REGEN

Geoprint for Energy Club Connections and Operations (GECCO)

GECCO Landscape Report

JULY 2026

About Sponsor

This Network Innovation Allowance (NIA) project is sponsored by National Grid Electricity Distribution (NGED), the distribution network operator for the Midlands, South West and South Wales.

About Regen

Regen provides independent, evidence-led insight and advice in support of our mission to transform the UK's energy system for a net zero future. We focus on analysing the systemic challenges of decarbonising power, heat and transport. We know that a transformation of this scale will require engaging the whole of society in a just transition.

Acknowledgements

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Executive summary

Geoprint for Energy Club Connections and Operations (GECCO) examines how local energy balancing can enable new renewable generation in grid-constrained areas, reduce network costs and deliver benefits to communities. This report sets out the evidence for this by reviewing relevant models, drawing on lessons from past projects and mapping out what's happening in the market today.

Five categories of local supply models were assessed to determine which are most aligned with GECCO's objectives. This analysis identified community-led complex site arrangements as the only model that meets the criteria. This model:

- Demonstrates strong community involvement and decision-making
- Is constrained to a defined network area (typically aligned with a primary substation)
- Enables local matching of generation and demand to reduce network impacts
- Shows evidence of deployment and growth.

A review of previous innovation projects relevant to GECCO was conducted to assess how local balancing schemes have performed in practice and to draw lessons. Several key findings emerged from this review:

- Local balancing schemes have been proven to provide network benefits
- A financial value can be placed on the costs and benefits of local balancing
- Local balancing can enable new connections for both demand and generation
- Tools, guides and frameworks have been developed to optimise the design and operation of local supply and balancing schemes.

Mapping of the existing local supply landscape indicates that community-led complex site arrangements are proven, but at an early stage of growth. Energy Local has demonstrated the model's viability, establishing 18 operational clubs. There is significant growth potential, with a further 15 clubs in development, new market entrants such as 100Green launching their own community-led offerings, and strong interest from community energy organisations. Regulatory developments, including Balancing and Settlement Code (BSC) modification P441, are expected to support further growth by simplifying set-up processes and enabling more flexible configurations across voltage levels.

However, there are barriers to wider deployment. Complex site arrangements are resource-intensive to establish and operate, and identifying viable sites requires significant effort. In response, alternative models are emerging. Providers such as Younity and UrbanChain are developing licence-exempt supply schemes for community and non-domestic customers. These models are not currently included within the scope of GECCO, as they are not constrained to a network boundary, and it is unclear whether they provide a sufficiently strong price signal to incentivise demand shifting.

An initial, high-level cost–benefit assessment of the Geoprint connection approach indicates that it could deliver a range of benefits. For the electricity network, the primary benefit is potential deferral of network reinforcement, with secondary benefits including reduced losses and improved network resilience. For customers and communities, benefits include enabling participation in local supply models, reducing energy bills, supporting community energy organisations and delivering wider socio-economic value. Increased levels of local supply could also improve perceptions of fairness in local energy projects, thereby supporting greater public acceptance of the energy transition.

Case studies are included to provide context and ground the Geoprint concept in real-world projects. Three community energy partners are being brought into the GECCO project to support this. This report outlines the selection process and presents the case studies, setting out the local context, details of the generation they'd like to build and the local supply arrangements they intend to put in place.

Contents

Introduction

The GECCO project and this landscape report

The Geoprint for Energy Club Connections and Operations (GECCO) project focuses on using local energy balancing (or ‘energy clubs’) to overcome grid constraints and enable more community-owned generation to connect to the network. By applying a new ‘Geoprint’ approach, it tests whether local matching of supply and demand through energy clubs can reduce the need for costly network upgrades, lower bills and increase returns for communities. In doing so, GECCO aims to unlock new capacity for community energy and support the wider transition to a flexible, low-carbon energy system.

This landscape report sets the scene for the GECCO innovation project and summarises the current understanding of local balancing models in Great Britain.

- It provides an overview of the local balancing approaches currently being explored, identifying those most relevant to the aims and delivery of the GECCO project.
- It draws together key insights from previous innovation projects, ensuring that GECCO builds on existing evidence, avoids duplication, and reflects emerging best practice.
- It maps the current landscape of energy clubs and related community energy initiatives, highlighting where they are operating, their potential for growth and the barriers to wider uptake.
- It also considers alternative delivery and governance models to help frame future opportunities for local energy balancing.

The report also includes a high-level qualitative assessment of the potential costs and benefits of local balancing and community-led energy approaches, considering the possible impacts on consumers, communities, network operators and the wider energy system.

To provide context, the report introduces three case study communities and explains why they were selected to support the GECCO project. These case studies illustrate a range of local circumstances, challenges and opportunities, helping to ground the analysis in real-world experience.

Together, the findings presented in this report establish a shared evidence base to inform the next stages of the GECCO project and support the development of scalable and effective local balancing models.

1 Local balancing models

An introduction to the different models and their relevance to GECCO

A range of local balancing models exists across the UK, but they remain relatively niche.

There has been a growing interest from community energy organisations and local authorities in both owning power generation and buying power locally. This has led to various trials, with some approaches moving into business-as-usual operation. However, most current models rely on workarounds layered on top of the existing centralised supply framework.

Despite this progress, significant challenges continue to limit wider adoption:

- Many schemes depend on the voluntary participation of licensed suppliers, who operate under tight margins and have no obligation to support local initiatives
- The incomplete rollout of smart meters and the slow transition to Market-wide Half-Hourly Settlement (as opposed to using estimates based on profiles) restrict the functionality of these models
- Difficulties in capturing the full value of local balancing, for example, by offsetting network reinforcement costs, affect the uptake and sustainability of these models.

Recently, the government's Local Power Plan signalled renewed support for local supply. The Plan aims to "give communities fairer access to energy markets" by working with Ofgem and Elexon on key code modifications, and to "make it easier for communities to sell their power", for example, through supply exemptions, by developing a definition of a 'community energy group' and encouraging licensed suppliers to work with communities.

This landscape is complicated by inconsistent terminology. Terms such as Local Energy Markets (LEM), Smart Local Energy Systems (SLES), local supply, local balancing and flexibility are often used interchangeably, even though they refer to overlapping but distinct concepts. This project focuses on local balancing, which, for this report, we have defined as a price signal that stimulates local matching of generation and demand, thereby reducing network impacts.

Comparison of local supply approaches

There are different local balancing models. These vary by market structure, types of actors, focus on shaping demand, and levels of localism and smartness. This section presents five key models, then discusses which are relevant to the GECCO project and why.

Table 1: Overview of local balancing models and their key characteristics

Model	Description	Local balancing mechanism	Role of communities	Growth potential	Connections potential
Complex sites	The virtual grouping of multiple energy assets – both generation and demand – allowing them to operate as a single party and balance energy without sending internal flows to the wider market	Lower 'match' price for local generation supported by exemption from some use of system and policy costs	Energy Local Clubs (ELCs) were designed for communities – the clubs' key decision-makers	12 ELCs and growing. P441 could support.	High
Retailer-led	Main types include local generation-linked tariffs, sleeved PPAs connecting generators and large users, and retailer-led energy clubs working with community groups	Discounts for matched generation and demand from license-exempt supply	Tend to be led by the retailer, with some community engagement	Strong near-term growth potential	Medium
Microgrids	A localised power network that combines generation, demand and often storage, and can operate in grid-connected or island mode	Can use storage or demand side response to match generation and reduce grid imports	Some use by Community Land Trusts for community developments	Limited community use	Low
Local flexibility markets	These allow DSOs to pay flexibility service providers (FSPs) to adjust electricity consumption or generation to manage local grid constraints	Payments to FSPs to shift electricity usage to reduce specific network constraints	Currently limited. FSPs tend to be large batteries, generators and aggregators	Growing but limited domestic participation	Low
Smart local energy systems	An integrated systems approach to connect generation, demand, storage, EVs, heat and Information and Communication Technology to optimise across vectors and participants	Uses a combination of software coordination and markets	Community engagement is seen as key	Pilots only	High

Not all of the models listed above are relevant to the GECCO project. GECCO is exploring a new type of flexible connection for community energy groups, in which generation and demand are balanced locally within a defined ‘Geoprint’ area.

In collaboration with the GECCO project team, a set of criteria has been developed to identify which local supply models are relevant. These models must:

- Demonstrate community buy-in and include local decision-making powers
- Operate within a defined local network area, typically aligned with the scale of a primary substation
- Facilitate local matching of generation and demand to reduce impacts on the wider network
- Be established, with evidence of practical application and growing adoption.

The only model that currently meets all these criteria is **community-led complex sites**. At present, these are facilitated by Energy Local and 100GreenCommunities.

There is potential for both smart local energy systems (SLES) and retailer-led models to become relevant to GECCO. SLES have the potential to create network capacity for new generation, but they are limited to pilots and don’t yet have a standardised model or offering. Retailer-led models based on license-exempt supply aren’t required to have a geographic restriction or community buy-in. However, if local license-exempt supply grows and the model proves successful at shifting demand, it could become relevant to GECCO.

There is also potential to widen the definition of “community buy-in”. The GECCO project is starting with community energy groups as the main connecting customer and key stakeholder in the local balancing scheme. However, this could be expanded to include local authorities and local businesses.

Previous innovation

A review of previous innovation projects relevant to GECCO was carried out to ensure we built on existing knowledge and evidence. The review focused on projects that included local matching of generation and demand to reduce network impacts, rather than broader flexibility studies. A summary is provided below, with further information included in Annex 2.

Previous projects have established that local balancing schemes can **provide network benefits**. Bethesda Home Hub demonstrated that households in Energy Local Clubs could successfully shift their electricity usage and maintain this behaviour change over time. Similarly, Urban Energy Club demonstrated that this was also possible in blocks of flats with PV and a communal battery. In the US, the Urbanova Shared Energy Economy project demonstrated network benefits from local balancing at the district level, and the Pacific Northwest Smart Grid Demonstration Project demonstrated network benefits from regional-level balancing.

