UK Rural - November 2022

SPOTLIGHT
Savills Research

Energy security and infrastructure

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Electricity network • ESG and renewables • Energy self-sufficiency

38 GW
of renewable energy generation capacity already exists across the UK

129%
The minimum required increase in UK generation by 2050 to meet demand

16 GW
of battery energy storage is currently in the UK planning pipeline

Solving the energy trilemma

The UK is on track to achieve net zero electricity by 2050, but a struggling electricity network will hamper progress if prompt action is not taken

Current UK energy policy has long been apathetic to many renewable energy sources. Onshore wind currently suffers from an effective ban on development in England and support for solar photovoltaics (PVs) continues to be withdrawn. The recently released Growth Plan promises to bring "onshore wind planning policy in line with other infrastructure to allow it to be deployed more easily in England"; however, the summer Conservative leadership campaign openly criticised field-scale solar PV. Former Prime Minister Liz Truss has previously called these solar farms "a blight on the landscape" and removed subsidies when environment secretary in 2014.

Yet the lack of government support is a moot point as public drive supersedes that of policymakers – 38 GW of renewable energy generation capacity already exists across the UK, provided by solar and wind (both on and offshore). Close to the same amount again (33 GW) is either under construction or awaiting construction, having received planning permission, with another 15 GW contained within planning applications awaiting a determination. Almost 16 GW of battery energy storage is present within the planning pipeline to support the greening of the UK's electricity supply, as well as providing grid balancing services.

The reasons for this enthusiasm are stark. Energy supply must fulfil the "energy trilemma": security, affordability and sustainability. As renewables are deployed more widely, they are increasingly seen as able to fulfil all three of these requirements. In contrast, the crises that have occurred across the globe since the start of the decade have shown fossil fuels to be wanting in all instances.

Multiple net zero pathways have placed significant weight on renewable technologies, such as the Future Energy Scenarios (FES) created by National Grid. Research by Savills shows that the UK is potentially on track to hit the renewable energy waypoints and targets set under the FES. By bringing projects in the planning pipeline to fruition (those that are under construction, awaiting construction or have applied for planning permission), the UK has the potential to hit targets in batteries, onshore wind and solar PV without any further additions to the current pipeline.

GRIDLOCK

However, despite a promising collection of projects, the inadequate status of the national electricity infrastructure is already seeing

> **“Energy supply must fulfil the ‘energy trilemma’: security, affordability and sustainability. As renewables are deployed more widely, they are increasingly seen as able to fulfil all three of these requirements”**

developers face as much as a 14-year wait to connect new generation capacity to the grid. Such delays mean all but the very largest projects are likely to see investor confidence shaken as backers look to secure nearer-term returns for their clients. It is entirely possible that, in addition to failing to reach 2050 targets, we may see the existing pipeline of projects fall away. Planning consent on most projects is also temporary, meaning in some cases that consent may well expire. This potential for mass exodus is doubly concerning when the FES predict the total capacity of UK generation increasing by at least 129% on 2021 levels by 2050 in order to meet future demand.

Extreme weather events regularly expose weaknesses in the UK electricity grid. Most recently, heatwaves revealed flaws in the design and construction of the supporting infrastructure. As the temperature of the conducting cable increases, so does resistance. High ambient air temperature slows heat dissipation, meaning resistance increases too. Winter poses other challenges. Storm Eunice caused what was believed to be a record national power outage, with 1.4 million homes being affected.

