# HYDROPOWER BRIEFING

## Report by: Director of Environment

### Wards affected

County-wide

### Purpose

1. To inform Members about the potential for developing hydropower within the County and how any proposals may relate to the Unitary Development Plan, the Economic Development Strategy, the Council's commitment to reduce carbon dioxide emissions through its Carbon Management Action Plan, and the recently adopted Herefordshire Partnership Climate Change Strategy.

### Financial implications

2. None.

### Considerations

3. The Unitary Development Plan, Herefordshire Economic Development Strategy and the Herefordshire Partnership Climate Change Strategy.

### Background

4. Herefordshire Council's Environment strategy states the Council's commitment to promoting the use and development of appropriate sources of renewable energy "where they are economically and environmentally sustainable through the Unitary Development Plan (UDP)". The UDP acknowledges that investment in renewable energy can help meet commitments to reducing greenhouse gas emissions and notes government policy to stimulate the development of renewable energy sources – as long as they are "economically viable and environmentally acceptable". Any benefits that accrue from the development of renewable energy, says the UDP, "should be balanced against the need to take full account of the impact upon the landscape of the County, local amenity, and the potential for pollution".

5. A key aspect of renewable energy schemes is that the generation of energy is decentralised, that is, it occurs at various locations located as close to demand clusters as possible, and is managed locally. This minimises power losses through transmission, increases opportunities for local economic development and employment and ultimately improves energy security by means of diversity of supply, local choice and local control.

6. For decentralised renewable energy systems to meet their potential they should include a mix of different energy sources, to include as many as possible from wind, solar thermal, solar electric, biofuels and hydropower. Such a mix would reflect that called for in the government's recent Energy Review.

Further information on the subject of this report is available from Trish Marsh, Sustainability Manager on 01432 261930

7. The Regional Energy Strategy for the West Midlands (2004) sets a stretching regional target of 5% renewable generation by 2010 (the national target is 10%) and 10% by 2020. It calls upon Local Authorities to “encourage proposals to for the use of renewable energy resources … through their Development Plans” (see also RPG11).

8. Hydropower systems convert potential energy stored in water held at height into kinetic energy and use it to turn a turbine and produce electricity. According to the British Hydro Association, small-scale hydropower is one of the most cost-effective and reliable clean energy technologies. Definitions vary, but generally and for the purposes of this paper, a hydroelectric plant that produces less than 1000 kW (1MW) of electricity is termed micro-hydro (sometimes the phrase mini-hydro is used for plants between 100kW and 1MW). Such installations can be operated as local power sources or, above a certain threshold, can supply to a grid. Improvements in small turbine and generator technology mean that useful amounts of power can be produced from even a small stream; there are several examples of hydropower plants in the 50kW range selling electricity to the national grid.

9. The energy available in a body of water depends on the mass of water flowing per second and the height (or head) through which the water falls. There are many hydroelectric system designs but they are generally divided into three categories: low, medium and high head. Low head systems can be installed in, for example, old mill sites with a weir and sluice. High head schemes are geared to fast-flowing upland streams.

10. Small-scale hydropower has particular advantages over wind, wave and solar power, namely: a high efficiency (70 - 90%); a high capacity factor (typically greater than 50%); a high level of predictability, a slow rate of change (output power varies only gradually from day to day, not from minute to minute), robustness (systems can be engineered to last for 50 years or more) and little effect on the local environment (small-scale hydro is in most cases 'run-of-river' requiring no water storage).

11. Hydropower requires the water source to be relatively close to the site of power use, or to a suitable connection to the national grid. It is possible for single households with a mains connection located near a hydro source to install a micro-hydro system. Allowances should be made for seasonal variations in water flow, such as having access to a back up power system.

