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Brampton 2 Zero

Low Carbon Options Appraisal

21st November 2022

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1. Introduction

In 2022, Brampton 2 Zero (B2Z) secured funding through the UK Government Rural Community Energy Fund (RCEF) to undertake a low carbon feasibility study in Brampton, Cumbria. This study explores local options for low carbon energy generation and mobility in the town, focusing particularly on the development of a solar PV cooperative across public and private rooftops, as well as EV charging and a community car club for residents and visitors.

This study forms part of B2Z's ambitions to:

1) **Create a solar energy co-operative,** to reduce the town's reliance on fossil fuels, reduce associated carbon emissions, meet the electricity needs of multiple non-domestic rooftops, and integrate with battery storage and electric vehicles (EVs) where appropriate;
2) **Establish an EV car club in Brampton**, via the installation of EV chargers in Brampton, to provide accessible mobility services for local community use, and integrated with solar generation and battery storage;
3) **Develop a low carbon business case,** to reduce residents' and local businesses' energy bills and to generate income for low carbon development.

This study was undertaken between June and September 2022, comprising a baseline energy and financial assessment of energy use, costs and carbon emissions in the town, technical and commercial modelling to assess energy generation and low carbon mobility opportunities, and a commercial roadmap to guide the development of viable options beyond the feasibility stage.

Further information, including graphical outputs, mapping and data resources can be found in the report appendices.

1.1. Brampton Context

Brampton is a small market town of around 4,600 people (UK Census, 2011), located 9 miles east of Carlisle in Cumbria, in north west England (Figure 1.1). It is situated within the City of Carlisle District of Cumbria. The town sits at the edge of the Hadrian's Wall world heritage site (WHS) and has several historical listed properties within the town centre, particularly the octagonal Moot Hall, built in 1817, which now houses the town's Tourist Information Centre, and St Martin's Church, the only Pre-Raphaelite church containing a famous series of stained-glass windows which were executed in the William Morris studio.

There are 2,105 households within Brampton Parish, with the majority centred on the town itself. The area has a relatively high average age, with around 51% of residents over the age of 65. Employment within Brampton is generally focused on the retail, health and social care, and education sectors, with many residents commuting elsewhere (e.g., Carlisle) for jobs. The housing stock within Brampton is varied, including historic (and listed) properties within the town's core and larger private housing towards the fringes of the settlement, as well as newer housing estates and social housing located across the town.

Brampton is passed by the A69 road, and the Brampton railway station is located about a mile southeast of the town, near the village of Milton. Services within the town include a Co-operative supermarket, medical practice, Brampton community centre, hotel, and numerous other B&Bs, cafés, restaurants, and convenience shops. The Townfoot Industrial Estate is located to the west of the town centre, comprising a large number of varying business and industrial unit types. There are two schools in Brampton – Brampton Primary School and the William Howard secondary school.

Brampton benefits from its location close to the well-connected and visited city of Carlisle to the west, which is located on the M6 corridor and the east-west motorway which spans to the northeast of England and the southwest of Scotland. Larger towns nearby to Brampton are also easily accessed via public transport, with the most regular bus services running to and from Carlisle and Newcastle, as well as from the main train station.

Within the relevant Lower Layer Super Output Areas (LSOAs) for Brampton (Carlisle 002A, 002B, and 002C), UK Government data recorded a total of 3,077 vehicles, comprising 2,486 cars, 144 motorcycles, and 447 listed as 'other body types', as of Q1 of 2022.

Between 18% of properties within the town are off gas grid, therefore using electricity or oil heating sources rather than mains gas. This figure rises to 36% for properties outside of the town, in more rural areas. Fuel poverty rates range between 8% (rural areas) to 11.5% (urban area), although these figures are expected to be much higher in 2022 due to increasing cost and volatility in electricity and heating fuel prices (Non-gas Map, 2022).

Brampton 2 Zero is one of several local environmental groups in Brampton: the Brampton and Beyond Community Trust (BBCT) is a community-based development trust serving Brampton and the surrounding area. The organisation has operated since 2010, working to develop local carbon energy schemes in the area, in particular including a community-owned anaerobic digestion plant. BBCT aims to provide accessible, affordable, and responsive services for local people and seeks to be self-financing. Furthermore, B2Z has a sister organisation, Sustainable Brampton, which initiated the Brampton and Beyond Energy (BABE) group, which is planning a 500-kW anaerobic biodigester in 2019 to support local heat, electricity, and fertiliser.

Parts of Brampton centre were designated a Conservation Area in 2003, described as "an area of special architectural or historic interest the character or appearance of which it is desirable to preserve or enhance" and which is included in Figure 1.1. This Area has implications for building regulations and planning permissions, among others, for which additional scrutiny and considerations will be made before granting development proposals. Of particular relevance to the ambitions of this project, permitted development rights for rooftop solar do not apply within conservation areas.

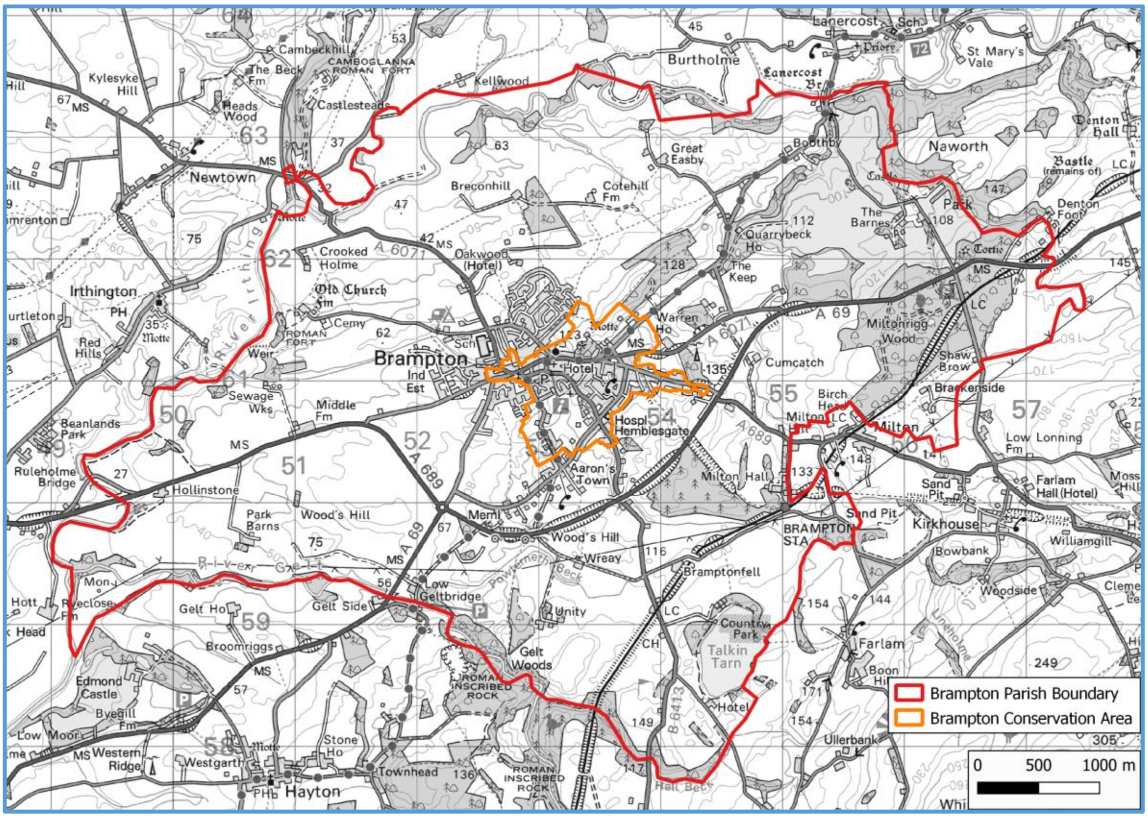


Figure 1.1 - Map of Brampton Parish and the Brampon Conservation Area.

1.2. Organisations

The following organisations are relevant to the study and have played a role in supporting and creating this report.

Brampton 2 Zero

Brampton 2 Zero is a Community Interest Company (CIC) set up to implement sustainable energy solutions and a scheme for community land management in Brampton, Cumbria. Through their projects across community woodland, home retrofits, solar panel installations, and electric vehicles, they aim to increase local biodiversity and carbon sequestration and make Brampton a net carbon zero town. B2Z is working closely with local educational institutions – including Brampton Primary School, Lanercost School, Irthington school, The William Howard School, and Lancaster University – to develop interest and support for local low carbon projects

Rural Community Energy Fund

The Rural Community Energy Fund (RCEF) is a £10 million programme which supports rural communities in England to develop renewable energy projects, which provide economic and social benefits to the community. The RCEF is administrated by the North West Net Zero Hub and has provided funding for this heat network feasibility study. The RCEF closed in April 2022 and is not expected to provide any further project funding to local energy projects in 2022/23.

Scene

Scene Connect Ltd. (Scene) is a UK based social enterprise established in 2011 with the intention of furthering the community energy sector. The organisation works with landowners, developers, and community groups to further opportunities for a range of community developments, expanding from its initial focus on renewable energy, through benefits packages, joint ventures, and wholly owned projects. Scene is the technical consultancy which produced this feasibility study in partnership with B2Z.

2. Planning & Environmental Baseline

A review of relevant environmental and planning policy and regulation in relation to low carbon development has been carried out. The following reference sources are of relevance:

- The Climate Change Act 2008, (HM Government, 2008)
- Energy white paper: Powering our net zero future, (HM Government, 2020)
- Heat and Buildings Strategy, (HM Government, 2021)
- Carlisle District Local Plan (2015-2030)
- The Environmental Permitting (England and Wales) Regulations (2016)

2.1. National Context

There are a number of relevant UK Government policies and strategies which underpin the UK's ambitions and progress in relation to energy and carbon. Brampton's low carbon ambitions fall within the aims of these policies, meaning that any associated development proposals are expected to start with a presumption of support from a planning policy point of view. Further information on the specifics of local planning is provided in Section 2.2.

Climate Change

The UK is a leading country in terms of climate change policy and action. It has made considerable progress, reducing emissions by 48% on 1990 levels, including a reduction of 3% between 2018 – 2019 (CCC, 2019). This has largely been driven by renewable power deployment and a large reduction in coal use. The UK also benefits from a strong policy framework for climate commitments in the form of the Climate Change Act (2008).

Energy Policy

The Energy Security Strategy was published in April 2022 in the context of increasing climate change concern, the UK cost of living crisis and Russian invasion of Ukraine. The policy reviews the UK Government's energy strategy, providing an approach to meeting low carbon targets whilst reducing reliance on international fossil fuel imports, including oil and gas. The strategy sets out an ambition for 95% of the UK's electricity to come from low carbon sources by 2030, ahead of a complete decarbonisation target in 2035.

Zero emission vehicles

In November 2020, the UK government announced a commitment to end the sale of new internal petrol and diesel vehicles by 2030, and that all new cars and vans will be required to be fully zero emission at the tailpipe by 2035. More than 10% vehicles sold in 2020, and 25% in 2021 were zero or ultra-low emission vehicles. In 2019 the figure was less than 2%. Although the expectation is that the majority of drivers will do most of their charging at home, a public charge point infrastructure is required to support longer distance journeys and those without off-street parking. By 2030, the Government expects "around 300,000 public charge points as a minimum in the UK, but there could potentially be more than double that number"[1].

National Planning Policy Framework (NPPF)

In respect to energy development, there are a number of important sections within the NPPF which are laid out below. Whilst these sections provide the justification, guidance and policy base for energy planning, all sections of the NPPF must be considered in respect to any planned development.

It addresses topics that are relevant to the economic, environmental, and social sustainability of development proposals, including but not limited to:

- **2. Sustainable Development s**tates that, 'at the heart of the Framework is a presumption in favour of sustainable development,' meaning development plans should seek to promote development which meet

[1] HM Government Electric Vehicle infrastructure strategy https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1065576/taking-charge-the-electric-vehicle-infrastructure-strategy.pdf

the development needs of their area; align growth and infrastructure; improve the environment; mitigate climate change; and adapt to its effects.

- **9. Promoting Sustainable Transport** states that 'the environmental impacts of traffic and transport infrastructure should be identified, assessed and taken into account,' in local planning. It highlights that new development should be designed to enable charging of plug-in and other ultra-low emission vehicles in safe, accessible, and convenient locations.
- **11. Making Effective Use of Land** states that 'Local planning authorities, and other plan-making bodies, should take a proactive role in identifying and helping to bring forward land that may be suitable for meeting development needs,' which includes identifying opportunities for development, as considered within this study.
- **12. Achieving well-designed places**, highlights the need to remain sympathetic to local character and history (including built environment and landscape setting), whilst optimising the scale and extents of development. Where available, development must follow local design guides or the national design guide and code in their absence.

Solar PV Array Development

Part 14 of *The Town and Country Planning (General Permitted Development) (England) Order 2015* provides details regarding the development constraints and conditions for the development of solar equipment. In general, developments are assumed to be permitted on residential homes and blocks of flats, except when the proposed solar array does not meet the requirements of size, spacing, and natural or cultural heritage constraints. The document should be consulted thoroughly before a development application is considered.

Within the Brampton context there are few situations where solar PV would not be considered a permitted development, in particular for listed properties and where rooftops are clearly visible from the nearby world heritage site. There are also additional development constraints relevant to solar panel placement lie within the Brampton Conservation Area, where solar panels should be situated in a way that reduces impact on the nature, look and feel of the town. This often requires placement of panels facing away from roadways and public-facing orientations.

This impacts particularly on domestic properties within the conservation area and several non-domestic properties in this study.

EV Charging

Part 2 of *The Town and Country Planning (General Permitted Development) (England) Order 2015* provides details around the development conditions for installing both wall-mounted and upstanding electric vehicle charging points. It states that planning permission is not required for the installation of either a wall mounted or upstanding electrical outlet for recharging of electric vehicles as long as the area(s) is lawfully used for off–street parking. This includes factors such as distance from a highway and parking space, dimensions of the charging unit, and relative location to any scheduled monuments or listed buildings. The document should be consulted thoroughly before a development application is considered.

2.2. Local Plan – Development within Carlisle District

Brampton is included within the City of Carlisle's district ward and development jurisdiction, and therefore covered by the policies and ambitions set forth in the *Carlisle District Local Plan 2015-2030.* The Local Plan outlines several strategic objectives which themselves include multiple policy aims. Those most relevant to this low carbon study in Brampton are outlined in Table 2.1, below.

Relevant Strategic Objectives	Relevant Policies	Relevant Sections
Spatial Strategy and Strategic Policies	SP1: Sustainable Development SP8: Green and Blue Infrastructure	"To contribute to protecting and enhancing our natural, built and historic environment (including improving biodiversity), using natural resources prudently, minimising waste and pollution, and mitigating and adapting to climate change including moving to a low carbon economy."
Infrastructure	IP 1: Delivering Infrastructure IP 2: Transport and Development	"Developers will be encouraged to include sustainable vehicle technology such as electric vehicle charging points within proposals."
Climate Change and Flood Risk	CC 1: Renewable Energy CC 2: Energy from Wind CC 3: Energy Conservation, Efficiency and Resilience	"Proposals for renewable energy development will be supported where they can demonstrate, through identifying and thoroughly appraising any potential individual and cumulative effects, that any associated impacts are or can be made acceptable." "It should be noted that within Carlisle District there are a number of additional landscape and functional constraints that may limit renewable energy development in certain locations…"
Health, Education and Community	CM 3: Sustaining Community Facilities and Services CM 5: Environmental and Amenity Protection	"Planning has a social role to play in supporting strong, vibrant and healthy communities, by ensuring there are accessible local services that reflect the community's needs and support its health, social and cultural wellbeing"
Green Infrastructure	GI 1: Landscapes	"The aim of the policy framework is to protect and enhance green infrastructure assets and the functions they perform, ultimately for the sake of their own natural value, but also through recognition of the many wider social and economic benefits they perform, including: the opportunities they present for positively improving the health and wellbeing of the population; for sustainable travel; for mitigating and adapting to climate change and for their amenity value."

Table 2.1 – Relevant policies within the Carlisle District Local Plan 2015 – 2030

2.3. Local Developments

Existing or planned local developments within or around Brampton may have an impact on the likelihood of future energy developments securing planning permission. This may include future limitations on local infrastructure, visual impact, among others, or may be an opportunity in terms of impact and cost reduction.

Relevant local planning applications and their status within Brampton, found through Carlisle City Council's Planning Portal are detailed in Table 2.2. There are no large applications currently in planning which affect possible low carbon development within Brampton resulting from this study, but it is reasonable to expect that the EIA Screening for the solar farm at Leaps Rigg will progress to a full application in due course.

Application title	Address	Application Ref No.	Decision/Status
Installation Of Solar Panels to Southern Roof Elevation	Blacksmiths Barn, Lanercost, Brampton, CA8 2HG	21/0953	Grant Permission
Replacing Existing 15 Diesel Generators with New Low Carbon Battery Energy Storage System Within Existing Fenced Compound	Capon Generation Compound, Capon Tree Road, Brampton, Carlisle, CA8 1QW	21/0626	Grant Permission
Request For an EIA Screening Opinion for Development of Solar Farm (49,90 MW, 88.0 ha)	Leaps Rigg, Walton, Brampton, CA8 2DZ	21/0004/ESO	Response – proposal not likely to have significant effects on the environment.

