drax

Moving mountains:
energy storage for a secure, sustainable future

Drax plays a critical role in supporting UK energy security, providing more renewable power for the country than the next two generators combined. We're investing £2.5bn in enhancing grid stability, boosting energy resilience and positioning the UK as a global leader in carbon capture and pumped storage hydro. Through pioneering green technology and innovation, we're helping the UK decarbonise, creating a path to net zero and beyond.

At this critical time for the UK, Drax is supporting the country by:

1. Bolstering UK security of supply
2. Creating and supporting thousands of jobs across the UK
3. Pioneering bioenergy with carbon capture and storage (BECCS) to help the UK decarbonise
4. Making the UK a global leader in climate-saving technologies
5. Sustaining healthy, growing forests across the world

Discover more

drax.com/pledges

Introduction to Cruachan

Renewables are essential to supporting energy security and further decarbonising the grid at a lower cost.

UK Government has been working to increase renewable capacity for the country's grid, including plans to power every UK home by offshore wind by 2030, and to fully decarbonise the UK's power grid by 2035. This is a bold and necessary step, but we must be cognisant of the nature of the power that wind and solar bring to the grid.

Intermittent power sources – such as wind or solar – only generate electricity when conditions are optimal. A grid overly reliant on these sources can fall victim to unfavourable weather conditions, leading to too little or too much power generation – risking blackouts, or requiring electricity generators to be paid to to stop producing power, which is costly.

Through providing vital storage to reduce renewable power going to waste, pumped storage hydro is an essential component to ensure our grid is not only greener, but stable, affordable and flexible.

Will Gardiner
Drax Group CEO

"Last year, the UK's lack of energy storage capacity meant wind farms had to be paid to turn off and we lost out on enough renewable power to supply a million homes. We need to stop renewable power from going to waste by storing it, and Drax is ready to move mountains to do just that."

Affectionately known as 'The Hollow Mountain', Cruachan is one of only four pumped storage hydro stations in the UK. The station has a capacity of 440 MW – enough to power more than 880,000 homes – and can store up to 10 million m^3 of water at any given time. Sitting on the northern shores of Loch Awe in Argyll and Bute, Scotland, one of the wettest areas in Europe, Cruachan is ideally located to support the UK's energy needs when required.

Drax wants to go even further and unlock the UK's full dispatchable and renewable potential by expanding Cruachan pumped storage hydro plant, which would more than double the site's generating capacity to over 1 gigawatt (GW) of power.

This would not only support the UK's renewable targets by enabling more wind and solar to connect onto the grid, but it would also deliver cumulative savings of more than £350 million to consumers as the grid continues to decarbonise.

The UK has led the world in the transition from fossil fuels to renewable power, and Scotland has been at the forefront of this renewables' revolution. However, to support energy security and further decarbonisation of the grid at a lower cost, the country will need more energy storage provided by pumped storage hydro – and Drax is ready to help deliver it.

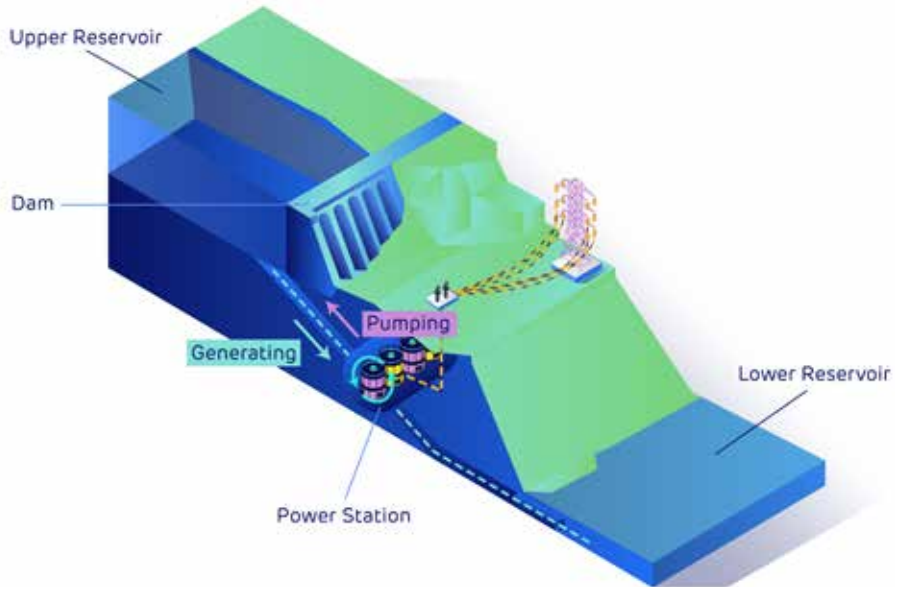
How does pumped storage hydro work?

