What are BESS?

Battery Energy Storage Systems or BESS are the hoped for answer to the problem of variable renewable energy (VRE) generators such as wind farms or solar parks.
The idea is that when the wind isn't blowing and the sun isn't shining these industrial batteries will release their stored electricity to the national grid when there is peak demand or insufficient renewable or other generation. BESS also have other uses, such as 'black starting' a windfarm – providing in house power to get systems and turbines running slowly after a windless period to get over the turbine inertia. (They may replace the diesel generators which are otherwise used for this purpose)
It's important to understand BESS as they're increasingly being included simply as an ' incidental add on' to industrial scale windfarms in Scotland with little or no consideration by consenting authorities. Large BESS also being consented as stand alone planning applications- often near urban areas.
There are serious hazards and risks associated with BESS which can have major environmental and human impacts without appropriate mitigation. Understanding these risks should allow more informed comment to be made to planning applications.

Most BESS are based on lithium ion technology. These batteries have decreased in price by over 70% since 2010 and may well continue to get cheaper with more recent discoveries of large amounts of accessible lithium (eg in the USA). We should therefore expect more numerous and larger BESS planning applications in future.
Electricity from a BESS is inherently more expensive- it is generated elsewhere but has had to be stored in a very expensive box and basic physics means that the BESS will not give out as much energy as is put in.
BESS also attract capacity subsidies (paid for by UK electricity consumers). Capacity payments are paid as a retainer for power sources to be on 'stand by' to top up the grid at short notice – even if they're not used.
Capacity payments are given to non VRE potential generators – such as hospitals and businesses with large diesel generators, coal and gas power stations as well as BESS – any power source able to provide electricity at short notice on demand.
Not only will BESS attract UK capacity subsidies, but they are able to sell their power to the grid at a time when the wholesale price will be at its highest – even though they will recharge at times of plenty when electricity prices are at their lowest. This is providing consumers with renewable electricity that is extremely expensive.
A windfarm operator gets constraint payments from National Grid not to produce electricity/turn off turbines at a time when the grid cannot cope either with excessive generation or their is low consumer demand (eg at night). If a BESS is directly connected to a constrained windfarm (as opposed to being connected via the National Grid), then instead of the windfarm shutting down, that constrained off electricity can go instead to charge their directly connected BESS, without the windfarm losing their constraint payment. The BESS gets also gets a capacity payment and is then able to sell the 'constrained off' power back to the grid at the highest price when demand is highest. The windfarm/BESS owner will therefore get two lots of public subsidies and the highest wholesale price for generating the same unit of renewable electricity which is eventually sent to the grid! And the politicians would have us believe renewable energy is cheap!

A few technical terms to understand the size and capabilities of a BESS:

- BESS Energy capacity is the maximum amount of stored energy (in kilowatt-hours [kWh] or megawatt-hours [MWh])
- Rated power capacity is the total possible instantaneous discharge capability from a fully charged BESS (in kW or MW), or the maximum rate of discharge that can be achieved.(This is not the same as kWh or MWh stored capacity)
- Storage duration is the amount of time BESS storage can discharge at its power capacity before depleting its energy capacity. E.g. a battery with 1 MW of power capacity and 4 MWh of usable energy capacity will have a storage duration of four hours.
- Like domestic lithium batteries, the more a BESS battery is charged/discharged, the shorter the battery life. BESS units are expected to last just over 8 years before they require replacing.
  Cycle life/lifetime is the amount of time or cycles a battery storage system can provide regular charging and discharging before significant deterioration or failure.

The largest BESS in the world (Vistra Moss in the USA – 1200MWh) may produce enough electricity to power thousands of homes for more than a day, but most BESS will provide electricity only for a few hours. The largest BESS in the UK is currently (May 2023) 99MWh, costing £30 million, near Luton. The Vistra Moss entered service in 2021, but had to shut down due to overheating problems until 2022.

Like lithium ion batteries in phones, lap tops and cars, the BESS last longer if not fully charged or discharged. Therefore whilst capacity payments may be based on the overall capacity of a BESS, the reality is that the rated power capacity, what will actually be released when needed, will be significantly less to protect the BESS. Rapid charging or discharging will also cause the battery to heat up, risking thermal runaway, so the storage duration will also limit what can be released by the BESS in a short period of time.

Thermal runaway is a process of overheating due to a chemical reaction in the battery, which then affects adjacent cells in the battery producing an exponential heating event and eventually fire. This is increasingly being recognised as a major problem in other lithium batteries – such as the spontaneous vehicle fires causing ships transporting EV's to sink (Freemantle Highway July 2023 and Felicity Ace September 2022). BESS fires and explosions have occurred in several countries around the world causing death and injury to firefighters. Lithium ion battery fires and explosions are very difficult to put out, generating intense heat enough to melt metal and requiring very large volumes of water. In addition to releasing toxic fumes (which required warnings to stay inside and shut windows to local residents of a BESS fire in Liverpool in 2021), the water used on a fire reacts to produce corrosive and dangerous hydrofluoric acid- amongst other noxious components. This is extremely damaging to the environment.
BESS facilities should therefore have large volumes of water available on site for fire fighting as well as containment facilities for that water in the event of a fire, to prevent that contaminated water reaching water courses, drinking water supplies and the wider environment.

To avoid thermal runaway, BESS require air conditioning to be kept cool – thus consuming energy even if they are not in use.

Higher temperatures in summer months, especially during heatwaves, means more air conditioning and electricity use is required – even if the wind fails to blow and there is a power shortage.
Thermal runaway is more likely during extreme temperatures and so charging or discharging BESS may be discontinued due to safety concerns.
High humidity or water penetration to the battery increases the likelihood of thermal runaway.
Winter months (especially in Scotland) can cause problems with very high rainfall, high humidity or water penetration, potential flooding and snow melt on top of BESS containers. (Perhaps BESS are not ideally suited to the West of Scotland!) Air conditioning units should therefore not only cool but dehumidify air within the BESS.
BESS containers should be kept at a regular temperature. Power cuts that might affect air conditioners could be disastrous. Of course, industrial air conditioning units themselves may cause noise disturbance to neighbours and should be questioned in planning applications if near to housing.
Because of the serious risks of often unpredictable thermal runaway from BESS fires - to the environment, local residents and to emergency services, it could be argued that opinion should be obtained from Fire and Rescue services to inform a planning decision.
If BESS applications are for temporary planning permission, details of restoration should be included so that concrete bases and cabling, as well as the multiple metal containers are eventually removed and land restored appropriately.

Finally, BESS are not electricity generators but are a short life electricity storage mechanism that consume electricity simply to function and consume non-recyclable materials such as lithium salts. They have potential to cause serious environmental damage and do not improve biodiversity at all. Whilst they make VRE generators more viable in terms of evening out grid supply and stability, it could be argued that BESS have few other attributes listed under NPF4 that should favour supporting planning consent.