Table 2.2 - Existing planning applications relevant to this low carbon study.

2.4. Natural & Cultural Heritage

Natural and cultural heritage issues must be addressed to satisfy the local planning authority and to avoid or minimise any negative impacts of low carbon implementation and installation on natural and cultural assets within Brampton.

Cultural Heritage

A preliminary assessment of cultural heritage designations has been undertaken of locally and nationally designated sites within and near to Brampton, presented in Table 2.3 and in Figure 2.1 . These designations may have an impact on the development of renewable electricity assets (solar PV, wind turbine) or heat infrastructure, including generation infrastructure, supply routes and internal works (e.g., energy efficiency measures).

Designation	Name/Description
World Heritage Site	Brampton is situated on the edge of the Hadrian's Wall World Heritage Site (WHS), which runs along the northern edge of the town.
Scheduled Monument	There is 1 Scheduled Monument in Brampton town centre, the Mote castle mound and site of late medieval beacon.

Designation	Name/Description
	Outside the western edge of Brampton's centre, there are a further 5 scheduled monuments.
Listed Buildings	There are 54 Listed Buildings within and around Brampton's town centre. Of these, 1 is Grade I listed (Church House), 52 are Grade II listed, and 1 is Grade II* Listed (Moot Hall).
Conservation Area	Since 2003, parts of Brampton have been designated as a Conservation Area, providing additional development and planning protection to buildings, trees, and land within the Area.

Table 2.3 – Cultural heritage designations within or near to Brampton.

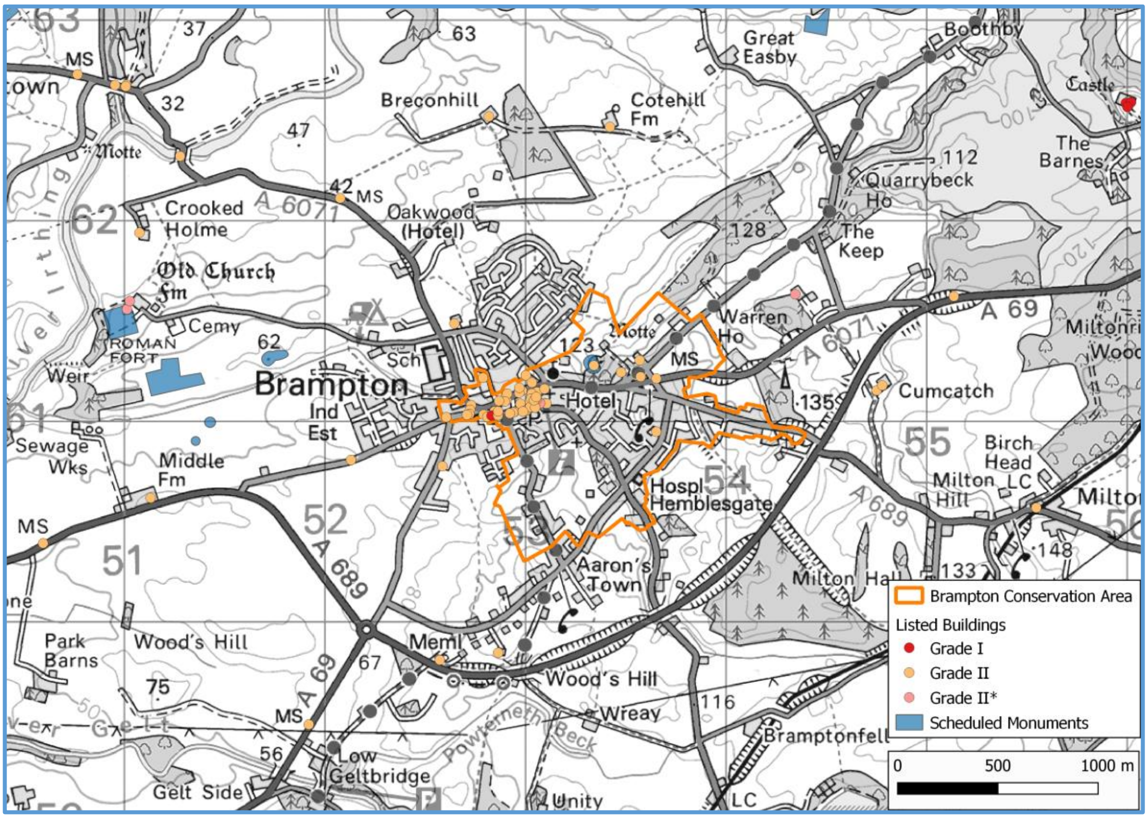


Figure 2.1 - Map of cultural heritage designations within and nearby Brampton.

Natural Heritage

Brampton is situated 2km away from a number of Sites of Special Scientific Interest (SSSI) – including the River Eden and Tributaries (SSSI ID: 8540), the Unity Bog (SSSI ID: 4764), and the Gelt Woods (SSSI ID: 1900). The town centre is not within or overlapping with any Green Belt, Nature Reserves, or Environmentally Protected Areas. Figure 2.2 provides an overview of local designations.

Proposed developments in the north of the town, closer to the World Heritage Site, may be expected to be more restricted than elsewhere.

As both Solar PV and EV charging infrastructure are permitted development (GDPO, 2015), it is unlikely that problems would occur in relation to any of the designations noted above. The most likely constraint is expected to be the positioning of solar PV panels to face away from, or be restricted in views from, the WHS. Due to the fact that the WHS is to the north of the town and the preference for south facing solar PV panels, this is unlikely to be an issue for the proposed development.

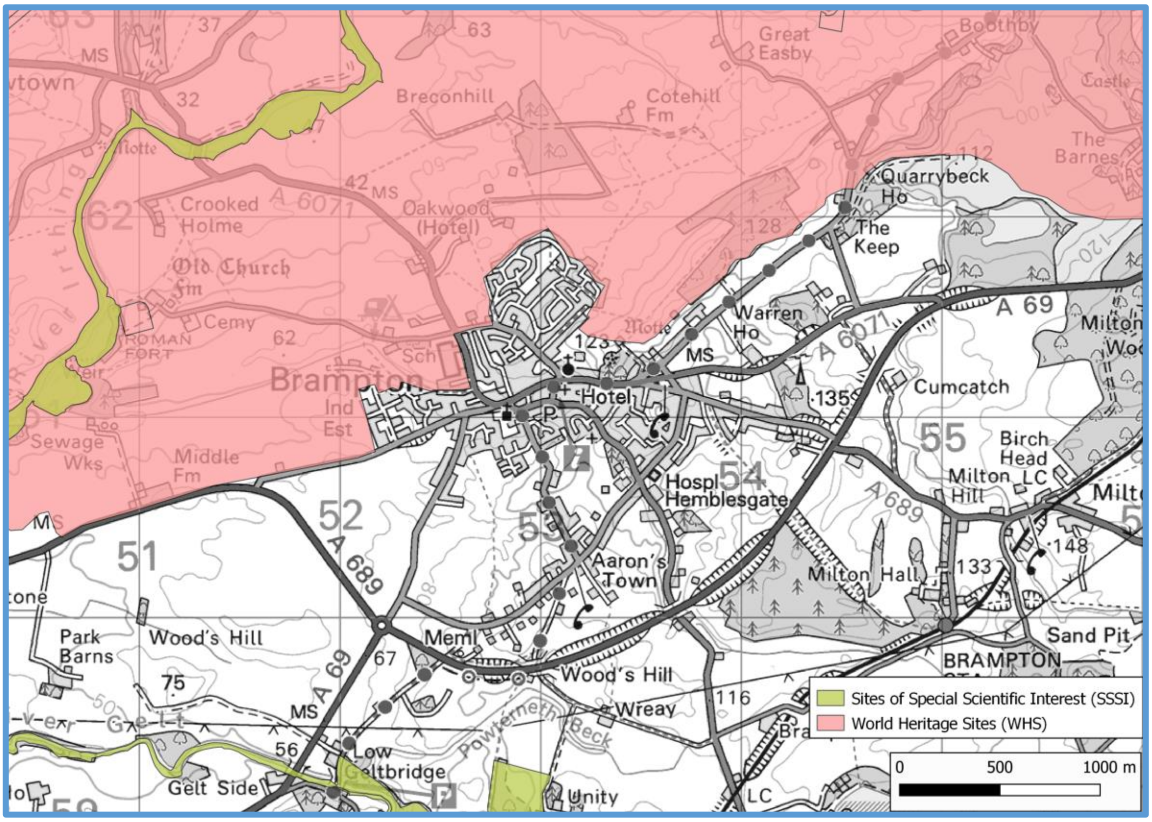


Figure 2.2 - Map of natural heritage designations with and nearby Brampton.

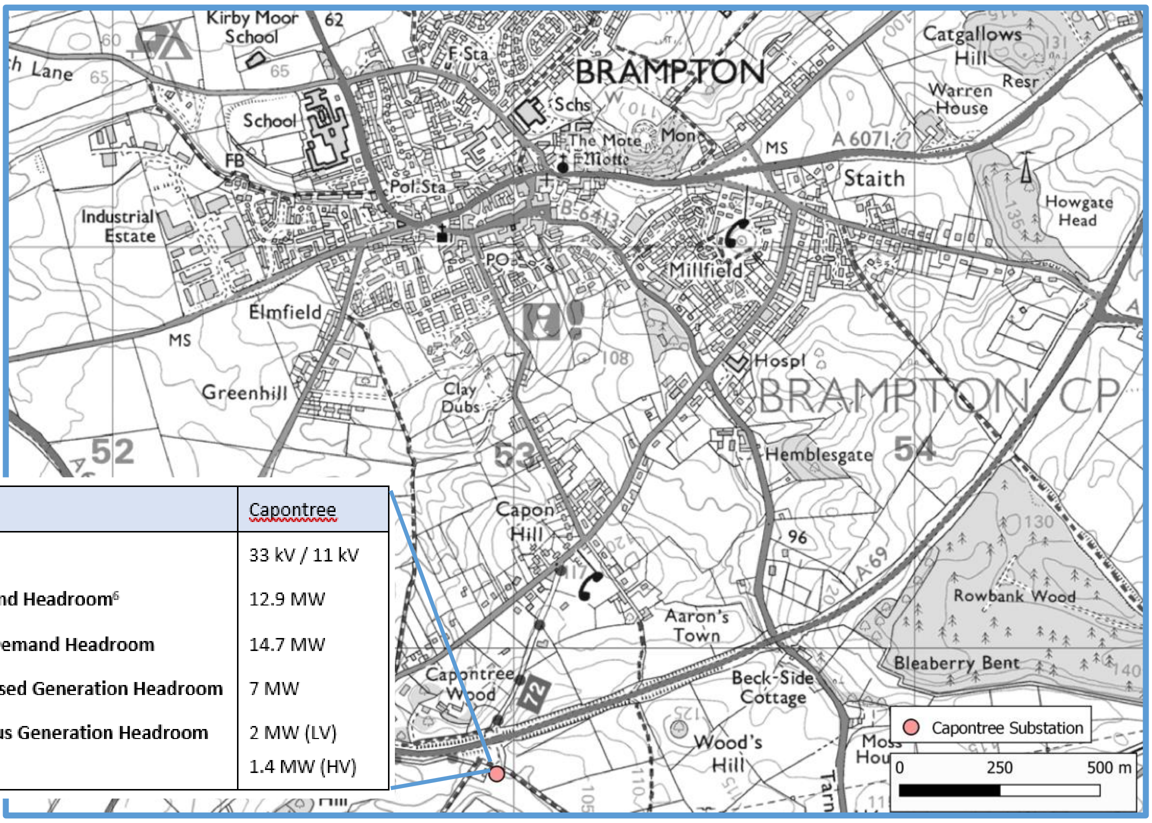
2.5. Local Electricity Network

A review of the local electricity network is necessary to understand the renewable electricity generation and connection potential within and around Brampton, which is serviced by the local Distribution Network Operator (DNO), Electricity North West (ENW).

ENW's network capacity heatmap shows that the closest primary substation for potential future connection is around 1.4km from the centre of Brampton, just south of the Brampton Bypass (Figure 2.3). It is a 33 kV / 11 kV substation, named 'Capontree' with significant headroom and connectivity potential for new sources of both demand and generation (Figure 2.1Figure 2.3). A more detailed phone call with ENW's Low Carbon Connections Advisor noted that a grid connection assessment for solar PV and EV chargers would be required on a per-site basis, to ensure that the expected voltage rise and transformer capacity are suitable to support such new connections. ENW would fund the cost of additional connections required for domestic properties but not for commercial sites.

Local use of energy is the preferred option in nearly all instances, as it offsets high energy costs on site. Export to the national grid will be assessed in regard to larger scales of generation as well as excess generation after local energy demand has been satisfied.

The expected cost of any new local grid connections will be provided by ENW following a grid connection application for the project. Our discussions with ENW found that a single application comprising the multiple sites would be acceptable, though likely requiring longer review time than timeframes specified for standard single-site applications. Before submitting the application, a pre-application meeting can be arranged with ENW's engagement team to discuss the details of the application requirements, client expectations, and expected turnaround time. Expected connection costs are not known until ENW's technical assessment has been completed.



Name	Capontree
Rating	33 kV / 11 kV
Firm Demand Headroom[6]	12.9 MW
Non-Firm Demand Headroom	14.7 MW
Inverter Based Generation Headroom	7 MW
Synchronous Generation Headroom	2 MW (LV) 1.4 MW (HV)

Figure 2.3 - Location of nearest primary substation to Brampton.

3. Baseline Energy Assessment

This chapter provides an overview of the current energy situation across key sites of interest within Brampton, including both electricity and heating. This baseline energy information is a critical building block in understanding the low carbon energy options available to Brampton and the associated economic, social, and environmental impacts.

The electricity demand from the 25 sites listed below are those considered within this baseline assessment (Table 3.1), to be enable scaling of solar PV generation options and EV charging locations. Sites were selected based on level of interest demonstrated by owners / tenants and suitability of buildings for solar PV generation.

Further to this, aggregate energy demand across all domestic properties has been highlighted in Table 3.1. Individual solar PV assessments have not been conducted for any residential sites due to the high number of properties.

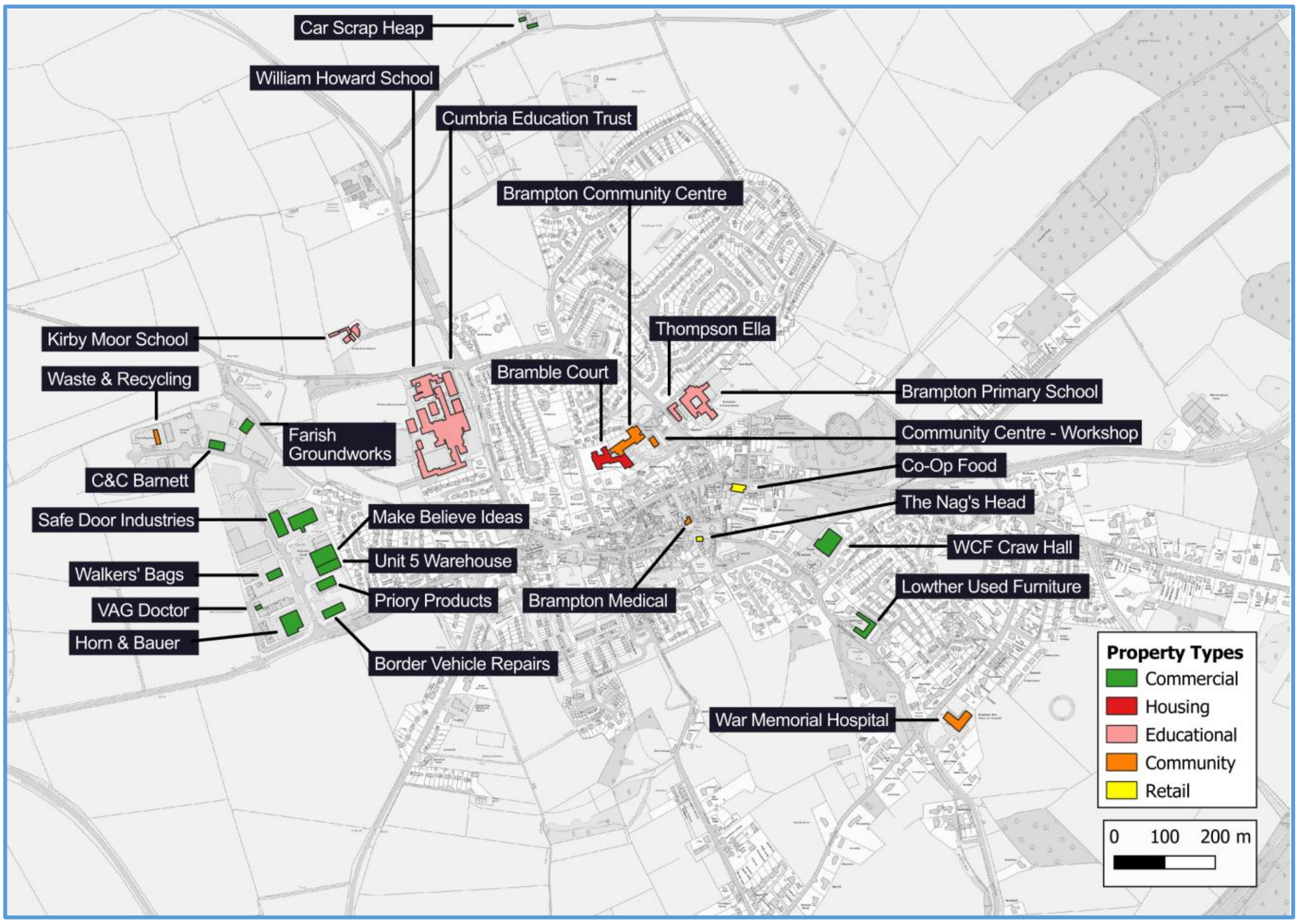


Figure 3.1 – 25 non-domestic buildings within and around Brampton included within this study.

