

## **Electricity generation from historic water-mills**

### **Summary**

South Somerset Hydropower Group (SSHG) is a group of water-mill owners based in South Somerset. They are using hydropower turbines to generate electricity in an environmentally sensitive manner.

The UK has thousands of historic water mills previously used for weaving or grain milling which have fallen out of use. These sites usually had a mill-pond from which water led through a channel to drive the mill wheel. Small hydropower turbines can be installed at many old mill sites to generate electricity. They have minimal impact on water flow, or local ecology. The hydropower installations generally promote the preservation of the historic mill buildings that house them, because mills used to generate electricity will be kept in a good state of repair. SSHG have emphasised the general maintenance of mill buildings, and installed energy efficiency measures where possible. Mill owners earn an income from the sale of electricity.

SSHG is currently working with ten sites, two of which were in operation in June 2005. The total annual electricity generation at the ten sites is estimated at about 600 MWh, which is sufficient to supply 150 average homes and will avoid the production of 260 tonnes of CO<sub>2</sub> per year.

SSHG estimates that there are about 40,000 mill sites in the UK that might be suitable for micro hydropower. In the South West there is a high concentration of such sites, and SSHG is helping a similar group in North Dorset to start up.

### **The organisation**

SSHG was formed in 2001 by Keith Wheaton-Green, an Environmental Projects Officer at South Somerset District Council. Interested mill owners were invited to an open meeting at the historic Gant's Mill where talks were given by hydropower consultants and the Environment Agency. Twelve mill owners came together to form the group.

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## **Technology and use**

SSHG uses hydropower turbines designed for low water head (fall distance), which can be installed with minimal disturbance to historic mill buildings, and usually without any significant new structures. The turbines used to date are crossflow designs, manufactured by either Valley Hydro or Ossberger. They have to be individually specified, because each site has a different water flow distribution and head. Great care must be taken to minimise adverse affects to the ecology of the river from which water is abstracted, or to the rest of the natural environment. SSHG have to obtain Abstraction Licences and Land Drainage Consents from the Environment Agency, and the water must return to the river after it has passed through the turbine.

The maximum power that can be generated by a hydroelectric scheme (the design output) depends on the maximum water flow and head. The design output of the individual SSHG schemes ranges from 3.7 to 30 kW, with a total of 147 kW for the ten schemes in the programme. The two schemes that SSHG had installed by June 2005 have rated capacities of 12 kW and 3.7 kW. The group is also working with some sites in North Dorset with design outputs up to 64 kW.

To connect the systems to the mains electricity grid, electronic systems were designed to meet UK grid regulations. Depending on the size of the system, the electronics must be certified to meet either G83 or G59 grid regulations.

A cheaper, modular turbine called the HG200 is now being developed by Hydro Generation Ltd, and is intended to be used at two SSHG mill sites. The turbine will have a polymer-moulded rotor and stator in a fibreglass housing, and should allow shorter installation times as well as costing less.

In addition to micro hydro, the project has integrated energy efficiency improvements in nine of the participating mills. Measures installed include extra loft insulation, double glazed doors, energy efficient light bulbs, and energy efficient appliances.

## **How users pay**

Grant funding has provided about 50% of the estimated cost of the ten-mill programme, and mill owners have to provide the additional funds. Predicted costs for the installations are from £1,000 to £4,500 per installed kW. The smaller systems are the most expensive per kW, and individual site factors also affect costs. Each mill acts as an independent electricity supplier, and can sell excess electricity to the grid. SSHG is working with policymakers to make it easier for mill owners to earn Renewable Energy Certificates (ROCs) on their electricity sales.

## **Training, support and quality control**

SSHG has thrived through sharing information and skills. Some members have expertise in organisation, others in engineering, and some have significant practical skills. Professional expertise is brought in under contract for feasibility studies, turbine manufacture, and most of the installation work.

## **Benefits and replicability**

For different sites, the predicted electricity generation varies between about 3 and 6 MWh/year per kW installed, depending on the variation in the water flow. Output can differ considerably from year to year, because of variations in rainfall. For instance, Gant's Mill (the first site to be installed) has a predicted average generation of 43 MWh/year but generated only 25 MWh during its first year of operation (2004), because of very low summer rainfall. The predicted generation for the ten SSHG schemes is 600 MWh per year, which is equivalent to the demand of about 150 average homes. This can provide a significant income for mill owners from electricity sales.

The electricity generated by the mills replaces grid electricity, and therefore reduces carbon dioxide emissions. Assuming the average emission of 0.43 kg CO<sub>2</sub> per kWh of grid electricity, Gant's Mill in its first year saved about 11 tonnes of CO<sub>2</sub>. The predicted annual saving when all schemes are in operation is about 260 tonnes of CO<sub>2</sub>. There will be additional savings from the energy efficiency measures installed at the mills.

By bringing the disused mills back into operation, SSHG is helping to preserve the buildings. It is also raising awareness of renewable energy. Following commissioning at Gants Mill, local friends and neighbours were invited to view the installation. Because many of the mill sites are of historic interest, they attract visitors. In 2004, over 4,000 members of the public visited Gant's Mill, and many showed interest in the hydro installation. SSHG have also published a leaflet about their work, and attracted considerable press attention.

SSHG estimates that there are 40,000 mill sites across the UK where small scale hydro might be viable, with significant potential in South Somerset and the South West. It is actively helping to develop a similar initiative in North Dorset, the Stour and Vale Hydro Group.

## **Management, finance and partnerships**

SSHG has an elected Chairman, Secretary, and Treasurer, but works as a relatively informal organisation. Group members share experiences, skills, and knowledge amongst themselves at bi-monthly meetings. South Somerset District Council continues to help the group by providing the time of Keith Wheaton-Green and auditing facilities.

The overall cost of the ten schemes is estimated at about £240,000. SSHG obtained £8,000 from the Energy Savings Trust (EST) to support feasibility studies at nineteen mill sites in South Somerset and North Dorset, also £88,000 from the EST and £45,000 from the SWEB Green Electron Fund to provide funding towards installations. The remaining cost of installations has to be met by the individual mill owners.

Feasibility studies for SSHG are carried out by consultants Renewable Heat and Power Ltd, while Hydro Generation Ltd undertakes the detailed design and installation at all sites. Local Parish and District councils have been consulted over planning applications: in one case this resulted in a Parish meeting where concerns of local neighbours could be addressed.

## **Use of the Ashden Award**

SSHG wanted to increase the number of mill owners it could help, and the Ashden Award has enabled it to do just that. Additional grant funding has been received from Wiltshire and Cranborne Chase AONB Sustainable Development Fund, which has also helped them towards their goals. Since the Award, the following action has been taken:

- Funds have been given to two mills to enable feasibility studies.
- Funds have been given to eight mills to move onto the detailed design stage.
- Five mills with completed feasibility studies have been identified to possibly be funded for the next stage of development.

SSHG have also been approached by a developer of low-head hydro turbines to work on a new design with a plastic propeller and submersible generator.

*This report is based on information provided to the Ashden Awards judges by South Somerset Hydropower Group; and findings from a one-day visit by one of the Ashden judges to see their work in Somerset*

*Dr Anne Wheldon, Technical Director of the Ashden Awards, May 2006.*

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