BRITISH HYDROPOWER ASSOCIATION

Call for Evidence:

UK's Seventh Carbon Budget, Wales's Fourth Carbon Budget and Northern Ireland's Fourth Carbon Budget

16th January 2024

Question

1. Pathway considerations: Have we captured the main technological, social, economic and commercial factors we should be considering in our pathways? Do you have any evidence for barriers in specific sectors and technologies?

## Contents

## 1) Hydropower technologies in the UK

Hydropower technologies have been underutilised and underestimated in the route map to technologies. The hydropower indsutry can mobilise and deliver low carbon hydro generation from Hydropower, Pumped Storage Hydro and Tidal Range assisting with the resource adequacy question, improving energy security and enabling a route towards a stable, operable decarbonised grid.

*Table 1 – The BHA 'Asks' to Government*

| | **Hydropower:** | **Pumped Storage Hydro:** | **Tidal Range:** |
|---|---|---|---|
| **Current capacity deployed** | Installed capacity: 2GW<br>Generation: 5.5GWh<br>Storage: 900GWh | Installed capacity: 6.8GW<br>Storage: 26.2GWh | 0GW |
| **Potential deployable capacity** | 1GW | 15GW` | 20GW |
| **What is the BHA calling on Government for?** | Move to 'Enhanced' Levelised Cost of Energy inc whole systems benefits.<br>Replace 1 GW of coal with 1GW Hydropower.<br>CfD tweak for AR6:<br>– Strike price £140/180MWh.<br>– Reduce >5MW to >1MW.<br>– Ring fence and aggregation potential for Capacity Market inclusion | A cap and floor, to enable delivery of the **15GW** called for in this CCC report | Regulated Asset Base, used for Nuclear, to enable delivery of 20**GW** |
| **What are the main barriers to support?** | Hard to raise relevance (seen as, too small, can't scale, too expensive) | Geographically constrained, market can deliver batteries | Too expensive (ie, Swansea Bay) |
| **Why are these technologies important?** | Resource adequacy, hydropower is cheaper than gas peakers (Reservoir hydro currently provides 900GWhs of storage and load follows) | Storage, reduced curtailment and balancing costs, grid stability/ flexibility (pumps and generates) currently 29GWhs, pipeline 135GWhs | Non-weather dependent, generation near increasing demand centres (circumvents transmission constraints), flood defence , socio economic value. |
| **The counter points:** | **Longevity:** All these technologies are intergenerational assets that will deliver well beyond 2050 – true energy security.<br><br>**Resource adequacy:** What's the answer to 3 week Low wind period in 2035? These technologies will help alleviate this risk. | | |

| | |
|---|---|
| | **Energy sovereignty:** Gas interruption, interconnector failure, French nuclear fleet refurbishment.<br><br>**Reliability:** Hydro/ PSH/ TR are all proven, reliable, long lasting & deliverable<br><br>**Cost:** LCOE: cheapest kWhs will not deliver a stable grid. Lowest cost is not always best value. We need to move to 'Enhanced' LCOE and account for Non price factors.<br><br>**Path to net zero:**<br>• Fraught with delivery risk and time slippage<br>• To mitigate risk, we need diversity.<br>• We need all technologies being progressed rather than a favoured few.<br><br>**Grid:** How can we deploy localised energy solutions that will not be hampered by Transmission constraints. |

## 2) Hydropower

Birmingham University in their research 'Hydropower resource 2022' suggests that with a CfD of ~£160/MWh another 1 GW of Hydropower can be deployed giving the UK the many further benefits of Hydropower.

- Proven and reliable
- Operational life of 80+ years and with refurbishment, a further 80+ years: true energy security.
- Reservoir hydro offers low carbon, dispatchable generation (a key requirement for a decarbonised grid).
- Provides inertia and other grid systems benefits.
- A generation profile well matched to the UK's energy demand, ie baseload, winter generation, including peak demand.
- The true value of Hydropower to the consumer, is replacing high cost and high carbon fuels such as gas peaking plant

The Industry is calling on Government to bring forward policy support that will allow 1GW Hydropower deployment through:

• Changes to the Contracts for Difference (CfD)scheme.