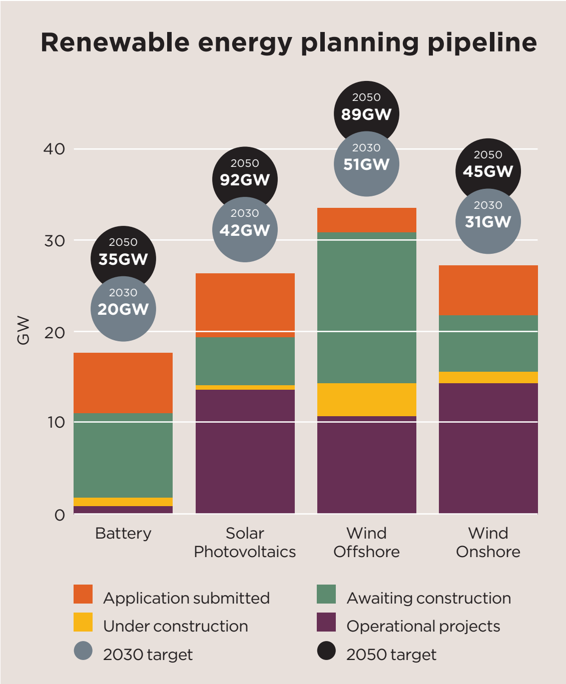


figure 1 **Source** Savills Research, BEIS, National Grid

IMPACT ON PROPERTY DEVELOPMENT

Weaknesses within the infrastructure are having a perceivable effect on reliant sectors, such as property. West London is facing a shortage of grid capacity that could soon compromise its ability to support new homes. Blame is placed on an influx of requests for new electricity connections throughout the boroughs of Ealing, Hillingdon and Hounslow from data centre operators who have sought to co-locate adjacent to fibre optic cables. No planned housing schemes have currently been affected and Hillingdon council claims there is evidence that power capacity has been reserved for developments that may never take place, freeing capacity for future developments. Power and energy has previously been a secondary consideration when considering a new development.

The current status of the grid means that power now needs to be among the first considerations in order to ensure success and progress. It is therefore beholden upon developers to communicate with transmission and distribution operators early in the process to achieve this.

WHAT ARE THE FUTURE ENERGY SCENARIOS?

The Future Energy Scenarios presented by National Grid are three scenarios that would each deliver net zero by 2050, though each with different approaches.

■ **Consumer Transformation**
Net zero is achieved by 2050 with a reliance on greater consumer engagement. The electrification of heating means this scenario has high peak electricity demands.

■ **System Transformation**
Significant supply side changes achieve net zero by 2050. There is less disruption to the way consumers heat their homes, with a high demand on hydrogen.

■ **Leading the Way**
The fastest decarbonisation pathway, reaching net zero by 2047 and going on to achieve a carbon negative scenario by 2050. Reliant on investment in decarbonisation technologies.

Three steps to creating grid

Government and industry can take action to mitigate the risks

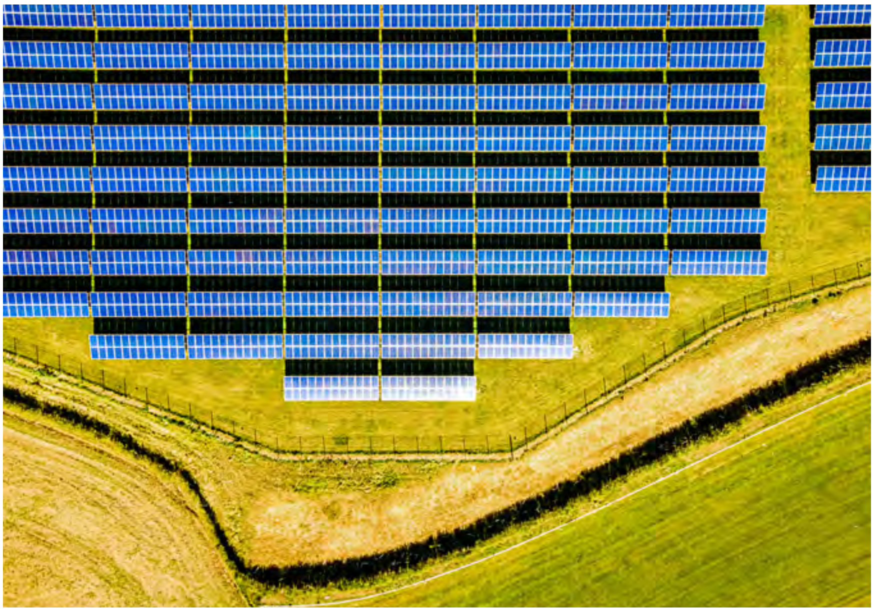
Although upgrades to the electricity network are coming in the long term to support renewables deployment, the risk to investors, net zero targets, and reliant sectors stands to be realised in the near term if action is not taken. Both government and industry are adapting policy and practice accordingly to mitigate this short-term risk. Below are three steps to create more capacity:

1 Storage support
As subsidy has been withdrawn and the technology matured, the proportion of sites utilising energy storage has increased markedly. In 2014, no solar PV or onshore wind projects possessed co-located storage. By 2021, this proportion increased to a quarter of all ground-mounted solar PV and onshore wind projects equal to, or greater than, 1 MW. Energy storage is not explicitly a requirement for renewable energy but it is an enabler and as the ambition of carbon reduction increases, so too does the system benefit offered by energy storage.

