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The energy transition and emerging alternative energy solutions

By **Simon Hannah**:
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Technology is developing, energy transition is high on the agenda and security of supply is a growing issue. Is now the right time to take more control of the energy solutions on offer and reduce reliance on the centralised system? Could a community, local building complex or just a single property be completely self-reliant for all its energy needs, even selling surplus power for additional income?

At Optimised Strategic Solutions, we specialise in sustainable energy systems and are working on numerous commercial models to help increase the attractiveness of installing assets for individuals, communities and businesses. Focusing on technology that is available today, whilst planning for future opportunities as technology evolves, provides our clients with the best chance of developing enduring solutions for their energy needs.

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Energy crisis

The focus on climate change and energy couldn't be more prominent, following the latest COP27 meeting. At the same time, as Russia continues its attack on Ukraine, holding back supplies of gas to Europe, the fragility of energy security for individual nations has been highlighted. The increased challenges of climate change, as well as growing concerns around security of supply, strengthen the cause for an increase in renewable generation.

Not only is the need for energy security growing, but the demand for electricity is also on the rise. In the UK, the 'road to net zero' relies heavily on a transition away from fossil fuels for transport and heating. This growing energy demand will make the management of the network even more challenging. Peak demand will increase with heating and cooking, adding to the demand spike in residential properties, and electric vehicle charging will increase overnight demand. Even when hydrogen solutions are more viable, the production process itself will use huge amounts of electricity.

Does reality trump utopia?

Of course wind, solar and hydro should make up a large proportion of the energy mix for any country and it would be wonderful if these free and natural sources of energy could fulfil the total need for power.

However, there is one obvious problem with this utopia: the wind doesn't always blow and the sun doesn't always shine. This leaves the real challenge of finding ways to fill the supply gap when renewable generation is low, as well as having more flexible generation to manage peak demand periods.

Currently, this supply issue is addressed by burning coal, gas and oil, but this must stop if we are to combat climate change. Needless to say, it is not straight-forward and in some parts of the world fossil fuel lobbyists are highly influential. The problem is compounded by countries putting economic and industrial development above solutions to climate change and reducing environmental destruction. For those nations fully committed to removing fossil fuels from

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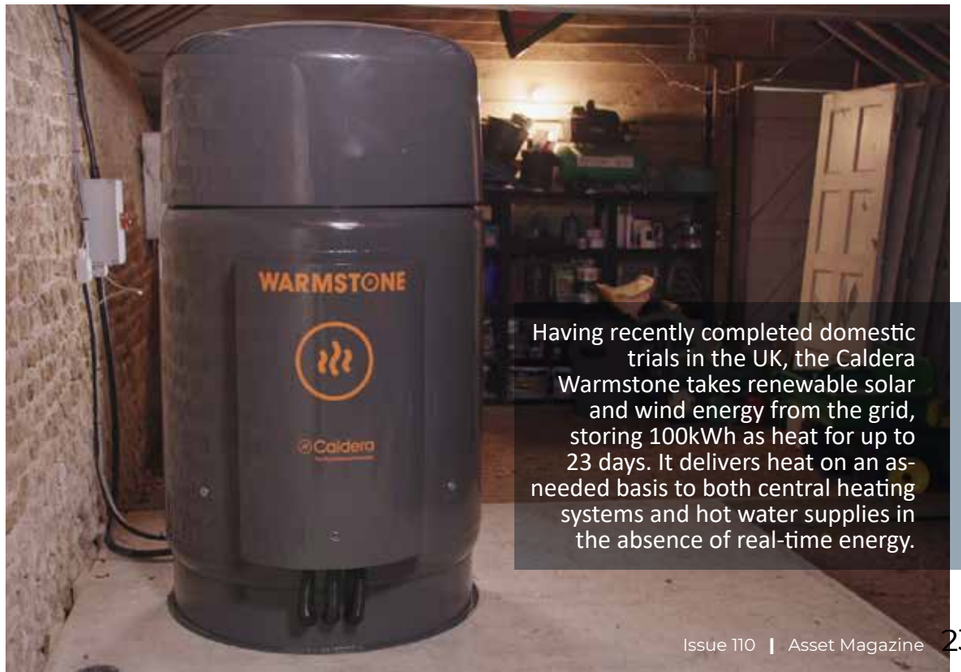

Having recently completed domestic trials in the UK, the Caldera Warmstone takes renewable solar and wind energy from the grid, storing 100kWh as heat for up to 23 days. It delivers heat on an as-needed basis to both central heating systems and hot water supplies in the absence of real-time energy.

The UK is witnessing an increase in own-use supply of generation assets.

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the energy mix, the intermittent output from renewable generators is a key challenge.