  - A reduction from the current 5MW minimum installed capacity (a legacy from the Feed in Tariff) to 1MW with the ability to aggregate pipelines of projects.
  - Setting a strike price at £160MWh to enable pipelines of shovel ready projects to move forward.
  - Allowing a Hydropower ring-fenced pot. Hydropower can not compete on cost with Wind and Solar, but it shouldn't need to, it should be compared to the cost of gas peaking plant, as that is what it can replace.

• Consideration of an "Enhanced" Levelised Cost of Energy, which considers whole systems benefits.

• Consideration of how technologies such as hydropower can replace high fossil fuel generation such as Coal and gas peaking plant.

• Review of how Hydropower's 900GWh of storage can be enhanced and increased.

A recent report by Biggar Economics suggests that existing Hydropower can give a value of £1 Billion to consumers each year alongside added value from a UK based supply chain, high value rural jobs and supporting the decarbonisation of the rural grid as heat and transport are electrified.

## 3) Pumped Storage Hydropower

Serving as a dynamic energy storage solution, Pumped Storage Hydro (PSH) involves two reservoirs at different elevations. During periods of low energy demand, surplus electricity is used to pump water to the higher reservoir. When demand peaks, the stored water is released, generating electricity. Fossil fuel gave us huge amounts of energy storage and also flexibility, as we decarbonise the grid and replace these fossil fuels with increasing amounts of intermittent Solar and Wind, we will need considerably more storage to cover periods of low wind and flexibility to ensure demand is always met in real time. Energy storage is crucial for keeping the lights on.

**Proven, Reliable And Deliverable**: The 4 existing Pumped Storage Hydro schemes, in the UK, were state funded over 60 years ago, to consume and store overnight generation from Nuclear, as nuclear was unable to ramp up and down to meet the changing profile of electricity demand. As was the case then, and increasingly now, PSH has a vital role in balancing the grid, as we have an increasing penetration of intermittent renewables online.

**Grid Resilience**: PSH Is ideally suited for smoothing the vast majority of fluctuations associated with a net zero wind and solar fleet. It is a proven, reliable technology that can deliver a wide range of services, creating value for the energy system across timescales from sub-second to days. PSH delivers inertia (physical rather than synthetic), very fast frequency response, upward and downward reserve, resilience (black start), energy balancing on intra-day, day, and multiple day timescales, and relieving transmission constraints on the same set of timescales.

**Added Value:** According to Imperial College London, if deployed, PSH could deliver grid system cost savings of up to £680m per year in 2050. A recent Biggar Economics report looking at the economic value of PSH found that six PSH projects currently under development could deliver £5.8 billion of investment and almost 15,000 years of employment by 2035.

## Developing more PSH

Pumped Storage Hydro is a mature, proven technology. With the right price stabilisation mechanism, the pipeline of projects can deliver an additional storage capacity of 135GWh to the UK Grid within the next 5-7 years. These projects are capable of delivering durations of tens of hours and offer the lowest cost of storage £/MWh for the crucial 10 – 50 hour duration segment. Significantly beating batteries on costs per unit of energy stored at durations above 6 hours. Unlike interconnectors PSH is fully controllable by the GB electricity market and system operator, offering intergenerational energy security. The pipeline of projects could bring significant additional value of £13.3-14.8 billion GVA and 228,700-253,700 years of employment.

*Table 2 – UK pipeline of PSH projects*

| Site | MW capacity | GWh capacity |
| --- | --- | --- |
| **Coire Glas** | 1,500 | 30 |
| **Red John** | 450 | 2.9 |
| **Glenmucklock** | 400 | 1.5 |
| **Glyn Rhonwy (Wales)** | 100 | 0.7 |
| **Cruachan extension** | 600 | tbc |
| **Balliemeanoch** | 1,000 | 45 |
| **Corrivarkie** | 600 | 19 |
| **Dorothea (Wales)** | 450 | 2.1 |
| **Halviggan (England)** | 150 | 1.2 |
| **CCSQ (Wales)** | 100 | 0.6 |
| **Earba** | 900 | 32 |
| **Loch kemp** | 600 | |
| **Total** | **6,850** | **135** |

## Unlocking new development

The Industry is calling on Government to bring forward an Energy storage policy that recognises that all forms of energy storage must contribute to a stable, operable, secure grid. Provide a ‘Cap and Floor’ price stabilisation mechanism that will allow the PSH pipeline to begin deployment by: de-risking and unlocking investment for these capital intensive projects in a competitive global investment market, enabling cheaper financing;

- providing a Cap where revenues recover capex, opex and an allow cost of equity (with system efficiency incentive above the cap);
- providing a Floor – with a recovery of debt service requirement;
- protecting developers, owners and operators from global energy price volatility.

