Water Protection Using Market Tools

The EAWAG Project "Green Electricity"

The goal of the project "Green Electricity" was to define an ecological label for the identification and promotion of hydropower produced in an environmentally friendly way. Power plants receiving such a label would need to satisfy a set of basic standards with respect to stream ecology and in addition, invest part of their revenues towards the protection, improvement and/or rehabilitation of the catchments they use.

Approximately 60% of Switzerland's energy production comes from hydroelectric power plants. With a development degree of some 80%, practically all major and many smaller streams in the country are utilized for hydropower production.

Hydroelectric Power and Stream Protection – A Contradiction?

On a global scale, hydroelectric power is environmentally desirable since it is both renewable and emissions-free. Locally, however, hydroelectric power production often results in massive negative impacts on streams. In light of the liberalization of the energy market, it is questionable whether or not an ecolabel can make a positive contribution to stream protection. But, assuming that environmentally conscious customers are willing to pay a higher price for electricity, which in turn improves streams, the opening of the electricity market should actually benefit both the environment and businesses. Based on experiences in other countries, however, this will require a credible and independent certification of the producer; such a certification must guarantee that both the global and local environmental impacts are as small as possible.

Experiences with International Electricity Labels

Since the appearance of the first "green" electricity offerings on international markets in the early 1990s, the number of companies offering this type of product, as well as the number of such, have sky-rocketed. There are over 300 "green" pricing schedules worldwide, with additional product combinations also available; however, only seven independent "Green Electricity Certificates" are currently in existence [1]. All of these certificates deal primarily with renewable energy sources – sun, wind and biomass. Until recently, no generally accepted certification procedure for environmentally friendly hydroelectricity plants was available. In addition, existing certification procedures consider local environmental impacts only minimally or not at all. EAWAG was determined to close this gap with the project "Green Electricity". In the past three years, an interdisciplinary team has developed a procedure and specific criteria, which consider both impacts on stream ecology and economic aspects of hydroelectric energy generation in terms of integrated water management [2].

Ecological Credibility and Practical Realization

According to experiences made so far, a successful green electricity product must fulfill two conditions:

1. The certification criteria must be credible from a stream ecology point of view.
2. The criteria have to be effectively applicable.

In the context of hydroelectricity, this means that the procedure has to consider global environmental factors (e.g., low CO_2 emissions) as well as the ecological function of local stream systems (e.g., the connectivity of the stream, a dynamic drainage regime, the natural diversity of species). These ecological considerations have to be balanced with the managerial aspects of the power plants. The practical realization of such a procedure is only possible if the business management aspects, the social framework, and the legal, financial and political situations are taken into account in the overall management approach.

The Environment-Management-Matrix

EAWAG has developed the so-called "Environment-Management-Matrix" in order to diffuse the conflict between protection and utilization and to achieve credibility as well as pragmatic realization of proposed concepts (Fig. 1). The matrix is based on the ecological requirements of integrated stream protection and management, but

Conditions for Green Electricity Certification

According to the procedure developed by EAWAG, hydroelectric power plants can be certified as "Green Electricity Power Plants" if they demonstrate environmentally sensitive operation and installation. Two conditions have to be met voluntarily by the power plant before the certification process can be initiated:

1. The power plant meets the *"Basic Green Electricity Requirements",* an ecological standard that is measured against requirements for new operating permits in Switzerland. The standard is based on independent scientific criteria and is the same for all hydroelectric power plants.

2. Beyond that, the power plant has to contribute a fixed percentage of its revenue from the sale of green electricity for the rehabilitation, protection or amelioration of the catchments the plant is utilizing. These so-called *"green electricity contributions"* guarantee that some of the environmental improvements are made on the local level. It is intentional that this requirement is separate from the basic requirements. The explicit link between the sanitation of the local ecological system and the profit made from green electricity can be used to promote and communicate such improvements.

Certification will only be granted if both these conditions are met.