3.1. Methodology

Energy data from these sites was collected through correspondence with relevant property owners, council members, and other representatives of Brampton throughout July and August 2022 via email and online video calls. This data included:

- Spatial and planning information, such as site maps, building plans, and planning proposals;
- Energy and technical data, such as energy consumption, fuel use, and building Energy Performance Certificates (EPCs);
- Building and land use types;
- Times of use.

An initial site visit was conducted by Scene in June 2022.

A hierarchy of data sources was used to ensure the greatest level of detail and accuracy possible, whilst ensuring the full coverage of relevant assets required to form an accurate energy baseline (Figure 3.2). Where real and reliable data (smart metering, energy billing) was not available, prior EPC data has been used and applied to standardised domestic and non-domestic energy demand profiles to generate demand profiles. Where EPCs are unavailable or out of date, energy modelling based on building size, type, age, and use was used to generate demand profiles. Due to the COVID-19 pandemic affecting typical energy profiles over 2020 – 2021, a preference for 2019 (pre-pandemic) data was used in this study.

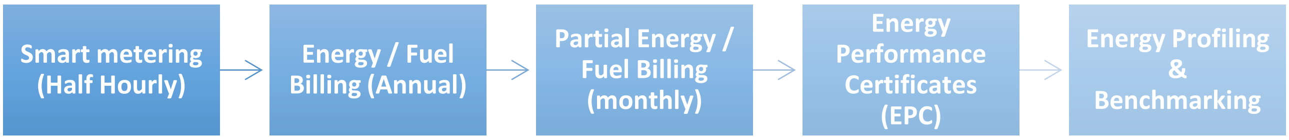


Figure 3.2 – Energy Data Hierarchy

Energy consumption data for the majority of the relevant buildings was provided in the form of monthly energy bills per site between 2019 and 2022. To this monthly and annual energy demand dataset, a series of hour-by-hour energy use profiles was able to be applied, suited to each building type and times of use. This process was also supported by the client, who gave details on visitor and staff numbers, opening and closing times of the various sites, and any relevant holidays, to inform a more accurate energy use profile of sites across the year.

3.2. Energy Demand Assessment

Total baseline energy demand across the 25 sites amounts to **3,156 MWh per year**, with an estimated further **8,951 MWh per year** of electricity demand across domestic properties within Brampton.

Figure 3.3 provides an overview of non-domestic electricity demand across properties in Brampton. This demonstrates that there are several properties with very high usage – including the William Howard School and Make-Believe Ideas. Further to this, there is a concentration of high demand properties on the Townfoot Estate, west of the town.

Figure 3.4 provides an overview of total energy electricity demand for the non-domestic properties in this study within Brampton over a typical year. The profile demonstrates peak demand loads in the winter months and lower demand throughout the summer and autumn months. This variance in heating energy demand is predominantly due to use of electric sources of light and heating within those properties used more often during the winter months, including electric heating systems and fireplaces, portable radiators, electric blankets, and evening lamps.

Metering and billing data was provided for 4 properties, with EPC and / or CIBSE benchmarking utilised to understand electrical loads at wider non-domestic properties in Brampton. Understanding of exact electricity demand, via energy metering or billing, is necessary to fully understand the case for a solar PV cooperative in Brampton. Further detail on non-domestic property electricity demand and carbon emissions can be found in Appendix B.

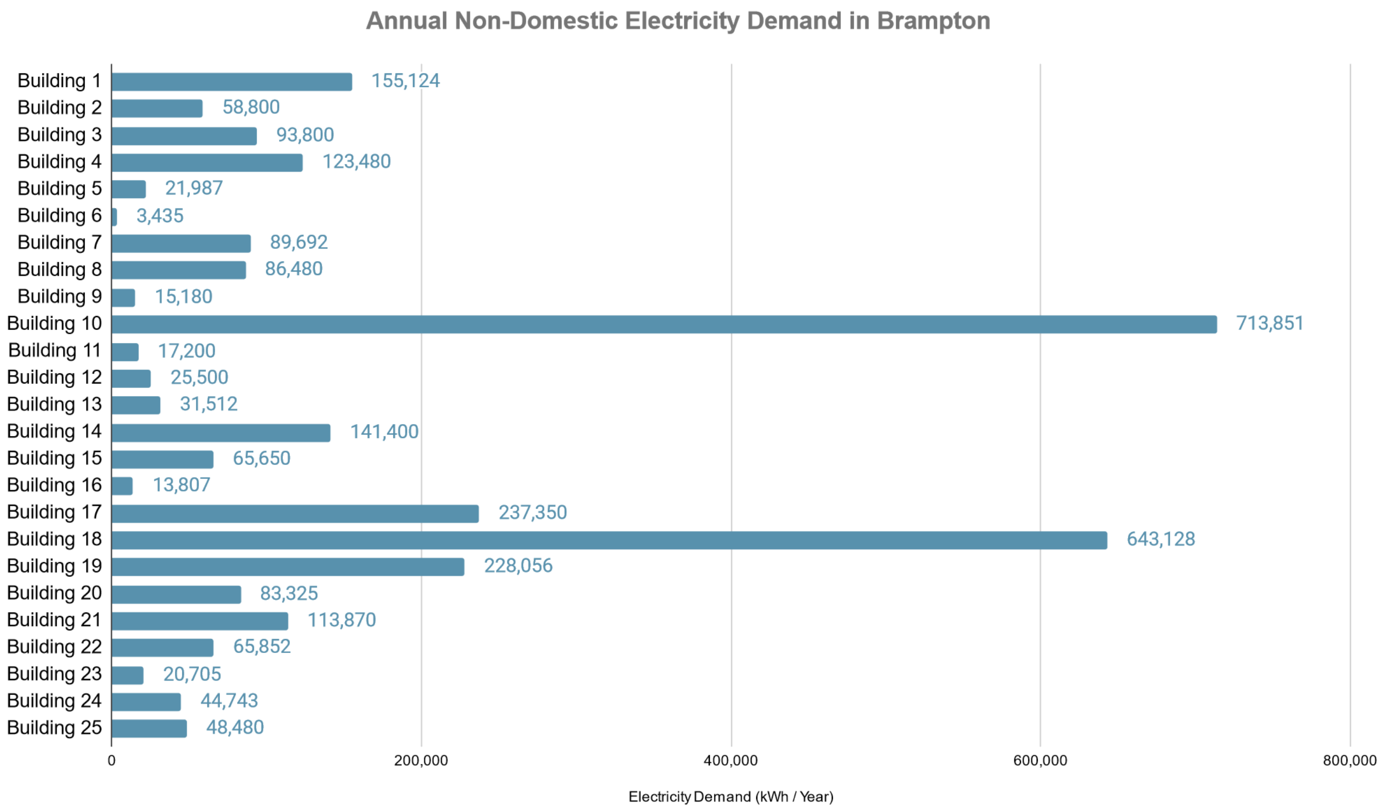


Figure 3.3 – Non-domestic electricity demand in Brampton.

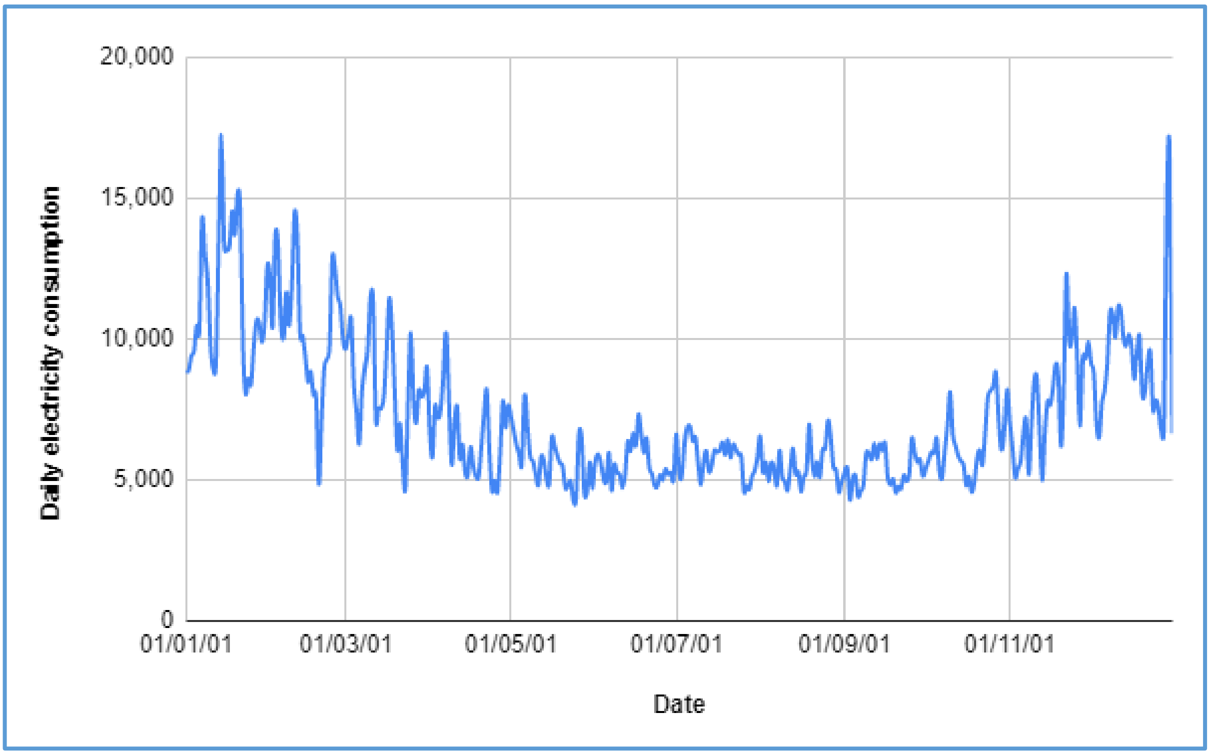


Figure 3.4 - Annual electricity demand profile for non-domestic properties in Brampton

Whilst non-domestic properties form the core of this study, both in terms of understanding demand and as potential solar cooperative members, an understanding of local domestic demand may enable a greater number of lower demand cooperative members.

In total, there are 2,296 properties in Brampton, therefore a full appraisal of electricity demand is not feasible with real world data. Using average electricity demand values and profiles for the North West of the UK, it is projected that domestic properties use ~8,908 MWh of electricity a year. This is significantly greater than the total non-domestic demand in Brampton and demonstrates the scale of the opportunity for aggregating domestic properties within a solar PV cooperative.

Based on an average solar PV installation size of 4kWp, these properties have a combined solar PV capacity potential of 9.2 MW. In reality, only a moderate proportion of properties will be able to install solar PV: from excluding those with existing solar PV arrays, unsuitable orientations, a lack of interest, siting within the Brampton Conservation Area, or other development constraints. Further scenario analysis of potential domestic solar PV capacity and generation is provided in Chapter 4.

Domestic Energy Demand and Emissions	
Total number of households	2,296
Average annual domestic electricity consumption	3,880 kWh
Total domestic electricity consumption, per year	8,908,480 kWh (8,908 MWh)
Total CO_2e emissions, per home	76.7 tCO_2e
Potential domestic solar PV array scale	9,184 kWp *Based on an average installed capacity of 4kW per household*

Table 3.1 - Domestic electricity demand data for the properties within Brampton.

3.2.1. Carbon Emissions

Total annual carbon emissions resulting from electricity generation across all sites was calculated using an electricity carbon factor of 0.19338 kg CO_2e per kWh of grid electricity assumed, and a gas carbon factor of 0.180 kg CO_2e per kWh of natural gas consumed. Both figures are provided by the UK Government's *Greenhouse gas reporting: conversion factors* data for 2022.

Using these assumptions, total carbon emissions from the 25 sites within the study amounts to 610 tCO_2e per year. Brampton's 2,296 domestic properties contribute a further 1,731 tCO_2e, bringing the total carbon emissions throughout Brampton to 2,341 tCO_2e.

Demand and emissions figures only account for electricity consumption across the properties. Heat consumption within Brampton is primarily from the gas grid, with around 18% of households using alternative heating fuels such as oil and wood logs, both of which have a significantly higher carbon emissions factor than gas.

3.3. Climate Change & Action in Brampton

Low carbon projects are often underpinned by ambitions to address the ongoing climate emergency, whether through reducing emissions or adapting to future climatic conditions. Whilst the financial case for low carbon projects is essential, environmental metrics (e.g., carbon emissions reduction) can provide a justification even when the financial case is marginal.

Part of the Brampton community energy survey focused on locals' views in relation to climate change and the actions undertaken by residents to address the climate emergency. details respondent types across the 180 surveys received, with 95% of respondents Brampton residents and / or business owners.

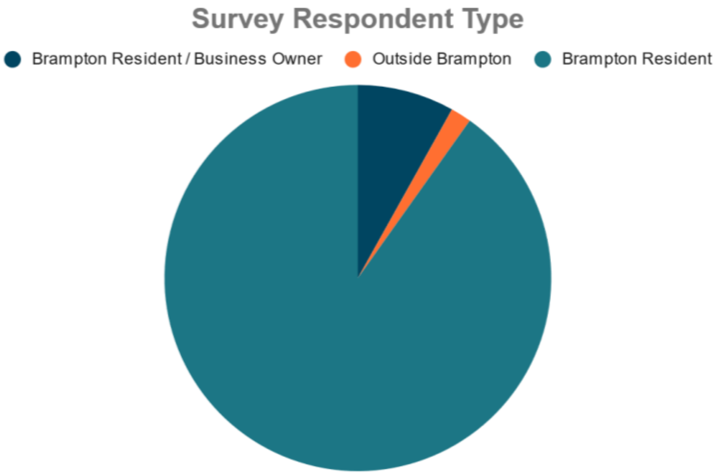


Figure 3.5 – Survey respondent types

Figure 3.6 demonstrates a high level of concern in relation to the climate emergency in Brampton, with 94% of respondents stating they are "concerned" about climate change, and 55% as "very concerned" within that number. 90% of respondents noted that they take action to tackle climate change, including:

- Reduce carbon impacts through dietary change, including consuming seasonal vegetables, less meat, and less dairy products;
- Limit of single use plastic purchases;
- Use low carbon energy supplier and investing in home energy efficiency;
- Create greenspaces at home;
- Having fewer children;
- Buy second hand products, including clothes; or
- Limit driving and air travel.

95% of respondents also noted that they are willing to take one or more of the above actions to address climate change in future. On average, 8% of respondents stated that they are unwilling to undertake the actions stated above. The questions posed were aligned with a national YouGov poll issued in 2022, demonstrating that Brampton residents have a greater awareness of, and are willing to undertake greater actions to address, climate change.