Some innovation projects have provided useful **data on the costs and benefits of local balancing**. The method applied to balance demand and supply varied between projects, but the findings provide a useful comparison with the Geoprint approach.

- Community DSO: a flexibility trial proxy value of £7k was established for each cell (per LV feeder per year), resulting from communities managing local generation, storage and demand within defined capacity limits. This was based on avoided network costs.
- Level-Up: an estimated saving of £185k in the Carluke area, resulting from the use of a digital platform to optimise local energy balancing (a timescale was not provided). This was based on avoided network reinforcement.
- LEO-N: an estimated saving of £68bn across GB between 2025 and 2050, resulting from the large-scale implementation of FutureFit (the optimised installation of building fabric upgrades and smart technologies). The CBA extended beyond network benefits to include other financial, social and environmental benefits.
- The Urbanova Shared Energy Economy project (USA) identified the main value streams that are created by local supply and balancing: avoided reinforcement costs, improved utilisation of local energy, overall system efficiency gains, improved network reliability and resilience.
- The Pacific Northwest Smart Grid Demonstration Project (USA) calculated that $6bn could be saved across the Pacific Northwest by smart grid technologies, which balance local supply and demand.

In addition to reducing network impacts, some innovation projects have looked at whether local balancing can **enable new connections**. The first project to test the concept in the UK was the Sunshine Tariff in 2015. This project explored the feasibility of an 'offset connection' for new solar PV on a constrained network using a time-of-use tariff to balance additional generation. The Sunshine Tariff was not successful, mainly due to the lack of flexible load available at that time (limited EVs, batteries and smart appliances).

However, this was followed by ACCESS – Local Constraint Management, which successfully demonstrated that a community could balance the output from a new hydro generator with new controllable demand installed in homes. The findings informed the creation of SSEN's alternative and flexible connection offers. More recently, SSEN launched a trial of 'Community Smart Access' connection offers to enable faster demand connections when power can be balanced locally.

Alectra GridExchange (Canada) demonstrated that feeders can support additional distributed energy resource (DER) installations or electrified loads if local demand and generation are actively managed. Electric Access System Enhancement (USA) demonstrated that further capacity is unlocked if local balancing can operate within Dynamic Hosting Capacity limits for feeders, instead of feeder Static Hosting Limits, which are based on worst-case peaks.

Two EU-funded projects, eNeuron and COMPILE, have **developed tools, guides, or frameworks** to optimise the design and operation of local supply and balancing schemes. A new SIF project in the UK, Neighbourhood Watts led by UK Power Networks, aims to create a community-led blueprint to share and manage local electricity more efficiently. GECCO will build on previous innovation projects that have proven the value of local balancing to networks. It has similarities to the Sunshine Tariff and ACCESS projects, which explored the potential for local balancing to enable new connections. However, it fills an innovation gap by testing whether a local tariff, without controllable demand, in today's energy landscape of more flexible load can offset additional generation on a constrained network.

2 Mapping and market overview

Relevant local balancing models, locations and growth potential

The community-led complex site model was identified as the only model that currently meets all the criteria for inclusion in Project GECCO. Therefore, this section focuses on its current locations and growth potential. It goes on to discuss retailer-led license-exempt supply arrangements, which may prove to be relevant to GECCO in the future.

Community complex site growth potential

As of April 2026, the Energy Local scheme is the only established, commercialised example of community-led complex sites.

The first Energy Local club was formed in Bethesda, North Wales, in 2016. 18 clubs are now active across England and Wales, linking customers to electricity provided by local solar, hydro and anaerobic digestion generators. Some of these active clubs are unable to expand because no additional local generation is available to meet increased customer demand. However, others are actively recruiting new demand customers. By pioneering the community-led complex site approach, Energy Local has attracted national press coverage and won energy sector awards.[1]

15 Energy Local clubs are currently progressing through development. These sites have been assessed as viable locations by Energy Local; further clubs are in more speculative, early-development. This dispersed pipeline of new clubs suggests strong interest in the model and its growth potential.

As further evidence of healthy interest and growth potential in the community-led complex site model, 100Green, which acts as the licenced supplier and bill provider within Energy Local clubs, is now launching its own scheme, '100Green Communities'.[2] Engagement with 100Green has confirmed it will operate this scheme while continuing to support Energy Local. In addition, Iquira Energy Innovation, which delivers software services for the Hook Norton

[1] Energy Local and friends win at Green Energy Awards 2026, Energy Local, 2026

[2] 100Green Communities, 100Green, accessed April 2026

Energy Club (formerly an Energy Local scheme), is offering its services to enable more clubs to form; the Hook Norton Energy Club is itself expanding, again in partnership with 100Green.[3] [4]

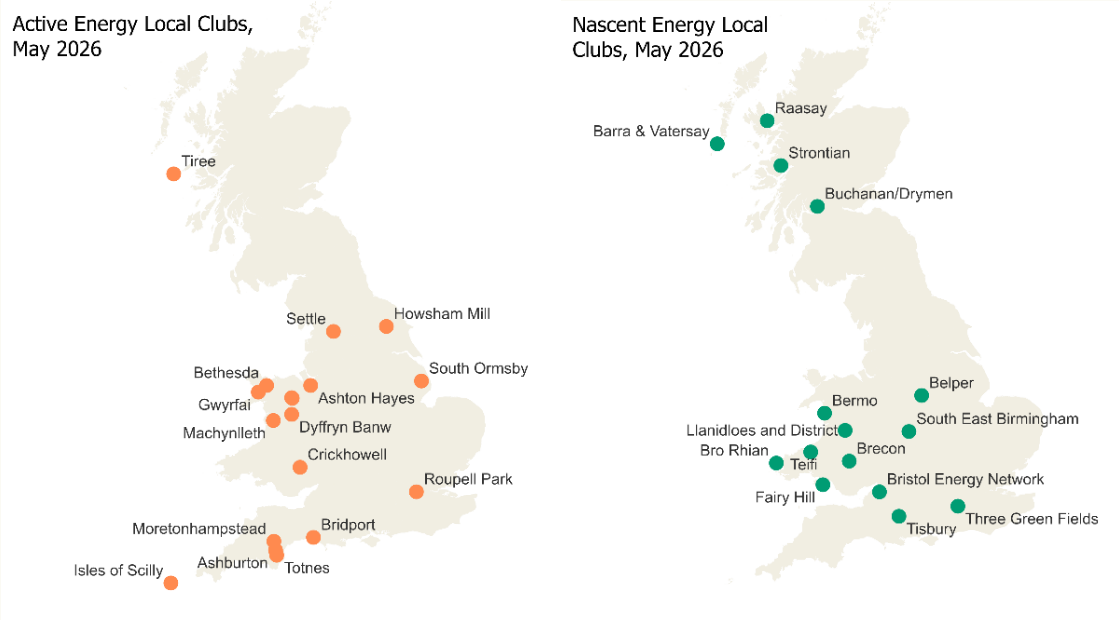

Figure 1: Active and Nascent Energy Local clubs across the UK, May 2026

To better understand the appetite for community-led complex site arrangements, or local supply and balancing schemes more generally, Regen conducted a survey of community energy organisations within NGED's licence areas. The results indicate strong interest in local supply and balancing schemes, especially among community groups developing projects that face grid constraints. This supports the view that there is growth potential for the community-led complex site model:

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[3] Iquira Energy Innovation, Iquira, accessed April 2026

[4] Hook Norton Energy Club , Hook Norton Low Carbon, accessed April 2026

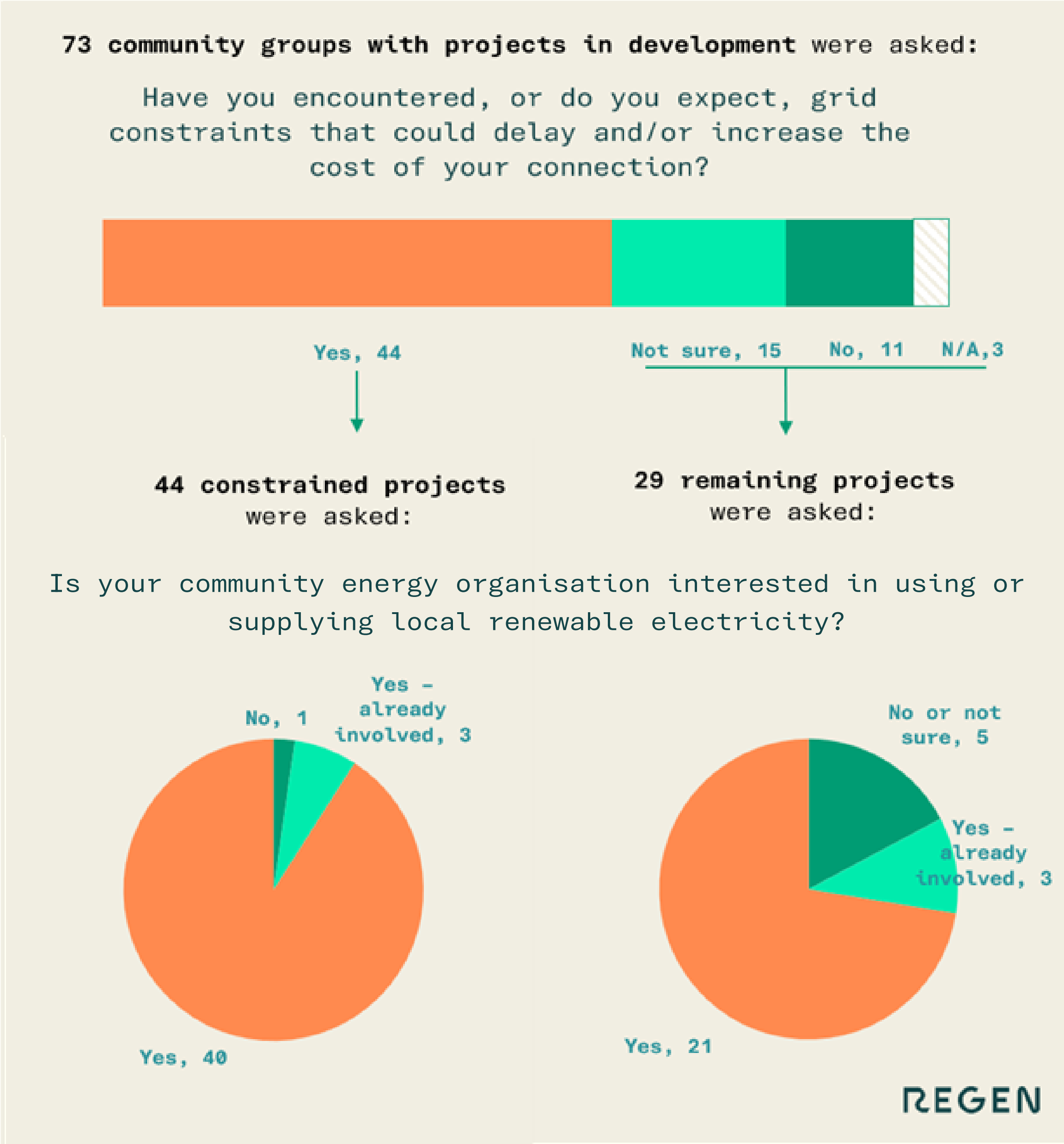

Figure 2: Community energy projects' experience of grid constraints and interest in local renewable supply

