Multipurpose Small Hydro Power and Global Warming

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Climate change due to GHG emissions – mainly CO_2 - has been a serious concern to the international community and is a major environmental challenge to be faced nowadays. Of the several routes for production of energy and especially electricity, Small Hydro Power has been rated as one of the least environmentally damaging. More than that, one GWh of electricity produced by Small Hydropower (SHP) means a reduction of CO_2 emissions by 480 T. Hydroelectricity is the world's leading source of renewable energy, supplying 19% of the world's electricity (only 10 to 12 % of it is SHP), and it is accounting for 63% of the total electricity generated from renewable energy sources.

Water, being the basis of life, and as its availability is shrinking, with global warming linked in a vicious circle, it has attracted serious political and scientific attention recently. Starting from the 1992 Rio Conference, this concern has been growing much stronger, leading to Europe adopting a Water Framework Directive and for SHP, an Environmental Integration Strategy. Globally, rivers have been modified for several reasons such as flood control, irrigation, drinking water supply, tourism, fish farming etc and power production is only one among them. Globally, extraction of energy has not been the largest of all these applications.

SHP in most cases does not affect the environment in any serious way. Multi-purpose plants may combine drinking water or waste water systems, with the environmental impact of SHP use thus being considerably reduced. The key is the use of existing artificial waterways and water use structures like reservoirs built for other purposes. On a global level there is no doubt about the following environmental benefits of converting energy via SHP plants:

- **Climate change mitigation:** 1 GWh avoids the emissions of ~ 480 tons of CO_2
- **Reduced emission of substances into the atmosphere:** no emissions of acidification substances, dust particles etc.
- **Reduced risk of flooding:** Reservoirs and dams function as "shock absorbers" and thus reduce the risk of flooding.
- **Emergency preparedness**: SHP can create a more diversified electricity system that is located close to the consumers and transmission losses are the least.
- **Reduced land requirements:** Only a small area is needed for SHP projects.
- **High energy payback** ratio: The "energy payback" is the ratio of energy produced during its normal life span, divided by the energy required to build, maintain and run the generation equipment. If a system has a low payback ratio, it means that much energy is required to maintain it and it can produce major environmental impacts.

According to a study carried out by Spanish Association ofl Renewable Energy Producers (APPA) entitled "Electricity Costs externalities: a Life Cycle Analysis Approach" on environmental impacts of different technologies for electricity production, SHP is the technology with less environmental impacts among the 8 forms studied, viz. Lignite, Coal, Fuel-oil, Natural gas, Nuclear, Wind and Small hydro of less than 10 MW.

- The environmental impact of conventional energies is 31 times higher than the one of renewable energy sources.
- To produce one kWh of electricity with the best renewable system – small hydro – has an environmental impact:
    - 300 times less than with Lignite
    - 250 times lower than the one generated with coal or petroleum
    - 125 times lower in relation with the one produced with uranium
    - 50 times lower than the one generated with natural gas.

The analyzed environmental impacts in this study are related to 12 aspects such as Global warming, Ozone layer depletion, Acidification, Eutrophication, Heavy metal pollution, Carcinogenic substances, Winter smog, Summer smog, Generation of industrial wastes, Radioactivity, Radioactive waste, and Depletion of energy sources.

Apart from all these, a new hydrokinetic technology has emerged, in which generation of electricity from moving water without impoundments or diversionary structures is possible (U.S. Patent # 6,955,049), and is also deployable downstream of existing hydropower facilities (known as Hydro+(TM)). The City of Hastings is installing a two-turbine Hydro+(TM) project downstream from its 4.4 MW run-of-river SHP plant.

Research leading to an updraft free exit flow turbine, giving hope for a weight reduction to one third of the normal, cost reduction of 30-60% over conventional axial flow turbines, avoiding the costly draft tube and making it environmentally and fish friendly is expecting commercialization in the near future. Another technological innovation is the studies conducted simultaneously in China and Finland jointly on the performance prediction of Bulb turbines by flow simulation and bringing predictions close to reality.

India has a gross SHP potential of about 15,000 MW of which only 16% has been developed so far. There is immense opportunity for developing at least 50% of the remaining potential, if private participation as well as community involvement and government policies develop pro-actively. Also, the following strategies are to be considered for approval.

1. As in EU recently and in China since 1952, Framework Directives on simultaneous and multipurpose use of water resources be adopted.

2. In India SHP is a mini version of Large Hydro. Effective change over to a cost effective SHP development is possible, if separate codes of practices are notified, including the use of permissible construction materials.

3. The SHP projects offer an opportunity to mitigate carbon emissions and bringing them under carbon credit scheme will make the projects more economical too. In Oct 2005, the Executive Board of CDM approved the first CER certificates for two SHP projects in Honduras is indicative of the fact that economic benefits to the tune of around 32% are possible and this can make the project very much economically viable.

4. Effective training for local technicians for planning and executing SHP projects should be organized to keep the construction tempo at a higher plane.

"The planet is about to break out with fever, indeed it may already have, and we [human beings] are the disease. We should be at war with ourselves and our lifestyles."

Thomas Lovejoy, *Scientist, Smithsonian Institution*