These decisions must be made now, and it should be considered to be a No Regrets opportunity with low deliverability risk

## 4) Bringing forward Tidal Range potential in the UK

Tidal Range is a significant low carbon domestic, indigenous generation opportunity for the UK, offering energy security at scale, with multiple schemes along the UK Coast, especially in the West, from Cumbria to Somerset.

### UK Statistics

- UK holds 10% of the world's tidal resource
- Potential for 20GW Installed capacity
- Generating 30 TWh/yr ~12% of UK demand

### Tidal Range Challenges

- Large initial investment
- Complex environmental considerations
- Changes to water hydrodynamics
- Competition with other marine users

### Advantages

- Mature & proven technology
- Non weather dependent
- Long term asset
- Durable & low maintenance
- Predictable & reliable
- Generates near population densities
- Circumvents grid barriers
- Mitigation for flooding and erosion
- Can provide baseload power

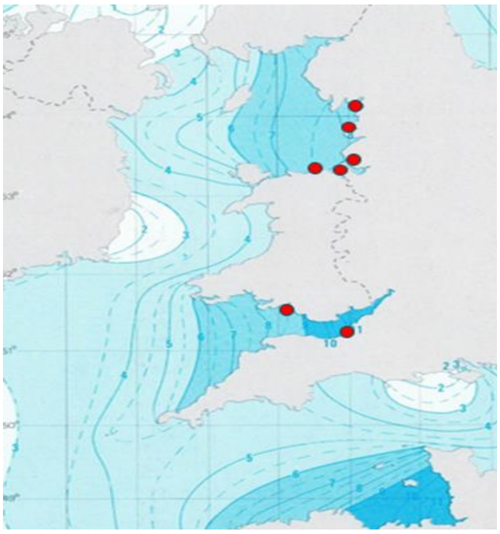

*Figure 1 – Sites of Tidal Range Schemes across the UK*

*Table 3 – Potential Tidal Range projects*

| Location | Power GW | Energy TWh/yr | Cost £Bn | CAPEX* /AEP | Non Energy Benefits |
|---|---|---|---|---|---|
| Swansea Bay Lagoon | 0.32 | 0.5 | 1.3 | 2.6 | Lagoon pilot |
| Severn Barrage | 8.6 | 21.5 | 30.0 | 1.4 | Flood defence |
| West Somerset Lagoon | 2.5 | 6.5 | 8.5 | 1.3 | Flood defence |
| North Wales Lagoon | 2.3 | 5.0 | 7 | 1.4 | Flood defence |

| | | | | | |
|---|---|---|---|---|---|
| Mostyn Docks | 0.13 | 0.3 | 0.6 | 2.0 | |
| Wyre Barrage | 0.1 | 0.2 | 0.4 | 2.0 | Barrage pilot |
| Mersey Barrage and Lagoon options | 1 to 5 | 2 to 7 | 3 to 9 | 1.3 | Regeneration |
| Morecambe Bay and Duddon Estuary | 4.0 | 7.2 | 10 | 1.4 | Road connection & regeneration |
| **TOTAL** | **≈ 20** | **≈ 44** | **≈ 64** | *CAPEX - Capital Expenditure<br>AEP - Annual Energy Production | |

## Tidal Range energy – why now?

There are two very different types of tidal energy:

I. tidal stream, which captures kinetic energy and needs large depth and high currents to be commercially viable;
II. tidal range, which needs an embankment (via a barrage or lagoon) and captures potential energy and needs shallow depth and a relatively high tidal range.

Tidal Range is very efficient in that large lagoons and barrages capture considerable energy.