2 Maximising existing capacity
Smart control strategies hold the key to liberating existing capacity within the grid and have already been proven within the UK. The Orkney Isles are home to one of the most energy-rich climates in the world and have successfully captured vast volumes of energy through innovative technologies, making the islands a net exporter of power but fundamentally overloading the local grid. By pioneering active network management in 2009, 22 MW of capacity was created. In early 2021, National Grid installed 48 SmartValves across northern England, creating 1.5 GW of extra network capacity. These valves balance power flows on transmission lines and can push power off overloaded lines or pull power onto under-used lines. There are now plans to scale up this trial to create a further 500 MW of additional capacity using the existing network.

3 Overhauling electricity markets
The most comprehensive government action to date is the Review of Electricity Market Arrangements (REMA), published in July 2022. This consultation seeks to provide solutions on the delivery of new infrastructure, the cost of stabilising an increasingly volatile system, and resolving the energy price crisis. Several mechanisms have been suggested to use pricing to drive investment, such as Locational Marginal Pricing. This replaces the national wholesale price with local or zonal prices, where the physical constraints of the network are reflected in the wholesale electricity price, acting to direct investment where it's needed. REMA is likely to take several years to come to fruition itself, as the Electricity Market Reform process before it did, and the exact fleet of solutions that will be adopted is unclear.

> 2015 proved to be a watershed moment for renewables. Savills research shows how the priorities of developers evolved in the face of reformed and reduced subsidy support



Energy produced per unit of land

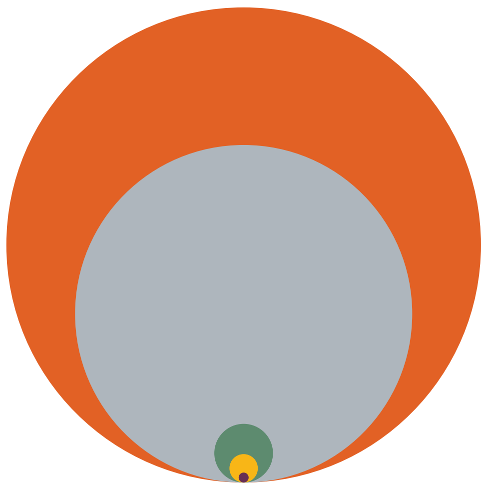


figure 2 **Source** Zalk & Behrens

Earth or electric?

Renewable energy will permanently occupy less than 1% of the total UK land area, but it must still compete against existing and emerging land uses

Renewable technologies are energy-dilute, meaning that a large land area is needed to generate each unit of energy. *Figure 2* shows how the amount of energy produced per unit area from natural gas is several orders of magnitude greater than biomass, wind and solar. So, will fulfilling the FES 2050 renewable energy targets demand swathes of the UK to be turned over to power generation?

MODELLING LAND USE DEMANDS

Solar PV currently covers just over an estimated 17,000 hectares, less than 0.1% of the total UK land area. To fulfil the most ambitious FES model, "Leading the Way", Savills research estimates a total of 186,000 hectares will be required, or 0.8% of the total UK land area; less than that covered by sports facilities, including golf courses. This is the most extreme scenario, accounting for increased demands in electricity consumption by consumers but not permitting for any further improvements in solar PV efficiency. Academic studies have shown the amount of energy generated per unit area of solar PV has been increasing over time, meaning 186,000 hectares is likely to be an overestimate.

The land use required by onshore wind to meet the demands of the same scenario initially appear larger. Savills research estimates that wind would require a total land use of 865,000 hectares (3.6% of the UK's land area). However, only 13,000 hectares of land stand to be directly affected by wind installations, or 0.02% of the UK land area; less than that occupied by landfill or airports. The difference (852,000 hectares) would be only partially compromised. It could not be used for housing or forestry, however agriculture, soil-based carbon and biodiversity projects could continue on land between the turbines.

