Hydro schemes

Snapshot: A well established sector, with proven technologies tapping into one of Scotland's most abundant natural resources, hydro power performs a vital role in renewable electricity production, balancing supply and demand and providing grid back-up.

Recent studies have shown a significant untapped potential in Scotland's watercourses. Whilst opportunities for large scale impoundment are likely to be limited, there is potential for numerous smaller impoundment and run-of-river projects. Planning authorities are expected to play a key role in identifying opportunities, working with hydro developers and consultees at an early stage, mitigating impacts, including cumulative effects.

Scottish Ministers have issued a policy statement on balancing the benefits of renewable electricity generation from hydropower schemes and the protection of the water environment. Emphasis will be placed on supporting hydropower developments which can make a significant contribution to Scotland's renewables targets whilst minimising any adverse impacts on the water environment. Following on from the Ministerial Statement, Scottish Environment Protection Agency (SEPA) has also developed guidance on run of river hydro schemes (see below).

On June 1, 2011 the Electricity Act 1989 (Requirement of Consent for Hydro-electric Generating Stations) (Scotland) Revocation Order 2011 came into force. It means that from that date onwards the threshold above which applications for hydro-electric generating stations are made to Scottish Ministers under the Electricity Act 1989 is revoked to 50MW. Applications below that will be determined by planning authorities.

Suggested areas of focus for planning authorities:

- Provide guidance on where there are greatest opportunities for hydro developments within the planning authority area and the type of hydro schemes that are likely to be the most appropriate;
- Detail criteria to be applied in assessing hydro applications;
- Establish a clear protocol for involving key consultees at spatial planning, policy making, pre-application and application stages;
- Identify proportionate levels of information to service pre-application discussions and for assessing applications;
- Secure support from local communities, hydro operators and other stakeholders on policies and procedures.

Opportunities within Planning Processes for Planning Authorities:

Stage in Planning Process	**Possible Actions**
Monitoring and Evidence Base and Main Issues Report	• Collate existing information and use further information from key consultees for hydro (such as SEPA, Scottish Natural Heritage (SNH), environmental non-governmental organisations (NGO)s, Scottish Canoe Association) in order to: o Map water resources within area; o Update map based records of former, consented and operational hydro schemes, including details of scale, type and pumped storage; o Map known sensitivities such as landscape, nature conservation, cultural heritage, water quality, fisheries and recreational interests.

	• Consider other possible constraints such as land ownership, access, grid and transmission; • Consider if there are opportunities to restore former hydro schemes or to create new hydro schemes in area; • Discuss untapped potential with consultees, hydro operators and key local stakeholders; • Consider if there is likely to be increased interest in a particular type of hydro as a result of changes in Feed in Tariffs or other incentives; • Determine if bringing forward additional hydro in the area, in itself, or as part of a wider renewable energy strategy merits consideration in the Main Issues Report
Spatial Planning	• Consider the adequacy of any existing spatial plans for hydro in the planning authority area • Consider cumulative effects and optimisation of the resource taking account of consented and operational hydro schemes, consulting if necessary other stakeholders • Work closely with consultees to ensure that spatial plans identify known sensitivities and potential constraints and identify areas of greatest opportunity; • Consult Scottish Environment Protection Agency (SEPA) to ensure that spatial plans have regard to river basin management plans (spatial plans should not put in place a sequential approach to determining applications outwith areas of greatest opportunity) • Consider if spatial guidance prepared for hydro helps to identify opportunities for new and restored hydro, including opportunities for particular scales or types of hydro • Ensure that spatial guidance recognises the potential for cumulative impacts
Drafting Development Plan Policy	• Ensure that hydro policies cover: o The range of potential scales and types of hydro, o Construction, design, supporting infrastructure and management of schemes o The restoration of former hydro schemes or the alteration of existing schemes (including dam raising) o Landscape, nature conservation, cultural, fisheries, water quality, amenity and recreational interests o Cumulative impacts and decommissioning • Ensure that other development plan policies for new developments encourage hydro as an energy option where impacts can be managed • Ensure that only matters of detail and guidance are reserved for supplementary planning guidance (SPG) • For Strategic Development Planning Authorities, provide strategic guidance to manage cross-boundary and cumulative impacts of hydro • Consult key consultees for hydro at an early stage on the drafting of hydro energy policies