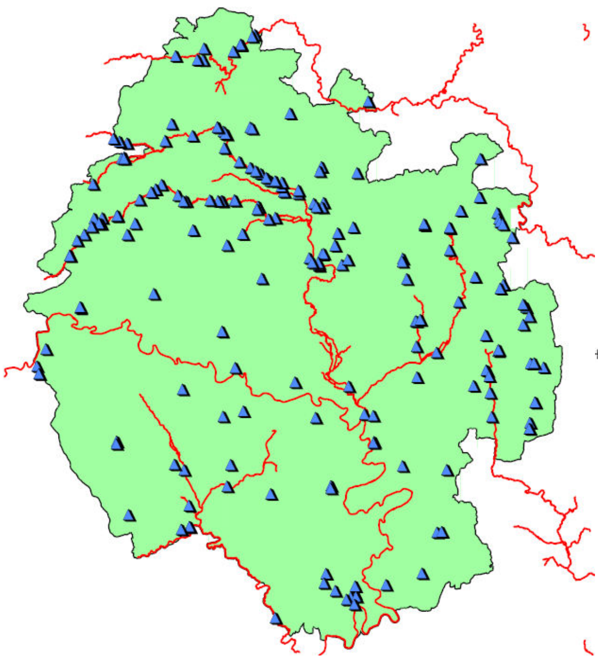
12. Capital costs are fairly high, but lower if some basic infrastructure, such as an old mill or weir, is already present. The Energy Saving Trust estimates that for low head systems (not including the civil works – so assuming an existing pond or weir), costs will be in the region of £4,000 per kW installed up to about 10kW, and dropping per kW over that level. For medium heads they estimate a fixed cost of about £10,000, and then about £2,500 per kW up to around 10kW. Running costs after installation are minimal.

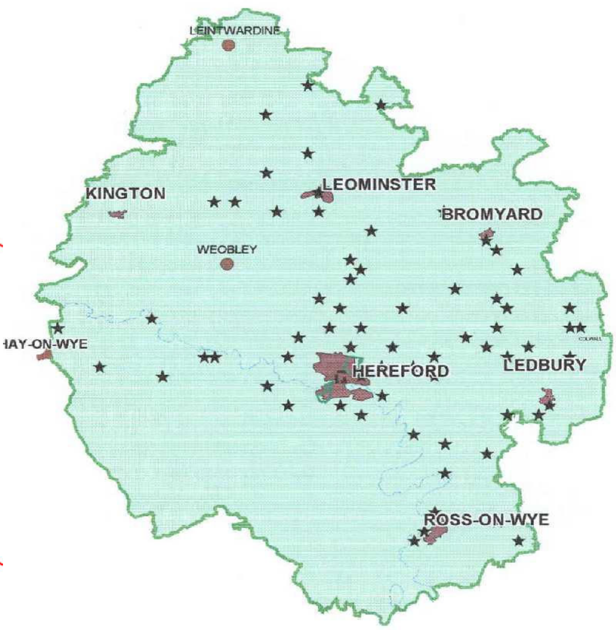
13. To assess the suitability of a potential site, its hydrology needs to be known and a professional site survey carried out to determine actual flow and head data. For a run-of-river scheme the capacity of the scheme will be limited by the mean flow value. According to the British Hydro Association, preliminary investigations by a hydrologist will typically require 2-3 days’ work and will cost between £300 and £1000 at 2004 figures. If the outcome were promising this would need to be followed by a feasibility study.

## Local developments

14. Activities to promote biofuels development and the take-up of wind and solar power are already underway in Herefordshire. Little progress has been made to date in establishing the feasibility of hydropower. However a local conservation group called the Lugg Valley Heritage Network is actively interested in exploring the feasibility of installing hydroelectric plants along the length of the River Lugg.

15. The obvious sites to explore for possible hydropower development are those with existing or historical water mill, weir or sluice infrastructure. The Lugg Valley Heritage Network has referred to "one hundred water wheels" that once generated power along the Lugg. The map (below left) indicates the 193 weirs identified on OS maps of the county.






16. The first known mill in Herefordshire was at Wellington, dated by dendrochronology to 696 AD. By the time of the Domesday Survey of 1086 there were at least 116 mills in the county as seen on the second map (below right). This includes 16 in and around the manor of Leominster. There were probably several more unrecorded mills in the town of Hereford. Altogether 348 mills are listed in the council's Sites and Monuments Record dating from the medieval period to the 20$^{th}$ century. However, a complete survey has not been carried out and there were probably far more in total.

17. Some river flow data is maintained at the National River Flow Archive, managed by the Centre for Ecology and Hydrology. This tells us that of the rivers flowing through Herefordshire, the faster ones include the Lugg, which at Lugwardine has a mean flow of around 11.2 $m^3$/s, the Arrow at Titley Mill, which flows at around 2.4 $m^3$/s and the Wye at Belmont, which reaches 47.4 $m^3$/s. Most other gauging stations in the county show rivers flowing at around 1 $m^3$/s or less. A scan of local OS maps suggests that a head of more than 5m will be difficult to achieve given the terrain.