In all instances, the land requirement is low, but finding appropriate sites remains a challenge. For example, deployment is recommended on land that is not classified as best and most versatile. However the relationship between poorer quality agricultural land and that of the connection points, along with other development factors such as topography, construction access,

Number and size of planning applications for renewables

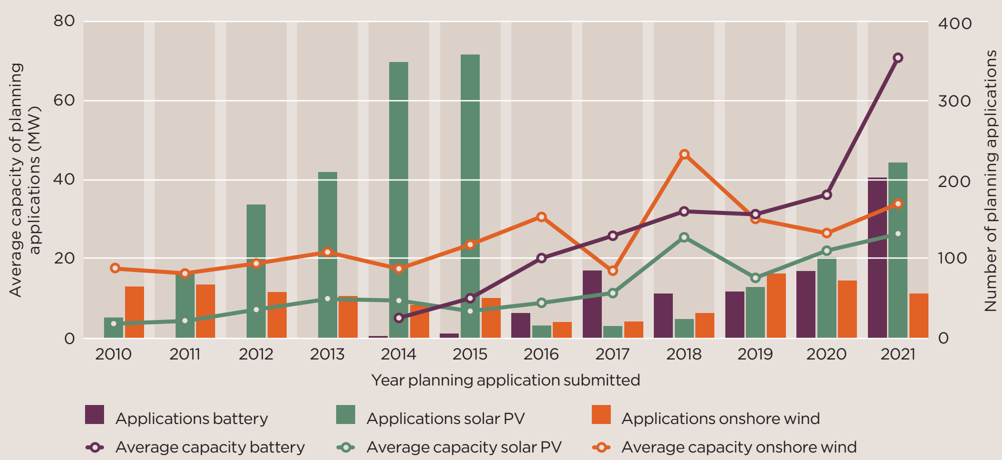


figure 3 **Source** Savills, BEIS

0.02%
of the total UK land area stands to be directly affected by wind installations

50 MW
The largest permissible solar PV project without becoming an NSIP

202
The number of planning applications for battery storage in 2021

wind resource and flood risk, all form part of the equation that determines the overall suitability of a site.

ADOPTING RENEWABLES AT SCALE

2015 proved to be a watershed moment for renewables. Savills research shows how the priorities of developers evolved in the face of reformed and reduced subsidy support (*figure 3*). Despite a significant decrease in the number of planning applications for solar PV between 2015 and 2016, as well as a slight decrease in onshore wind, there is a gradual increase in the scale of solar PV and battery projects beyond 2015. Battery storage makes a sudden appearance and rapidly rises to prominence in the following years.

The average capacity per application obscures the extensive changes occurring in the world of renewable energy development, most notably for solar PV. The renewable energy planning database indicates that only eight of the 2,750 planning applications for solar PV exceeded the 50 MW limit that tips a project into the realms of a Nationally Significant Infrastructure Project (NSIP). All these projects submitted planning applications during or after 2018, with the majority being after 2020. All exceeded 300 MW. Planning applications for this scale of project are expected to increase in future.

In 2020 and 2021, applications for solar PV projects between 49 and 50 MW (the largest permissible without becoming an NSIP) accounted for around a fifth of all applications; each of these sites is likely to require approximately 100 hectares of land. Before 2015, sites of this capacity never exceeded 1%. It is clear developers are pursuing scale and recent government consultations on the NSIP planning process indicate a desire to make the process easier and faster.

While energy should demand a relatively small proportion of land nationally, large-scale projects will have a local impact. Taking the rule of thumb that each megawatt of solar PV capacity requires roughly two hectares of land, the very largest will consume as much as 1,000 hectares or more; enough space for two million trees, 14,000 homes, or wheat for 14.5 million loaves of bread per year. The local impact of this scale of solar PV development will necessitate careful community engagement.

17,000 ha
is currently covered by solar PV, less than 0.1% of the total UK land area

Beyond energy

Ensuring communities see the local benefits

Given the near paralysis experienced by the UK's electricity infrastructure, those sites that can host renewables and connect to the grid rapidly are a golden opportunity. Developers must now invest in a wider fleet of measures to ensure renewable energy at these prime locations is welcomed by local communities and provides local benefits. Environment, social and governance (ESG) are terms often deployed at this stage, but we look here at what they mean for renewable energy in practice.