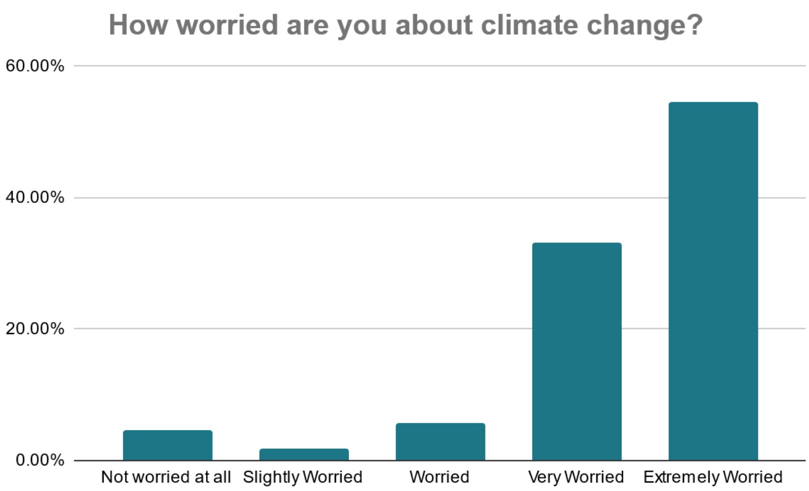


Figure 3.6 – Survey respondents' views on climate change

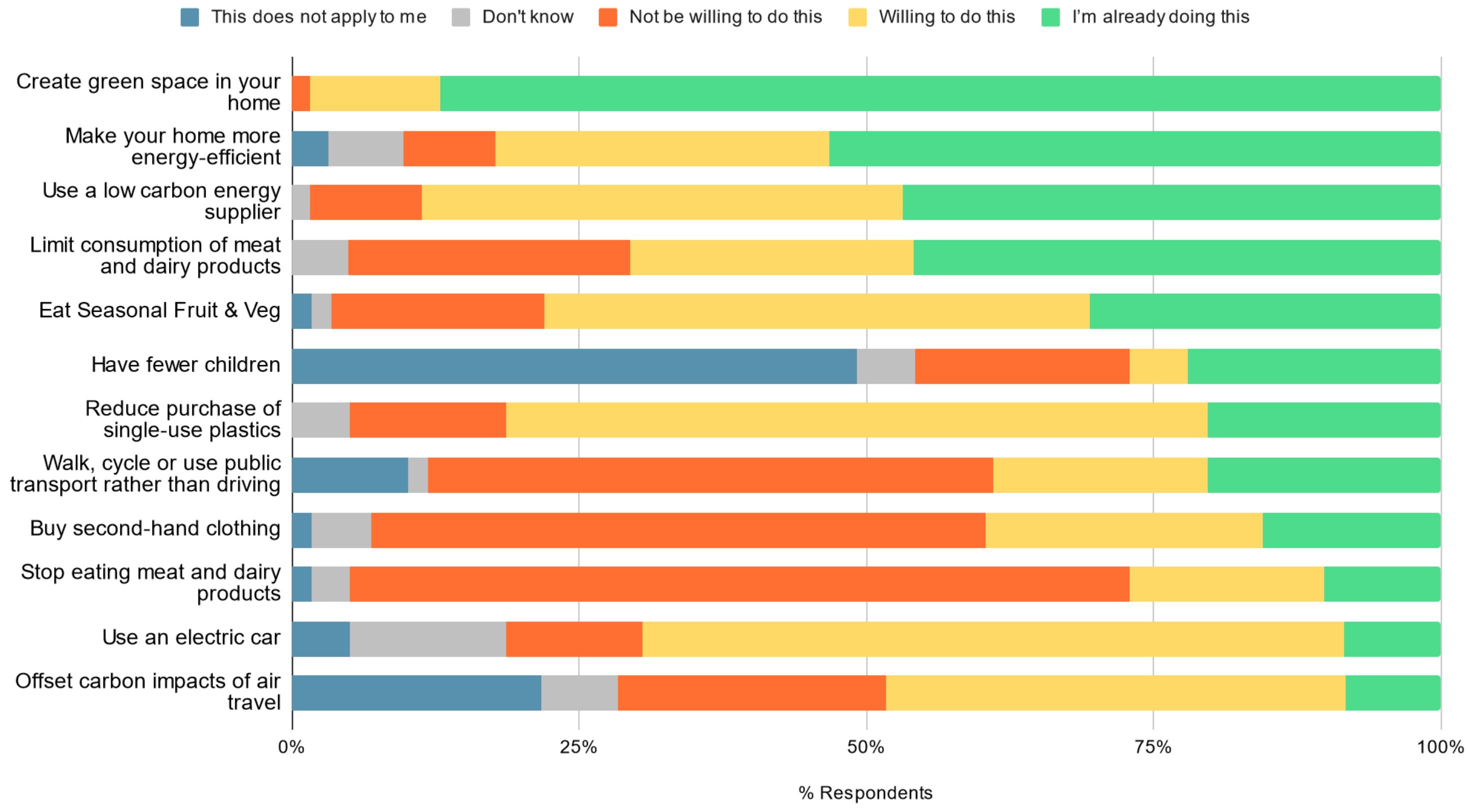


Figure 3.7 – Respondents' actions to address climate change

The above survey responses and analysis demonstrate that there is a large appetite for climate action in Brampton. In particular, respondents noted an interest in activities which can be actioned at a local level – including greenspace improvements, home energy efficiency, energy switching, and sustainable consumption. Community energy organisations, such as Brampton2Zero, are particularly suited to supporting and enabling such activities. A solar PV cooperative in Brampton would fulfil some of the demand for, and ambitions surrounding, low carbon energy in Brampton. Similarly, an EV car club would help residents to address travel impacts and provide a simple route for those interested in electric vehicles to reduce their own transport emissions.

It is important to note that surveys of this type may not be reflective of the entirety of the Brampton community. Both respondent biases, where those with an interested in climate change and low carbon energy are more likely to respond, and wider biases, such as time availability, internet access, and language, all play a role in defining survey respondent types. Further information resulting from the survey can be found throughout this report and in Appendix C.

4. Technical Appraisal

This section presents the results from the technical, energy and environmental modelling of a simulated solar PV cooperative across multiple buildings in Brampton. It details solar PV options, opportunities, and constraints for non-domestic and domestic rooftop solar PV installations.

4.1. Solar Photovoltaics

Solar PV (Solar Photovoltaics) is the generation of electricity using energy from the sun. Modern solar panels produce electricity from daylight and do not require direct sunlight, although more electricity is produced on bright, sunny days.

Enough sunlight falls onto the earth every hour to meet the world's power demands for an entire year, so harnessing and using this free energy can help reduce our reliance on other sources of energy and be beneficial to the environment as well. By installing Solar PV panels, you can produce free, green energy for your home or business. Solar PV panels are normally mounted on the roof of your building although they can also be placed on the ground when a suitable roof is not available. A device called an inverter changes the DC electricity produced by the panels into 'useable' electricity that can then be used to power appliances in your home or can be fed back into the National Grid. Solar PV panels contain no moving parts, are low maintenance and roof mounted systems will typically be adequately cleaned by rainfall.

In the UK energy market, domestic and non-domestic solar PV arrays are frequently installed across the country. Demand for solar installations has increased dramatically in 2021 / 22 due to dramatic increases in electricity prices. The cost of solar PV is generally on a decreasing trend, as panel performance increases and production costs decrease. Supply chain issues resulting from the COVID-19 pandemic and increased demand has led to short term increases in solar PV costs and material availability.

Within the Carlisle City Council area there are 341 domestic solar PV installations per 10,000 households, totalling 6.2 MWp of solar generation capacity, with a further 2.7 MW of non-domestic solar installations in the region. Solar PV is by far the most dominant small-scale generation technology, comprising 59% of all small-scale renewable energy generation.

4.2. Solar Cooperative Engagement

Critical to the success of a solar cooperative model is the sign up of properties and locations to install solar panels and arrays. This may be non-domestic or domestic rooftops or land where ground-mounted arrays may be installed.

During the course of this feaisblity study, engagement with both non-domestic and domestic property owners has demonstrated a keen interest in a solar cooperative approach in Brampton, as well as helping to identify a large number of potential sites for devleopment. Figure 4.1 details responses from the community survey, showing that over 100 residents were intersted in developing solar on their rooftop or land, with a further 40 respondents unable to commit to solar PV installation but willing to invest in a local solar PV cooperative.

Qualitative responses to the survey demonstrated a wide range of reasons for a lack of interest, including:

- Respondents who did not feel solar PV was viable on their properties as they sit within the Brmapton Conservation Zone;
- Respondents who are interested but unsure of the cooperative model and what the benefits to them individually might be;

- Respondents with previous experience with solar PV rooftop leases concerned about negative impacts on future property sales and mortgages;
- Respondents who felt that solar PV was not a suitable route forward for Brampton due to a preference for wind energy, a lack of belief in renewable technologies, and a perception that the carbon emitted during manufacture is greater than carbon saved through operation.

It is clear that there is a strong investor and participant interested in a solar cooperative in Brampton but further engagement is required to detail the business model and benefits to local people.

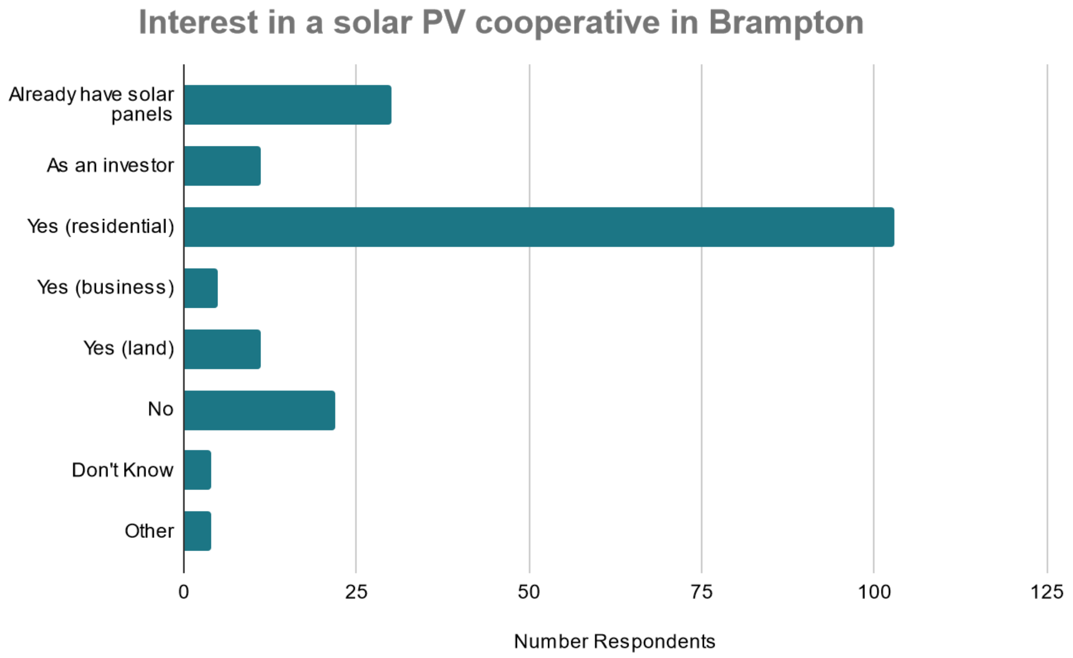


Figure 4.1 – Level of interest in a Solar PV Cooperative in Brampton

4.3. Solar Capacity Assessment

An assessment of potential solar generation was carried out across non-domestic sites in Brampton and compared against electricity demand profiles to explore possible cost and carbon savings for non-domestic sites and project as a whole. Industry standard *PV*SOL Premium 2021* software was used for the solar assessment, producing hourly solar generation figures.

Assessment against energy demand profiles is an important process as it demonstrates how much electricity can be used locally, therefore reducing high-cost energy bills (£0.28 – 0.40 / kWh). This is a preference to energy export to the electricity grid, which offers comparatively low-income generation potential (£0.05 – 0.20 / kWh). Throughout this study, energy bill savings through local energy use is preferred to grid export.

Table 4.1 below details the rooftops included within the solar assessment, and the potential solar capacity and generation output of each site. Total estimated solar capacity is **1.31 MWp** solar PV, producing **1,069 MWh** of solar generation per year.

Sites such as the Building 7, Building 10, Building 14, Building 17, among others, are considered as priority sites for high potential solar generation, given their suitable rooftops and sufficient baseline demand to yield significant cost and carbon savings.

Conversely, Unit 3 of the Townfoot Industrial Estate and Building 1 are considered particularly poor candidates for solar generation. This is due either to the orientation and spatial characteristics of their rooftops or because their baseline energy demand is unlikely to be great enough to derive significant cost or carbon savings.

Finally, the Stalker's Transport Services building within the Industrial Estate already hosts a significant existing solar array, and so was excluded from the study. Figure 4.2 - Figure 4.4 provide examples of rooftop solar arrays as simulated within *PV*SOL* software.

#	Site Name	Solar Capacity (kW)	PV Generation (kWh/year)
1	**Building 1**	2.25	2,025
2	**Building 2**	13.5	12,394
3	**Building 3**	81.00	69,810
4	**Building 4**	30.00	27,726
5	**Building 5**	42.00	36,896
6	**Building 6**	11.25	9,429
7	**Building 7**	94.24	77,846
8	**Building 8**	43.5	33,620
9	**Building 9**	12.75	8,329
10	**Building 10**	249.75	181,199
11	**Building 11**		
12	**Building 12**	6.38	16,310
13	**Building 13**	48.75	33,968
14	**Building 14**	97.88	85,288
15	**Building 15**	90.00	71,954
16	**Building 16**	65.63	50,656
17	**Building 17**	165.75	142,062
18	**Building 18**	31.5	27,911
19	**Building 19**	57	51,012
20	**Building 20**	40.13	32,728
21	**Building 21**	22.5	18,810
22	**Building 22**	31.5	28,383
23	**Building 23**	10.13	9,182
24	**Building 24**	22.5	9,182
25	**Building 25**	36.0	32,782
	Totals	**1.31 MW**	**1,069 MWh**

Table 4.1 - Longlist of 25 non-domestic buildings within the Brampton study

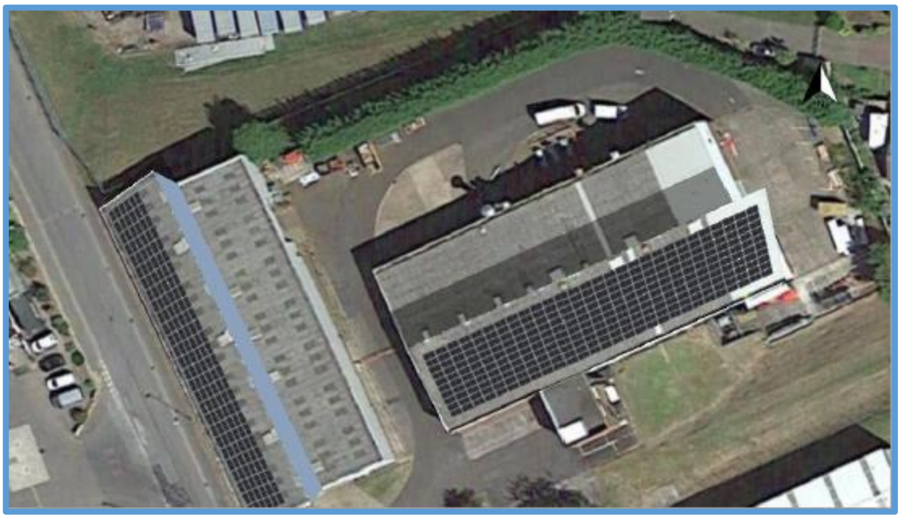


Figure 4.2 - A 165.75 kW array simulated on the rooftops of the Building 17.

Figure 4.3 - A 30 kW array simulated on the Building 4

Figure 4.4 - A 2.25 kW array simulated on the rooftop of the Building 1.

4.4. Solar PV Energy Modelling

To understand how each building's solar PV capacity potential can provide energy and environmental benefits, building-by-building energy modelling was undertaken to assess levels of local electricity use, export, and the benefits of integrating electricity storage.

4.4.1. Modelling Assumptions

The potential solar cooperative comprises a total of up to 25 non-domestic buildings, including educational, industrial, retail, and healthcare sites. A variable number of domestic residences within Brampton is also included within the model, to simulate the possible inclusion and outcomes of residential homes within the cooperative also. The model uses the properties' electricity bills where available, and otherwise EPC and floor area measurements, compared against simulated solar generation produced through the PV*SOL software described in the previous chapter.

Electricity Prices & Tariffs

Where instantaneous electricity demand is met by solar generation, for each hour of a typical year, an electricity cost saving is assumed, equivalent to the current unit cost of electricity at the particular site. An electricity tariff of £0.40/kWh has been assumed across all properties in line with the 2022/23 energy price cap and through conversations with property owners.

Where solar PV generation exceeds demand, excess electricity is modelled as exported to the electricity grid with a typical Smart Export Guarantee (SEG) rate paid to the cooperative. While typical SEG rates are up to 0.12p / kWh exported for individual properties, a solar cooperative comprising multiple sites could be able to negotiate a Power Purchase Agreement (PPA) with a supplier. A PPA rate of £0.185 / kWh has been assumed within the model, based on recent projects and rates secured by Scene.

Existing solar cooperative examples in the UK utilise lease agreements with building owners typically including a PPA for the direct supply, where a price is agreed per kWh for use of electricity generated by the cooperative's solar PV array. Within all modelling it is assumed that building owners / tenants would pay a set £0.20 / kWh for all electricity consumed from solar cooperative energy infrastructure (i.e., solar PV or battery storage). Given this provides a substantial saving to energy bills, it is assumed there would be no cost paid to the building owner for the rooftop rental. A different model could be required if the building owner and bill payer are different.

Carbon Emissions

Based on the UK Government's latest *Conversion factors for company reporting of greenhouse gas emissions*, a value of 0.193 kg CO2e (carbon dioxide emissions equivalent) per kWh used/avoided has been assumed.

Capital (CAPEX) and Operating (OPEX) Costs

Solar PV cost data from 2021/22 published by the UK Government (BEIS, 2021) has been used to model capital costs for the solar arrays. These costs are provided for multiple scales of the solar installation (Table 4.2).

Further information on all assumptions made within this study can be found in Appendix A.

Battery Storage

Battery storage has been modelled to enable greater local use of electricity within the solar cooperative scenario. Battery storage modelling assumes a 40% increase in local use of electricity, and therefore greater energy bills savings.

Installation scale (kW)	Median £/kW installed
0-4	£1,618
4-10	£1,531
10-50	£1,016

Table 4.2 - Unit costs assumed for solar cooperative capital cost estimations.

Table 4.3 below details the solar capacity, cost and carbon savings, and estimated capital costs for each of the non-domestic properties included within the modelled cooperative.

Notable properties include the Building 5 / 6, Building 7, Building 12, and Building 13, meeting around 40% of their annual electricity demand through solar generation. Building 1 and Building 18, on the other hand, have relatively high demand compared to their low solar potential, and represent poor opportunities.

Particular consideration should be given to those sites within the Brampton Conservation Area (BCA in the table) - namely, Building 1, Building 2, Building 3, Building 4, Building 20, and Building 21 - for which solar development may be more difficult to gain approval.

