PB05 - Options for ESBC to develop community wealth-building energy projects

Appendix Four: Types of Technology (Expanded from main report)

Multiple technologies will likely be needed as part of a diversified local energy strategy and each has strengths and weaknesses that complement one another.-

The following section explores some of the most common types of renewable technology currently available and how it could be utilised locally:

> Solar Photovoltaic (PV)

Solar technologies such as photovoltaic (PV) panels produce electricity from sunlight and can be easily installed on new and existing buildings or in secure open areas including those that have limited potential for other land uses, such as capped landfill sites, airfields and under-used agricultural land. Solar thermal units heat liquid which is transferred to a building's hot water system using a heat exchanger.

Roof-mounted panels are suitable for most types of council buildings, particularly buildings with large flat or pitched roofs such as leisure centres, depots and offices.

The electricity that is generated can be used on-site, stored, or exported to the local electricity network.

Benefits:

- Low maintenance and modular scalability
- Can be integrated into buildings/structures
- Generates power at the point of use to offset purchases

Risks:

- High upfront capital costs
- Power output depends on sunlight - weather and seasonal variability

Constraints:

- Limited generation capacity per unit of land vs. other renewables
- Available roof/ground area, structural suitability for panel loads, orientation, over shading by trees or other buildings, planning in conservation areas and the ownership of buildings/land.

Dependencies:

- Grid connection or onsite storage to utilise power
- South-facing orientation optimal

Solar PV is the most common renewable energy deployed across the borough. There are tried and tested models in operation and are a relatively easy option for the Council to deploy.

Other solar technology to considerations could include solar carports (SCP**).** A SCP is a renewable energy system mounted on canopies, installed over car parking spaces and can integrate Electric Vehicle (EV) charge points and where appropriate, a Battery Energy Storage System (BESS) to provide a cost-effective, innovative way to power both building and EV chargers, whilst shading the vehicles beneath.

> Wind

Onshore wind is an established technology and offers one of the least-cost options for renewable energy supply, delivering electricity cheaper than conventional fossil-fuel technologies. Despite the strengths of onshore wind energy, wide-scale deployment of the technology in England and Wales has been largely restricted since 2015 due to local and national planning requirements.

Benefits:

- Established and cost-competitive technology
- Utility-scale provides bulk renewable power

Risks:

- High capital costs
- Intermittent power source dependent on wind
- Potential noise/visual impacts

Constraints:

- Requires sufficient wind resource
- Needs height for productivity so options limited
- Planning permission is hard to obtain

Dependencies:

- Grid integration is essential
- Careful site selection based on wind data

The Staffordshire County-wide Renewable/Low Carbon Energy Study published in 2010 states:

> *"10.2.2 East Staffordshire's renewable energy contribution is heavily influenced by wind, mostly due to its highly rural character and hence fewer constraining features such as proximity to buildings and roads."*

The study goes further and identifies wind as the largest potential contributor of renewable energy in the area, with a potential sixteen turbines across seven medium-sized sites identified. The study includes an 'Energy Opportunity Map' indicating where these sites could be, this is included as Appendix 2: Staffordshire County-wide Renewable Energy Study (Figure 38: Energy Opportunity Map for East Staffordshire).

It is worth noting that study is several years old (2010), and an updated feasibility assessment would be needed, as constraints may have changed.

> Heat Networks

A heat network, also known as district heating is a shared system providing a number of connected buildings with hot water and/or space heating from a central source.

It uses a heat source, or sources, to power an energy centre, which then transfers heat to connected properties in the form of hot water, through a network of insulated pipes.

The most efficient heat source technologies include combined heat and power engines (CHP), biomass boilers or heat pumps.

District heating is beneficial for new developments due to the lower cost of civil works on new sites, and in areas where there is a high energy demand.

Benefits:

- Enables use of waste heat and range of heat sources
- Can integrate renewable energy
- Provides affordable heat to residents

Risks:

- High upfront capital costs
- Requires sufficient customer density
- Long payback periods

Constraints:

- Identifying a sufficient heat demand density.
- Network construction disruption
- Customer buy-in essential
- Technical expertise needed

Dependencies:

- Anchor heat loads like civic buildings
- Spatial mapping of heat demands
- Long-term commitment to network

East Staffordshire's rural nature means that the potential for district heating within the existing built environment is limited to pockets around the more urban Burton town area, making the Project D – High Street regeneration site a good example of this.