E is for services
Specifically, ecosystem services. The carbon credentials of renewable energy are no longer enough to satisfy the environmental component of ESG, and additional investment can bring renewable developments outside of "carbon tunnel vision". With appropriate management, renewable energy developments can provide carbon storage, biodiversity, pollination and more. A rising compliance baseline makes certain elements of this potential mandatory. The Environment Act sets a requirement for every new Town and Country Planning Act (TCPA) development in England to deliver a measurable biodiversity net gain (BNG) of 10% from November 2023. This is also likely to apply to NSIPs from 2025. In Wales, developers are required to maintain and enhance biodiversity (known as biodiversity net benefit). For solar farms, this should be easily achievable with gains of 20% to 100% over arable cropping known to be possible. Biodiversity investment also softens the visual impact of developments. Developers can incorporate natural or educational spaces, further enhancing the appeal to local communities.

S is for community
Stakeholder consultation is a core part of any planning application, yet approaches can vary greatly between projects. Engaging with all stakeholders, from statutory bodies to local community groups, should be undertaken from an early stage to avoid surprises later in the process. The importance of effective engagement cannot be understated, but nor should it be feared. Simple outreach exercises to allay community fears and explain benefits can build trust and understanding between owners, developers and communities. For example, rural village communities may be concerned about the impact of heavy goods vehicles passing through small rural roads, particularly if carrying wind turbine blades in excess of 50 metres in length. Simply explaining the function of a blade lifter and how it assists in manoeuvring turbine blades may be enough, along with noting the likely need to renovate and improve such roads to ensure they are appropriate for heavy traffic. Developers often provide a community benefit based on the size and type of project to compensate communities for unavoidable impacts. This may range from financing day-to-day maintenance, to providing new local facilities, or even promoting community ownership of part of the renewable energy asset. In Scotland, community energy funds have been so successful, they have been recognised internationally as a pioneering example of bottom-up policy to renewable energy development. The consultation process can be used to understand what is preferred by the community and what would provide them with the most benefit. Community engagement will rarely eliminate all opposition, but by addressing local concerns, developers can maximise their chances of planning success.

G is for supply chain
Governance can relate to a variety of factors regarding decision-making and procedures within a company. Of these, values and transparency are particularly important; companies should be seen to be acting with integrity to ensure the long-term viability of their undertakings. Within renewable energy, this integrity is perhaps most keenly reflected in supply chains and there is increased awareness of the potential for forced labour to be present. According to the University of Nottingham, 15%-30% of the cobalt in lithium-ion batteries comes from mines in the Democratic Republic of Congo, where forced and child labour are common. Failing to take early action on such issues could well result in supply chain disruption, particularly if other nations follow the US example requiring importers to provide "clear and convincing evidence" that imports do not include Xinjiang-sourced forced labour in its supply chain. In Scotland, there is an emphasis on supply chains for offshore wind projects as part of ScotWind. Successful applicants must outline a Supply Chain Development Statement at the outset of the project that details initial commitments across the full life cycle of projects.

40
Land for solar PV can be let for as long as 40 years in a single contract

£2,100
Income per hectare from solar PV before tax

4x
annual income from solar PV is over 4x that from in-hand farming before

Renting and renewables

Turning agricultural land over to solar PV developments can be a complicated decision-making process. We weigh up the potential benefits and considerations

Industry widely quotes returns of £2,500 per hectare for renting land for large solar PV developments, a figure that clearly exceeds agricultural returns. However, the appraisal of the opportunity and decision-making is more complicated. Principally, this is because agricultural land farmed by a trading business or let using a Farm Business Tenancy benefits from Agricultural Property Relief (APR) from inheritance tax at 100%, with Business Property Relief (BPR) also potentially available for aspects such as development value. However, letting the land for solar PV will mean that it is no longer used for agricultural purposes so eligibility for APR is lost. From a BPR perspective for the property in isolation, the lease means the land is an investment asset and therefore not eligible. However the relief may be available if the landlord's overall business is deemed to be a trading business.