Pumped storage hydro is based on two water reservoirs at different elevations on a steep slope.

When there is excess power on the grid or demand for electricity is low, power is absorbed from the grid and used to pump water from the lower to the upper reservoir through reversible turbines.

When demand is high, the water is released downhill into the lower reservoir, driving the turbines in the other direction to generate electricity.

Pumped storage hydro facilities act as vast 'water batteries'. They are a flexible, efficient and cost-effective way of storing excess energy generated by renewables at scale. Pumped storage hydro has been used for more than 50 years in the UK and accounts for more than 99% of the global bulk energy storage solutions.



Why Cruachan is important for the UK

Intermittent power sources like wind are key for countries to meet their climate goals, but pose stability challenges for power grid operators.

The challenges we face

As the UK moves toward net zero emissions, low carbon and renewable power sources will become the norm. However, it's not as simple as swapping in renewables for the fossil fuels the grid was built around.

Many renewables are intermittent. For example, wind can produce 25% of the UK's energy, as it did across 2020, but on single days when the wind doesn't blow, this figure can be less than 10%.

A further challenge is transporting renewable energy to the consumer. As the UK's electricity system continues to change, so do its requirements for transporting energy. The switch from a few very large power stations to a greater variety of electricity sources, including wind and solar, means that there is a need for services to balance the subsequent variety in frequencies and voltage to the grid to keep it stable.

£806m

This is the estimated total cost to consumers of wind curtailment in 2020 and 2021. Pumped storage hydro can help address this.

The knock-on effect

When network constraints mean that intermittent energy sources cannot be safely transported across the grid at the right frequency and voltage, intermittent energy generators need to be paid to turn off their services, meaning that excess renewable energy generated in one area, such as Scotland, cannot be transported to high demand areas, such as those in England.

This is a highly inefficient way to run a power grid; in 2020 and 2021, there was a total wind power curtailment – the total wind power wasted because it couldn't be transported to the right areas – of 5.8TWh – enough wind power to supply around 800,000 homes. This problem is particularly prevalent in certain areas, for example in Scotland, where 88% of this wind curtailment took place.

On days where intermittent service providers turn off their services, carbon-intensive gas generation typically needs to be turned up to compensate, resulting in higher carbon emissions which compromises long-term efforts to deliver UK Net Zero by 2050.

A secure solution

Pumped storage hydro is an essential component to ensure our grid is not only greener, but stable, more affordable and flexible.

When called upon, Cruachan can reach its maximum output in 30 seconds to provide flexible power to stabilise the grid. And it works - the facility has been supporting the UK's energy security for over 50 years.

Why we need Cruachan 2

The secret to enabling a net zero electricity system, powering an additional one million homes, and creating hundreds of jobs.

A vital supporting role

As the electricity system transforms through a range of low-carbon and renewable technologies, the amount of energy storage on the UK grid will need to expand from 3GW today to over 30GW in the coming decades. National Grid, who manage the UK's electricity network estimate that by 2030 at least 13GW of new electricity storage capacity will be required on the system to meet the challenge of intermittency from wind and solar. New pumped storage hydro is expected to play a significant role in providing this additional storage capacity.

Pumped storage hydro power stations require very specific sites, with substantial bodies of water between different elevations, to deploy. There are hundreds, if not thousands, of potential sites around the UK, including disused mines, quarries and underground caverns, but the cost of developing entirely new facilities is large. A more cost-effective way to increase storage capacity is by expanding existing plants, such as Cruachan.

Creating jobs for the community

Our planned expansion of Cruachan would more than double the site's generating capacity to over 1GW of flexible dispatchable power.

The construction and operation of Cruachan 2 would directly create 300 jobs over the five-to-six-year construction period and support a total of nearly 900 jobs across the wider supply chain in Scotland– not to mention provide a range of ancillary grid services such as inertia that help keep the network stable.

900

Jobs created across the supply chain from expanding Cruachan.