Solar PV Technical and Financial Overview							
Property	**Solar PV capacity** kW TIC	**Demand met by solar (% of demand)** kWh/year	**Electricity cost savings** £/year	**Export income** £/year	**Carbon savings** tCO_2e/year	**Estimated cost** £	**BCA**
Building 1	2.3	2,025 (1%)	£810	£0	0.4	£3,641	Yes
Building 2	13.5	10,383 (18%)	£4,153	£372	2.0	£13,716	Yes
Building 3	81.0	23,640 (25%)	£9,456	£8,542	4.6	£82,296	Yes
Building 4	30.0	22,943 (19%)	£9,177	£885	4.4	£30,480	Yes
Building 5	42.0	8,102 (37%)	£3,241	£5,327	1.6	£42,672	No
Building 6	11.3	1,343 (39%)	£537	£1,496	0.3	£11,430	No
Building 7	43.5	19,365 (22%)	£7,746	£2,637	3.7	£44,196	No
Building 8	94.2	35,586 (41%)	£14,234	£7,818	6.9	£95,748	No
Building 9	12.8	5,099 (34%)	£2,039	£598	1.0	£12,954	No
Building 10	249.8	164,285 (23%)	£65,714	£3,129	31.7	£253,746	No
Building 11	6.4	9,243 (36%)	£3,697	£1,307	1.8	£9,768	No
Building 12	48.8	11,422 (36%)	£4,569	£4,171	2.2	£49,530	No
Building 13	97.9	34,130 (24%)	£13,652	£9,464	6.6	£99,446	No
Building 14	90.0	18,429 (28%)	£7,372	£9,902	3.6	£91,440	No
Building 15	32.8	4,300 (31%)	£1,720	£3,890	0.8	£33,340	No
Building 16	32.8	4,300 (31%)	£1,720	£3,890	0.8	£33,340	No
Building 17	165.8	58,341 (25%)	£23,336	£15,489	11.3	£168,402	No

Solar PV Technical and Financial Overview							
Property	**Solar PV capacity** kW TIC	**Demand met by solar (% of demand)** kWh/year	**Electricity cost savings** £/year	**Export income** £/year	**Carbon savings** tCO_2e/year	**Estimated cost** £	**BCA**
Building 18	31.5	27,557 (4%)	£11,023	£66	5.3	£32,004	No
Building 19	57.0	36,159 (16%)	£14,464	£2,748	7.0	£57,912	No
Building 20	40.1	25,178 (30%)	£10,071	£1,397	4.9	£40,772	Yes
Building 21	22.5	18,751 (16%)	£7,500	£11	3.6	£22,860	Yes
Building 22	31.5	14,252 (22%)	£5,701	£2,614	2.8	£32,004	No
Building 23	10.1	4,555 (22%)	£1,822	£856	0.9	£10,292	No
Building 24	22.5	9,422 (21%)	£3,769	£1,787	1.8	£22,860	No
Building 25	36.0	12,330 (25%)	£4,932	£3,784	2.4	£36,576	No
Totals	**1,306**	**581,138 (18%)**	**£232,455**	**£92,182**	**112.2**	**£1,331,424**	**-**

Table 4.3 - Outcomes of initial solar PV cooperative modelling, for each non-domestic building.

4.4.3. Domestic Modelling

According to UK Government data on domestic meter numbers within the relevant Lower Layer Super Output Areas (LSOAs), there are 2,296 domestic properties in Brampton as of 2020. Domestic modelling assumes an average electricity consumption of 3901.7 kWh per year, based on subnational electricity consumption statistics data for 2020 and applies a typical domestic electricity use profile from Ofgem to plot this energy consumption for every hour of a typical year.

A conservative estimate of 3 kW of rooftop solar was assumed for a typical household (Figure 4.5), comprising 8 modules of 375W solar PV panels. A system of this scale would generate a total of 2,717 kWh solar energy per year in Brampton. As with the non-domestic properties, this was then compared with hourly energy demand to estimate electricity cost saving, export income, and carbon savings (Table 4.4).

Due to a combination of rooftop size, orientation, shading, and the Brampton Conservation Area, not all the 2,296 houses will be viable for rooftop solar panels.

Further scenario analysis of the technical and financial viability of including domestic properties in a solar cooperative can be found in Section 5.

Solar PV performance for an average domestic property in Brampton	
Electricity demand (kWh/year)	3,902
Solar PV generation (kWh/year)	2,717
Demand met by solar (kWh/year) (%)	997 (26%)
Electricity cost savings (£/year)	£399
Export income (£/year)	£318
Carbon emissions savings (tCO_2e/year)	0.2

Table 4.4 - Annual outcomes of supplying a typical domestic property with rooftop solar panels.

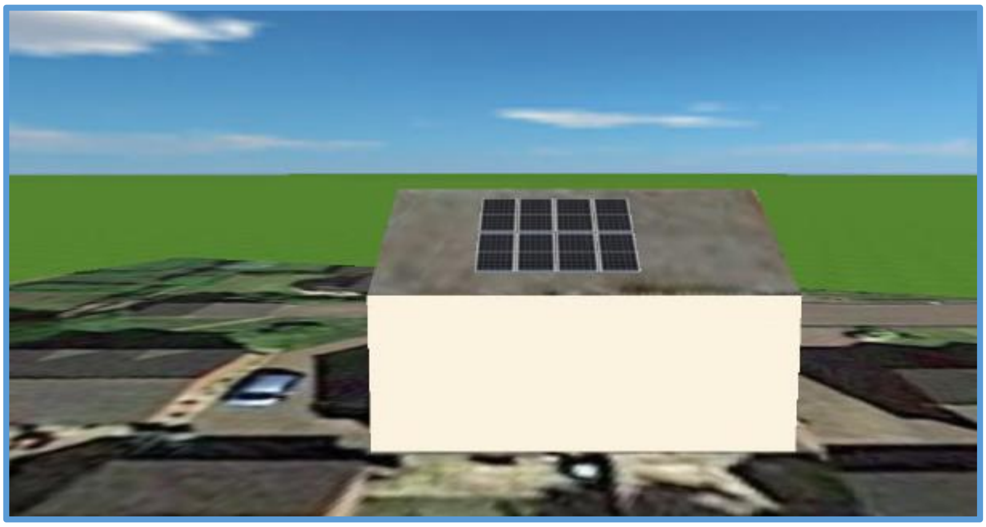


Figure 4.5 – An example domestic rooftop solar PV array of 3kW

4.5. Electric Vehicle (EV) Car Club

This section provides a technical assessment of EV car club options and opportunities in Brampton. Understanding the level of local demand for a car club, establishing potential locations for car club infrastructure (i.e., vehicles and chargers), and optimising proposals to meet estimated levels of demand are important steps in developing an EV car club.

There are two options presented:

1. An EV car club owned and operated by a community organisation in Brampton.
2. An EV car club operated by a commercial operator in Brampton.

All variables and assumptions used within this assessment are detailed in Appendix A.

4.5.1. Demand Assessment

The community survey conducted in June 2022 provided initial information on levels of interest in an EV car club in Brampton. Of the 180 respondents, 110 showed some level of interest in participating in a car club.

Primary reasons for interest included those currently without access to vehicles and reliant on inconsistent public transport, those interested in buying an EV but unable to afford one currently, and those looking to get rid of a second car on both cost and environmental reasons.

Those uninterested stated a lack of understanding of the business model to be used, costs compared to ICE vehicles, expected inability to use the car club due to distance from Brampton town centre, and a lack of confidence in car club operation and EVs in general.

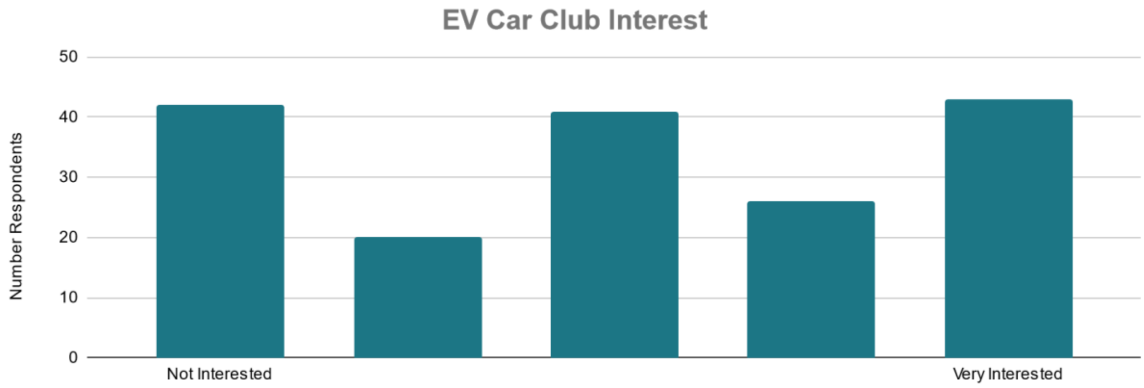


Figure 4.6 – Survey respondents' interest in a Brampton EV Car Club

Respondents stated how they were most likely to use an EV car club, with the greatest number of respondents suggesting infrequent use – one to two times a month – was the most likely scenario for them. This data was input into the demand assessment to provide a weighted annual distance assessment for typical user types (Figure 4.7).

Respondents were further asked their views on possible tariffing structures. In general, respondents requested a daily tariff of <£10, highlighting the high costs of other car clubs (e.g., Enterprise, ZipCar) and lack of price parity with ICE vehicle use.

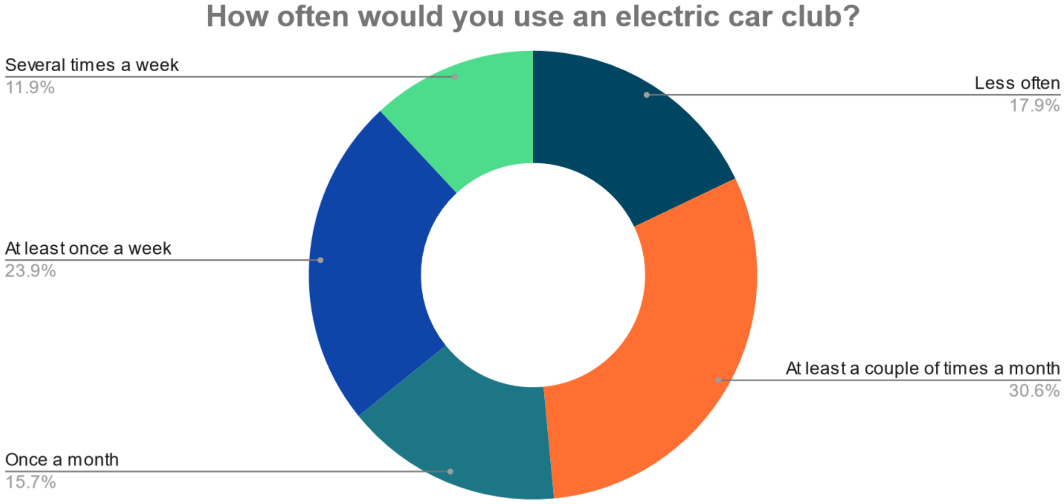


Figure 4.7 – Survey respondents' views on how they would use an EV car club in Brampton

From survey responses and local data on transport use, a demand assessment was conducted. The proposed EV car club has been scaled to meet local demand, ensuring there are a suitable number of vehicles and charging points to deliver an accessible service for local people (Table 4.5).

It is important to note that this demand assessment underpins all technical and financial modelling. This is a scenario that is supported by both local population and transport dynamics, as well as the survey responses received. Increased demand scenarios would improve the financial viability of the scheme, though may require greater levels of capital investment (e.g., vehicles and chargers). The opposite would be true in reduced demand scenarios.

EV Car Club Characteristics	No.	Notes
Electric Vehicle	3	Renault Zoe (or similar)
EV Charger	3	22kW 'fast' charger
Number of users	110	-
Average miles per trip	20	-
Average miles per user per year	798	-

Table 4.5 – EV Car Club characteristics

4.5.2. Spatial & Technical Analysis

Spatial analysis was conducted to understanding the distribution of EV car club demand and to propose locations for EV cars and charging infrastructure.

The community survey results suggest that the highest level of demand is in Central Brampton, as the most likely area to have high car club demand due to having the highest population density in the area.

Figure 4.8 provides an overview of local car club demand as a heat map of the Brampton area. Access to the A6071 and A69 is a requirement, as the major trunk roads connecting Brampton to nearby settlements (e.g., Carlisle). Several potential locations for EV cars and / or EV chargers are shown.

1. **Townfoot Estate**: position to enable access to those working on the estate and potentially make use of solar cooperative electricity generation sites.
2. **Brampton Community Centre**: Positioned in the centre of Brampton with easy access to both the town and A6071, as well as likelihood of support for any proposal.
3. **William Howard School**: providing access to the town and A6071, as well as providing a resource for families and school users.
4. **The White Rabbit Tearoom**: providing easy access to the Brampton Bypass (A69) although limited onwards transport into Brampton itself.

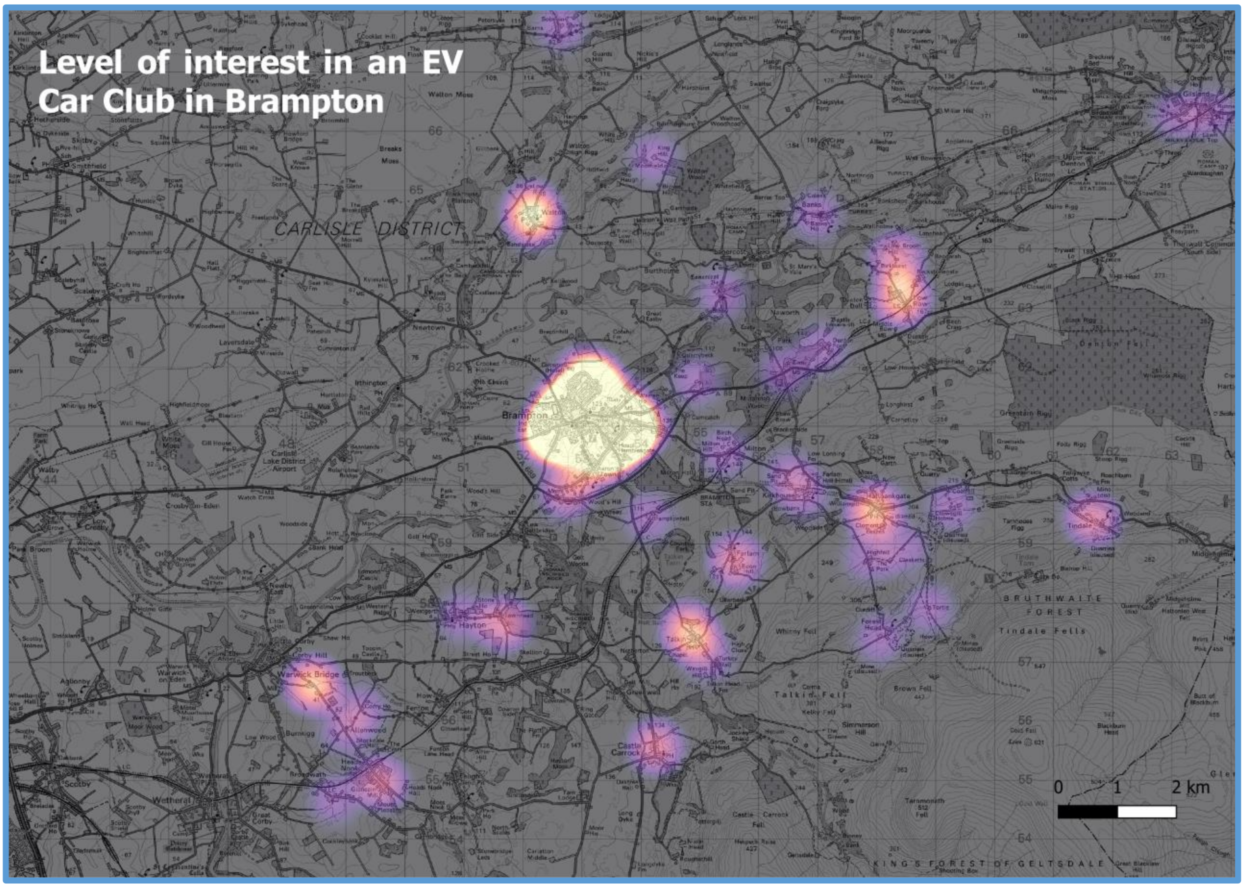


Figure 4.8 – Map of EV car club interest in Brampton

5. Financial Appraisal

This section provides a financial appraisal of the options and opportunities considered within section 4. It provides detailed financial forecasting and metrics and considers the feasibility of both solar cooperative and EV car club projects in Brampton. Full detail on the financial variables and assumptions used within this section can be found in Appendix A.

All financial modelling presented in this section assumes that initial financing is raised through a community share offer with an annual return of 4%.

5.1. 5Solar Co-operative

A 20-year financial model was developed for a solar cooperative based on the non-domestic properties included within this study. Integrating domestic properties into the solar PV cooperate is expected to improve financial viability, with greater generation potential and therefore larger income streams (Section 5.2).

Solar PV

Implementing solar PV across all non-domestic properties in the study is expected to cost £1,464,567, with an annual running cost of £29,291, including maintenance, servicing, replacement, metering, and billing, and share administration costs.

Income would be generated through PPAs with building owners / users (£116,228 / year), and export of electricity (£92,182 / year). Alongside OPEX costs of £29,291, share interest of £58,583 is anticipated from year 2 onwards.

The 20-year net present value (NPV) is projected to be £847,224 with an internal rate of return (IRR) of 5%. The project is expected to breakeven at year 13.