18. As a rough calculation, a micro-hydro installation (with a 70% efficiency) running on the Lugg at Leominster with average flow of 5.64 $m^3$/s and a head of 1.5m would give

a power output of 59kW. With a load factor of 66% (which scales the output according to the proportion of time that the turbine is actually used to produce power) the energy output over a year would be around 342 MWh, enough to meet the annual electricity demand of 100 homes.

19. Alternatively the electricity generated by such a scheme could be sold directly back to the grid. At current prices small renewable producers can get around 6.5p per kWh as well as Renewables Obligation Certificates or ROCs (see 27) worth 4p per kWh, putting the direct financial benefit at around £35,500/yr. Assuming a total cost of construction in the region of £100,000 - 200,000 (excluding grants), return on investment could be envisaged within 3-6 years.

20. Alternatively, assuming the average household electricity bill is around £300, the financial benefit of such a scheme that directly meets the electricity demand of 100 homes would amount to around £30,000/yr plus ROCs worth around £13,000/yr (see para 27).

**Regulatory considerations**

21. Planning permission will be required for most hydro developments. While likely to be generally supportive, planners will have concerns for the visual appearance of the scheme; potential noise impacts on nearby residents; preservation of structures of historical importance; and environmental impacts, on which the Environment Agency and English Nature will also be consulted. Special consideration will need to be given to the needs of any migratory fish.

22. The appropriate licence must be granted by the Environment Agency, depending on whether water is being abstracted (even if it is being returned later), impact on migratory fish and on the structural alterations required for the surrounding land. An environmental impact assessment may also be required, depending on the size of the scheme.

23. It is also necessary to establish whether the required permissions will be granted to use all the land required – both to develop the scheme and to maintain the necessary access to it. Since water-courses often form property boundaries, the ownership of the banks and existing structures may be complex.

**Grants and funding**

24. The Government's Low Carbon Buildings Programme offers grants to "community" hydropower schemes, which must be owned and operated by non-profit organisations such as councils, schools and housing associations, and run for the benefit of the local community. A grant of up to 50% of project costs can be obtained up to a maximum of £30,000 from stream 1 of this programme. Smaller grants are available for domestic schemes, and considerably larger grants will be available when stream 2 comes online.

25. South Somerset Hydropower Group, supported by South Somerset District Council, now has ten members producing electricity on the region's waterways. This initiative has attracted cash from the Council, a £45,000 grant from the South Western Electricity Board's green electron fund and, in 2002, a £95,000 grant from the Energy Saving Trust (Times article, 'Hydro power to the people,' 1 September 2006).

**Potential benefits**

26. Supporting increases in renewable energy generation capacity contributes to the reduction of greenhouse gas emissions from the county and helps fulfil the objectives of the Herefordshire Partnership Climate Change Strategy, to which the Council is signed up.

27. Creating and managing the associated new technology and infrastructure will boost economic regeneration and provide skilled jobs in the area. The payback from the sale of electricity will be boosted by an additional revenue stream from Renewables Obligation Certificates, which are issued for each unit of renewable electricity produced, and which are currently trading for around £40 per MWh/year.

28. Including hydropower in the county's renewable energy portfolio will contribute to the diversity and breadth of the renewable energy choices available locally (see para 7).

**Further considerations**

29. More research is needed in order to determine whether the potential for such schemes would be of sufficient benefit to Herefordshire and what the potential is for securing any external funding.

30. To identify whether there are viable sites for hydropower development in the county it would be prudent to first carry out a scoping study. Such a study might be available for around £10,000, although the commercial rate is well above this figure. It would look at river flow and dynamics and assess overall potential for hydropower.

31. The British Hydropower Association is looking to conduct a study of England and Wales in the near future and it may be possible to establish information relevant to Herefordshire from this.

32. Subsequently, if appropriate sites are located and there existed the desire to pursue the development of a hydropower scheme, it would be necessary to carry out a full feasibility study of each site as discussed earlier (see para 13).

## RECOMMENDATION

**THAT the report be noted, subject to any comments members may wish to make to the Cabinet Member (Environment).**

**BACKGROUND PAPERS**

- None Identified.