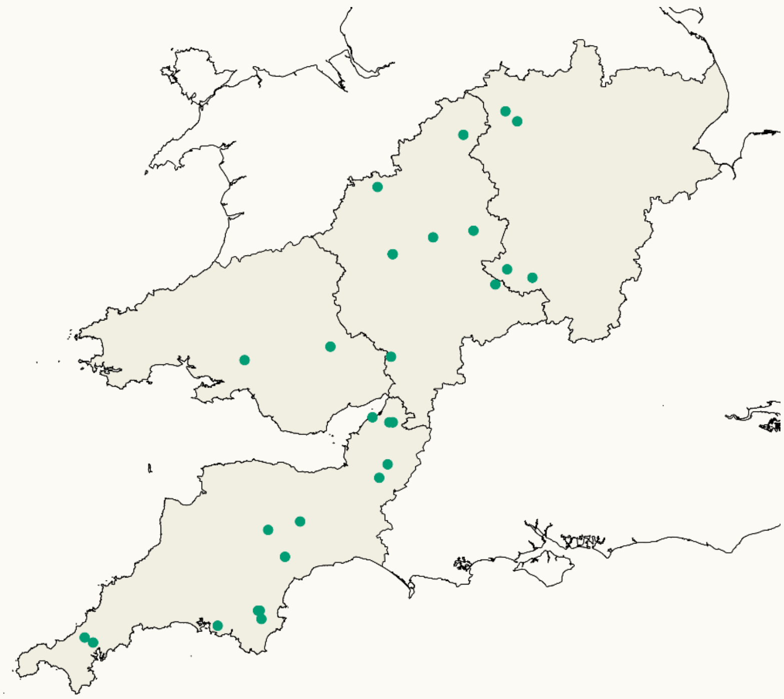

Figure 3: Community energy organisations in NGED licence areas interested in, or actively exploring, local supply and balancing schemes identified by a Regen survey, March 2026.

Barriers to growth in complex site arrangements

While the success of existing schemes, the emergence of new schemes, and high levels of customer interest are signs that community-led complex site arrangements could see strong growth over the coming years, key barriers could prevent this.

Setting up and operating a complex site scheme is resource-intensive. It requires investment in IT systems, frequent monitoring by experienced staff and a significant amount of customer service resources. In early schemes, billing has also been impacted by data issues, such as incomplete half-hourly data.

It is also challenging to identify areas where complex sites can be set up, as both the generator and the local community need to be engaged and willing to participate actively in the scheme and currently need to be located at the same voltage level.

BSC Modification P441

Balancing and Settlement Code (BSC) modification P441 is a regulatory change currently being considered by Ofgem. If approved, P441 will provide a more robust regulatory framework for complex site arrangements and simplify the set-up process. It would also enable generation and demand connected at different voltage levels to form complex sites, significantly expanding the number and size of potential sites.

It is hoped that these changes will provide the confidence needed for more licensed suppliers to invest in their own complex site schemes. A final decision from Ofgem is expected in 2026.

Licence-exempt supply arrangements

As stated above in section 1, retailer-led models based on license-exempt supply were not included in the early stages of the GECCO project because they are not limited geographically and do not require community buy-in. However, if local license-exempt supply grows and the model proves successful in shifting local demand, it could become relevant to GECCO.

Under licence-exempt supply, electricity supplied below a capacity threshold and matched with domestic and/or commercial demand is exempt from policy costs, which are normally included on electricity bills. [5] These policy costs include the Renewables Obligation (RO), the Feed-in Tariff (FiT), Contracts for Difference (CfD), and Capacity Market charges. Historically, they have accounted for 16% of a typical electricity bill[6] – meaning licence-exempt supply arrangements could provide significant savings for participating customers.

Notably, these licence-exempt supply schemes do not require generation and demand to be in close proximity on the network. This means there is the potential for a large number of clubs to be formed, incorporating geographically dispersed generators and demand customers, which do not provide network balancing benefits.

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[5] Only 2.5 MWh per half hour, with a maximum of 1.25 MWh to domestic customers; generators under 50 MW only and generators cannot be ROC accredited.

[6] Household energy bills include green levies, NESTA, 2024

BSC Modification P442

BSC modification P442, implemented in February 2025, is a change to the UK Balancing and Settlement Code that enables accurate identification and reporting of licence-exempt electricity supply within central settlement. It introduces a new role, the Exempt Supply Notification Agent (ESNA), to calculate and submit half-hourly volumes of exempt versus licensed supply, ensuring exempt volumes are excluded from Electricity Market Reform (EMR) levies such as Contracts for Difference and Capacity Market charges.

It applies primarily to small-scale generators, below 5 MW capacity, and supports arrangements where their output is matched with demand. Overall, P442 aligns settlement processes with regulatory rules, standardises reporting, and makes it easier for smaller and distributed generators to participate in exempt supply arrangements.

Examples of licence-exempt suppliers

Founded in 2018, UrbanChain forms private electricity markets of generators and non-domestic demand customers who engage in peer-to-peer trading (sleeved PPAs). The price of electricity is negotiated in these markets, and UrbanChain provides real-time data on how energy is matched.

One example of an UrbanChain market is the Bloom Rural Energy Network (BREN), linking farms in Devon which operate generation assets to local businesses that purchase their excess electricity. There are plans to create a Southwest Grain Network within the BREN, as a specialised market for Devon grain producers and users.[7]

UrbanChain reports to be the third fastest-growing UK tech company over the past three years, raising over £15m in capital, while expanding to over 70 staff across the US, UK and EU. As of April 2026, ten private markets had been set up across the UK. They have roughly 300 GWh of annual volume live, and 1.3 TWh contracted.[8,9] This evidence suggests there will be significant near-term growth in the licence-exempt supply market sector.

Younity has now also announced its own Community Power Club licence-exempt supply scheme, to launch in spring 2026.

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[7] Bloom Rural Energy Network, Bloom renewables, accessed April 2026

[8] About UrbanChain, UrbanChain, accessed April 2026

[9] Regen Engagement with UrbanChain, March 2026.

Comparison of complex sites and licence-exempt supply

Complex sites are currently limited to one voltage level, which restricts their size. This does not apply to licence-exempt models, which enables them to reach a larger number of consumers. However, the lack of a network boundary makes it harder to monitor network benefits.

Complex sites are also classified as licence-exempt supply, which means that they are both exempt from paying policy costs and some network costs. This creates potential savings for demand customers.

Table 2: Comparison of complex sites and licence-exempt local supply models

	Complex sites	**Alternative licence-exempt supply models**
Number of potential sites/generators enabled	*Requires generation and demand to be in close proximity on the electricity network. P441 may allow complex sites across different voltage levels.*	*Do not require generation and demand to be in close proximity on the network.*
Potential savings for demand customers	*Locally matched power is exempt from paying policy costs and some network costs.*	*Matched power is exempt from paying policy costs only.*

Challenges with licence-exempt supply

The potential for BSC modification P442 to result in a large number of licence-exempt supply schemes is a concern for some in the industry. Too many licence-exempt supply arrangements will shift the burden of policy costs (unfairly) onto those who remain within conventional supply arrangements. In addition, the network benefits of true local supply and balancing, as offered by complex site arrangements, are not delivered by a non-local licence-exempt supply arrangement. This may result in future reform, limiting licence-exempt supply to clubs within a defined network or geographic boundaries.

Summary

There is significant growth potential for community-led complex site arrangements. To date, Energy Local has established 18 clubs, demonstrating the model's viability. 15 more sites are in development, with more in pre-development. 100Green has just launched its own community-led complex-site offering and expects to support many groups in setting up clubs. A survey of community organisations shows that 91% of organisations affected by constraints are interested in, or actively exploring, local supply models. If passed, BSC modification P441 will simplify the set-up process and enable complex sites to form across different voltage levels.

However, high resource demands and the workload of identifying sites are current barriers; this has led some organisations to pursue alternative models. Younity and UrbanChain are offering license-exempt supply schemes for community and non-domestic customers, respectively.

Community-led complex site arrangements will be pursued for Project GECCO, as they offer the strongest potential price signal to shift demand, and are highly linked to the local electricity network - a direct tie enabling local connections. Licence-exempt supply arrangements could provide an additional model with a lower potential price signal; but this would require the Geoprint connection to impose geographic or network limitations to focus on enabling local connections.

3 Cost-benefit analysis

Methodology and results of an initial high-level CBA

During project initiation, it was estimated that Geoprint connections could deliver £640,000-£800,000 per year in grid flexibility benefits alone by 2030 within the NGED license area. This section presents a high-level assessment that builds on this estimate, outlining the main areas of benefit for the electricity network and society, drawing on existing studies where relevant. A more detailed cost-benefit analysis (CBA) will be undertaken once network modelling of the three Geoprint case study areas is complete.