This is deemed to be a reasonable return over 20 years which balances several objectives:

1. Providing an income stream for the community solar cooperative to finance future system replacement costs and / or develop further low carbon projects;
2. Providing building owners with energy bill reductions through access to solar energy via a PPA at £0.20 / kWh.
3. Providing shareholders with reasonable returns on their investment.

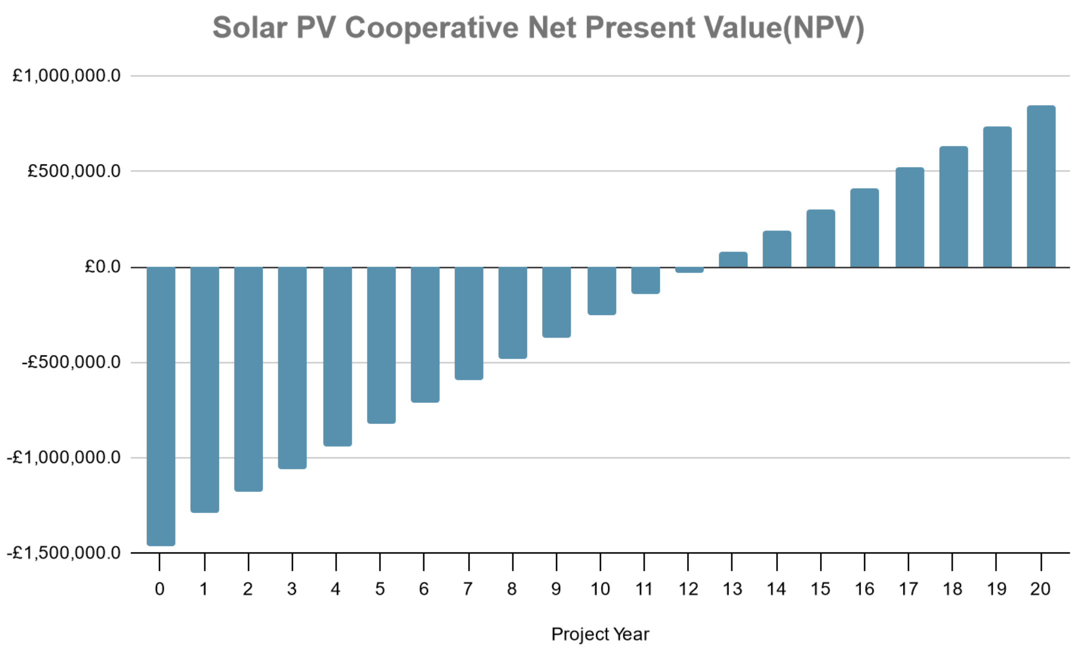


Figure 5.1 - Cashflow outcomes for the non-domestic solar PV cooperative.

Solar PV with Battery Storage

As detailed in Section 4, battery storage capacity has been modelled on a building-by-building basis. With greater income resulting from local use over grid export, battery storage has the ability to improve the financial viability of a solar cooperative, increase local energy use, reduce carbon emissions, and reduce cooperative members' energy bills.

Implementing solar PV with battery storage across all non-domestic properties in the study is expected to cost £1,927,775, with an annual running cost of £38,555, including maintenance, servicing, replacement, metering, and billing, and share administration costs.

Income would be generated through PPAs with building owners / users (£348,683 / year), and export of electricity (£30,727 / year). Alongside OPEX costs of £38,555, share interest of £77,111 is anticipated from year 2 onwards. Replacement expenditure (REPEX) is included within this model for battery storage, with a cost of £347,406 at year 10 include for the replacement of all cooperative-owned battery systems.

The 20-year net present value (NPV) is projected to be £2,808,995 with an internal rate of return (IRR) of 7%. The project is expected to breakeven at year 8.

This shows that battery storage improves viability of the scheme, though detailed energy modelling is required on a building-by-building basis to better understand system sizing and latent electricity use potential.

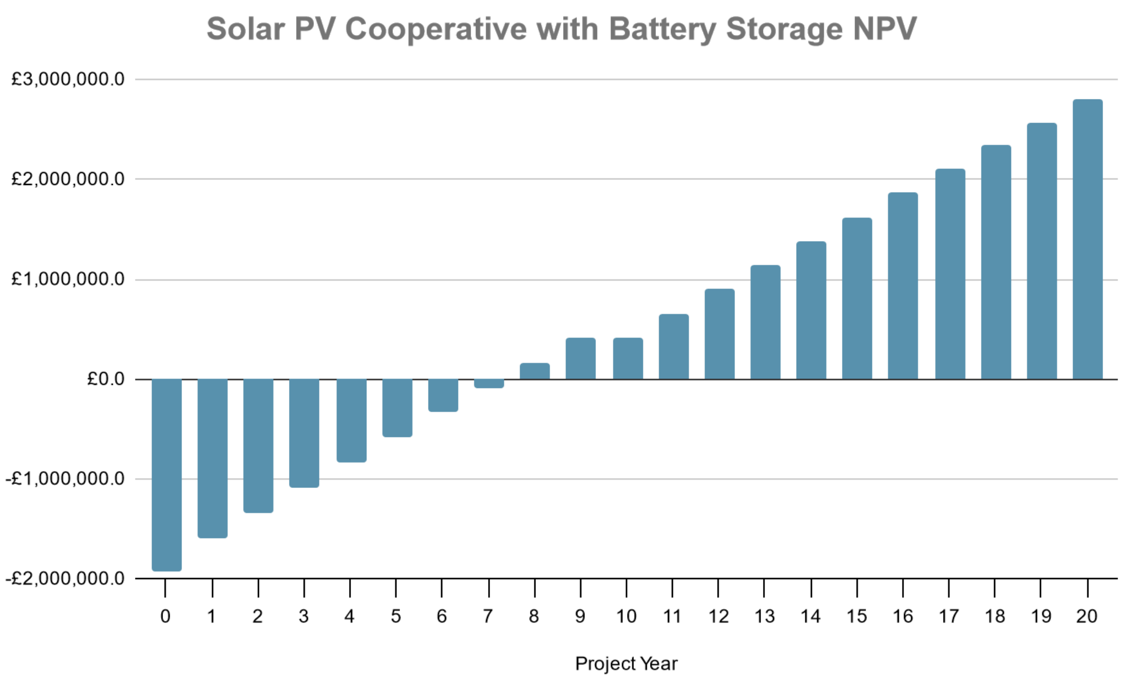


Figure 5.2 - Cashflow outcomes for the non-domestic solar PV cooperative with battery storage.

5.2. Domestic Properties

With a financially viable option to develop a solar cooperative with non-domestic properties in Brampton, it is worthwhile considering the opportunities arising from involvement of domestic properties. A financial model was created to understand the potential for solar PV development in Brampton, the costs of development and potential benefits from the perspectives of the solar cooperative and potential members.

Table 5.1 demonstrates that 10% of domestic properties within the study (~230 properties) could support up to 0.69 MW of solar capacity. This would deliver £91,540 in aggregate cost savings to property owners / tenants, as well as generating £118,831 in income for the solar cooperative, via export (£73,061) and building PPAs (£45,770).

Greater levels of ambition would result in capacities as high as 2.06 MW of solar installed, providing local benefits of £274,621 and generating £356,494 for the solar cooperative per year.

The numbers detailed above have been provided as indicative scenarios and do not account for a number of important variables, indulging:

- Size and scale of property;
- Local constraints, including cultural, environmental, and technical barriers;
- Property suitability for solar, including roof type, space, and orientation;
- Potential capital and operating costs for smaller scales of development, as would be implemented for domestic properties.

Also, commercial rooftop lease and PPA agreements typically have a duration of 15-20 years, to provide long-term security over the investment. These time periods may not be acceptable to many households, and consumer protection issues may become relevant to domestic supply which are not factors for non-domestic supply.

Based on the above limitations, detailed cashflow modelling has not been conducted for domestic properties within the solar cooperative. Further assessment should be conducted once specific properties have been identified and owners engaged with to confirm interest and suitability for the solar cooperative proposal.

Domestic Properties Participation Level	**30%**	**20%**	**10%**
Number of Properties	689	459	230
Installed solar (MW)	2.06	1.38	0.69
Demand met by solar (MWh/year) (%)	26%	26%	26%
Electricity cost savings (£/year)	£274,621	£183,081	£91,540
Total income (£ / year)	**£356,494**	**£237,662**	**£118,831**
Export income (£/year)	£219,183	£146,122	£73,061
PPA Income (£/year)	£137,311	£91,540	£45,770
Carbon emissions savings (tCO_2e/year)	132.5	88.3	44.2

Table 5.1 - Solar viability for domestic properties within Brampton Parish

5.3. EV Car Club

This section provides an assessment of financial viability for an EV car club in Brampton. Full details on the financial variables and assumptions used within this study can be found in Appendix A.

Demand data used within this assessment was collected through a community survey conducted in 2022. This survey demonstrated that ~110 users were interested in an EV car club in Brampton, although with varying levels of use type and regularity. The views of these respondents have been used to develop the below user demand assessment and tariffing structure (Table 5.2). The proposed tariffing structure has been developed to support a scheme which meets the required scale and use characteristics for Brampton.

Demand Assessment	**Unit**
Estimated number of users (annual)	110
Average number of trips / years	40
Average Trip Length	20 miles
Average annual user distance covered	796 miles
Proposed Tariffing Structure	**Unit**
Annual Membership Fee	£60
Fixed tariff (per journey)	£7
Variable tariff	£0.20 / mile

Table 5.2 – EV Car Club demand assessment and tariffing structure

Based on the tariffing structure, demand assessment and technical appraisal, a 20-year financial model has been developed for an EV car club in Brampton (Figure 5.1). Implementation is expected to cost £100,500, with an annual running cost of £29,291, including insurance, servicing, metering, and billing, software platform licences, and administration costs.

Income would be generated through the annual membership fee (£6,600 / year), fixed tariffs for journeys (£30,646 / year), and variable tariff payments (£17,512 / year). Alongside OPEX costs of £33,758, share interest of £865 is anticipated from year 2 onwards. Replacement expenditure (REPEX) is included for EV and EV charger replacement, with a cost of £54,000 at year 5, £43,200 at year 10, and £38,880 at years 15 and 20.

The 20-year net present value (NPV) of is projected to be £100,017 with an internal rate of return (IRR) of 7%. The project is expected to breakeven at year 9.

Modelling assumes that all vehicle charging is conducted using grid supplied energy, and therefore subject to electricity costs. If EV chargers were to be integrated with solar PV and / or battery storage to supply electricity, then 20-year NPV is projected to be £326,387, with an IRR of 10%, breaking even in year 4.

An EV car club is therefore viable within Brampton, although it is unlikely to generate significant income due to the high operating costs and requirements for frequent replacement cost investments. Further understanding of local demand and acceptability of the proposed tariff structure is required to better understand the opportunity.

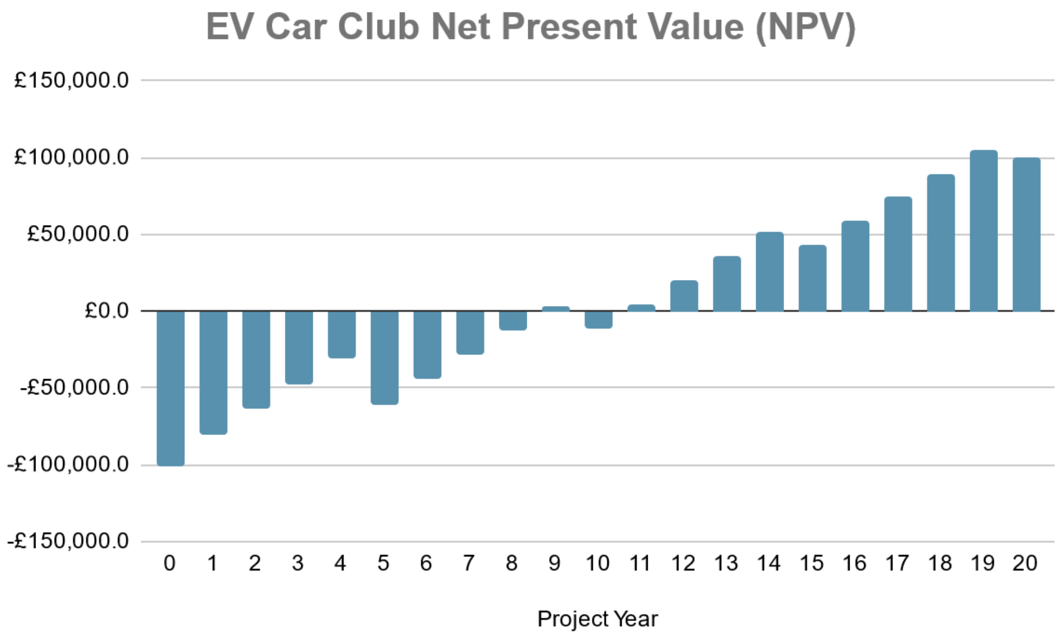


Figure 5.3 – Net Present Value for an EV Car Club over a 20-year lifetime

5.3.1. Individual User Costs

An assessment of EV car club costs to the users in comparison to ownership of a typical internal combustion engine (ICE) vehicle is provided in Table 5.3. It demonstrates that, whilst per trip costs may be higher for EV car club users, annual costs are significantly lower based on the average user profile. This demonstrates that an EV car club is cheaper annually in nearly all circumstances and would remain so until a usage of 1200 miles / week. This is an extremely unlikely use case for a car club vehicle.

Annual carbon emission from EV car club use would be 40 kg lower per year, totalling 4.4 tonnes of CO_2e across a user base of 110. This figure is expected to increase as EV emissions reduce due to decarbonisation of the UK electricity grid.

Cost Category	Example Annual User Cost		Notes
	EV Car Club	Non-EV Car Ownership	
Upfront Cost	£0	£2,333	Based on a £7,000 purchase price over a 36-month payment plan
Annual Membership	£60	£1,040	Includes Insurance, car tax, MOT, and breakdown cover
Single Journey *(20 miles)*	£11	£3	Non-EV vehicle assumes petrol @ 1.65 / litre and an average mileage of 11 miles per litre (50 miles per gallon)
Annual cost *(1 trip / week)*	£572	£156	
Total Annual Cost	**£632**	**£3,532**	
Average Monthly Cost	**£53**	**£294**	
CO_2 Emissions (kg)	30.2	70.7	EV at 46.4g/mile Petrol at 108.8g/mile

Table 5.3 – Comparative assessment of proposed annual car club costs and car ownership costs

6. Commercial & Governance

This section provides an overview of the commercial and governance considerations for both solar cooperatives and EV car club creation and operation.

6.1. Energy Cooperatives

Energy cooperatives share certain internationally agreed-upon principles and are organised on a fundamentally democratic basis, often operating according to a 'one-vote- per-member' principle. In these cases, no shareholder can exert disproportionate control over the cooperative as voting rights do not increase based on the amount invested. Often only a small contribution is sufficient to become a member of the cooperative and hence, to have a say in its future development.

There are more than 200 energy coops in the UK. These include cooperatively owned wind turbines, utility scale and distributed solar PV arrays, and national cooperative initiatives which encompass installations in many regions of the UK. Examples include Bristol Energy Co-operative, Brighton & Hove Energy Services Co-operative, and Westmill Wind Farm Co-operative.

Energy cooperatives offer potential to help mobilise finance for reaching renewable energy targets, while involving citizens and other stakeholders in the production and use of renewable energy. Those who sign up as members can buy shares of the cooperative, which in turn owns renewable energy installations and provides a return on investment to its members over time. Provided the energy cooperative acts as, or sells to, a licensed supplier, members can also get access to locally produced green electricity at a fair price.

6.1.1. Solar Cooperatives

Solar Cooperatives have been set up in a variety of forms in the UK, such as community-led initiatives where solar infrastructure is owned and operated by a cooperative organisation or where domestic or commercial members work together to design and procure systems which are in turn owned by the property owner. This section focuses on the former example.

In a basic sense, solar cooperatives work by developing a site or portfolio of sites (e.g., rooftops) for solar PV implementation, therefore increasing scale of development, impact, participation and, maybe most critically, reducing capital costs. Furthermore, a cooperative approach enables membership and therefore equitable distribution of costs and benefits across all participating sites and members (i.e., investors).

There are several models of solar cooperative development and operation, although they follow a similar process:

1. Feasibility assessment of solar PV opportunities.
2. Onboarding of potential sites and development of a cooperative business plan across all viable sites.
3. Constitution of a cooperative organisation.
4. Detailed site design, consenting and development.
5. Development and issue of a share or bond offer and securing of wider financing requirements.
6. Procurement, installation, and commissioning of sites.
7. Project operation and administration.

Within the above process there are several options in terms of business model and revenue generation, detailed below.

- **Electricity export**: This is highly likely to be a core income stream for any solar cooperative, with energy exported to the grid and income accrued by the cooperative.
- **Fixed lease agreements**: This would be a simple lease agreement with the building or landowner which enables use of the land or roof space for solar PV generation, whilst providing a nominal income to the cooperative, often based on the scale of development.
- **Variable lease agreements**: This would be similar to fixed leasing but may be a variable cost based on potential generation capacity, actual generation, or level of local energy use (i.e., direct consumption by the building owner / tenant).