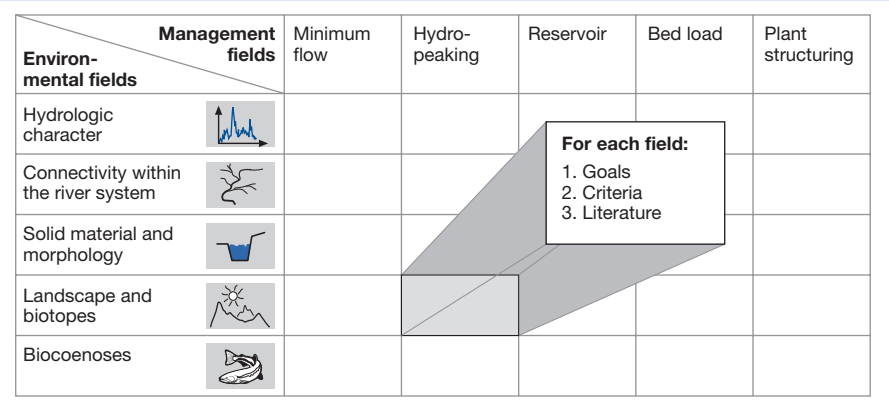

Fig. 1: The Environment-Management-Matrix.

also takes into consideration the realities of renewing the operating permit for hydroelectric power plants. The matrix provides a scheme for the entire process and focuses on five environmental criteria as well as five management criteria (Fig. 1). The environmental criteria were selected to insure the ecological function of the stream; the management criteria are primarily related to the operational and structural aspects of hydroelectric power plants.

The procedure proposed by EAWAG [2] defines basic requirements for each of the 25 fields of the matrix in order to satisfy the designation of environmentally friendly electricity production. Beyond that, the procedure provides criteria and methods for meeting these requirements. It also contains an extensive bibliography on quality assurance, including comments from the project team.

The Two-Step Management Concept

The EAWAG concept proposes a two-step approach to the certification procedure. In the first step, the power plant must demonstrate that it fulfills the basic requirements of green electricity production, the stringency of which are consistent with the standards for Swiss relicencing rules taking into account the revised stream protection law. The power plant must achieve this first step on its own[1]. Once these basic requirements have been met, the EAWAG procedure provides for the second step; namely, the implementation of specific remediation options in the affected catchment. Part of the revenue from higher green electricity prices will be funneled into so-called “eco-investments” (currently 0.01 CHF per kWh). These funds must be used for local improvements to the stream system. Which improvements will be realized would be decided in negotiations that include local interest groups. This procedure should result in remedial action plans that are ecologically meaningful and widely accepted, without being bogged down in conflict. Before the green electricity label is actually awarded, an independent entity would have to conclude that the procedure was followed correctly and that the required improvements were implemented.

Practical Application in the Case of Minimum Flow Requirements

The goal of green electricity criteria with regard to minimum flow is to guarantee flow regimes that are appropriate for the natural character of the stream. To determine “appropriate” minimum flow volumes, the EAWAG procedure proposes to use criteria that are customized to the stream system and based on the habitat concept, such as the ones that have already become an international standard [3]. These criteria may be developed with the use of computer-based models, describing water temperature or habitat condition, as was demonstrated in the case study of the green electricity project conducted on the Brenno (Canton Ticino, Fig. 2). These models can be either developed from the ground up (see article of W. Meier, p. 13) or adapted to a specific stream [4, 5]. Using such approaches, it is possible to simulate the habitat diversity for a range of organisms, such as fish or macroinvertebrates, within a specific stream section under varying residual water conditions. The model juxtaposes these results to the annual electricity production of the power plant and the basic requirements established for “minimum flow” in the management area (Fig. 3). This will allow for optimization of ecological considerations as well as aspects of the business operation.

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Fig. 2: The Luzzone storage reservoir in Canton Ticino. Location of the EAWAG case study “ Green Electricity”.

[1] Although “green electricity” certification meets the ecological standards of new operating permits, requirement of new operating permits is de facto not necessary. However, since “green electricity” certification is a voluntary market tool, it may not replace new operating permits.