Tidal range schemes are designed to last for at least 120 years offering predictable, indigenous renewable energy and also offering benefits of protection against coastal erosion, flooding, and defence against sea level rise. Tidal Range energy completements tidal stream and other generation technologies and would be a valuable long term asset, bringing diversity to a domestic energy generation mix.

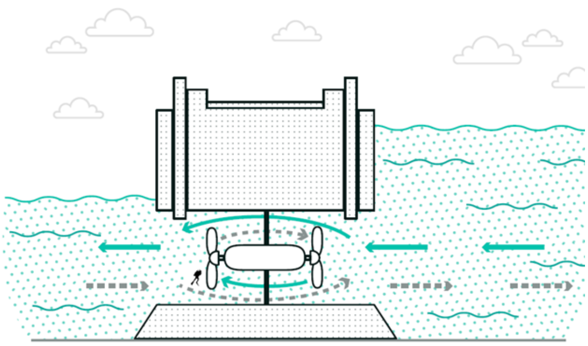

*Figure 2 - Bi-directional turbine to maximise ebb and flood generation, turbine height 8-9m*

### Proven, Reliable and Deliverable

Tidal Range is proven as can be seen in the  2 examples below of schemes providing timetabled energy generation.

La Rance scheme in Brittany:

- Completed in 1966
- 24 Turbines & 6 Sluices
- 240 MW total capacity  =  0.54 TWh/yr
- Turbine operation – Ebb only (and pumping)
- Passage of fish, without major problems

Shiwa, South Korea

- Completed in 2011,
- 19 Turbines,
- 245 MW total capacity.
- Ebb and flood generation
- Designed to flood mitigation and agricultural purposes

### Overall benefit to the UK

Tidal Range offers timetabled, non-weather dependent generation from long term assets with 120 year operational lifetime.

With a huge indigenous resource in the UK and with no other renewable technology offering these characteristics, the UK Government must focus on how to unlock this proven technology and bring forward this impactful industry. The added value of regeneration benefits through the high UK construction and supply chain content, alongside flood and coastal erosion mitigation, will give strong locational benefits.

The ability to create large generation near centres of power demand circumvent the Grid constraint issues of offshore wind and offer real potential to deliver long term value to consumers.

Large scale, long term energy assets give the potential for longer term energy security and price resilience.

### The Value for money question

The Independent Review into the feasibility and practicality of tidal lagoon energy in the UK, led by Charles Hendry, published January 2017, was an in depth report reviewing the benefits of tidal lagoons, with the conclusion that Tidal lagoons could:

“play a cost effective role in the UK’s energy mix and there is considerable value in a small (less than 500 MW) pathfinder project.”

- Help deliver security of supply; they would assist in delivering our decarbonisation commitments; and they would bring real and substantial opportunities for the UK supply chain.
- At scale, could deliver low carbon power in a way that is very competitive with other low carbon sources.
- Secure the pathfinder project as swiftly as possible, so the learning opportunities it offers can be maximised.
- Pathfinder project needs to be operational before we move to larger scale projects.
- This means that a clear **long-term Government strategy in favour of tidal** lagoons will be required if the full supply chain and cost reduction opportunities are to be realised.

“Tidal lagoons can be an important and exciting new industry for the United Kingdom. We are blessed with some of the best resources in the world, which puts us in a unique position to be world leaders.”

However, the Business& Energy Secretary at that time, Greg Clark failed to offer the pathfinder project the price stabilization mechanism it needed to bring forward investor certainty. The argument was centered around the Levelised Cost of Energy (LCOE) being higher than alternatives, including Nuclear.

The counter arguments around the longevity of Tidal Range, supply chain benefits and cost reductions for subsequent projects, failed to move the dial and Tidal Range has continued to receive no Government support.

### Levelised Cost of Energy

Levelised cost of energy is a very blunt instrument to help measure the value of energy generation technologies and their ability to bring forward a decarbonised, stable and operable gird, fit for the future.

LCOE fails to wrap in the costs of additional factors to give real end to end costs, including lifecycle costs. Off-shore wind has become successively cheaper, until the latest AR 6 which saw prices rise. This was, in part, due to inflation, but also supply chain issues and the fact that shallower waters, where offshore wind is cheaper to build, have now been built out and deeper water means higher costs. However, other costs, such as grid transmission constraint costs, rebalancing costs, curtailment costs, storage costs, back up costs (no wind or sun) are not included. so current LCOE does not give the overall systems costs.