Savills research has shown the true margin to be closer to £2,100, much lower than £2,500, however sensible tax planning could improve returns beyond the final £588 annual net income figure. In addition to a fixed annual income and inheritance tax (IHT) implications, there are other considerations that a landowner should contemplate before entering into an agreement.

BENEFITS

■ *Guaranteed income over the long term:* If a landowner successfully negotiates a contract with a prospective developer, they will receive a guaranteed rental income. Leases often last between 20 and 40 years, securing stable income from the land for an extensive period. Indexing rent will ensure that returns are not eroded by inflation or left lagging by the future market.

■ *Retaining rights to alternative income streams:* Landowners are increasingly retaining rights to alternative income streams within their lease agreements, including carbon and biodiversity. While currently pursued as income streams, retention of these potential credits could be of greater benefit in the offsetting of a landowner's own actions in the future. While it is possible to "stack" these credits (e.g, carbon and biodiversity credits may be quantified and obtained on top of income from energy assets), a landowner must prove additionality; that the outcomes are demonstrably new and additional and would not have resulted without the income from the environmental credits.

£588
Annual net income per hectare from solar PV

CONSIDERATIONS

■ *Locked in:* Agreeing a contract with a renewable energy developer locks the land into a use for a prolonged period, leaving the owner unable to utilise that land and adjoining land for any other opportunities. While indexing rent will insulate against some elements of market fluctuation, it remains possible that competing land use markets outperform renewable energy in the contracted period.

■ *End of lease:* Both developer and landowner may wish to continue with the arrangement after the defined period of the lease and options to extend are often included within the initial agreement to permit this. Should that not be the case, landowners should ensure that the initial contract includes arrangements for a decommissioning bond, whether this be accumulated over the course of the lease or set aside from the outset. Landowners should also ensure developers produce an agreed "record of condition" prior to the commencement of works. Once the project ends, developers would be obliged to return the land to this condition.

Comparing land uses per hectare

	Solar PV	Farm business tenancy	In-hand farming
Annual income	£2,100	£310	£450
Income over 25 years	£52,500	£7,750	£11,250
After income tax	£31,500	£4,650	£6,750
Potential IHT cost	£16,800	£0	£0
Final income over 25 years	£14,700	£4,650	£6,750
Final annual income	**£588**	**£186**	**£270**

The table above is based upon a number of assumptions:

- *All figures per hectare*
- *Higher rate income tax payer*
- *No inheritance tax (IHT) nil rate band available*
- *Income remains constant and is not indexed*
- *Landowner is not an incorporated entity*

> By first understanding the demand profile of the operation over various timeframes (monthly, weekly, daily, hourly), renewable energy solutions can be tailored to fit that demand profile

