up the project and in running it so far has shown that the fierce opposition between the interest parties — which can be traced back to the political discourses of the 1980ies — may slowly be overcome. The sustainable use of hydropower could be seen by a substantial number of plant operators as an opportunity and far less as a threat. Environmental organizations, on the other hand, are more and more accepting to balance requirements for local impacts on ecosystems with global issues of green house gas emissions.

So, it seems that the fundamental change in the framework conditions of the market in which the sector operates may generate learning processes which favor sustainable modes of resource use. Not much learning would have been to expect if the market order stood the same. By this, we do not want to claim that deregulation *per se* will promote sustainable resource use and even less that it is a sufficient condition for achieving this goal. Quite the contrary, unsustainable practices will become dominant if deregulation is carried out focusing exclusively on short term interests and the power of certain stakeholder positions. The issue of deregulation is about how to re-regulate the sector in order to enable new solutions to take shape. The discussion about the shaping of green electricity products has shown to be a fruitful context in which to develop such solutions.

Perhaps the effectiveness of green power products will in the end not only be measured by the market share it will reach, i.e. by the square meters of photovoltaics which will additionally be installed on top of roofs of environmentally concerned communities and by the catchment areas of rivers which show improved ecosystems integrity. The important point of the emergence and establishment of green power products is that this will differentiate a commodity which was homogeneous for most of its history. The product meaning will be radically transformed and so may relationships between users and producers by way of the products, i.e. use patterns and eventually

life styles may be subjected to change. So, green power products will have a role to play in making electricity consumption and its conditions more conscious to most of the citizens. But learning shall not be restricted to the individual citizen. Green power products could also be an element of political discourse in which citizens begin to actively analyze their local and regional energy needs and look for potential solutions in their local communities.¹²

What does this tell us beyond the specific case of hydropower in the Alpine regions for the promotion of more sustainable modes of water use? Environmental assessment criteria for dams which store water for drinking water, irrigation and electricity production are a global theme of prime importance. Currently a joint commission of the World Bank and the IUCN (International Union for the Conservation of Nature) has been set up to define criteria for sustainable dam construction and operation. Although the specific context of green consumers being prepared to pay extra for an intact environment may be specific to industrialized countries and a specific market order, the underlying criteria for sustainable water management are not.

Furthermore, if sustainable resource management shall be achieved on a world wide scale, this will require some fundamental restructuring of the institutional frameworks in which water is captured, transported and consumed. Privatization and deregulation may be means to achieve a more effective and efficient use of the resource. However, in order to promote sustainable resource management, the actual framing of these reforms is decisive. Of central importance is the question how specific interest groups may get heard and how sustainable operation modes may become an attractive option for industry, consumers and governments. A careful analysis of the incentive structures in the economic sectors is an important prerequisite for that and new modes of stakeholder involvement have to be developed. Research projects like *Ökostrom* may play an important role in analyzing and supporting such institutional reforms.

¹² There is acutally one specific project in the context of the *Ökostrom* endeavour which aims at developing this kind of public discourse methodology (Düreenberger 1998).

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