Benefits for the electricity network

Geoprint connections deliver their primary network benefit through deferring network reinforcement. Secondary benefits are delivered through the potential to reduce losses and improve network resilience.

Deferred High Voltage network reinforcement

With monitoring at all primary substations, network operators understand the capacity available in the Extra High Voltage (EHV) network. Regen estimates that, due to the electrification of heating and transport, 45% of primary substations across the country will require upgrades by 2035.[10]

Local generation and balancing enabled by the Geoprint at or below a primary substation will reduce net imports through the transformer, thereby reducing its peak load. In addition, Geoprint connections will create a larger customer base able to offer flexibility. These two factors will enable the deferral or avoidance of upgrades. Network reinforcement is capital-intensive, and even deferral can represent a significant saving.

Generate learnings on Low Voltage network savings and deliver them

There is an opportunity to integrate Geoprint trials with the ongoing rollout of Low Voltage (LV) network monitoring. This could yield insights into how local generation and balancing affect the LV network and the extent of savings achievable through LV network reinforcement. This can build upon work that has already evidenced the value of LV local balancing:

[10] Electrification: The local grid challenge, Regen, MCS, 2024

- Community DSO: exploring LV 'cells' where local generation, storage and demand are managed within defined capacity limits. Modelling showed a saving of £7k per feeder, per year.[11]
- Level-Up: tested a system that optimises local balancing and reduces LV network peak demand across nine substations. Modelling showed a £185k saving in reinforcement costs for the area.[12]

Generate learnings on the impact on losses

Driven by higher utilisation of the transmission and distribution networks, losses across the networks are projected to increase from the current annual level of 22.6 TWh to 30.4 TWh by 2035 – a 34% increase. By 2050, losses could reach 56.5 TWh – a 150% increase on 2023.[13] This represents a cost of £7.2bn per year to the network by 2050 (2023 prices).[14]

Through local supply and balancing, Geoprint keeps electricity generation and consumption geographically close, so power travels shorter distances through the network. This reduces losses on the electricity network, improving overall system efficiency. GECCO will generate insights into how local supply and balancing can help reduce overall losses, and whether and how line-loss factors need to be updated in response.[15]

Improved network resilience and security of supply

Outages have a significant economic impact. Estimates for a single Value of Lost Load (VoLL) figure for use in policymaking suggest £23,271 per MWh (real 2025 prices).[16] This is likely to increase in the future as electricity becomes ever more integral to society through the electrification of industrial processes, heat and transport.

The increased number of distributed small-scale generators enabled by Geoprint connections increases redundancy in the electricity network, reducing single points of failure. This can make the electricity network more resilient to extreme weather events and could reduce the impact of future outages.

Reduced transmission network constraint management costs

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[11] Community DSO, NPG, 2024-2028

[12] Level-Up, SPEN, 2021-2024

[13] FES: Data Workbook 2025, NESO, 2025: 'Ten Year Forecast' and 2050 'Electric Engagement' scenario

[14] Renewable Energy Costs: £127/MWh Ofgem average for 2023

[15] A line loss factor (LLF) is a multiplier used in the electricity industry to adjust metered electricity volumes. It accounts for the electrical energy that naturally dissipates as heat as power travels across transmission and distribution networks, ensuring accurate billing and energy balancing

[16] Value of Lost Load Study in Great Britain, NERA, 2025

In 2023/24, the cost of constraint management on the transmission network was £1.9bn. Projections for constraint costs in 2030 range widely, from £3-4bn per year to as high as £8bn.[17,18] As networks and their constraints are interlinked, promoting local balancing at the distribution level can contribute to a more efficient and less constrained system overall.

Geoprint actively involves NGED in a developing sector

The local supply and balancing model is currently being commercialised by suppliers and technology companies, working within existing connection structures. By creating the Geoprint connection, this enables NGED to play a role in shaping the sector, ensuring network considerations and impacts are well understood, maximising potential network benefits and minimising potential negative impacts.

Benefits to customers

During project initiation, it was estimated that the Geoprint methodology could deliver £48 million in local economy benefit per annum across the UK by 2030. This was based on an extrapolation of benefits delivered by the Hook Norton scheme. The main mechanisms for the Geoprint to deliver customer value are discussed below.

Geoprint responds to customer interest in local supply and balancing models

Community energy organisations served by NGED were asked to complete a survey on their project plans and interest in local energy schemes. 73 community energy organisations completed the survey.

Of these 73 respondents, 44 (60%) have encountered or are expecting grid constraints that delay and/or increase the cost of their project's grid connection. 40 (91%) of these constraint-impacted organisations are interested in, or are actively exploring, local supply models. Of the 29 respondents who are not encountering grid constraints, 21 (72%) are interested in, or actively exploring, local supply models showing that network constraints are accelerating interest in local supply

There is further evidence of high customer interest in local supply and balancing. 15 Energy Local clubs are currently being set up, with 18 already operational. [19] Younity and 100Green are both launching their own local supply schemes.

By developing and offering a Geoprint connection, NGED would lead and promote local supply, deliver value to these customers, and enable their connections.

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[17] 2025 Annual Balancing Costs Report, NESO, 2025

[18] Clean Power 2030 advice on achieving clean power for Great Britain by 2030, NESO

[19] Energy Local Clubs, Energy Local, accessed March 2026

Local economic stimulus through reduced energy bills

Through complex site arrangements linking local generation with local demand, energy clubs can reduce customer electricity bills. Using this approach, the Energy Local model has delivered 10-30% savings on energy bills for participating customers.[20] [21]

Reducing energy bills is not only a direct benefit to the club customers. When customers spend their additional disposable income locally, it creates a multiplier effect, delivering value to the wider local economy.

Socio-economic benefits of enabling community energy groups (CEGs)

The Geoprint connection offer will specifically support CEGs to deliver projects. The socio-economic benefits of CEGs and projects have been discussed in detail within existing cost-benefit analyses:

- Studies have estimated that community energy projects create 0.7-1.1 full-time equivalent (FTE) jobs per MW of installed capacity.[22] It has also been shown that CEGs create 1.1-1.3 times more local jobs during construction, and 1.1-2.8 times more local jobs during operation, than commercial developers.[Error! Bookmark not defined.]
- CEGs pay ongoing returns to local stakeholders, often delivering significantly higher local benefits than commercial project developers. [23] In modelling a 30 MW solar farm, CAG Consultants estimated £15 million in additional local value over a 20-year lifetime compared with a commercial development. [24] [Error! Bookmark not defined.]
- For both of these, local multiplier effects also occur when stakeholders spend their additional revenue locally. [25] In 2024, UK CEGs distributed £3.97m through community benefit funds and spent £20.5m of organisational income locally.[26]
- Community energy projects can create a greater sense of pride, empowerment and cohesion within the community.[27]

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[20] Energy Local – FAQ, Energy Local, accessed March 2026

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[25] Devon Community Energy: Socio Economic Impact Assessment, CAG consultants, Devon County Council, 2021

[26] Community Energy State of the Sector 2025, Community Energy England, Wales & Scotland, 2025

[27] The co-benefits and risks of smart local energy systems: A systematic review, Rachel Brey et al. 2024

In addition, the Geoprint connection will offer a means for community groups to engage with flexibility services – something which, up to now, they have not done in NGEDs licence areas.

Public acceptance of renewable generation

It has been shown that perceptions of the fairness of economic benefit distribution can influence local support for renewable energy projects.[28] Within a Geoprint area, demand customers can benefit economically from local renewable generation projects through lower energy bills. This could improve the perception of fairness around local projects and increase public acceptance of energy transition.

Next steps for the Geoprint CBA

In subsequent work packages within the GECCO project, TNEI will model case studies to enable more detailed quantification of Geoprint's costs and benefits, linked to the categories outlined above.

The range of network and community benefits that Geoprint connections can deliver should be assessed against an estimated cost of delivery. At project initiation, it was estimated that the annual cost to NGED of rolling out the Geoprint connection by 2030 would be £223,264, based on additional salary costs. This cost estimate will also be refined in further work.

[28] Why does community ownership foster greater acceptance of renewable projects?, Jessica Hogan, 2024

4 Local supply in practice

Three communities were selected to be case studies for the GECCO project

The purpose of the case studies

These case studies ground the Geoprint connection concept in real-world community energy projects currently in development. They describe the types of projects being developed, the organisations leading them, and their experiences with local supply and grid connections, including their motivation for engaging with local supply. Each case study also captures the project's initial perspective on the Geoprint connection concept, including its opportunities and risks.

Through these examples, the project team gains a clearer understanding of the types of community energy projects likely to be customers of a Geoprint connection, including the practical challenges and opportunities they face. They also provide early stakeholder feedback on the concept, highlighting how it is perceived in real project contexts.

Community selection process

The selection process was undertaken to identify additional case studies that would complement one another and provide a range of technologies, local supply arrangements and network contexts.

Regen and the project partners developed a set of selection criteria to identify suitable case study organisations. The criteria focused on organisations developing new generation projects, pursuing local supply arrangements and experiencing network constraints, while also seeking a balanced portfolio of case studies. Regen conducted a survey as part of this work package, which provided a long list of potential organisations interested in local supply. Following this process, Energy Local recommended Totnes Renewable Energy Society and Llagantock Green Valleys as organisations that appeared to meet the project requirements. Regen subsequently engaged with both organisations to confirm their suitability and interest in participating. The selection criteria can be seen in Annex 3.

The project initially sought to include an urban example and held discussions with a relevant organisation regarding a potential case study. While initial analysis suggested the proposed project may face network constraints, discussions with NGED planners indicated that a project of the proposed scale would likely connect at 11 kV, where adequate network headroom was available. As a result, the project was considered unlikely to experience the types of connection constraints that GECCO is seeking to address and was not progressed further. TNEI's full assessment of the urban example is presented in Annex 3.