- **Power Purchase Agreement (PPA):** This would be a tariff applied to all electricity consumed by the building owner / tenant. A PPA would be agreed for a fixed term (e.g., 1 year) and renegotiated in line with changing electricity market prices. For example, in 2022 typical electricity tariffs are £0.30 - £0.40 / kWh. A PPA of £0.20 would reduce costs to the building owner / tenant whilst generating income for the cooperative. A PPA may also include a fixed rate (i.e., standing charge) to cover specific costs, such as maintenance or replacement costs of the solar PV infrastructure or to reduce the cooperative's exposure to the risks of unexpectedly low energy consumption.

It is important to note that the above revenue would be utilised for a specific set of purposes, set out and agreed in the cooperative's constitution, including (but not limited to):

- **Covering operating costs** (OPEX), such as maintenance, servicing, share administration.
- **Repaying capital costs** (CAPEX), such as commercial loans, share or bond interest payments and repayments.
- **Accruing income for replacement costs** (REPEX), such as replacement of solar PV panels, cabling, or battery storage systems.
- **Accruing income for contingency costs**, often capped at a set value (e.g., 10%) in case of unexpected costs (e.g., changes in wholesale electricity prices reducing PPA rates, sites dropping out of the cooperative, unanticipated share repayments).
- Using income to initiate and finance wider **community-led and / or low carbon projects,** often via a community benefit fund.

Case Study – Edinburgh Community Solar Cooperative (ECSC)
Edinburgh Community Solar Co-operative (ECSC) was formed in December 2013 as an Industrial & Provident Society, which is governed by its Rules and run by a board of directors. ECSC, supported by Energy4All, raised the required funds (£1.4 million) to install 25 solar PV arrays. This was achieved with a public share offer, giving priority to Edinburgh residents to become members of the co-operative by purchasing shares for a minimum of £250. During operation, some or all of the electricity generated is used by the building, depending on internal demand. This electricity is sold to the Council through a Licence Agreement. ECSC also receives income through the Feed in Tariff. Any surplus electricity is exported to the grid, for which ECSC also receives income. The actual level of income depends on the level of daylight, how much electricity is used internally and the operational efficiency of the plant. Each year, after operation and administration costs have been covered, share interest is paid to members. The return on share capital is capped at 5%, which will rise with RPI each year. The surplus funds generated after payment of share interest is allocated to the community benefit fund. By year 21, members will have all their original investment returned and the panels will revert to the Council.

Case Study – The Big Solar Co-op
The Big Solar Co-op is developing a business model and organisational structure to maintain a national-scale post-subsidy solar cooperative. By 2023 it aims to install 100MW of rooftop solar that will save nearly 40,000 tonnes of CO2 emissions a year and produce enough electricity for over 250 million miles of electric car journeys. The project seeks to support the expansion of the community renewables sector by taking away some of the barriers faced by volunteer-run local community renewables groups. Through this approach, communities work locally and as part of a UK-wide solar co-op to support the growth of its volunteer base by: • Providing support through training and peer mentoring • Breaking down the work into more manageable portions to enable people with less time to participate • Bringing volunteers together with a sense of national movement with a shared low carbon vision. The project intends to engage 250 active volunteers across 25 local groups, generate 5 new sustainable jobs, and create ethical, accessible social investment opportunities - raising £25m and saving over £300,000 annually on fuel bills for community buildings and social housing.

6.1.2. Cooperative Governance

Cooperatives are based on seven principles agreed by the International Cooperative Alliance:

1. **Voluntary and open membership**. Cooperatives are voluntary organisations, open to all persons able to use their services and willing to accept the responsibilities of membership, without gender, social, racial, political, or religious discrimination.
2. **Democratic member control**. Cooperatives are democratic organisations controlled by their members, who actively participate in setting their policies and making decisions. People serving as elected representatives are accountable to the membership. In primary cooperatives members have equal voting rights (one member, one vote), and cooperatives at other levels are also organised in a democratic manner.
3. **Member economic participation**. Members contribute equitably to, and democratically control, the capital of their cooperative. At least part of that capital is usually the common property of the cooperative. Members usually receive limited compensation, if any, on capital subscribed as a condition of membership. Members allocate surpluses for any of the following purposes: developing their co-operative; benefiting members in proportion to their transactions with the co-operative; and supporting other activities approved by the membership.
4. **Autonomy and independence**. Cooperatives are autonomous organisations controlled by their members. If they enter into agreements with other organisations, including governments, or raise capital from external sources, they do so on terms that ensure democratic control by their members and maintain their cooperative autonomy.
5. **Education, training, and information**. Cooperatives provide education and training for their members, elected representatives, managers, and employees so they can contribute effectively to the development of their cooperatives. They inform the public - particularly young people and opinion leaders – about the nature and benefits of cooperation.
6. **Cooperation among cooperatives.** Cooperatives serve their members most effectively and strengthen the cooperative movement by working together through local, national, regional, and international structures.
7. **Concern for community**. Cooperatives work for the sustainable development of their communities through policies approved by their members.

Currently there is no cooperative legal form in the UK, and so organisations wishing to become cooperatives must choose one of the existing legal forms to begin operation. It is usually advisable for a cooperative, whatever its type, to incorporate to limit the liability of its members and governing body.

Industrial and provident society (IPS)

It is generally accepted that the IPS route is most robust form for a cooperative. It contains statutory protection of the cooperative principles - for example, one member one vote - and is designed to enhance democracy and protect the rights of the members. IPSs are registered with the Financial Services Authority (FSA). The FSA scrutinises the governing document (Rules) of applications to register as an IPS.

Before a cooperative is registered, the FSA checks to ensure that the rules meet the requirements of the Act to register as a cooperative, and it also has the power to refuse any amendments to the rules post registration if it believes that they are not in keeping with the original ethos of the society. IPS's are permitted to issue shares to the public, so if a cooperative - particularly a community co-operative - wishes to raise funds from the public then the IPS legal form is probably the most appropriate one to choose.

BenComs are a form of Industrial and Provident Society (IPS) and are a type of co-operative enterprise. BenComs are managed by an elected Board of Directors and owned by members (shareholders). Shares in BenComs are a form of ethical investment: members receive a yearly fixed interest agreed by the members at an AGM. Unlike shares in normal limited companies, IPS/BenCom shares cannot be sold, although they can be repaid at par by the Society. They are also an ethical and affordable way to raise capital. See 6.2.1 for further details.

Private company limited by guarantee / shares

The limited company legal form is the most well-known. It is widely used by cooperatives and is familiar to most advisers, professionals, and funders. Company law does not offer any protection of the cooperative principles, but it is flexible, and its governing legislation is accessible and up to date.

Private companies limited by shares are prohibited from offering shares to the public, so if the propose cooperative wishes to raise funds from the public this legal form should be avoided

Community interest company (CIC)

The CIC is a limited company but with special features and is available for use by organisations that wish to conduct their business for community benefit. One of its key features is an asset lock, whereby assets of a CIC are protected and cannot be distributed for private benefit. The asset lock may be useful for cooperatives wishing to apply for funding or promote themselves as not-for-private profit. It is not possible for a CIC limited by guarantee to pay dividends to members and a dividend would be subject to a cap in a CIC limited by shares. The asset lock would also prohibit distribution of assets to members at the point of winding up.

Like limited companies, CICs don't offer any protection of the cooperative principles and, as with a company limited by shares, public share issues are prohibited.

6.2. EV Car Clubs

There a several business models commonly employed for community-led car clubs in the UK:

Informal Car Club

Setting up and running an informal car club is not that complicated and does not involve much more work than goes with being an individual car owner. This is typically conducted on an ad hoc basis between individuals, with a simple management structure, agreement of responsibilities and costs, and insurance covering named drivers across one or more vehicles.

Peer-to-peer car club

A peer-to-peer car club is a brokerage service which allows individuals who own cars to rent them out to people who need to borrow them. The owner supplies details of their vehicle and its availability to the club, which displays them on the central website. The club ensures that drivers are insured and handles the financial transactions. Example operators in the UK are Hiyacar, easyCar Club and Rentecarlo.

Until recently, peer-to-peer car clubs were difficult to establish as they needed commitment from the car owner to be available to meet the driver to hand over the keys for each booking. However, modern technology now available means that a telematics unit can be easily installed in the owner's car which means that the driver can then unlock it for the time that they have booked it using a phone app.

Independent car club

Car clubs can be run entirely by the community for the benefit of their neighbours without depending on services provided by third parties, but insurance can be expensive, especially for fleets with fewer than 5 vehicles.

The largest independent community car club in the UK is Moray Carshare, with 13 cars based around Findhorn in the north of Scotland and over 100 members. It works on a trust-based system with the keys kept in a nearby combination-lock safe, and logbooks in the car for drivers to record their journeys. This low-tech model works best in small communities where car club members know each other. Members are relied on to only take the car during the periods for which it is booked, and to accurately record vehicle hire times and mileage.

This system has the advantage of not needing access to a mobile phone signal but can be labour intensive for volunteers or local employees to process data and handle billing and payment collection. Online booking providers (e.g., SuperSaaS) and low-cost telematics (e.g., Instacar) can help to reduce this burden and the reliance on user reporting.

National Operator License

Licensing a car club model from a national operator can reduce the burden of running a car club independently. You will pay a monthly fee for access to the scheme, but benefits include expert advice, centralised 24hr support for members, access to promotional materials, an online presence, being part of a national network, etc. Two examples – Moorcar and Co-wheels – have worked with Enterprise Car Club, with a further example in Strathaven working with Karshare for their community car club.

Commuter Car Club

Car clubs usually do not work for commuting as when you pay for the vehicle by the hour, it is expensive to have it sitting outside offices all day. Examples, such as Wheelshare Anstruther, show that agreements with other local or regional car clubs can enable commuter use of a car club. The Wheelshare Anstruther vehicle is used locally at weekends by car club members, with members commuting to Dundee during weekdays, where the vehicle joins the Co-Wheels Dundee fleet between 9am – 5pm.

6.2.1. Legal Structures

Legal structures which are suitable for community-led car club operation in England include:

Community Interest Company (CIC) - this relatively new legal form is simple to set up but requires annual reporting to both Companies House and the CIC register. Requiring both a ‘community interest statement’ and an ‘asset lock’ charity (who will decide on disposal of assets if the company is wound up). Co-wheels, the national car club operator is a CIC.

Co-operative Society (Co-op) – One of several types of ‘mutual societies,’ coops are set up mainly for the benefit of its members under a democratic one-member, one-vote constitution. As previously detailed, cooperatives can take several forms. Integration of a solar cooperative and car club cooperative may be possible, but delineation of asset ownership and liability is critical between the two operations and may be better suited to operation under separate but related commercial entities.

Community Benefit Society (BenCom) – another form of ‘mutual society,’ which can choose from a set of ‘model rules,’ but modifications to ‘model rules’ take time and cost money. Differs from a Co-op in that it is set up for the benefit of the wider community, rather than just members e.g., a group working to improve local transport options. Regulated by the Financial Conduct Authority (FCA)

Company Limited by Guarantee (CLG) with an appropriate “asset lock” and social mission. This is the easiest format to set up (can be as little as 2 weeks). Annual reporting to Companies House is straightforward.

Companies Limited by Guarantee, BenComs and Co-ops can also be registered as a charity with associated tax benefits. Further information relating to car club governance, commercial structuring and operation is available from CoMoUK, the national charity for shared transport (https://www.como.org.uk).

7. Funding & Finance

Table 7.1 provides an overview of available and relevant funding streams which may support the development of a solar cooperative and / or EV car club in Brampton.

Funding Opportunity Assessment		
Solar PV	**Community Financing**	Whilst there are no specific supporting mechanisms for solar PV at either national of local levels, community financing is an intention of Brampton 2 Zero via a share raise. Community solar cooperatives have had success in the UK using community share offers and bond offers to raise finance. This can be a low-cost source of finance which may attract environmentally and socially aware investors.
	VAT	To support households against rising inflations and energy prices, in April 2022 the UK government scrapped the previous 5% VAT tariff on energy-saving measures, which includes solar panels. In March 2027 this period will finish and a VAT rate of 5% will return.
	Smart Export Guarantee (SEG)	In January 2020, the UK Government replaced the Feed-in Tariff (FiT) with the Smart Export Guarantee (SEG), under which energy companies offer competitive tariffs for exported renewable energy to the grid. SEG rates are available for solar panels, hydro power, wind power, anaerobic digestion, and micro combined heat and power (CHP), and currently range from as high as 18p / kWh down to 1.5p / kWh.
	Power Purchase Agreement (PPA)	For larger scale and aggregate export (>100kW), it is possible to enter into a direct contract with an energy supplier to sell the power exported from site. Scene has recently secured a PPA with Younity (which exclusively buys community renewable energy) for 18.5p/kWh.
Electric Vehicles & Charging	**OZEV Grant Scheme**	The EV charge point grant provides funding of up to 75% towards the cost of installing electric vehicle smart charge points at domestic properties across the UK. The scheme is available for tenants, landlords, carparks, and staff fleets, and species a list of approved electric vehicle models, charge point models, and technical installers whose products and services they help to fund. The Workplace Charging Scheme (WCS) is a separate funding mechanism, issuing vouchers to support the up-front costs of purchasing and installing electric vehicle charge points for eligible businesses, charities, and public sector organisations.
	Workplace Charging Scheme (WCS)	The Workplace Charging Scheme (WCS) is a voucher-based scheme for businesses for electric car charger installation. It can cover up to 75% of the cost and a maximum of £350 for each socket, for up to 40 sockets. This may be an appropriate route for charger installation at non-domestic premises and possibly at the Brampton community centre.
	On-street Residential Chargepoint Scheme (ORCS)	The On-street Residential Chargepoint Scheme (ORCS) provides funding for local authorities towards the cost of installing on-street residential electric car chargers. This is great for people who don't have off street parking.

Funding Opportunity Assessment		
		The scheme, run by the Energy Saving Trust (EST) for OLEV, has an allocated pot of money available to local authorities on a first-come, first served, basis. This funding route would require partnership with the local authority to implement.
	Plug-in Car Grant (PICG)	This grant is available through car manufactures and dealerships who pass the discount to customers. The vehicles have to be on the government's approved list. Grant available for car purchase is up to 35%, capped at £1,500

Table 7.1 - Funding opportunities for solar PV and EV infrastructure

7.1.1. Community Financing

A community share or bond raise is a good way to raise finance for community-owned energy projects. Share and bond offers have been used frequently throughout the UK community energy sector over the last decade, financing all types of low carbon energy infrastructure.

A share issue is an offer for shares by a company or an industrial and provident society (IPS) (i.e., Cooperative). Bond issues or loan stock issues (the terms are interchangeable) are offers to several people to lend money to an organisation on similar terms for several years. It is long-term debt capital.

Several organisations in the UK support share and bond offers from community organisations, including Co-operatives UK, Ethex, Sharenergy, and Resonance. Share and Bond offers can be time-consuming tasks due to the level of advertising, engagement, and administration required to successfully raise the required level of finance. It is highly recommended that B2Z work with a recognised expert partner for any share or bond offer issue.

It is important to understand investor motivations when it comes to community shares, enabling the issuing organisation to clearly state the benefits of their proposed project in a way that captures investor attention and, in turn, secures investment. Co-operatives UK (2020) details investor rationales (Figure 7.1), demonstrating that financial performance and returns, whilst important, are not the most critical underpinning factor in most community share raises.

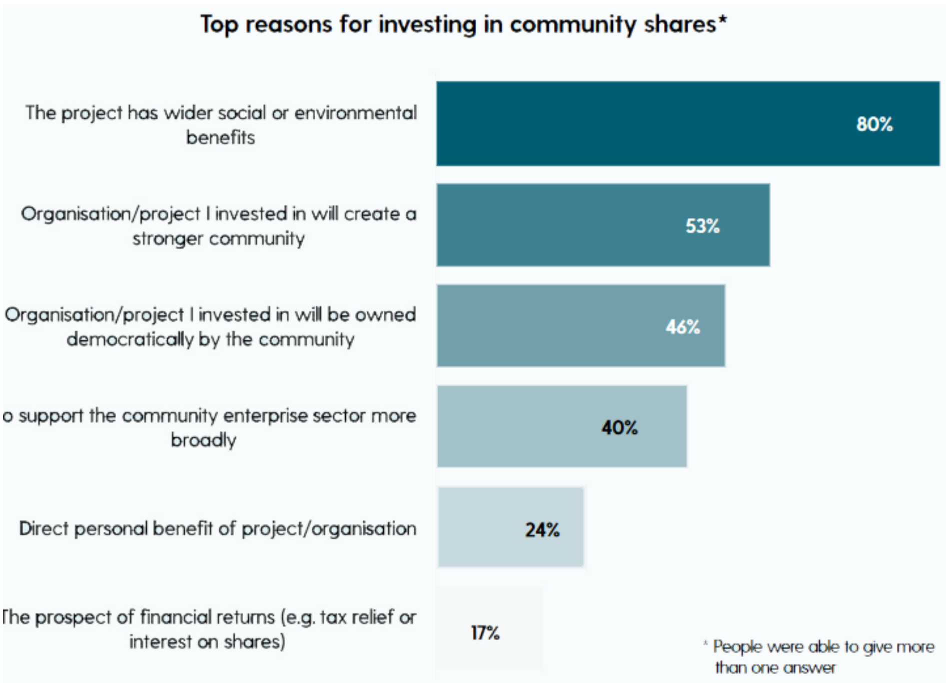


Figure 7.1 – Reasons for community share investment (Cooperatives UK, 2020)

Figure 7.2 provides an overview of the share / bond offer process, detailing the steps required prior to, during and after a community-financed project.

