Annexe 2

The case for hydropower

We believe that the case for hydropower as part of a secure energy mix has not until recently been properly considered. Hydropower is the largest generator of electricity from renewable resources in the world and the UK. In Scotland, it provides 47% of the renewable energy capacity and the recently completed *Hydropower Resource Study,* referred to in the consultation document, showed that there is the potential for an additional 657MW, 50% more than current hydropower generating capacity excluding the potential from tidal barrages.

Hydropower is:

- **efficient** – about 90% of the potential energy stored in water can be converted to electricity. (Thermal power plants emit 3-4 units of "waste heat" for every unit of electricity produced.);
- **clean** - hydropower in the UK is a negligible contributor to greenhouse gas emissions;
- **renewable** – it uses proven technology, produces negligible amounts of emissions and is the only renewable energy technology that is commercially viable on a large scale;
- **a low cost generator** - running and maintenance costs are low. Plant life can be extended relatively economically through periodic replacement of electro-mechanical equipment;
- **storable** - it is the least costly way of storing large amounts of electricity;
- **a positive factor in project viability** – it is able to play a key role in multi-purpose projects (for navigation/transport, agricultural irrigation, water supply, flood protection, fisheries support recreation, etc.) – often making the project feasible;
- **a source of vital infrastructure strengthening** under-pinning remote communities and acting as an economic stimulus;
- **endowed with well known long-term benefits** – practically indefinite service life, highly reliable performance, extremely low operating costs, as well as avoiding emissions and being highly sustainable;
- **flexible and reliable** contributing to black start capability, spinning reserve, voltage support, synchronous condenser, steady-state operation of thermal units, etc. It enhances the efficiency of thermal generated base-load and back-up for other, intermittent renewable generators. Storage hydropower has a fast response time to meet sudden system fluctuations;
- **a mature industry** - it is the most industrially mature, commercially viable contributor to electricity generation. It continues to innovate to maintain this edge;
- **an eliminator of fuel price risk** like all renewable energy.
- **highly energy efficient** with operating efficiencies of more than 95% in modern plants compared with 60% in the best of the fossil fuel plants. It has the highest energy payback - only hydropower can produce over 200 times more energy from an installation than the energy needed to build and run it. This is ten times more than oil-fired power stations.
- **long-lived** -hydropower plants can have useful lives of over 100 years.

By comparison with hydropower, thermal plants, with the exception of nuclear power plants, take less time to design, obtain approvals, build and recover investment. However, thermal plants have higher operating costs and typically shorter operating lives. Any infrastructure development has an environmental and social impact potential. Hydropower offers net benefits to the environment when compared with fossil fuel generation - it has been estimated that the existing hydropower capacity has saved greenhouse gas emissions equivalent to all the cars on the planet in terms of avoided fossil fuel generation. In the UK most new hydropower power plants will be lower impact, run-of-river schemes. We believe there is potential for an additional 1,800MW- 3,600MW of conventional hydropower.

The case for pumped storage hydropower

Pumped-storage hydropower comprises an upper storage reservoir and a lower storage reservoir connected by tunnels, a powerhouse, switchyard and transmission or pipelines. It is the only proven technology for large-scale energy storage. Pumped storage schemes can have very rapid start-up; at Dinorwig from shutdown to full load generation can be achieved in 90 seconds (spinning in air to full load takes only 16 seconds). It is the fastest in the world. At Ffestiniog, shutdown to full load generation can be achieved in 5 minutes (spinning in air to full load takes 60 seconds). Before the 1950s the typical pumped-storage plant had a capacity of under 100MW. Smaller pumped storage plants, such as these, cold serve to maximise generation from wind power, storing off-peak generation for later use. Pumped storage offers a range of system benefits:

- **peak-shaving** or load-shaping is the traditional role for pumped storage; pumping water for storage at off peak demand for use at peak demand. The typical daily cycle is pumping for 8 hours with generation for 6 hours. It displaces alternative peaking capacity such as open cycle gas turbine generators.
- **load pick-ups** use the rapid response capability of pumped storage to meet very sudden demand increases, such as “TV pick-ups” at the end of popular programmes, or where there has been a tripping of major generation units, or sudden transmission loss such as by lightening strikes. There is virtually no alternative to pumped-storage for this function other than high-head hydropower or load shedding.
- **load following** provides flexibility allowing variable output to match demand. It can rapidly start-up and shut down many times a day and operate efficiently across a wide output range. Thermal power can increase output at only 3-5% per minute, requires a start-up of between 1-8 hours and is significantly less efficient at part load. The use of thermal plant for load following puts stress on equipment and increases maintenance costs.
- **stand-by.** Pumped-storage provides a quick response to generation loss.
- **firming intermittent generation** such as wind power or time shifting outputs from predictable sources such as tidal energy. It can be used to increase the value of off-peak generation of all types of renewables. When directly linked to “green energy” projects pumped storage retains its “green” status.
- **systems management.** Pumped storage increases flexibility of despatch and can be used for power factor correction, frequency control and voltage regulation.

The case for offshore hydropower

Tidal power has a long history and the first commercial tidal project, La Rance, at St Malo in France, has operated since 1965 using a barrage and hydropower turbines. In the UK, there have been long standing proposals for offshore barrage/bridge hydropower schemes such as large schemes like the Severn estuary and across Morecambe bay or even in smaller proposals

such as a new fixed link to replace the existing ferry service between Luing and Seil in western Scotland. Other proposals are for tidal lagoons; areas of shallow sea enclosed by a circular wall into which are built turbines capable of generating on both incoming and outgoing tides. A House of Lords committee reported that 24,000GWh could possibly be generated from tidal lagoons. It has been estimated that the Severn estuary could provide enough tidal power per unit price as three nuclear power stations.

Barrage schemes do not flood land, cause the transfer of people, or encourage water-borne diseases and, to-date, single-basin, double-effect tidal power plants can offer an economical and environmentally benign source of electricity. These schemes have advantages over other offshore schemes. The fixed link makes it easier to export the electricity generated and the maintenance of installations as well as improving road or rail transport connections. Tidal lagoon schemes could provide harbourage for the maintenance of offshore wind facilities which are being sited in shallow coastal waters or act as a node for the collection of electricity generated by them. The electro-mechanical equipment is well established and there is extensive experience of barrage schemes from plants at La Rance, in Nova Scotia, Canada, and other countries including China where there are a number of small schemes. There are draw-backs; at several sites substantial tides coincide with high silt content but the design of tidal power plants encourages flushing.

The international context

Hydropower is the world's leading source of sustainable energy - about 20% of the world's total electricity generation is from hydropower. In developing countries hydropower generates one-third of the electricity used. Between 2000 and 2010, 695,000MW of new capacity will be installed: 27% in coal-fired plants, 26% in gas-fired plants and 22% in hydropower plants.

Worldwide hydropower developments are frequently part of multi-purpose facilities helping to secure water supply, irrigation for food production, flood control, navigational improvements, industrial developments, fishery opportunities, tourism and increased recreational opportunities. Hydropower is clean, renewable electricity. It can provide unique benefits rarely found with other sources of energy. In Africa, Asia and Latin America, where approximately 2 billion people in rural areas are without electricity supply, hydropower offers potential for contributing to a vast improvement in living standards. The UK has an established skills base across the whole range of activities in the hydropower industry with particular strengths in design and consultancy. We have extensive, long-standing and continuing experience in a wide range of overseas projects and the UK hydropower industry retains considerable export potential.

British Hydropower Association
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