Scottish Renewables – Pumped Storage – Position Paper

Hydro Electric Pumped Storage is currently the only electricity storage technology which can operate on a commercial scale.

Such schemes work by using electricity to pump water from a lower to a higher reservoir where it can be stored and then, when required, be released to generate electricity, as a conventional hydroelectric power station would. In this way Pumped Storage technology effectively acts like a giant battery, storing energy when it is not required and releasing it when it is.

This ability means Pumped Storage has the potential to play a hugely important role in helping to deliver a safe and secure energy system for the UK, along with providing a number of other technical, environmental and economic benefits. Undoubtedly, the case for developing new Pumped Storage capacity has never been clearer than it is today.

The UK currently generates 14.8% of electricity from renewables. However this figure is set to grow rapidly in order to reach legally binding renewables targets set for 2020 and climate change targets in 2030 and 2050. New Pumped Storage can help to facilitate the move to this low-carbon future, ensuring that renewable energy can be stored when generated and used when required. This enables efficient management of a more diversified mix of energy generation, smoothing differences between demand and supply and enabling savings to be made on transmission upgrades and balancing services.

In addition, Pumped Storage is also essential for energy security, guarding against black outs from unplanned shutdowns of large power stations by reacting quickly and effectively to gaps in demand.

Yet currently, the UK is home to just 3 GW of pumped storage capacity, a relatively small amount in comparison to Germany (6GW), France (4.5GW) and Austria (8GW). Considering the UK is an island nation and therefore less able to rely on interconnections with other states to manage the supply and demand of electricity, the case for additional pumped storage in the UK seems even more apparent.

Whilst there are initial plans for investment in new and upgraded pumped storage schemes in Scotland, which could unlock over £1 billion worth of investment and create several hundred jobs during construction and operation, continued progress in developing such projects is reliant on a satisfactory and supportive long-term public policy and regulatory framework being in place to allow commercial developers to confidently take investment decisions on their plans. However, despite the clear benefits and the relatively low capacity levels in the UK, Pumped Storage is not currently recognised within the Electricity Market Reform (EMR) framework.

As a matter of urgency, Scottish Renewables and our members want to work with both UK and Scottish Governments to establish an inter-governmental panel with key organisations including National Grid and Ofgem to consider how Pumped Storage should be supported in future for the benefit of the environment, the economy and most important, the general public.

Pumped Storage in the UK

There are currently four Pumped Storage schemes in the UK with a total capacity of almost 3GW and a storage volume of 27.6GWh. These plants include Dinorwig (1728MW) and Ffestiniog (360MW) in Wales and Cruachan (440MW) and Foyers (300MW) in Scotland. There are initial plans for further stations and upgrades in Scotland including a new scheme, Coire Glas, near Invergarry, with a planned capacity of 600MW. Coire Glas received planning permission from the Scottish Government in December 2013.

Plans to expand Cruachan were submitted into the Scottish Government's National Planning Framework 3 and, while the development of this new scheme is at an early stage, there is an opportunity to develop up to 600MW of additional capacity, taking the scheme up to 1040MW from its current 440MW.

Why do we need more pumped storage?

The Economic Case

Planned investment in the two proposed Pumped Storage projects in Scotland is estimated to be over £1 billion, with much of this going directly to the local economy.

A great deal of this investment will come in the form of employment within the local economy with the two most advanced schemes expected to employ several hundred people during construction and operation. Due to the location of pumped storage sites, many of the jobs created will be situated in some of the most remote parts of the country and provide a significant boost to local economies.

In the longer term, improvements in the efficiency and effectiveness of our electricity system and reduced network costs will add further economic advantages. It has been estimated that savings made by Pumped Storage could be worth £10bn per annum to the UK economy by 2050[1].

Storing Energy

The primary role of Pumped Storage is to store energy generated at times of excess supply for when it is needed most. . Pumped Storage offers more capacity to do this than any other available storage technology and new Pumped Storage schemes will not only increase the generation capacity available but also plan to have much larger storage capability, meaning they can provide electricity for longer periods. This will undoubtedly complement a more diversified electricity system which includes a much greater amount of variable, low-carbon generation.

By way of example, the total storage capacity of the four schemes currently operating in the UK is around 27GWh. If built, planned schemes could increase this figure significantly and would offer far greater flexibility in how their storage and generating capacity was utilised. For example, the planned scheme at Coire Glas alone has been consented with a storage capacity of up to 30GWh.