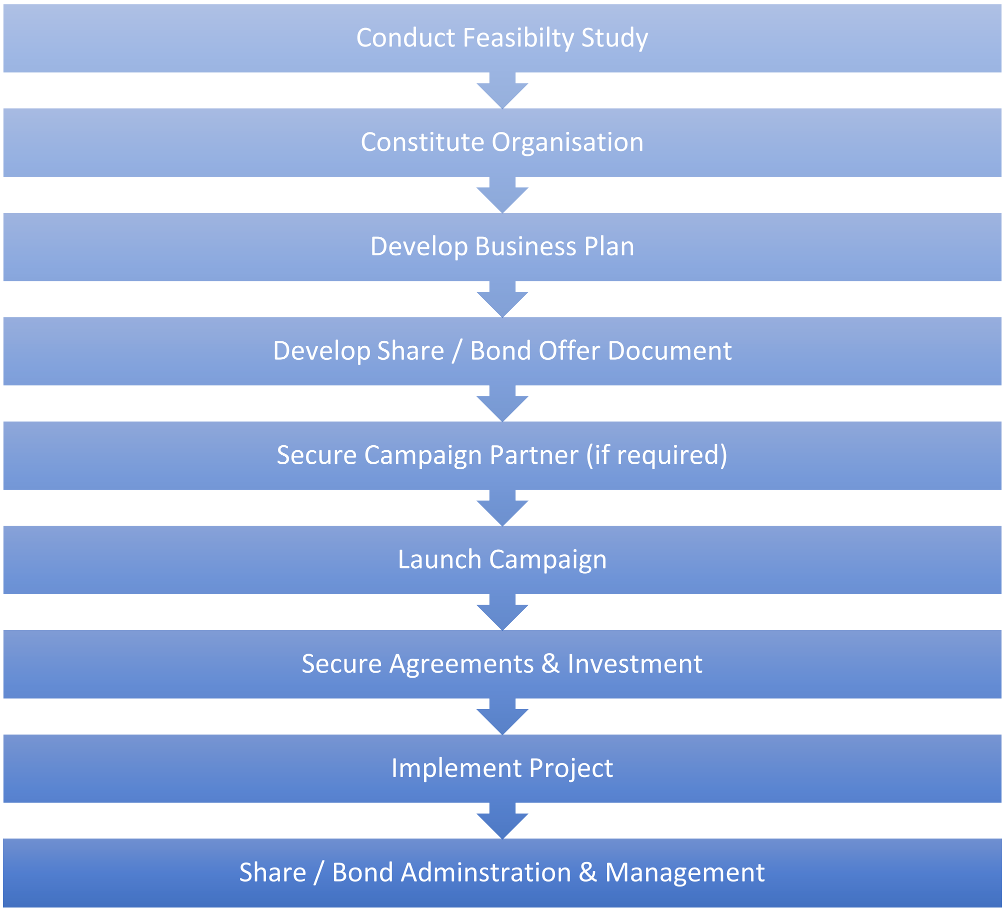


Figure 7.2 – Share / Bond offer journey

8. Conclusions

As detailed within this study, both a solar cooperative and EV car club are viable within Brampton, both in terms of level of local demand, as well as from technical, financial, and environmental perspectives. This study has focused on defining project proposals which are more than financially viable, seeking to deliver the greatest local economic, social, and environmental impacts whilst ensuring the self-sufficiency of the overall solar cooperative and car club.

8.1. Community Solar Cooperative

This report finds that:

- There is **sufficient demand and interest from residents and businesses** to develop a number of viable sites for solar PV in Brampton. Non-domestic is seen as the primary opportunity due to the established level of interest and high potential solar PV capacities which could be implemented on non-domestic rooftops. Domestic solar PV could form an integral part of a solar cooperative, but further work is required to establish interest and model solar PV capacities for specific domestic properties.
- Based on our analysis, there is the potential for **1.31 MW of non-domestic rooftop solar PV generation**, producing 1,069 MWh of low carbon electricity and offsetting 112 tCO_2e annually.
- Additional of just **10% of Brampton's domestic properties to these figures would increase generation capacity by 0.69 MW**, totaling 2.0 MW of domestic and non-domestic rooftop solar PV generation, producing 1,632 MWh of low carbon electricity and offsetting 156 tCO_2e annually.
- Integration of **battery storage would help to increase the level of local energy use by up to 40**%, therefore reducing property owners' energy bills and increasing revenue for the solar cooperative. Further assessment of specific battery storage capacities and costs is required on a building-by-building basis.
- Development of non-domestic properties would require **capital expenditure (CAPEX) of £1.4m, with an annual operating expenditure (OPEX) of £29,000.** With battery storage integration, total costs would total £1.9m with an operating cost of £38,000.
- Based on the revenue generation assumptions made, the proposed scheme would have an **annual income of £208,000**, comprised of electricity exports (44%) and PPA income from cooperative member properties (56%). This would rise to £379,000 with battery storage integration, from export (8%) and PPA income (92%).
- **Lifetime Net Present Value (NPV) for the proposed cooperative would be £0.85m with an internal rate of return (IRR) of 5%**. With battery integration NPV would total £2.8m with an IRR of 7%. All financial analysis assumes a community share offer is issued, raising all finance through this means and providing an annual share return of 4% to investors from year 2 onwards.

8.2. Community EV Car Club

This report finds that.

- There is **demand and interest from residents** to develop an EV car club in Brampton, obtained from a community survey and via anecdotal evidence. Further engagement and demand assessment is recommended to ensure the demand assumptions made within this report are valid.
- Based on our analysis, there is **sufficient demand to support the development of a car club with an estimated 3 vehicles and 3 x 22kw fast chargers**. As anticipated, the greatest level of demand is within the town of Brampton, although there are pockets of demand in rural locations which should be considered.
- Developing a car club with a regular user base of 100 users would require a tariffing structure which includes **membership fees (£60 / year), single journey fees (£7 / journey) and mileage fees (£0.14 / mile).** This is in line with both community and commercial car clubs in the UK. These figures should be revised in line with detailed understanding of local transport demand and project costs.

- Development of the proposed car club would require **capital expenditure (CAPEX) of £101,000, with an annual operating expenditure (OPEX) of £34,000.** Based on the revenue generation assumptions made, the proposed scheme would have an **annual income of £55,000**, comprised of membership fees (12%) and fixed tariffs for car club journeys (56%), and mileage income (32%).
- Analysis of the above values on an individual basis suggest that, compared to a typical car ownership scenario, an EV car club would be up to **£3,000 cheaper annually and reduce user carbon emissions by around 40 tCO_2e / year**.
- **Lifetime Net Present Value (NPV) for the proposed cooperative would be £100,000 with an internal rate of return (IRR) of 7%.** If the EV car club was supplied with electricity for all EV charging from the solar cooperative, then lifetime NPV would increase to £326,000, with an IRR of 10%. All financial analysis assumes a community share offer is issued, raising all finance through this means and providing an annual share return of 4% to investors from year 2 onwards.

8.3. Project Roadmap

A project roadmap has been set out below, demonstrating the scope of works required to develop the heat network proposal to the point of investment ready.

Community and Stakeholder Engagement	• Secure Written Interest in Solar Cooperative / Car Club • Engage with Local Planning Authority • Ongoing Engagement
Detailed Design	• Building-by-building Solar PV Design • EV Charger Siting
Business Plan	• Detailed Financial Appraisal • Constitute Cooperative • Governance Strategy
Share Offer Development	• Develop Share Offer • Secure Partnership(s) • Marketing and Adminstration
Planning and Grid	• Engage with regulators (e.g., Historic England) • Grid Application • Planning Application (if required)
Implementation Roadmap	• Programming • Risk Assessment • Procurement
Construction	•Installation of Solar PV and Chargers •Purchase of Vehicle Fleet
Operation	• Monitoring & Evaluation • Ongoing Management & Maintenance

Appendix A – Financial Details

This financial appendix provides an overview of all variables and assumptions used within this feasibility study.

Variable	Value	Notes
Total Installed Capacity (MWp)	1.31	
Solar PV Generation / year (MWh)	1,079	
Solar PV Capital Expense (CAPEX)	£1,331,424	Based on UKGov solar costs[2]
Battery Storage CAPEX	£463,208	
Operating Expense (OPEX)	£29,291	2% of CAPEX
Share Raise Interest Payments (Year 1)	0%	
Share Raise Interest Payments (Year 2 onwards)	4.0%	
Battery Storage Cost	£510	£ per kWh
Electricity Price	£0.40	
Power Purchase Agreement Tariff	£0.20	
Smart Export Guarantee Income	£0.185	
Contingency	10%	Applied to CAPEX values
Discount Rate	3.50%	Annual
Inflation Rate	3.00%	Annual
Project Lifetime (Years)	20	

Table 0.1 – Solar PV Cooperative Assumptions & Variables

[2] https://www.gov.uk/government/statistics/solar-pv-cost-data

Variable	Value	Notes
Capital Expense (CAPEX), including:	£100,500	
Vehicle Cost	*£30,000*	*Renault Zoe (or similar)*
EV Charger Cost	*£5,000*	*22kW fast charger with installation*
Operating Expense (OPEX)	£29,839	Includes insurance, administration, servicing, maintenance, and management platform costs.
Number Vehicles	3	3 x Renault Zoe (or similar)
Number of EV Chargers	3	3 x 22kW fast chargers
Users	110	From positive survey responses
Membership Fee	60	£ / year
Fixed Tariff	7	£ / Use
Variable Tariff	0.2	£ / mile
Average Journey Distance	796	miles/user/year
Electricity Cost Per Mile	£0.095	Modelled using Renault Zoe and UK £0.28 / kWh (as of mid-2022)
Share Raise (Year 1)	0%	
Share Raise Rate	4.0%	
Contingency	10%	
Discount Rate	3.50%	Annual
Inflation Rate	3.00%	Annual
Project Lifetime (Years)	20	

Table 0.2 – EV Car Club Assumptions & Variables

Appendix B – Technical Details

This appendix provides an understanding of non-domestic building size, electricity demand, and carbon emissions.

Non-domestic Site Demand				
#	Building assessed for energy demand	Floor area (m^2)	Electricity demand (kWh/year)	Carbon emissions (tCO_2e/year)
1	**Building 1**	556	155,124	30.0
2	**Building 2**	200	58,800	11.4
3	**Building 3**	1,400	93,800	18.1
4	**Building 4**	420	123,480	23.9
5	**Building 5**	1,325	21,987	4.3
6	**Building 6**	207	3,435	0.7
7	**Building 7**	1,319	89,692	17.3
8	**Building 8**	2,162	86,480	16.7
9	**Building 9**	330	15,180	2.9
10	**Building 10**	17,411	713,851	138
11	**Building 11**	400	17,200	3.3
12	**Building 12**	500	25,500	4.9
13	**Building 13**	312	31,512	6.1
14	**Building 14**	1,400	141,400	27.3
15	**Building 15**	650	65,650	12.7
16	**Building 16**	450	27,614	5.3
17	**Building 17**	2,350	237,350	45.9
18	**Building 18**	1,524	643,128	124.4
19	**Building 19**	983	228,056	44.1
20	**Building 20**	825	83,325	16.1
21	**Building 21**	965	113,870	22.0
22	**Building 22**	652	65,852	12.7
23	**Building 23**	205	20,705	4.0
24	**Building 24**	443	44,743	8.7
25	**Building 25**	480	48,480	9.4
		Total	**3,156 MWh**	**610.3**

Table 0.1 - Estimated electricity consumption and carbon emissions of the non-domestic sites

Appendix C – Community Engagement

This appendix provides an overview of all community engagement work conducted during this study.

Stakeholder Engagement Plan

This document provides a plan for stakeholder engagement which supported the feasibility study for a community solar PV cooperative and EV car club in the town of Brampton. Scene delivered the described engagement in close coordination with Brampton 2 Zero (B2Z). The engagement methods described were designed to ensure that residents of Brampton and relevant wider stakeholders were made aware of the project, offered the opportunity to input into the development process, and to secure the support and participation of local people in a resulting cooperative and car club.

Stakeholder Overview

The most relevant stakeholders are described and typified below alongside specific outcomes that will maximise the prospects of a viable cooperative / car club. Further specific information on engagement actions and methods can be found on page 3.

Stakeholder	Outcome(s)
Brampton 2 Zero	• Ensure B2Z has the necessary information, recommendations, and roadmap regarding the feasibility of a solar cooperative / car club in Brampton.
Carlisle City Council (CCC)	• Inform CCC about the project aims, outcomes and impacts. • Gather data in relation to Council owned / managed land and properties in Brampton. • Secure support for involvement in cooperative / car club • Screen planning requirements.
Landowners	• Gather data on landownership boundaries. • Inform about the project aims, outcomes and impacts. • Secure support in principle from landowner(s) for locations of interest.
Non-domestic buildings (owners / tenants)	• Gather data on energy demand, efficiency, and generation. • Inform about the project aims, outcomes and impacts. • Secure support in principle for involvement in cooperative.
Domestic properties (owners / tenants)	• Gather data on energy demand, efficiency, and domestic generation. • Inform about the project aims, outcomes and impacts. • Secure support in principle for involvement in cooperative
Energy Networks	• Gather data on electrical demand and generation headroom on low-voltage (LV) network.
Regulators	• Inform on project designs and impacts. • Screen consents and permission needs and activity requirements.

Table 0.1 - Overview of Stakeholder Types and Actions

The below action plan provides a step-by-step guide to how community engagement was managed over the course of the project. It was designed with a clear hierarchy of engagement, namely: awareness raising; developing dialogue, building support, securing buy-in. Whilst the below plan is chronological, the engagement journey may differ between stakeholders in both form and timescales.

1. Awareness Raising

Awareness raising was conducted through several methods:

A. A community engagement event (21st June 2022 – see section 4)
   - **Outreach**: directly via email, in-person by B2Z
   - **Participants**: Invite only residents, businesses, and council, etc.
   - **Format:** A short presentation on the project ambition and objectives followed by a roundtable Q&A session with all participants.

B. A briefing for stakeholders, setting out project ambition, objectives, and outputs as of the end of phase 1. This will be shared directly and via engagement events.

C. Via direct communications with stakeholders, including requests for information (RFI), emails and phone calls with stakeholders.

The focus of this stage was on building support in the local area from potential scheme participants (i.e., Cooperative members). Engagement with regulators, network operators, etc., was conducted once initial demand and resource assessments were completed (phase 2 onwards).

2. Developing Dialogue

This stage is where negotiation occurs in the process and will include:

A. Discussing and securing land options for energy generation (solar PV) and mobility (Car club) infrastructure.

B. Developing discussions with potential members and customers via direct communications and sharing of the briefing for stakeholders.

The purpose of this stage is to identify opportunities for electricity generation and use, and to further discussions with stakeholders relevant to these areas. Further to this, identifying potential barriers (e.g., regulatory, non-supportive stakeholders) was conducted during this stage, with a view to removing or reducing these barriers through dialogue.

3. Building Support

This stage is where in-principle support for the project will be developed. This is achieved via:

A. Direct conversations to communicate specific activities, outcomes and benefits relevant to each potential member property(s), e.g., landowners, anchor loads or key stakeholders.

B. Ongoing engagement with non-anchor load stakeholders to understand and record expected level of support.

C. Developing support from relevant authorities and regulators through continued information sharing.

The purpose of this stage is to build the critical mass of energy customers / loads which will underpin project viability.

4. Securing Buy-in

This stage focuses on securing support in writing. This is particularly appropriate for anchor loads during the feasibility stage but may not be feasible for all properties until detailed individual property energy assessments are completed.

A. Establishing in-principle support from landowners, anchor loads and key stakeholders via a memorandum of understanding (MoU).

B. Continued engagement with all potential members / car club customers to maintain support and momentum.
C. Formal screening opinions and advice from regulators based on expected scheme designs.
D. Public presentation and media release of final reporting, project outcomes and development roadmap.

Engagement Event Agenda

The following details refer to phase 1 / 2 of the above action plan, focusing on a site visit and engagement event in Brampton.

Event Title: Low Carbon in Brampton

Date: Tuesday 21st June 2022

Venue: Brampton // Community Centre

Agenda

10:00am – Arrive Carlisle

10:30am – Short project meeting, including review of plans for the day, resources, and logistics.

11am – Site walkover

- This will include a walk around Brampton to spatially orientate the team. The key focus will be on generation opportunities (i.e., roof spaces) and mobility infrastructure (car parks, etc.).
- This may be an opportunity to meet specific building owners prior to the event.

12:00pm – Event setup

12:30pm – Event Open

1. Introductory presentation by Phil @ B2Z. (5mins)
2. Presentation from Sandy @ Scene (15mins), introducing solar cooperatives, benefits of community energy, options available to property owners / tenants, car club rationale, likely impacts of any projects, and wider work done to date.
3. Question & Answer session (30 mins)
4. Open period for one-to-one conversations, etc. (1hr)

3:30pm – Event Close + wrap up between Scene and B2Z

Resources Required

- Projector and screen (B2Z, if available)
- Laptop (Scene)
- Briefing for stakeholders (Scene)
- Sign-up Sheets (Scene)
- Table & Chairs (B2Z, if available)

Responsibilities

- Send invites (B2Z)
- Create presentation for Brampton (Scene)
- Update and print briefing for stakeholders (Scene)
- Discuss Frequently Asked Questions (All)