Development Plan Action Programmes	• Consider selecting an action officer to take forward development plan objectives for hydro. Typically this might involve sharing knowledge through a local hydro working group involving key consultees and landowners, producing a project plan to decide on focus and priorities, preparing local design guidance, development briefs and considering local solutions to local problems
Securing Sufficient Information to Determine Planning Applications	• Recognise that design statements are required for electricity generating stations 20MW or greater (including hydro), with design statements a voluntary measure for hydro schemes below • Develop Environmental Impact Assessment (EIA) scoping templates in conjunction with SEPA, SNH and Historic Scotland as necessary
Pre-Application Stage	• Prioritise early engagement with SEPA at pre-application stage, as applicants will also be required to obtain a water use licence from SEPA under the Water Environment (Controlled Activity) Regulations 2005 • Ensure that key consultees are given adequate opportunity to be involved in pre-application meetings / site visits • Gauge where the most significant issues are likely to lie with the particular application – if these relate to impacts on the water environment, advise the applicant that securing a controlled activity regulations (CAR) licence first may be financially more prudent (SEPA's early stage checklist will assist with this) • Determine information needs for applications at an early stage, particularly if seasonal ecological surveys are required or if the development might affect designated areas, and provide early advice on whether schemes require an EIA • Be aware works may need to be scheduled to avoid the breeding seasons of sensitive species
Determining Planning Applications	• Ensure that key consultees are given early opportunity for meetings and site visits on the application to help ensure that constraints are timeously overcome where possible • Planning authorities should obtain and have particular regard to SEPA advice and expertise on matters relating to the protection of the water environment • Planning authorities in balancing environmental, social, cultural and economic considerations in determining applications should note that SEPA also has a statutory duty to consider social and economic matters under the 2005 Regulations, including to ensure compliance with the Water Framework Directive. Early joint discussion with applicants is advised on these matters • Technical information and guidance on typical planning considerations associated with hydro are provided below which planning authorities should draw upon in determining applications.

Technical information for Hydro schemes:

Hydro schemes: Scotland's hydro industry encapsulates a wide range of hydro operation, of different scale and type, with a variety of physical configurations involving different turbine mechanics. This diversity allows different volumes of water and flow rates to be captured, schemes to be positioned within different positions within the landscape and for water courses flowing over different gradients to be used. There is a corresponding range of physical interventions and significant scope to vary the design and efficiencies of hydro schemes.

Main categories of hydro: Hydro-power schemes can be categorised into large scale impoundment, small-medium scale impoundment, pumped storage, diversion (run of river) and micro hydro.

- Large scale impoundment normally involves substantial flooding of rural landscape, a substantial dam artificially holding back large volumes of water on the flooded land to control water flow, significant pipework, a power station, a tailrace to slow and control water flow for release into land or a water course below, substantial electricity generation transmission lines and vehicular access for servicing.
- Pumped storage involves the same arrangements as large scale impoundment, but would normally use a natural loch or additional reservoir at the lower level. Water is pumped back to the upper reservoir using cheaper off peak energy, for later release. Often turbines can be used as pumps but if a separate pumping facility is required, there will be a need for additional pipework. [Pumped storage is discussed further under the energy storage and transitional technologies factsheet].
- Small-medium scale impoundment involves a scaled down version of large scale impoundment, but with greater scope to use naturally forming water bodies or contained areas within the landscape.
- Diversion (Run of River) schemes typically involve creating a small head pond, with a weir, which allows sufficient water to fill the intake of a penstock pipe which is typically buried or hidden running alongside river or within riverbed to a turbine below, whilst allowing a proportion of the water to continue to flow down the normal stream channel. The power house tends to be a building of modest 'double garage' proportions capable of housing a turbine, generator and transformer and involves a pipe or channel where water is returned to the watercourse. It tends to result in more modest electricity generation, tends to be either sold to the grid at preferential rates or serves a landowner or local community's own electricity needs. Sometimes a service strip for foot access to inspection chambers may be all that is required for the length of penstock pipe but on other occasions new vehicular access may have to be formed.

High head, low head: Hydro power schemes are also regularly divided into low head and high head schemes; where 'head' means the height that the water falls. Low head projects might include old mill sites with a weir and sluice, whilst high head projects tend to include fast flowing upland stream schemes.

Turbine Types: Irrespective of different configurations, there is a degree of commonality, with water flowing from a higher to a lower level being used to drive a wheel or turbine, to produce mechanical energy, to generate renewable electricity. The sector have tended to use two main types of turbines - the 'impulse' (e.g. Pelton and Turgo) and 'reaction' turbines (e.g. Francis and Kaplin) depending on head and water flow. The choice of turbine affects power output, impacts on fish and the type of equipment housing required.

Economics of Hydro-Power: The key aspects are the initial large capital outlays in comparison to alternative technologies. However, this is mitigated by the long lifetime, high reliability, low running costs and little or no annual fuel costs. The MW output will depend on the amount of water, the flow rate, the height which the water falls and the force of gravity. The efficiency of a hydro scheme depends on how it converts power available from water into electricity. Maximum efficiencies can be up to 80% but for smaller schemes a more realistic aim is 40%. Local circumstances will usually dictate the most relevant, appropriate and cost efficient technology.