Balancing Services and Security of Supply

As the GB System Operator, National Grid purchases balancing services to ensure that sufficient generation is operating to meet customer demand on a second-by-second basis. Pumped storage plants are particularly effective and competitive in reliably providing services such as:

- **Frequency response**: Automated increases or reductions in output on a second-by-second basis to re-balance generation to meet customer demand.
- **Fast Reserve**: Ability to generate at very short notice (less than 20 seconds) and for short periods to meet sudden increases in demand such as TV pickups or to meet unexpected generation shortfalls such as a trip at a thermal or nuclear plant. This is also essential in mitigating against shut

[1] Strategic Assessment of the Role and Value of Energy Storage Systems in the UK Low Carbon Energy Future, Imperial College London for the Carbon Trust (2012) – https://www.carbontrust.com/media/129310/energy-storage-systems-role-value-strategic-assessment.pdf

down of large scale power stations. With more large scale generators being introduced to the UK in the next few years the risk of loss due to a single point failure could be up to 1.8 GW. New Pumped Storage could play a significant role in providing capacity to cover this risk;

- **Reactive power**: Production or consumption of reactive power to help to provide a stable voltage, ensuring a high quality supply for customers;
- **Black Start**: In the event of a system blackout, black start providers can re-energise the network to get customers back on supply and to provide the "kick-start" required to re-start thermal and nuclear plants.

The demand for these balancing services is predicted to grow significantly in future years with the increase in new inflexible and variable generation being developed.

Increasing the Effectiveness of Renewables

Given that generation from renewable sources often varies with changing weather conditions, Pumped Storage can help to smooth peaks in generation. To use one example, Pumped Storage would allow for storage of power generated by wind farms during periods of high winds and low electricity demand for use when required. As the level of renewable electricity generation on the system continues to grow rapidly in the next few decades, this role will become increasingly important and especially so if we are to begin to realise Scotland's potential in offshore renwables in the form of wind, wave and tidal.

Therefore, Pumped Storage allows the UK to further diversify our energy mix to include a larger proportion of renewables. This clearly has carbon emissions reduction benefits and increases security of supply by enabling greater utilisation of our domestic energy sources.

Reducing Transmission Costs

By introducing new Pumped Storage, the need for additional transmission capacity to deal with increases in renewables generation can be reduced. As Pumped Storage schemes are able to store excess energy, it allows the transmission system to be sized for the average capacity rather than the peak generation or demand requirement.

Reducing Balancing and Service Costs for Consumers

In correspondence with the savings made on new transmission infrastructure, using Pumped Storage can reduce the need to pay generators to turn on or increase generation at short notice to meet demand and conversely avoids the need to compensate generators to switch off plants at periods of over-supply.

Similarly, there is an additional demand side benefit to Pumped Storage in that energy users will be less likely to be paid to stop consuming energy as this demand could be met in part by Pumped Storage plants. . This has the double-benefit of allowing industry and business to continue operating without interruption while avoiding the need to make additional compensation payments.

What are the issues with realising the potential of pumped storage?

There have been no new Pumped Storage facilities built in the UK in the last thirty years, however, this paper demonstrates that there is a very clear case for expanding the capacity of this technology. Whilst there are advanced plans for Pumped Storage stations in Scotland, these face significant investment challenges which need to be overcome before the benefits outlined in this paper can be realised.

Risks associated with time and cost

Pumped Storage schemes have significant capital costs associated with them due to the large proportion of specialist underground construction and dam works, long construction period and site specific electrical and mechanical components. Since the long lead times for a Pumped Storage project from development to operation could be as much as ten years, future market certainty is a significant risk throughout the development process.

Lack of reward for benefits provided

It is anticipated that the main source of revenue from a pumped storage scheme will arise from:

- arbitrage between prices at peak and off-peak demand;
- provision of balancing services;
- capacity payments available under EMR arrangements, but no specific mechanism which recognises the wider benefits of pumped storage.

At present, investors are concerned that forecast income from these three activities combined is insufficient to support investment and that the inherent benefits to consumers and the electricity system are not suitably rewarded.

No Long-term Contracts Available

Since pumped storage generally provides ancillary services to the System Operator that cannot be planned for in advance, such stations do not receive long-term contracts. This makes long term investment decisions more difficult as revenue is less certain.

It is not currently possibly to enter into forward agreements to capture peak/off-peak spreads or to provide balancing services for the period relevant to investment in Pumped Storage plants. These agreements are always less than 5 years in length but lead times to operation of Pumped Storage plants can be up to 10 years ahead and plants have an operational life of at least 50 years.

Transmission Charging

The current transmission charging regime means that transmission access fees for pumped storage projects located in Scotland are very high and there is no differentiation between Pumped Storage schemes and stations which are pure generators.

The current transmission regime does not recognise that Pumped Storage provides a benefit to the grid network and assists in reducing costs on the transmission network.

How do we ensure Pumped Storage has a Future?

Despite the benefits and clear requirements for new Pumped Storage schemes to be developed in the UK, the technology is not currently recognised within the Electricity Market Reform framework and there is no mechanism available to enable the necessary investment decisions in new Pumped Storage schemes to be taken and allow the development of projects to be taken forward.

In order to realise the economic, technical, environmental and social benefits that Pumped Storage offers, Scottish Renewables would like to work with the UK and Scottish Governments to establish a working group with industry and other key stakeholders to consider how pumped storage can be most effectively supported to encourage investment in the technology and realise the benefits it brings.

For further information on this paper please contact Joss Blamire, Senior Policy Manager at jblamire@scottishrenewables.com.