Tidal Range will also have to go through the cost curve of any first of a kind technology (just as off-shore wind did – see below) here deployment of the nth of a kind means the supply chains are more developed, and costs come down in other areas. All emerging technologies need Government support. The off-shore wind industry received this through a government / indsutry partnership and ~£8Bn financial assistance.

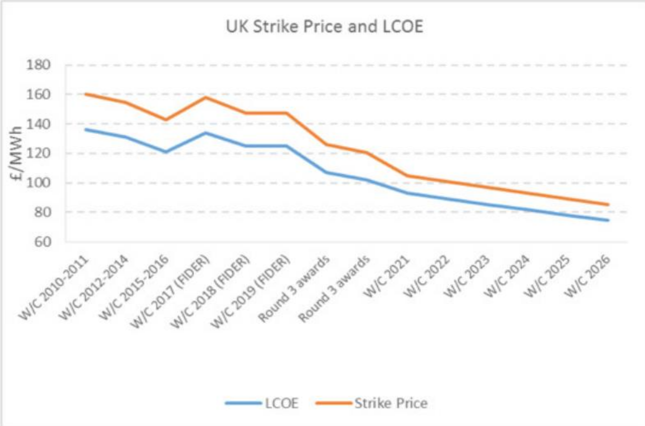


*Figure 3 – UK Strike Price & LCOE for off-shore wind.*

In 2023, offshore wind had no projects come through Auction Round (AR) 5 as the Administrative Strike Prices (ASPs) were deemed too low to enable schemes to come forward. All ASPs have now been adjusted for AR 6 and are as follows:

- Offshore wind: £73/MWh
- Floating offshore wind: £176/MWh
- Dedicated Biomass with CHP: £179/MWh
- Energy from waste CHP: £181/MWh
- Geothermal: £157/MWh
- Onshore wind: £64/MWh
- Solar PV: £61/MWh
- Tidal stream: £261/MWh
- Wave: £257/MWh
- Hydro: £102/MWh
- Nuclear (not under CfD) £92.50/MWh

Work undertake by Jacobs on behalf of the TRA has been done to examine the LCOE of Tidal range across a number of pipeline projects. It can be seen in the bar chart below larger schemes have lower LCOEs but, this needs to be weighed against other aspects of development, including environmental factors. However, the Swansea Bay lagoon (a small scheme at 320MW) has a smaller surface area to circumference ratio which means the cost of construction versus the energy generation is higher.

A Birmingham University study undertake in 2022 refuted the Government's claim that the Swansea Bay lagoon would not have offered value for money, and found that it would have returned profit to the Low Carbon Contracts Company.

Reviewing the LCOE costs seen below, against the ASPs, It can be seen that Tidal Range is firmly cost competitive against other technologies, including Tidal Stream, wave, Floating off-shore wind, Biomass, Geothermal and Nuclear