The final portfolio comprises Hook Norton Low Carbon, Totnes Renewable Energy Society and Llagantock Green Valleys. Together, these organisations provide a range of generation technologies, local supply arrangements and network constraint challenges relevant to the objectives of Project GECCO.

Interview methodology

Interviews were conducted with a representative from each of the three case study community energy organisations: Hook Norton Low Carbon, Llagantock Green Valleys, and Totnes Renewable Energy Society. Each interview was conducted online by Regen and lasted approximately one hour.

The interviews followed a semi-structured protocol organised around three thematic areas: project context and network connection experience; motivations for and experience of local supply; and initial reactions to the Geoprint connection concept.

Case Study 1: Hook Norton Low Carbon

- Project name: Hooky Energy Club
- Location: Hook Norton, Oxfordshire
- Local supply arrangements: Hooky Energy Club linked to 1 MW solar (1.1 GWh/yr) and 500 kW Anaerobic Digestion (AD) (3.3 GWh/yr)
- Current project: Additional new community generation that will be linked to Hooky Energy Club

Project overview and context

Hook Norton Low Carbon (HNLC) is a community energy organisation based in Oxfordshire that has been active since 2010. It has delivered a range of local decarbonisation initiatives, including community-owned rooftop solar, a social housing microgrid, communal EV chargers and a local supply club.

HNLC's work is driven by an ambition to enable the local community to take control of how it reaches net zero, with a focus on practical outcomes rather than ownership structures alone.

This case study focuses on HNLC's latest project: to add community-owned generation to the existing local supply club. Due to network constraints, the current connection offers would limit export to 750 kWp. The new, additional community-owned generation is intended to increase both the volume and diversity of generation feeding into the club, supporting more customers and improving opportunities to match local generation with demand.

Local supply: motivation and approach

The prime motivation for HNLC setting up local supply and trading is that it provides the overarching framework for the community to be able to set its trajectory to reach net zero. The community can set electricity pricing to incentivise the electrification of transport and heating. It can also ensure that more vulnerable members of the community are not left behind in the transition.

Due to significant grid constraints, HNLC focused on developing smaller-scale renewable energy projects. However, they found that projects below 1 MW were not financially viable and turned to local supply to increase generator revenues and enable these projects to proceed.

"We were limited to smaller projects due to high connection costs on larger projects, and we needed local supply to make them stack up financially."

In addition to improving project viability, Hooky Energy Club allows HNLC to offer lower-cost electricity tariffs to residents. They value the ability to set the match price and give residents an alternative to wholesale prices. For HNLC, this is a key way that the community can benefit from local renewables, regardless of ownership.

HNLC considered several local supply approaches. A private wire to local businesses was explored but ruled out due to cost and complexity at this scale. More recently, P442-based offers from suppliers, such as Younity and EDF, were considered; however, these were not pursued as they offer less control over pricing, reduce the financial benefits available to customers and generators, and weaken the link between local generation and demand.

HNLC was established as an Energy Local Club in 2024. HNLC sets the match price paid by club members when the generator is generating, with 100Green, the licensed energy supplier, setting the price the rest of the time. Initial development of the club relied on the expertise and processes provided by Energy Local. As the club has developed, it has transitioned to the platform provided by 100Green, which offers additional flexibility.

Hooky Energy Club includes both Solar and AD, enabling it to offer a consistent, low-cost tariff to club members and benefit a wider range of residents (whereas a club with only solar benefits only those who use electricity during the day). Recent volatility in wholesale prices has led to increased community interest in Hooky Energy Club.

At present, the club primarily consists of domestic customers, with half a dozen commercial customers. HNLC aims to attract additional commercial customers who would pay higher rates than domestic customers (but still less than standard commercial electricity tariffs). The additional revenue would be used in two ways: to provide a higher return to the generator and to reduce tariffs for non-commercial customers (ideally at a lower rate for those who need it most). So far, commercial customers have been challenging to convert due to their long-term fixed contracts.

As HNLC has a strong reputation amongst residents for delivering community projects, engaging potential generators and new customers has been relatively easy (though conversion of generators and commercial customers remains challenging). As they expand beyond their current substation, they are noticing that engaging both new generators and customers has been more challenging.

"They're used to the fact that we develop stuff that works."

Table 3: Domestic tariff structure in the Hooky Energy Club

Cost description	Cost
Daytime: 8am - 5pm	13 p/kwh + VAT
Nighttime: 5pm - 8am	20 p/kwh + VAT
Grid rate	22.3 p/kwh incl. VAT
Daily standing charge	56.5 p/day incl. VAT
Monthly 100Green administration charge	£5.95 /month incl. VAT

For comparison, a unit rate on a standard variable (price cap) tariff is 23.50p + VAT, with a standing charge of 54.49p + VAT.

Grid connection context and experience

The primary substation serving Hook Norton (Epwell Primary) is constrained, limiting additional generation capacity. The rural network was not designed to support the amount of generation it now serves, which now exports to the transmission network in certain periods.

Through conversations with NGED, HNLC has become aware that the neighbouring primary substation is less constrained, due to its larger demand catchment and lower levels of existing generation. Connecting their local supply club to the neighbouring primary opens up a wider range of sites for their proposed community-owned generation connection.

HNLC has worked with NGED for many years, including on a 2010 innovation project, which means that they have a level of familiarity with NGED's priorities, contacts and processes.

Before the Innovation project, the only option open to HNLC was to select potential sites first, and viability only became clear after connection estimates were received, sometimes requiring projects to restart elsewhere.

More recently, direct engagement with NGED through the Innovation project has enabled a more proactive, outcome-led approach, with early guidance on viable locations and connection strategies. HNLC sees this shift from trial-and-error to open dialogue as central to the Geoprint concept.

Initial perspective on the Geoprint connection concept

HNLC highlighted two main risks. First, it introduces an additional option to consider, adding complexity to an already challenging connections process. Second, Geoprint shifts greater commercial risk onto the community. HNLC is planning to present the project to investors based on higher revenues from local supply; however, if customer participation falls and matching is reduced, those revenues may not materialise. HNLC is willing to accept this risk, supported by its financial reserves and experience operating a local supply model.

A key opportunity highlighted by HNLC is the shift towards a more outcome-focused approach to network connections, enabled through closer engagement with NGED. Rather than starting from technical constraints and iterating through connection applications, this approach allows the project to begin with a clear articulation of what it is trying to achieve.

HNLC sees the Geoprint connection as an opportunity to formalise this way of working by considering the community energy system as a whole, rather than individual assets in isolation. It creates the potential to identify connection solutions that better align with both network constraints and local objectives.

Case study 2: Totnes Renewable Energy Society

- Project name: Baddaford Community Wind Turbine
- Location: Buckfastleigh, Devon
- Local supply arrangements: Energy Local Dart Valley to be established
- Current project: ~1 MW community-owned wind turbine, with potential solar and battery storage, to feed a new Energy Local Dart Valley club and a private wire to Riverford Organic Farmers

Project overview and context

Totnes Renewable Energy Society (TRESOC) is a community energy organisation based in Totnes, Devon, that has been active since 2010. It has delivered a range of local decarbonisation initiatives, including 46 community-owned rooftop solar sites and a 300 kW community hydro scheme on the River Dart, operational since 2015. TRESOC also operates Energy Local Totnes, a local supply club linked to the hydro and solar. TRESOC is a leading proponent of Energy Local and has supported the set-up of clubs in nearby Ashburton and Moretonhampstead. Its work is driven by a commitment to maximising community benefit from the energy transition.

This case study focuses on TRESOC's latest project: a proposed wind turbine in the neighbouring parish of Staverton, to be developed in partnership with Guy Singh-Waston, founder of Riverford Organic Farmers. The project will be delivered through a Special Purpose Vehicle (SPV), 50% owned by TRESOC via a community share offer and 50% by the Singh-Watsons. The turbine is intended to serve two purposes: firstly, to supply Wash Farm (Riverford Organic's Head Quarters) directly via a private wire and, secondly, to be the founding generator for a new Energy Local Dart Valley club.

Local supply: motivation and approach

TRESOC's motivation for local supply is to maximise community benefit. Community ownership of the turbine is the foundation, and the Energy Local club provides a second layer, offering low-cost electricity to a wider group of residents who may not be shareholders.

"*My key objective is to provide a double benefit - not only will it be 50% community-owned, so a portion of the profits will go back to local people, but it will also provide low-cost electricity through the Energy Local Dart Valley club*."

TRESOC has been exploring ways to sell local power to local people at reduced rates for many years, including looking at blockchain and other approaches. They have consistently found that the Energy Local model is the only one that works in practice. Energy Local Totnes is well-established, with members saving an average of 28% on their energy bills in 2025.

The Baddaford wind turbine will combine two local supply approaches: Private wire and Energy Local Club. The private wire to Riverford is considered essential to the project's economics:

Riverford is willing to pay up to 20p/kWh, driven by their community and environmental values, and interest in greater price resilience. Supplying Riverford via the Energy Local club was ruled out, as the club's fair-share allocation mechanism is designed for households and small businesses. Each member receives an equal share of locally generated electricity, regardless of size.

Energy local allocation mechanism

If 100 members are in the club, each is allocated 1% of the generation at any given time. A large commercial customer like Riverford would therefore only receive a small share of the lower-cost electricity and would need to purchase the majority of its demand at standard market rates, limiting the benefit of participating in the club.

TRESOC considered a P442-based licence-exempt supply approach, but this does not offer sufficient local value. The Energy Local model offered a stronger price signal to shift demand and a closer link between local generation and consumption.

One concern with this approach is that Riverford may use a large proportion of the electricity during both the morning and evening peaks, which are typically the most valuable periods for Energy Local club members to benefit from the match tariff. Riverford's processes begin early in the morning, overlapping with the morning peak, continue throughout the day, and are expected to extend into the evening as delivery vehicles return and require charging. As a result, much of the generation during these peak periods could be consumed via the private wire, reducing the amount available to be matched with households in the club. Current modelling suggests only a 10% saving on bills for club members. TRESOC is still exploring how generation will be allocated between the private wire and the local supply club, and whether battery storage or demand-side measures could improve the overall matching rate.