> Hydro power

Hydro power uses water dropping through a height ('the head') to turn a turbine connected to a generator. Small hydro projects are generally complex to develop, with many technical and legal issues to consider, including fisheries, flood risk, river laws and the engineering solution itself. They can be viable however, where the right geographical conditions exist.

Benefits:

- Reliable and predictable power once operational
- Long asset life

Risks:

- High upfront capital costs
- Droughts or floods can disrupt generation
- Environmental impacts require mitigation

Constraints:

- Few viable sites with the needed water flow
- Seasonal variability in output
- Licensing and permits requirement

In terms of Hydropower the Staffordshire County-wide Renewable/Low Carbon Energy Study found:

"The available data enabled assessment of eleven hydropower sites resulting in the region of the 2.5% to 4% of the generation potential."

The study identified 11 sites that may be suitable for a hydro project – however land ownership would be outside of the councils control adding a further layer of complexity.

Further analysis would be to be done to evaluate these sites to establish their viability.

Local Hydro Case Study: Congleton Hydro Technology

> Energy Storage

Energy storage technologies or battery energy storage systems (BESS), are designed to capture energy generated at one time and save it for use at a later time.

They offer flexibility by allowing the timing of energy use to be shifted, and help balance power grids by absorbing excess supply or discharging when demand is high. For instance, such technologies can store electricity when renewable energy generation is high and release it back onto the local grid during peak demand times.

This can help strengthen local networks, support electric vehicle charging, and facilitate the transition towards a low-carbon, renewable energy power system.

Benefits:

- Stores excess renewable power for later use
- Provides grid services like frequency regulation

Risks:

- Adds costs on top of generation assets
- Technology still maturing - changing landscape
- Potential fire risks

Constraints:

- Limited capacity and energy density
- Roundtrip efficiency losses

Dependencies:

- Requires good understanding of load profile
- Well-suited to complement intermittent renewables

The area of land required for storage is dependent on the size/scale of the storage, however each Battery Box typically the size of a shipping container, and can be placed of on grass verges or brownfield land that's unsuitable for development. Within East Staffordshire Borough Councils estate and assets there may be suitable to house this technology. A good connection to the grid would be required and well managed with robust emergency plans should be in place to mitigate any fire safety concerns,

> Virtual Power Plant (Or VPP)

A virtual power plant (VPP) is a cloud-based network of distributed energy resources (DER) that can be controlled as a single entity. A VPP can include smaller energy generating and storage devices, like solar panels, battery systems, and electric vehicles.

The purpose of a VPP is to enhance power generation, trade or sell power on the electricity market, and provide demand flexibility. A VPP can also integrate more renewables and offer cleaner and more affordable power.

Benefits:

- Aggregates and optimizes distributed energy resources
- Provides grid services and offsets consumption

Risks:

- Complex coordination of assets
- Requires robust software platform

Constraints:

- Needs significant connected resources to provide scale
- Participant engagement and coordination

Dependencies:

- Private wire connections or supplier relationships
- Access to energy usage data

Staffordshire County Council are currently in in the early stages of investigating the feasibility of a countywide virtual power plant (VPP) to manage renewable energy generation with energy and is hoping to help establish what opportunities and options exist for this across the county, giving ESBC a good partnership opportunity.

> Summary

In summary, a resilient local energy system will likely require a portfolio of complementary technologies.

Each option has unique strengths and weaknesses that address different needs. Solar PV offers emissions-free power but depends on sunlight availability. Wind provides bulk generation capacity but needs sufficient wind resources. Heat networks utilize waste heat and enable affordable heating for residents. Storage helps balance intermittent supply and demand. A virtual power plant aggregates and optimizes distributed resources.

Taking a diversified approach and combining the benefits of multiple technologies will be important. This provides redundancy if one solution underperforms, and allows masking the weaknesses of any single option.

Pursuing a mix of solar, wind, storage, heat networks, and other solutions will build robustness through diversity, while aligning with local resources and capabilities.