Claire Mack
CEO Scottish Renewables

"The Cruachan extension is a really exciting project and one that's really important for Scotland. It brings together a number of our really important skills – civil engineering and electrical engineering skill sets too. What we really want to see is a renewables industry that's thriving but also driving economic gain in Scotland. Pumped storage hydro has been part of Scotland's energy story for over 100 years, particularly Cruachan, which is incredibly unique and special within the landscape."

Delivering Cruachan 2

Drax is aiming to be a leader in UK dispatchable renewable energy generation and Cruachan 2 is at the heart of that objective.

Expanding our capabilities

The development – which could be the first newly constructed plant of its kind in the UK in more than 40 years – seeks to optimise the use of the existing Cruachan Reservoir and Dam through development of a new underground power station and associated infrastructure.

The development would provide an expansion of the power generation capacity with a second pumped storage hydro-electric generation station which would operate independently of the existing Cruachan station.

We're aiming to have Cruachan 2 operational by 2030, but that will rely on the right policies and commitments from Government to instil investor confidence in this large infrastructure project.

Supporting this ambitious project

In order to deploy this critical technology, Drax must secure planning consent under Section 36 of the Electricity Act 1989 from Scottish Ministers – a process which will take around one year to complete from the application's submission.

Alongside a successful Section 36 application, the project will also require an updated policy framework to support large-scale long-duration storage and flexibility technologies from the UK Government. The current lack of a framework for these technologies means that private investment cannot currently be secured in new pumped storage hydro and other projects, with no new plants built anywhere in the UK since 1984 despite their critical role in decarbonisation.

With Section 36 consent from the Scottish Government, and an updated revenue stabilisation mechanism from the UK Government, work to build the new pumped storage hydro power station could get underway in 2024, with the project becoming fully operational, supplying flexible power to the grid and bolstering the UK's energy security, by 2030.

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2030

Cruachan 2 fully operational, supplying flexible power to the grid and bolstering the UK's energy security.

How does it work?

Key components of the proposed development include:

- Control works at Cruachan Reservoir and Loch Awe to create intakes/outfalls
- A new underground waterway system to carry water between the upper and lower reservoir
- A series of underground power-house caverns containing reversible pump-turbines and motor-generators
- Above ground substation to provide a connection between the existing 275KV circuit that connects to Dalmally substation
- Ventilation shafts
- New quayside on Loch Awe adjacent to proposed lower control works
- Above ground administration and workshop buildings for day-to-day operations
- Access tunnels for health and safety and movement of power station personnel
- Upgrades to existing service roads to facilitate access by heavy machinery

Cruachan past, present and future

1930s

Sir Edward McColl, pioneer of hydropower in Scotland, conceives the idea for Cruachan Power Station.

1947

Tom Johnston, Wartime Secretary of State for Scotland, pushes Cruachan through Parliament.

1950

James Williamson begins designing Cruachan.

1959

A workforce of 1,300 men, affectionately known as the Tunnel Tigers, start construction. They set world tunnelling record of 560ft driven in 7 days during construction.

1965

Queen Elizabeth II opens Cruachan.

2009

Docomomo lists Cruachan as one of the sixty key monuments of post-war Scottish architecture.

2012

Cruachan receives the Institution of Mechanical Engineers' Engineering Heritage Award.

2015

Cruachan marks 50 years of service. A BBC radio documentary 'Inside the Rock', documenting construction, is released to mark the occasion.

2018

The acquisition of the portfolio of flexible, low carbon and renewable assets was announced on October 16, 2018 and the deal completed on December 31, 2018.

2021

Drax applies for planning permission to expand Cruachan and help meet the UK's energy needs.

"This is an exciting and important project which underlines Drax's commitment to tackling the climate crisis and supporting the energy system as it continues to decarbonise. Our plans to expand Cruachan will unlock more renewable electricity to power homes and businesses across the country, and support hundreds of new jobs in rural Scotland."

Will Gardiner
Drax Group CEO

77% of respondents to Drax's public consultation welcomed the proposals for expanding Cruachan power station.

Responses included:

- The scheme will help to meet the growing national energy demand
- Pumped storage will be increasingly important as renewable energy generation increases
- Need more large-scale energy storage – such as Cruachan – and small scale pumped storage schemes
- Great project and valid in light of the drive towards net zero ambitions
- Potential local supply chain benefits (such as the use of hotels in neighbouring towns and villages for workers during the construction phase)

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Discover more

drax.com/cruachan2