TRESOC raised several challenges in operating the Energy Local model. The set-up costs include paying for the Energy Local platform and advisory support to design, implement and launch the club, which together amount to around £10k, providing a potential barrier for some organisations. In addition, the club's ongoing operations rely heavily on volunteers. The work of the energy advisor is essential to coordinating the club, managing customers and supporting its ongoing development. However, TRESOC can pay an energy advisor for 2 days per week by bringing in additional grant funding, which is due to run out soon. To address the lack of a sustainable revenue model, TRESOC has introduced a new 1p/kWh charge on matched electricity (with the generator and consumer sharing equally) to cover the ongoing costs of running and maintaining the club.

Table 4: Domestic tariff structure in Energy Local Totnes*

Cost description	Cost
Match rate	15.5p/kwh +VAT
Super Off Peak Midnight to 7am	15p/kwh + VAT
Super Peak 4pm to 8pm Monday to Friday	27.08p/kwh + VAT
All other time non-match	24.55p/kwh + VAT
Daily standing charge	71.53p/day + VAT
EL charge (Included in customers' standing charge)	£12 per year
Any other charges – TRESOC charge	1p/kWh collected through Hydro Scheme

For comparison, a unit rate on a standard variable (price cap) tariff is 23.50p + VAT, with a standing charge of 54.49p + VAT.

**Note: this is the tariff structure for Energy Local Totnes. The tariff structure for* Energy Local Dart Valley is still to be determined.

Grid connection context and experience

The project originally considered a 2.3 MW turbine, which would have enabled them to increase the proportion of energy allocated to a local supply club. However, NGED has confirmed that any connection application exceeding 1 MW would trigger a Transmission Impact Assessment (TIA), adding time and cost uncertainty to the connection process and likely resulting in additional technical constraints on the scheme, such as export limitations or curtailment requirements, as the project would need to be assessed against wider transmission system limits rather than being treated solely as a local distribution connection.

TRESOC has recently learned that, due to their inability to transport a larger turbine along the narrow lanes to the prospective site, they will be limited to a 1 MW turbine. TRESOC is now focused on a ~1 MW turbine, potentially supplemented by solar and battery storage to improve the project economics and generation profile. A feasibility study into a small hydro installation at a weir on the same substation is also being explored.

TRESOC has had limited experience with grid constraints in previous generation projects, as these projects were developed before the current era of network constraints, with most installations completed in 2012–15, when capacity was readily available. Engagement with NGED on the Baddaford project has so far been limited, with most interactions handled by Communities for Renewables, the development consultancy supporting the project.

Initial perspective on the Geoprint connection concept

TRESOC did not view a Geoprint-enabled connection as essential for the project. With the scheme effectively capped at 1 MW to avoid triggering a TIA, the generation capacity is largely fixed, limiting Geoprint's scope to add value through increased generation size. While a Geoprint connection could, in principle, enable additional generation - such as co-located solar - this would depend on whether it allows the project to exceed this threshold without triggering a TIA.

The primary opportunity identified by TRESOC was the potential to reduce connection costs. Having received a budget estimate of £136,000 to connect, this puts pressure on the project's viability. A significantly lower cost - reflecting the fact that matched generation would not be exported to the wider network - could reduce some cost pressures facing the project.

More broadly, TRESOC welcomed the collaborative approach that Geoprint represents, starting from community objectives rather than solely from technical constraints. Being engaged as a partner rather than simply receiving connection cost estimates was seen as significant in itself.

Case study 3: Llangattock Green Valleys

- Project name: Black Mountains Community Energy. A Llangattock Green Valleys CIC solar and battery project
- Location: Crickhowell, Powys, Wales
- Local supply arrangements: New Energy Local club to be established
- Current project: 300 kWp solar array co-located with a 500 kWh battery energy storage system (BESS), to be the founding generator for a new Energy Local club serving local households

Project overview and context

Llangattock Green Valleys (LGV) is a community energy organisation based in Powys, Wales, which has been active since 2009. In that time, it has developed five community-owned micro hydro schemes, for which they raised just under £1m in a community share offer and later helped establish Energy Local Crickhowell, a local supply club. LGV has also supported a range of energy-efficiency and fuel-poverty initiatives across the area. Its work is driven by a commitment to using local resources to build a more sustainable and self-reliant community.

As part of the project, LGV will establish a new Community Benefit Society: Black Mountain Community Energy (BMCE) to build on LGV's work and advance it. The primary driver for creating a separate organisation is that LGV's Community Interest Company structure limits its ability to run share offers.

This case study focuses on LGVs proposed project: a 300 kWp solar array co-located with a 500 kWh battery energy storage system, which would be the founding generator for a new Energy Local club in the area. The project is currently in development, with a feasibility study having been recently completed. Community engagement began in the summer of 2024, during which they sought the views and opinions of the local area on the proposed generation project. This summer (2026), they will be seeking expressions of interest from potential club members.

Local supply: motivation and approach

LGV is motivated by a desire to increase the community's energy self-sufficiency while generating income to support local priorities, particularly fuel poverty. The development of the solar project is intended to both reduce reliance on external energy supply and create a sustainable revenue stream that can be reinvested locally.

Local supply is central to delivering these objectives. It enables LGV to supply electricity directly to local people, strengthening the link between generation and consumption, while also significantly improving project viability. Selling through a local supply club is expected to yield around 15p/kWh, compared with approximately 8.5p/kWh from grid export, increasing the project's commercial viability. Any surplus generated would be directed to a community benefit fund to support additional local initiatives.

LGV explored several alternative approaches before settling on the Energy Local model. Private wire was initially the priority, in part to navigate the grid export constraint (described below). However, there are limited options for suitably concentrated energy demand within the site's proximity. Private wire was also deprioritised because supplying a single business would not deliver the direct benefit of lower energy bills for community members, which is central to LGV's objectives. A combination of private wire and a local supply club remains an attractive option if a suitable site were to be identified in the future.

LGV has a longer-term aspiration for a model in which local generators, including households with domestic solar, could sell surplus electricity into a local club at a premium above grid export rates, enabling the whole community to benefit from locally generated power. Recognising that these approaches are still in their infancy, LGV concluded that the Energy Local model is the best fit for their current requirements, while remaining open to alternatives as the market evolves.

Energy Local Crickhowell was one of the original Energy Local pilot projects and currently has around 30 customers linked to a single micro hydro scheme. The new LGV project will require a new Energy Local club, with the intention of ultimately bringing the two together in due course. LGV sees the Energy Local framework as essential: without it, the barriers to local supply - setting up billing, managing ongoing administration and ensuring compliance - would be insurmountable. The move to 100Green as the facilitating supplier is viewed positively, both for addressing billing issues experienced with the existing club, and for enabling multiple generators to supply a single club - something the previous arrangement with Octopus did not allow.

LGV plans to grow the club by incorporating additional local generators. Current options include rooftop solar on a primary school that LGV helped develop in 2013, and on the buildings of a local farm.

They estimate they will need between 100 and 200 member households - a target they are confident they can reach given their existing contact lists and prior community engagement. When seeking expressions of interest for a related funding application at short notice, 30 names were gathered within a few hours.

"*There's a good community of locally produced and consumed food in this area - restaurants and hotels promote local produce. We hope we can latch on to that same idea with locally produced and consumed energy*."

Table 5: Domestic tariff structure in Energy Local Crickhowell*

Cost description	Cost
Match rate Period 1: 12-7am	9.5p/kwh + VAT
Match rate Period 2: 7am – 4pm	15.7p/kWh + VAT
Match rate Period 3: 4-8pm	16.2p/kwh + VAT
Match rate Period 4: 8-12pm	15.7p/kWh + VAT
Non-match rate 12-7am	15.8p/kWh + VAT
Non-match rate 7am – 4pm	26.1p/kWh + VAT
Non-match rate 4-8pm	27.1p/kWh + VAT
Non-match rate 8-12pm	26.1p/kWh + VAT
Daily standing charge	67p/day + VAT
EL charge	£8/year + VAT
Any other charges – Electricity supplier admin. charge	£5/month + VAT

For comparison, a unit rate on a standard variable (price cap) tariff is 23.50p + VAT, with a standing charge of 54.49p + VAT.

**Note: this is the tariff structure for Energy Local Crickhowell. The tariff structure for* Black Mountains Energy Local is still to be determined.

Grid connection context and experience

LGV's previous generation projects - all micro hydro schemes, with the largest at 29.9 kW - did not encounter significant grid constraint issues. Replacing a transformer was the only additional infrastructure cost on previous projects, which ended up being an additional cost, but not a blocker.

The current project has presented a different set of challenges. During an early feasibility assessment, NGED planners confirmed that the maximum export capacity available at any single site within the Crickhowell primary substation area was 95 kW. They believe that multiple connections at different sites may be possible, but each would be subject to the same individual limit. The group expect this to be a major barrier to their development ambitions, not least because it negates the economies of scale that would come from a single larger project, with each project having its own legal fees, planning surveys, landholder agreements, etc.

With the current project, the constraint fundamentally shaped the design. An initial feasibility study for a project approximately five times the current size - around 1.5 MW, in line with the minimum recommended by the development consultant for commercial viability was abandoned due to the 95 kW limit. LGV then worked backwards from the constraint: modelling different combinations of solar capacity and battery storage to find a configuration that could maximise the use of a 95 kW connection while meeting the project's financial requirements. This led to the current proposal of 300 kWp solar paired with a 500 kWh BESS, with the battery acting as a buffer - charging when solar output exceeds 95 kW and discharging to maintain the connection at capacity when generation falls below it.

NGED local planners have been constructive and positive in their engagement throughout. However, LGV's attempts to engage at a more senior level - to better understand the basis for the 95 kW limit and explore whether there are any alternative solutions - have so far been unsuccessful, with each contact directing them back to the local planner.