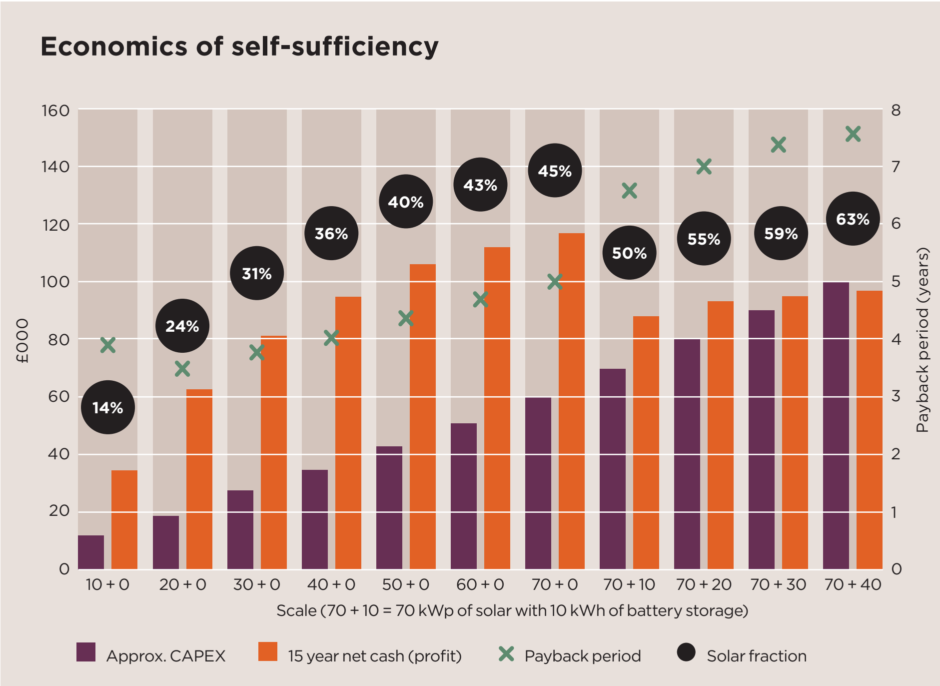


figure 4

Source Savills Research

DEFINITIONS

- **kWp:** the peak power of a solar PV system, indicating the rate at which it generates energy
- **kVA:** the measure of power that the system is capable of delivering to components that consume electricity
- **kWh:** in the case of batteries, kWh indicates how much electricity can be stored by the unit
- **Solar fraction:** the amount of energy initially derived from solar technology

Going (almost) off-grid

The key to self-sufficiency is understanding the site's demands

Savills Energy has simulated several scenarios of renewable energy adoption on a small dairy farm. The farm uses around 60,000 kWh of electricity per year with daily consumption being concentrated around a constant baseload demand of hot water and refrigeration need as well as two milking times forming two spikes in demand each day; one between 5:00 and 10:00, peaking around 8:00, and another between 16:30 and 20:00, peaking around 18:00. This profile is repeated consistently throughout the week and throughout the year.

Solar PV is deployed across all 11 scenarios ranging from 10 to 70 kWp, the most that could realistically be supported by a 50 kVA connection to the grid (connections to the grid typically become more complex beyond 50 kVA). Solar PV is often the technology of choice for farms when pursuing self-sufficiency due to being comparatively inexpensive and deployable on large barn roofs. Four scenarios feature battery storage co-located with the solar PV.

Wind and micro-hydro solutions can prove valuable as their dissimilarity to solar PV can provide added benefit and resilience. However, these technologies are often more difficult to deploy, being more site-specific in their requirements than solar PV. A tailored approach to each site and its attributes will ensure the best possible outcome from investing in on-site renewable energy.

The values used in this case study are approximate and unlikely to be seen across all sites. However, the relative values demonstrate the importance of a well-considered project that accounts for the effects of scale and consumption on farm. Exactly which of the scenarios the farm should pursue depends largely upon the farmer's objectives, and it is this that will define the case for investment:

■ **Lowest payback period:** The lowest payback period is not necessarily delivered by the smallest initial investment. In this case, 20 kWp of solar PV without battery storage delivers a shorter payback time than 10 kWp of solar. Beyond 20 kWp, deploying additional solar PV gives increased net cash profit over time but ultimately a reduced return on investment.

An improved balance between profit and payback period could be found if the farmer made efforts to match the supply of renewable energy to the energy demand of the farm. By first understanding the demand profile of the operation over various timeframes (monthly, weekly, daily, hourly), renewable energy solutions can be tailored to fit that demand profile, reducing the need to source energy from the grid and therefore minimising the cost of energy.

■ **Highest solar fraction:** The solar fraction is the proportion of energy derived from solar PV, whether directly or first stored through batteries and utilised later. The higher the solar fraction, the less reliant the farm is on energy supplied by the grid.

To maximise the amount of energy available to offset grid demand, the largest amount of solar PV deployment is necessary. By itself, this situation would deliver the highest net cash profit over 15 years but only offset 45% of the energy used on the farm as much of the energy generated by the additional capacity would be sold to the grid rather than being used to offset on-farm demand. The price of energy sold to the grid is much lower than the cost of purchasing energy from the grid, but if there is no on-farm demand for the energy at the time of generation, there is no other option.

The benefit of battery storage now becomes apparent. Though battery storage will lead to higher capital expenditure and longer payback periods, the non-financial benefits, including flexibility and resilience, are substantial. Energy can be stored in periods of excess supply, e.g. when the sun shines and no milking is occurring, such as between 10:00 and 16:30. Battery storage can then be called upon to supply the stored renewable energy when supply is lower and demand high, e.g. 18:00 to 20:00. The addition of battery storage means almost two-thirds of the energy used on the farm is derived from renewable energy assets. The payback period is below eight years and healthy profits can still be achieved despite the larger initial capital expenditure.

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