UK approach

In the UK, to manage the changing landscape of energy use and generation mix, there is an increasing move away from the centralised, transmission-based network, where large power stations are connected to the national grid. This move is towards a developing distribution-based model whereby smaller generation assets are located closer to the demand i.e. where the electricity is used. The UK is also witnessing an increase in own-use supply of generation assets. For example, solar PV, are connected behind the electricity meter of residential and commercial properties.

The distributed energy generation model has numerous advantages which include:

- Reduced energy losses as the electricity doesn't travel long distances through network cables;
- Enables smaller generation assets and is cheaper and easier to install and connect;
- For generation assets that produce heat, this could be used to provide district heating systems.

The modernisation of energy networks, as a result of the increased uptake of smart meters and the development of smart grids, will improve the ability to manage supply and demand on a more localised basis, adding to the attractiveness of distributed generation.

Other technologies

There are many innovative technologies around. The initiatives required to bring them to market are growing daily, and include nuclear generation assets. More environmentalists are now backing nuclear generation as a cleaner energy source than fossil fuels that could fill the gap renewables can't.

Currently large nuclear power stations which operate at a high pressure have led the way. However, the pressurised environment adds a significant cost to the reactor design to cover the required level of safety. There is growing competition to build small modular reactors (SMRs).

Some of the alternative SMR technology is designed to operate at atmospheric pressure, significantly reducing the cost of the reactor design as the safety requirements are much simpler. Some designs also claim that they can run on nuclear waste, reducing the burden of waste stock which remains an ongoing challenge.

The MoltexFLEX's molten salt reactor, combined with molten salt thermal storage units, are described as an advanced lower-cost nuclear technology and 'ideal complement' to wind and solar power.

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Two examples of these SMRs are the molten salt reactor and the liquid metal cooled reactors. The capacity of these reactors can range from 30MW to 300MW which gives them flexibility as to where they could sit within the energy system.

The smaller-sized reactors could be a solution for the growing requirement of the distributed energy model and be used to power localised areas. Former Microsoft CEO **Bill Gates** is supporting a group looking at liquid sodium cooled micro reactors of between 10MW and 25MW to power the maritime sector. Could this be a future solution for commercial property complexes as well?

Batteries as power-storage solutions

Lithium-ion batteries, as a power storage solution, are growing at pace. These can be used to store power during periods of surplus renewable generation, discharging back into the system when demand is greater than supply. This is an important feature of power storage as it can smooth the fluctuation of renewable generation, reducing the need to burn fossil fuels. However, the volume of batteries needed to provide a full solution is not viable, and the production of lithium-ion batteries is itself carbon-intensive with other additional, adverse environmental impacts.

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Polar Night Energy has built their first commercial sand-based heat storage for Vatajankoski, an energy utility based in Western Finland. It will provide heat for Vatajankoski's district heating network in Kankaanpää and has 100 kW heating power and 8 MWh capacity.

Could thermal storage and self-power generation solutions for commercial complexes emerge in the future?

About the writer: Simon Hannah is a partner in Optimised Strategic Solutions, a consultancy company focused on alternative energy solutions. He is a commercial expert with over 19 years' experience in the energy industry, ranging across energy markets, smart metering and emerging technology to data, energy storage and electric heating.

The use of corrosive and environmentally damaging materials, such as lithium, graphite, nickel and cobalt in the production process, along with the challenge of developing improved end-of-life recycling on a scalable basis, is a continuing problem for this technology. Vanadium flow batteries could rival the lithium-ion version on sustainability grounds and commercial solutions are emerging. Batteries are an essential part of any future energy system, but they are not the answer for longer term and higher volume storage requirements.

Thermal storage potential

Thermal storage assets could hold some exciting potential going forward. 'Batteries' that store heat in a sand or stone core are emerging in the domestic and industrial markets. These can store heat from renewable power sources and use it to heat water for properties, local communities or for industrial use.

Thermal storage on a much larger scale, including molten salt, could be used to drive steam turbines to produce electricity when required. This is being raised as a scalable solution to help make SMRs flexible, being a strong contender to complement renewable generation.

Could thermal storage and self-power generation solutions for commercial complexes and local communities also emerge in the future?

The ultimate goal of developing a perfectly sustainable, low-cost solution to achieve total energy self-sufficiency is some way off. However, with advances in renewable technologies and more innovative routes to market to drive competition in the sector, there will soon be more viable options to have buildings, complexes and local communities cover their own energy needs, eventually becoming net exporters of power to wider networks.

A concept design drawing for a residential Vanadium Redox Flow Battery system (5kwh-30kwh) by Australian Vanadium subsidiary VSUN Energy