LINK Briefing

Hydropower and Freshwater Habitats
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Hydropower and freshwater habitats

Summary

While pumped storage hydropower can provide renewable, grid balancing capabilities, the potential environmental impacts of large-scale projects must be carefully weighed to balance a need to decarbonise our energy grid and protect vital and sensitive freshwater habitats.

Environmental impacts of hydropower schemes can vary on a case-by-case basis, depending on local ecological and geographical considerations. Ultimately, any proposals to develop hydropower must undergo the most stringent environmental review and stakeholder consultation.

With a measured, evidence-based, and ecologically-centered approach, it may be possible to identify hydropower projects that can coexist with the protection of Scotland's iconic natural heritage. However, the bar for environmental sustainability must be extremely high given the inherent risks posed by hydropower infrastructure in these sensitive regions.

Background

Hydroelectric power has a long history in Scotland. The earliest generation schemes date from the 19th century but it wasn't until the 1920s that the first large hydroelectric scheme was developed, and further large schemes have since followed. In recent years there has been a proliferation of pumped storage hydropower and smaller 'run-of-river' developments across Scotland.

Small-scale 'run-of-river' hydro schemes are increasingly seen as sustainable solutions to energy supply. Rather than damming a river valley with a large concrete structure, these small-scale schemes divert a proportion of the flow from the main channel, through a turbine house, before returning to the main channel further downstream. Licence conditions require a defined minimum flow to be maintained below the intake to ensure that downstream ecology is not too badly impacted, but the flow changes also affect sediment movements. This may affect habitat quality as well as reducing the wetted area, which reduces the space available for aquatic species. This can lead to competition for food and space, and may lead to the loss of sensitive species or migration of species to more suitable habitat downstream.

Pumped storage hydropower is a form of grid-scale energy storage that involves using electricity to pump water from a lower reservoir to an upper reservoir. When electricity is needed, the water is released back down through turbines to generate power. This cyclic process allows pumped storage to provide valuable load-balancing and grid stabilization services.

While pumped storage hydropower can provide these valuable grid storage and balancing capabilities, the potential environmental impacts of developing these large-scale projects in Scotland's highlands and islands must be carefully weighed. Scotland's northern regions are home to some of the UK's most ecologically sensitive and biodiverse natural landscapes, and any disruption to these areas could have severe consequences.

The construction of pumped storage reservoirs and dams inevitably leads to the flooding and destruction of natural habitats. This could displace and fragment populations of rare and endangered

species, from iconic fauna like golden eagles and red deer to more obscure but equally important plants and invertebrates. The long-term viability of these sensitive ecosystems is a critical concern.

Beyond the direct habitat loss, the rapid and frequent changes in water levels and flow regimes needed to charge and discharge the pumped storage reservoirs inevitably significantly alter the hydrology of these watersheds and their sediment transport processes. This has the potential to disrupt aquatic food webs, and damage sensitive spawning grounds for migratory fish like Atlantic Salmon.

A further concern is the potential impact of climate change on upland waterbodies. The Scottish Environment Protection Agency (SEPA) predicts that summer river temperatures in Scotland will rise by almost 4 degrees Celsius by 2050. In addition, flows in some rivers may reduce by more than 25%. Water temperatures in lochs and other waterbodies are predicted to rise by 3 degrees Celsius by 2080, resulting in a higher probability of low oxygen concentrations and harmful algal blooms. Reduced flows and increased water temperatures are likely to have a significant detrimental effect on aquatic species. These effects may be exacerbated by the development of hydropower schemes in these waterbodies. It is essential that the impact of climate change on water flows and temperatures is taken into account when assessing schemes to ensure that there are no detrimental impacts on the ecology of the waterbody during the lifetime of the proposed hydropower scheme. It is also important that the feasibility of the scheme in terms of power output is assessed both on the basis of current flow and water level conditions, but also on those that might occur in 20-30 years' time. The operation of existing hydro-power schemes, and requirements for downstream compensation flows should also be re-assessed in light of climate change projections.

However, it is important to acknowledge that the site-specific nature of hydropower projects means the environmental impacts can vary considerably depending on the local geography and ecological conditions. Careful site selection, rigorous impact assessments, and robust mitigation measures may be able to reduce or offset some of the risks.

Ultimately, any proposals to develop hydropower must undergo the most stringent environmental review and stakeholder consultation. The long-term preservation of these precious natural habitats should be the overriding priority, balanced against the potential grid storage benefits that pumped storage could provide. Alternative energy storage technologies, such as green hydrogen, liquid air and gravity power, which may have smaller environmental footprints should also be thoroughly evaluated.

With a measured, evidence-based, and ecologically-centred approach, it may be possible to identify hydropower projects that can coexist with the protection of Scotland's iconic natural heritage. However, the bar for environmental sustainability must be extremely high given the inherent risks posed by hydropower infrastructure in these sensitive regions.

Scottish Environment LINK is the forum for Scotland's voluntary environment community, with over 40 member bodies representing a broad spectrum of environmental interests with the common goal of contributing to a more environmentally sustainable society.

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