Typical Considerations in Determining Planning Applications for Hydro

EIA procedures: Some hydropower schemes will require an EIA. Planning authorities are recommended to work with other relevant organisations, including SNH and SEPA, to ensure consistent application of the EIA requirements and to avoid developers being required to produce unnecessary information.

Siting in the Landscape and Design Considerations: Whilst hydro power schemes are inherently tied to the location of the water resource, there may be scope to adjust the precise siting of the components to achieve good integration with local landscape characteristics. There may be opportunities to conceal elements within existing woodland, provide new planting or carry out land re-profiling works. Careful consideration should be given to the architectural quality and materials of built elements, along with the surfacing treatments for access tracks. Measures to minimise the visual impact of headrace pipes and power lines should also be considered carefully at the design and planning application stages.

Habitats and Species: The EIA would be expected to establish whether or not there are any significant impacts on the biodiversity of an area, including aquatic and terrestrial ecosystems, habitats and species, e.g., breeding birds and/or freshwater fish. Areas of particular concern may relate to water quality, water quantity and flow, the transport of sediment, water temperature, impacts on migratory fish and freshwater pearl mussels. In designing a hydro scheme, it is likely that special account will have to be given to the ecological status of the water environment, as well as aquatic species and habitats, particularly those protected under the EC Habitats Directive. It should be noted that hydro power can provide natural heritage benefits. This might be through habitat creation and/or enhancement, fish re-stocking, and bankside planting. Some types of turbine may assist in increasing dissolved oxygen levels.

Social and Economic Considerations: Planning authorities are required to take into account social and economic considerations (alongside environmental and cultural considerations) in assessing planning applications. SEPA also has specific duties to consider the environmental, social and economic effects of proposed controlled activities when determining water use licence applications to ensure that the requirements of the Water Framework Directive are satisfied. Planning authorities and SEPA have duties to co-operate and adopt an integrated approach, as far as practicable, in exercising their respective functions.

Where a proposed hydropower scheme is likely to have a significant adverse effect on the water environment, planning authorities are strongly advised to obtain and have regard to the advice of SEPA on matters relating to the protection of the water environment. In some circumstances, SEPA may be able to provide this advice in advance of an application for a water use licence being made. This will depend on the scheme location and design. SEPA's guidance to developers of run of river hydropower schemes identifies the relevant

circumstances. The Ministerial Statement and SEPA's guidance both make it clear that for schemes of less than 100 kilowatt (KW) attention will need to be given to managing both individual and cumulative impacts. Generally no deterioration will be permitted, unless the proposed scheme delivers particularly significant benefits.

Mitigation: Many of the impacts, and therefore the opportunities for their mitigation, will be unique to individual schemes. Mitigation measures will be reported in the Environmental Statement. Typically, careful attention to location, design, finish, construction and operational arrangements can help to minimise adverse landscape impact, can provide opportunities for access and recreation, can reduce risk to water quality and fish stocks, and can reduce impacts on amenity from construction and traffic. Careful attention should be given as to whether conditions would be more appropriately included in the planning or water licence consent.

Good Practice During Construction: Planning authorities should generally encourage developers to appoint Ecological Clerks of Works to ensure that agreed designs and construction techniques are followed following planning approval.

Further elements of good practice are provided in the hydro case studies within the Scottish Government case studies webpage.

Useful References:

Scottish Ministers have issued a policy statement on balancing the benefits of renewable electricity generation from hydropower schemes and the protection of the water environment.

The Scottish Hydropower Resource Study produced for the Forum for Renewable Energy Development in Scotland (FREDS) in Autumn 2008, highlighting untapped potential in smaller and micro hydro schemes, estimating 657 megawatts of financially viable hydro electricity schemes to exploit in Scotland.

Further research into potential job creation from micro-hydro schemes has been published in The Employment Potential of Scotland's Hydro Resource (2010).

SEPA has published general guidance for hydro developers on siting and mitigation and supporting information requirements for hydro schemes, including run-of-river schemes. A Guide to Hydropower Construction Best Practice is also available.

SNH have produced guidance on hydro schemes and natural heritage

The British Hydropower Association has prepared a useful technical guide titled 'A Guide to UK Mini-Hydro Developments (2005)' to assist anyone in the UK who is planning to develop a small-scale hydro-electric scheme.

Scottish Renewables, the Scottish Government, SEPA and SNH have produced a 'Guide to Hydro Power Construction Good practice'