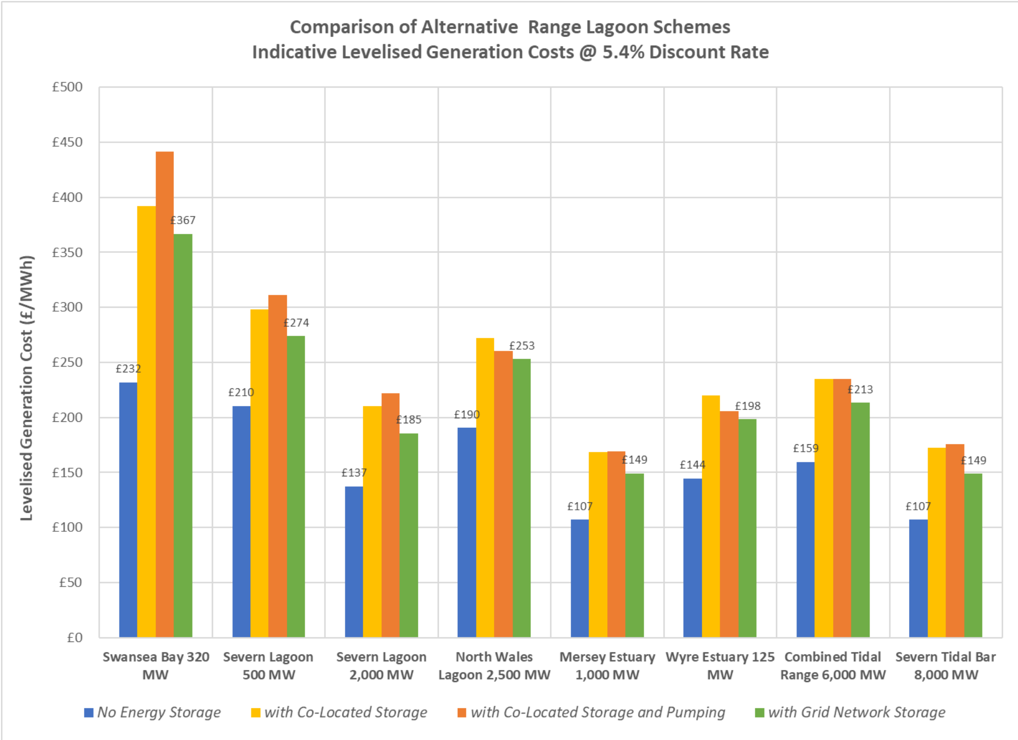


*Figure 4- Tidal Range Lagoon Comparative Tidal Range LCoEs – current Prices*

Figure 5 shows 2 of the 4 Future Energy Scenarios forecasts and the levelized costs associated with them inclusive of Tidal Range within the overall system cost of the wider energy system.

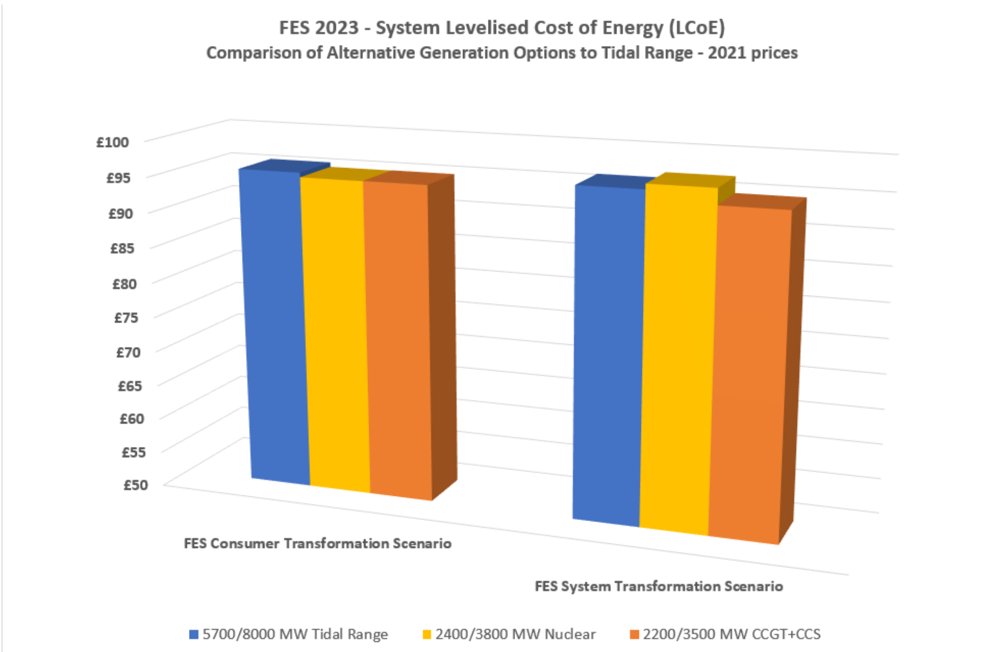


*Figure 5- Bar chart depicting the whole systems levelized cost of energy across the energy mis*

The key is,  the more technologies we have with different characteristics and variabilities, all working together, gives a more stable grid. As with an investment portfolio,  diversity gives stability and security.

Therefore,  there is a credible, price competitive  technology which needs to be considered as an integral part of the UK energy generation mix and needs urgent policy review to bring forward Government support.