TNEI view: rationale for the 95 kW limit

TNEI considers that the 95 kW limit may reflect the level of firm export headroom available at the site before 66 kV reinforcement is required, rather than the network's total physical capacity. Staying below this threshold appears to allow projects to avoid more complex planning requirements (e.g. Statement of Works) and potentially connect without waiting for reinforcement.

Constraints are understood to be primarily thermal (with some voltage considerations), linked to upstream reinforcement needs - an area Geoprint is intended to assess and help address.

Initial perspective on the Geoprint connection concept

LGV's immediate response to Geoprint was that a higher theoretical export limit (acknowledging that they would not export more than 95kW net generation, minus ELC consumption, at any one time) could, in principle, remove or reduce the need for the battery as a generation buffer. At the current stage of development, LGV is open to revisiting the project configuration, though this flexibility will diminish over the coming months as development progresses.

"*We're not wedded to the concept as it is. The battery just made the project viable, but if there's another way to do that, then great - because it (the battery) creates additional inefficiencies*."

More broadly, LGV has significant further ambition beyond this project, with plans to develop multiple schemes within the Crickhowell primary substation area over time. A larger theoretical export connection would be an enabling condition for future development.

5 Annex 1

Further information on the local balancing models identified in Section 2

Complex sites

A complex site treats multiple energy assets at a single boundary/connection point as a single market participant for metering, settlement and trading, enabling on-site balancing without exposing internal flows to the wider electricity market.

Elexon's current work under modification P441 aims to categorise different types of complex sites and clarify when netting of imports/exports across multiple boundary points is permitted.

The model is currently used by:

- local authorities
- universities
- commercial and industrial sites
- communities (these tend to be Energy Local Clubs).

Local balancing is enabled by:

- lower price for local generation – the "match tariff"
- additional imported power has a ToU Tariff, which incentivises greater use of the lower price local generation
- locally matched power is exempt from paying TNUoS, BSUoS and policy costs.

Case studies:

- Energy Local Bridport (Dorset) – based around a local farmer's wind turbine with a membership of 55 households.
- Energy Local Roupell Park (London) – 18 homes linked to solar PV on social housing, cutting bills by roughly 10–30% and giving residents visibility over generation patterns.

Retailer-led

There are currently three main types of retailer-led local balancing models:

1. **local tariffs** that link consumer energy pricing to output from a specific local renewable project (commonly wind turbines). Customers receive tariff discounts when that generation is producing.

2. **sleeved PPAs** that contractually link renewable generators with large demand customers using the public network, with a licensed supplier acting as an intermediary.

Used by local authorities and corporates that cannot develop their own generation or use a private wire. These can have a local element, but don't have to.

3. **Energy Clubs** (see Complex Sites above) led by the retailer but working closely with a community energy organisation.

Local balancing enabled by:

- local tariffs incentivise shifting demand to times when local generators are generating. Cheaper tariffs tend to be supported by P442.
- sleeved PPAs and P2P arrangements can also incentivise demand shifting to match generation and reduce exposure to wholesale price volatility.

Case studies:

- Octopus' Fan Club – discounted local tariff for customers living near an Octopus-owned wind turbine.
- UrbanChain – sleeved PPAs for non-domestic customers.
- Younity Community Power Tariff – a community club-based model, but does not have to have a local element, as it does not use the complex site model. All matched power receives a discount from the standard community tariff.
- 100Green Communities – a complex site, community club-based model.

Microgrids

A microgrid is a localised power network that combines generation, storage and loads, and can operate in grid-connected or island mode. While most UK microgrids today are a local distribution approach rather than a full peer-to-peer market, they can enable local balancing and resilience.

The model is currently used by:

- community-led housing schemes
- island communities
- C&I and public sector private wire arrangements.

Local balancing enabled by:

- local generation and storage help manage local supply/demand without relying solely on the national grid
- can prioritise renewables and dispatch storage to offset peak local demand
- local tariffs or peer-to-peer (P2P) trading to incentivise demand shifting.

Case studies:

- Hook Norton community land trust
- Bridport cohousing community land trust
- Brooklyn microgrid P2P trading

Local flexibility markets

Local flexibility markets allow DSOs to pay flexibility service providers (FSPs) to adjust electricity consumption or generation to manage local grid congestion. FSPs tend to be battery energy storage systems (BESS), generators and aggregators.

Local balancing enabled by:

- payments to FSPs to shift electricity usage to reduce network constraints.

Case study:

- Octopus Power-ups

Smart Local Energy Systems (SLES)

SLES take an integrated systems approach to connect generation (renewables), demand, storage, EVs, heat and ICT to optimise *across vectors and participants* at a local level. They aren't one specific market structure; rather they embed a range of *local market types* and control mechanisms.

Currently, only pilots are active in the UK.

Local balancing enabled by:

- uses software coordination and markets (e.g. local energy markets, flexibility markets, virtual network managers) to balance local supply and demand
- can incorporate demand-side response, storage dispatch and price signals.

Case studies:

- Project LEO (Local Energy Oxfordshire)
- UKRI Prospering from the Energy Revolution pilot SLES projects across cities and regions, integrating assets and markets.

6 Annex 2

Previous innovation projects and relevant learning for GECCO

Project	Description	Relevant learning for GECCO
Projects relating to the value of local matching for flexibility / avoided reinforcement		
Community DSO **(NPG 2024-28)**	The approach explored how the distribution network could be organised into hierarchical 'cell' structures at the low-voltage (LV) level, enabling communities to coordinate local generation, storage and demand. Under this model, local participants manage their energy assets within defined capacity limits.	The business case development: a flexibility trial proxy value of £7k was established for each cell (per LV feeder per year). This represents the annualised cost the network would incur without the Community DSO service, as modelled.
Level-Up **(SPEN 2021-24)**	Level-Up tested a digital platform to optimise local energy balancing, improve forecasting and reduce LV network peak demand. It aimed to support local balancing and enable faster, cost-effective deployment of LCTs by minimising the need for network upgrades.	CBA findings: the analysis was conducted across the Carluke area, which included 9 ground-mounted substations. Predicted EV and Heat Pump demand was projected onto the present base demand. A timescale was not provided. Base Cost (Conventional Reinforcement) - £243k Method Cost (ZUoS Platform) - £58k Potential saving in the Carluke area - £185k

LEO-N **(SSEN 2023)**	Built on Project LEO, it evaluated the network impact of large-scale implementation of FutureFit (installation of building fabric upgrades and smart technologies). Explored how the proposed behind-the-meter measures could be optimised to maximise use of the existing network.	CBA findings: between 2025 and 2050, local flexibility has the potential to deliver up to £68bn savings and 4.8Gt CO_2e reduction. This included avoiding network reinforcement, optimising network investment, coordinated deployment of LCTs, improved comfort, avoiding peak tariffs and less disruption.
Transition/LEO **(SSEN 2018-23)**	Project LEO ran trials in Oxfordshire to understand how new technologies and services, particularly at the 'edge' of the network – closest to the point where people are using energy – could benefit local people, communities and the energy system.	LEO showed that there is significant potential for optimising energy systems at the local level, rather than relying primarily on the transmission network to import and export power. It showed that local balancing creates economic value, mainly by: • avoiding costs (reinforcement), • unlocking revenues (flexibility markets), • and improving investment cases for low-carbon assets.
Bethesda Home Hub **(SPEN 2019-22)**	This project tested the ability and willingness of a residential community to proactively shift their electricity usage away from the traditional peak times of 4pm - 8pm. It explored how this could benefit networks, both in terms of connecting additional network load without the need for reinforcement, and the potential for community Sustain flexibility contracts.	Demonstrated that people are willing to change their electricity usage habits, and this change in habits can be maintained. It explored the concept of "stayability" and concluded that it was positively influenced by the ongoing nature of the Energy Local Club and may not be fully representative of other community groups. It may indicate that some kind of local organisation is needed to maintain behavioral change.
Urban Energy Club **(UKPN 2019-22)**	The project tested whether residents living in blocks of flats could access financial benefits from flexibility based on the virtual allocation of shared assets. A communal battery was	Designed and created a system that allows for flexibility provision within a virtually allocated energy storage asset, delivered demand turn-down services at specific times,

	installed alongside an existing PV array connected to a peer-to-peer trading scheme.	achieved bill savings through the ability to collectively self-consume cheaper power and demonstrated how the technical requirements for procuring LV flexibility from a community-owned battery could be met.
Pacific Northwest Smart Grid Demonstration Project **(USA, 2010-2015)**	A large-scale project to test how smart grid technologies that use local supply and demand balancing could improve the operation of the energy system.	Showed that smart grid technologies that balance local supply and demand can achieve meaningful peak reduction and load shifting, operate with very high reliability, and result in large system-wide economic benefits ($6bn calculated if scaled across the Pacific Northwest and with long-term infrastructure horizons).
Urbanova Shared Energy Economy **(USA, 2018-2020)**	A project that set up a district-scale energy club to test how rooftop solar, battery storage and building energy management systems could interact to deliver value.	Identified the key value streams that are created: avoided reinforcement costs; improved utilisation of local energy; overall system efficiency gains; improved network reliability and resilience.
Projects relating to local matching to enable connections		
Community Smart Access **(SSEN 2025)**	Trialling a new ‘community smart access’ connection offer for housing developments. The new option aims to manage electricity demand locally, while longer-term reinforcements to the electricity system are completed. It will use Dynamic Load Averaging (DLA) to accelerate the deployment of LCTs, such as heat pumps, EV chargers, rooftop solar panels and battery storage, in new homes.	SSEN has developed an ‘access product’ to enable faster demand connections when local power balancing is possible.
Connected Island **(SPEN 2024)**	“Connected Islands” were explored as a possible solution to alleviate the connections bottleneck and support integration of LCTs onto the electricity grid. The LCTs were	The research showed that it is possible to plan for large-scale LCT use without major upgrades to the electricity grid.