Environmental fields	Management field “Minimum flow”
Hydrologic character	■ dampened, natural flow regime ■ minimal, seasonally adjusted and inflow dependent base flow
Connectivity within the river system	■ interconnection between surface waters, ground water and adjacent land ■ no unnatural isolation of side streams ■ adequate water depth for fish migration
Solid material and morphology	■ preservation of the natural structure of the stream bed ■ coordination with bed load management
Landscape and biotopes	■ preservation of valuable habitats and landscape elements in their original function ■ separate regulations for the preservation of flood plains that are specially listed
Biocoenoses	■ preservation of the natural diversity, particularly with respect to indigenous fish species and rare and endangered communities ■ avoid critical temperature and oxygen conditions and preservation of self-cleaning capacity

Fig. 3: Criteria for the management field “Minimum flow”.

Is Green Electricity Viable in the Real World?

International experience shows that, in the long run, only a credible procedure, i.e., one that reflects the complexity of stream ecosystems, can guarantee the sale of green electricity. With the opening up of the electricity market, the conditions for a shift to green electricity production are very good in Switzerland. By the end of 1999, electricity producers, distributors, environmental organizations and consumer groups had formed an independent “Association for Environmentally Produced Electricity” (VUE, Verein für umweltgerechte Elektrizität). Its leadership is composed of representatives from all of the interest groups. In June 2000, the association announced the Swiss green electricity label “naturemade star” to the public. The certification process employed the EAWAG procedure presented in this article and so should satisfy the need for credibility for a long time to come. To ensure that the certification process is viable in the real world, pilot certifications were also initiated for six Swiss hydroelectric plants. By the Fall of 2000, all six certifications had been successfully completed; the first green electricity certificates based on EAWAG criteria have since been awarded. The city of Zürich, for example, can now sell green electricity produced at the Höngg power plant (Fig. 4), which has been certified according to the EAWAG standard. The EAWAG procedure itself is continuously being adapted and updated according to experiences made during the certification process.

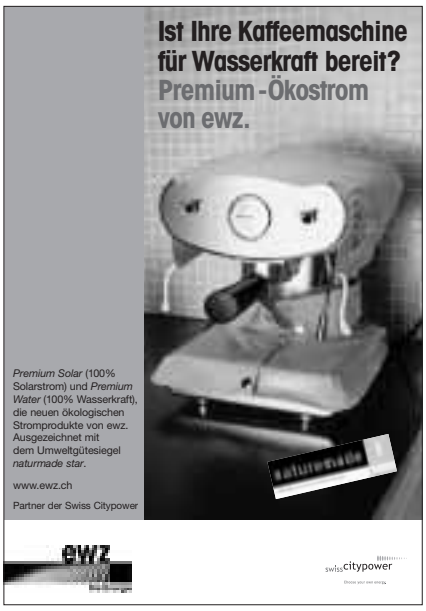

Fig. 4: Advertising campaign by the EWZ (Elektrizitätswerk Zürich) for its first green electricity products after completing the certification process using EAWAG standards.

Conclusions

From the very beginning, the research project “Green Electricity” employed concepts and methods that were geared to integrated water management. This is reflected both in the multitude of evaluation methods employed and the use of computer-based models for the evaluation of various utilization scenarios. In addition, all relevant interest groups within the catchment under consideration are explicitly involved in the certification process. Under these conditions, the market tool green electricity can indeed create a positive and innovative impulse in stream management. It is only because of recent scientific and technical advances that we are able to find ecologically *and* economically optimized solutions in water management. Different options can be compared in an objective manner, taking into account protection as well as utilization requirements. If the market tool green electricity can also be used to mobilize additional financial support, then sustainable water management has an excellent chance of becoming reality. Independent scientific groundwork is as important in achieving this goal as is the openness and willingness to compromise within the political negotiation process. We believe the project “Green Electricity” has created a solid foundation and delineated the path to realize sustainable, environmentally sensible water management.

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For additional information:
www.oekostrom.eawag.ch, www.naturemade.org

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