## What's changed?

### Energy security

Only fully capitalising on the UK's Indigenous energy generation potential will give true energy Security. As a country bestowed with an abundance of elements that can be harnessed for energy generation, reliance on global markets of fossil fuels or future hydrogen markets, is detrimental to the resilience of the UK and UK PLC.  The UK should and can become an exporter of energy and alongside that,  the skills and businesses that we're developing to enable the UK to become a decarbonised country.

### Grid

Energy policy must adapt to understand the complexities of a decarbonised grid and the opportunities of a diverse mix of energy generation that we'll need to develop a stable, operable, resilient  grid that will power the UK into the next decades.

The future is always uncertain, but preparing  for an uncertain future through creation of resilience within our systems is key to reducing risk. With so many of our interdependent systems reliant on electricity (banking, communications, food supply chains) a resilient grid is the backbone of a stable society. With more and more variable renewables connecting to the grid and the grid moving from a centralised to a decentralised system, grid constraints across the grid network have become a critical problem and could be the biggest barrier to the UK's net zero transition.

Tidal Range has the benefit of being located next to population demand centres (with an expected increase in demand of X2.5 through electrification of heat, transport and indsutry) the growing demand can be met by new Tidal Range generation and avoid the transmission constraints and the need to shift power around the country, at great cost.

One of the solutions to the grid constraints issue is to focus on Smart Local energy Systems solutions  (SLES). Local generation being consumed locally also opens up opportunities for more affordable energy through local energy markets which could help enable affordable, low carbon energy to become available for local communities.

Within large population centres that have been decarbonised, there is huge amount of embedded flexibility that can be utilised to meet the peak generation of Tidal – load shifting heat pumps, EVs and smart water cylinders across urban areas means there is less need for co-location of storage.

There is also the potential to use large locational generation such as Tidal Range to decarbonise heavy indsutry, whether that is Port Talbot, or enhancing Hydrogen Industrial clusters plans such as Hy-net on Merseyside.

### Resource Adequacy

To date, the Government has focused on Wind and Solar deployment and increased targets for future installed capacities to help decarbonise the grid. However, this highlights the problem of low wind, winter night times and how we can meet peak demand at these times – this is known as 'Resource Adequacy'. At the moment, we rely of Combined Cycle Gas Turbines and the Government's aspiration is that they will also attach Carbon Capture utilisation and Storage to reduce emissions or use thermal generation from Hydrogen. However, these are still nascent technologies and have yet to be proved cost effective, efficient or scalable.

As we look at the pathways to net zero, risk and mitigation plans must be in place to take into account new risks that the UK will face. Rising costs within the supply chain (as seen in AR6) costs escalating due to more complex sites needing to be developed ( off-shore wind in deeper water) global competition (supply chain – rare earth materials, or competition for capital – USA IRA)

Mitigation plans should be in place to ensure consumers are not burdened with energy costs from these technologies (CCGT & CCUS/ Hydrogen) , which could become exceptionally high through reliance on volatile global markets and geopolitical tensions.

Government needs to focus more on reducing risk within the Net Zero pathway by on-shoring as much of our energy generation and supply chain as possible and finding additional value from non-price benefits, for example,  including sea defences costs within Tidal Range.

### Innovation

Historically, Tidal Range has been developed using 'bulb' turbines which give more efficient generation on the Ebb tide. However, there is research and innovation around improving efficiencies on the flood  and also developing new bi-directional turbines and Very Low Head Tidal Turbines.

A recent Innovate UK Smart grant is enabling laboratory testing of a new innovative  Very Low Head Tidal Turbine (VLHTT). This is the first stage of a programmatic approach to development that next requires, Field Demonstration of a prototype VLHTT,  prior to integration in a first of a kind Modular Tidal Bar and a Commercial Pilot project.

Increasing the potential for more efficient turbines will yield a higher generation per MW and therefore reduce the LCOE, making Tidal Range even more competitive.