	introduced at scale within a self-managed community microgrid, without requiring major grid reinforcement.	A high-level CBA provided insights into the potential financial and environmental benefits of community microgrids, but highlighted the need for site-specific studies before any real-world deployment. 'Energy communities' were identified as key to enabling the energy transition, supporting the local economy, reducing fuel poverty and providing flexibility.
ACCESS – Local Constraint Management **(SSEN 2015-18)**	The ACCESS project explored the feasibility of managing the output from a 400 kW hydro generator with 600 kW of new controllable demand installed in up to 100 homes. The ACCESS commercial model enabled small-scale generation to connect to the network when network capacity was at its limit.	The overall project was successful and has been proven technically and commercially viable. SHEPD installed network equipment that monitored network parameters at potential constraint points and sent appropriate signals. This allowed third-party control systems to modulate generator output/heating demand, thereby protecting and maintaining network integrity. The output of this project has formed the basis for Alternative and Flexible Connections, which SSEN now offers within its standard connection procedure.
Sunshine Tariff **(NGED 2015-17)**	Tested the capacity, longevity and reliability of domestic demand side response and the feasibility of an offset connection agreement for both DNO and a solar PV developer.	The findings suggested that an offset connection agreement alongside a time-of-use tariff did not provide a straightforward solution to the network capacity problem at that time. Persuading customers to switch suppliers and change their consumption patterns was challenging. Furthermore, the shift in consumption to the middle of the day for customers without automation control technology was small. The findings suggest that 650 customers would

		be required to offset the generation from a 250 kW solar farm.
Electric Access System Enhancement **(USA 2020-2024)**	A project creating distribution level markets of solar, storage and flexible demand, specifically designed to increase the amount of generation that can connect without requiring a network upgrade.	Demonstrated that using Dynamic Hosting Capacity instead of Static Hosting Limits (based on worst case peaks), along with local balancing, enabled hosting of more generation beyond traditional feeder limits without upgrades.
Alectra GridExchange **(Canada, 2019-2022)**	Explored how a local energy marketplace could increase the grid's ability to accommodate new connections. Tested a blockchain-based local energy market of households with rooftop solar, batteries and EVs acting as "prosumers".	Demonstrated that if local demand and generation can be actively managed, then feeders can support additional DER installations or electrified loads (such as EV chargers) without immediate network reinforcement.
Projects relating to tools to enable local balancing		
eNeuron **(Italy, 2020-2025)**	The EU-funded eNeuron project developed tools for the best design and performance of local energy communities, integrating distributed energy resources and multiple energy carriers at different levels.	The project set out a practical framework for optimising the design and operation of local energy communities acting as energy hubs. Software and hardware solutions were developed and tested.
COMPILE **(Slovenia 2018-2022)**	An EU-funded project creating a toolset to maximise the potential of energy communities and other forms of energy-related citizens' organisations in Europe.	Developed GridRule, which assists those who operate, control or manage a local grid within network limits while improving flexibility, stability and security. Developed ComPilot, a tool that helps network operators and community groups to better monitor network usage and manage connection agreements.
Neighbourhood Watts	A new SIF alpha project looking at developing a scalable, community-led model for local energy balancing, designed	No learning yet, but an opportunity to see how the project relates to GECCO as it progresses.

(UKPN 2026)	to cut bills, support networks and widen participation in low-carbon energy systems.

7 Annex 3

Selection criteria as agreed by the project partners & TNEI's assessment of the urban example

Essential

	Criteria	Question	Detail	Significance
	Organisational requirements			
1	Legally constituted	Are they able to sign a subcontractor agreement?	All subcontractors must be able to sign a subcontractor agreement	Requirement
2	Capacity to engage	Do they have team members with time to participate in the project?	Selected organisations will be required for WP1, WP2 and WP3 The number of days will be similar to Hook Norton	Requirement
3	Access to project-related data	Are they able to provide the relevant data?	The following data is required: • Location/size/type of the generators • The participants in the scheme (or at least which feeders they are located on) • Metered energy exchange data (if possible)	Requirement
	Project characteristics			
4	Generation growth plan	Do they have plans to build new generation? Or existing generation that is currently facing a constraint?	They should be ready to apply for a new connection or have already done so.	Requirement

5	Local balancing scheme development	Have they already developed a local energy market, or are they planning one?	They should be open to starting a local energy market, or already operating one.	Requirement
6	Generator technology	Which generation technology is used?	We are seeking case studies that use different generation technologies (e.g. wind, solar and hydro). We are seeking projects that are using more than one technology type (e.g. solar and storage/ wind and hydro)	Portfolio consideration
7	Generator size	What is the capacity of the generation?	We anticipate most local generation will be between 150kw and 950kw We're also interested in generation of up to 5MW	Requirement
8	Model type	Which local supply model do they use? E.g. Energy Local or another?	We aim to include at least one organisation outside of the energy local model, if possible.	Portfolio consideration
9	Connection constraint	Are they currently facing connection issues?	We're interested in projects facing constraints.	Requirement
10	Geographic context	Are they rural or urban?	We will aim to include: - One rural - One urban	Portfolio consideration
	Network Context			
11	Region	Which part of the NGEDs supply area?	We will aim to include groups from 2 of the following regions: - South West - South Wales - West Midlands	Portfolio consideration

Considerations

In order to ensure we have a balanced portfolio of case studies, we may consider the following when making our final decision:

- Was it planned to be a local market from the start, or was a local supply model bolted on to the existing generator?
- How many potential local supply market customers? Are they domestic or commercial?
- What other project development challenges are they facing?
- What is the economic context of the area? Is the model explicitly trying to support low-income households?
- Does the substation boundary and “community” match?
- Are the relevant 11kV planners able to engage in this project?

TNEI assessment of the urban example

What we looked at

A proposed behind-the-meter renewable energy project comprising solar PV and battery storage, with an export-constrained connection to the local distribution network via a secondary substation and associated 11kV primary network.

Network characteristics

A scheme of this size would typically be expected to connect at HV rather than LV under normal NGED planning practice and the capacities usually accommodated at each voltage level. The site sits in an urban part of NGED's South West licence area. Using the Government's Rural–Urban Classification (RUC) as an indicator, the GSP area associated with this site is substantially more urban than those associated with the other sites being considered.

Urban networks typically carry higher demand density and tend to be more cable-heavy, often making demand driven reinforcement quite difficult and expensive. For generation, however, urban areas are usually less constraining than rural ones, as rural networks are spread thinner over larger areas and are more prone to thermal export and voltage rise issues.

Why it looked like it might be an interesting case study

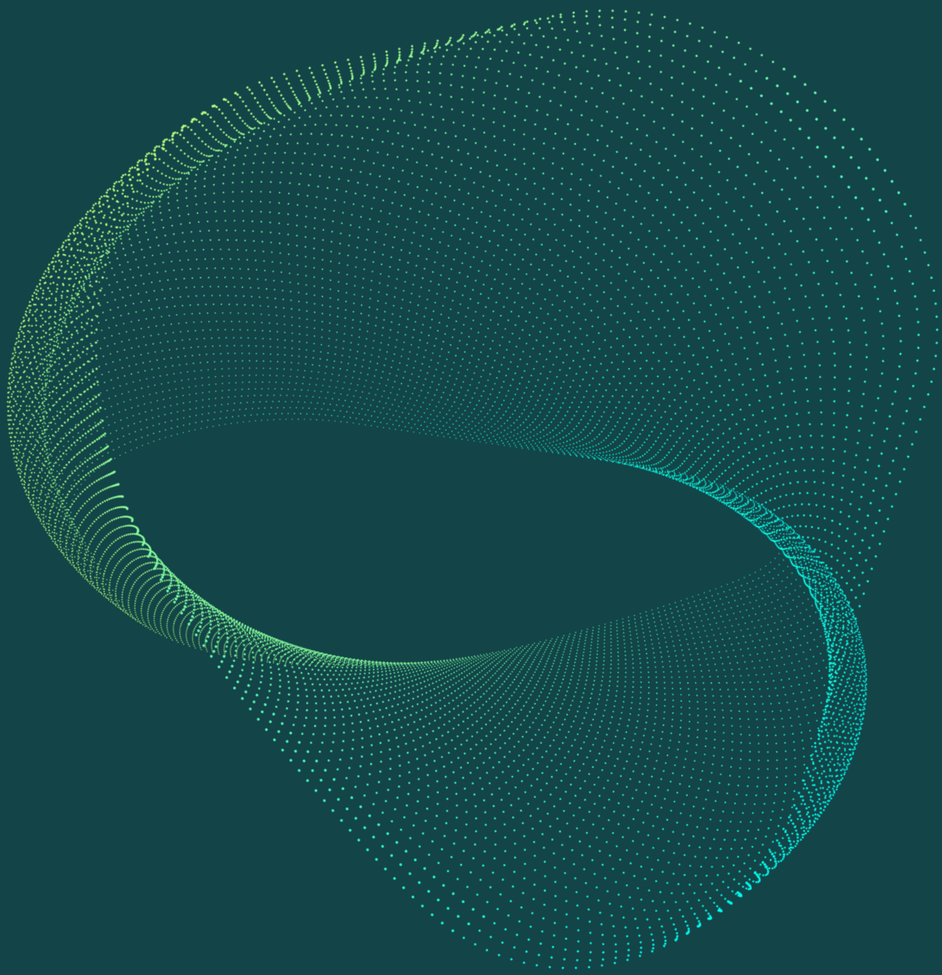
An urban setting would have given us a useful contrast to the more typical rural Geoprint use case and a chance to test the concept in a denser network. The combined solar + BESS technology mix was also attractive, and the scheme is at a stage where Geoprint could plausibly inform the connection design & location.

Why we determined it wasn’t appropriate

While reinforcement was flagged by NGED planners at the LV / service connection level, a scheme of this size wouldn't typically connect at LV anyway.

Based on discussions with NGED planners, no material export constraint is expected further upstream in the network, and the higher-voltage network appears to have significant available capacity. Taken together, this suggests that the constraint at this site is unlikely to reflect a wider thermal or voltage limitation.

By contrast, the constraints flagged at Totnes (voltage) and Crickhowell (thermal and voltage) are precisely the types Geoprint is built to address, which is why those two were preferred.



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