### UK supply chain content

Based on analysis of a large Tidal Range project  the UK supply chain content is around 66% with the potential to drive this up to 80% (this is considerably higher than off-shore wind). This is based on the following assumptions:

- **Civil Engineering:** the cost split for large heavy civils projects is usually 40% labour, 40% materials, 20% construction plant (cranes etc.). Labour should be 100% UK and materials:
    - Concrete: cement - European supply at present with UK aggregates supply.
    - Formwork: mainly a labour cost – 100% UK
    - Rebar: mainly European supply at present. Unlike dams for hydro, Rebar content in marine caissons is high and is about 50% of total materials cost.

- **Mechanical & Electrical:** an example split derived from discussion with a major supplier:
    - Turbines: fabrication in the Far East.
    - Generators and cabling: could be substantially UK supply for a large enough order.

With a Government/ Indsutry partnership to help enable a Tidal Range Industrial Strategy and roadmap, a programme would attract investment in UK turbine manufacturing and Off-Site Manufacture of steel and/or concrete caissons.

The shallow coastal waters and high tidal range that give the UK 10% of accessible global resources provide unique competitive advantage in the global Race to Net Zero. With global competition for manufacturing and construction sectors, alongside the competition for finance (highlighted by the USA inflation Reduction Act and the investor flight this has stimulated) the UK must have a credible roadmap and industrial strategy for Net Zero to ensure the UK retains and gains the skills and supply chains it needs to enable deployment.

Manufacturing and construction jobs in Green Industry Clusters harnessing Tidal Range power would level up coastal city regions as Local Development Plan policies press down on costs of development, operation and maintenance using locally sourced and owned technologies and recycled materials in businesses requiring high paid, high skill workforces.

## Industry 'asks'

In the British Energy Security Strategy, 2022, the government committed to "aggressively explore" Tidal Range technology as a source of energy security". To date, there has been only one step forward with the publication of "Tidal range projects: criteria and how to submit a proposal" issued by DESNZ, 19th December 2023.

To **unlock** the indsutry we need to gain investor certainty. This will come through a strategic partnership between indsutry and government which could emulate the one set up for off-shore wind. Investor certainty will also come through the development of a price stabilisation mechanism that supports long term energy generation projects such as Tidal Range.

- CfD can be rapidly adapted for smaller Tidal Range projects, including a pilot project, it could also be used as a stepping stone to:
- the RAB approach. Which is considerably more complicated but will unlock the GW scale Tidal Range that the UK will need to embed energy security and resilience in the future grid.

Next steps:

- More resource at DESNZ to work on Tidal Range (currently 1 FTE)
- Create a Government/ Indsutry partnership, similar to off-shore wind in 2012
- Create favourable policy for Tidal Range,  which includes CfD, to gain investor confidence
- Develop a road map for Tidal Range
- Create an Industrial  Tidal Range strategy, ensuring the supply chain is on-shored in the UK
- Build on work undertaken through the Tidal Lagoon Challenge
- Create a Tidal Range accelerator (utilising funding streams such as the Green Industrial Growth Accelerator)
- Develop a pilot demonstration scheme to accelerate progress in areas such as regulations, remove/reduce planning restrictions for test sites
- A pilot test site which would be supported by a CfD price stabilisation mechanism
- Work with Industry to continue to look at RAB as a mechanism to bring forward GW scale Tidal Range projects.

## Conclusion

The historic legacy of hydropower in the UK is marked by its longevity, reliability, durability, giving the grid stability and consistently helping meet peaks in energy demand. The longevity of hydropower has meant that hydropower schemes outlive all other energy generation technologies. Hydropower has watched the rise and fall of coal, gas, nuclear power plants and seen the repowering of the original wind farms, whilst consistently generating, decade after decade. In recent years, the Government's focus has been to bring forward 'mass generation' and with the costs of wind and solar reducing rapidly, there has been a rapid expansion of intermittent renewables enabling an accelerated path towards decarbonising the grid. Today, we are now firmly in the midst of the clean energy revolution, but policy makers must start to understand that a stable, operable, secure, decarbonised grid needs a solution based in physics, not the market. Further pursuit of the cheapest kWh needs to make way for delivery of technologies that will complement intermittent renewables and help balance the grid, not exacerbate the constraint issues that are causing us cost and delay as we transition away from fossil fuels. There must be support for all technologies that will allow a secure, decarbonised grid fit for the future.