Local Energy Guide

Contents

1. Introduction

This guide to local energy schemes provides an update on the status of the sector. It explains the role of new local energy hubs that have been established in each region of England and how, amongst other responsibilities, they will support public, private and community organisations to develop the business case for investment in energy schemes.

This document, alongside supporting material and appendices, can be found on the Energy Hub websites.

1.1 The Energy Hubs

There are five local energy hubs that have been established across England. Each hub has a self-determined role suited to the region in which it operates, so that activities reflect local contexts, supporting delivery of priorities identified by LEP energy strategies. All have the over-arching aims of bringing investment into energy infrastructure projects, making strategic linkages between local institutions and sharing best practice through knowledge exchange across the five Hub regions. This is summarised as follows:

- Increase number, quality and scale of local energy projects being delivered
- Raise local awareness of opportunity for and benefits of local energy investment
- Enable local areas to attract private and/or public finance for energy projects

Figure 1: Map of Local Energy Hubs

Links to the Energy Hub websites can be found below:

- South West Energy Hub, supported by the West of England Combined Authority
- Greater South East Energy Hub
- Midlands Energy Hub, supported by Nottingham City Council
- North West Energy Hub
- North East, Yorkshire and Humber Energy Hub does not currently have an online presence

See Appendix A for more detail on the current activities and successes of the Energy Hubs, and section 8 for links to the valuable resources create by the Energy Hubs.

1.2 Cornwall Insight

Cornwall Insight (CI) is the pre-eminent provider of research, analysis, consulting and training to businesses and stakeholders in the Great British, Irish and Australian energy markets. It leverages a combination of analytical capability, an appreciation of policy and regulatory frameworks, and a practical understanding of how markets function.

CI provides insight into decentralised energy markets and local transformation through new commercial models. It has delivered projects to clients including investors, developers, generation and storage operators, aggregators, Local Authorities (LAs) and Local Enterprise Partnerships (LEPs), energy networks, energy suppliers – both domestic and non-domestic, central and devolved government departments, and the regulator.

1.3 Document Guide

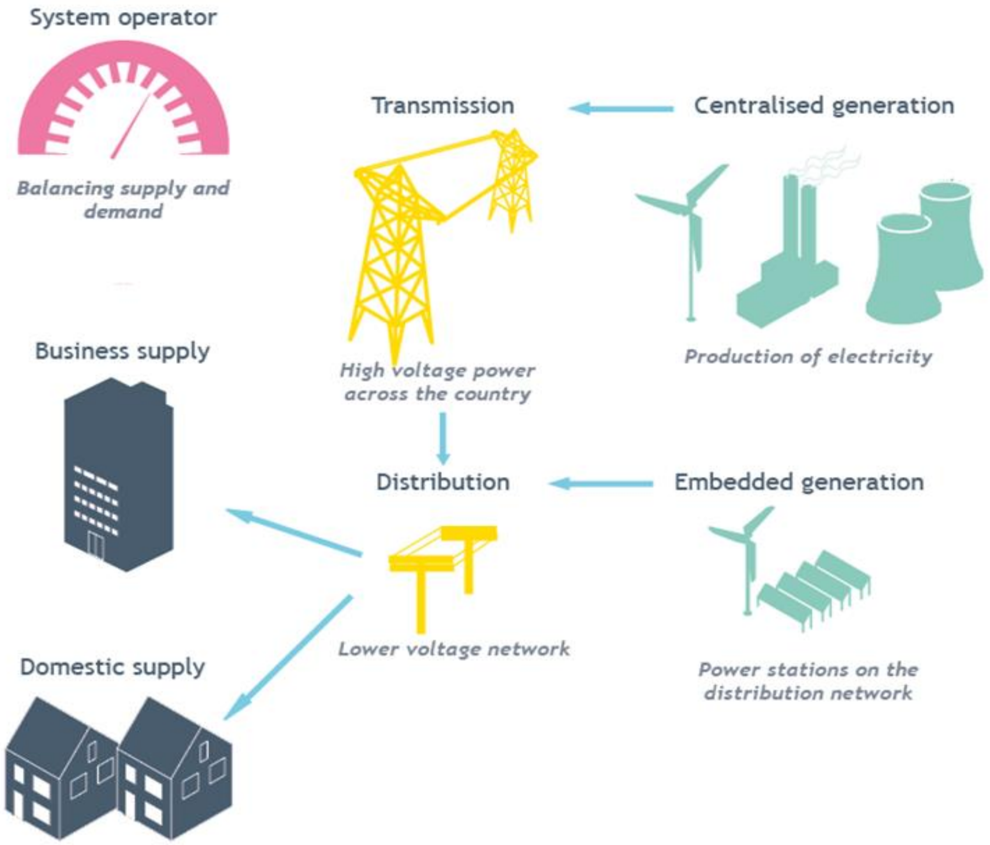
- Section 2 – provides an overview of the GB energy markets, regulation, governance and policy.
- Section 3 – summarises the routes to market for energy generation and how these might influence siting considerations.
- Section 4 – outlines the value of power exported and sold via the electricity grid or in a private arrangement with an offtaker.
- Section 5 – summarises some of the mechanisms for supporting low-carbon investment.
- Section 6 – provides an overview of the outlook for low-carbon investment, detailing potential factors affecting the investment case positively or negatively.
- Section 7 – outlines the planning regime for low carbon technologies.
- Section 8 – outlines some useful links and resources for local energy projects.
- Section 9 – contains a number of relevant case studies for local energy projects.
- Section 10 – provides a glossary of some of the key terms used in this document.

2 Overview of the GB gas and electricity markets

2.1 Key roles in the GB electricity market

The GB electricity and gas markets has numerous roles and functions encompassing infrastructure, competitive activities, and regulatory and policy authorities. A simplified overview of the electricity market roles is shown below in Figure 2. The physical infrastructure of the GB electricity market is made up of sources of energy input (electricity generators) and networks (transmission and distribution) to transport the energy to where it is consumed by final users (demand).

Figure 2: GB electricity physical infrastructure



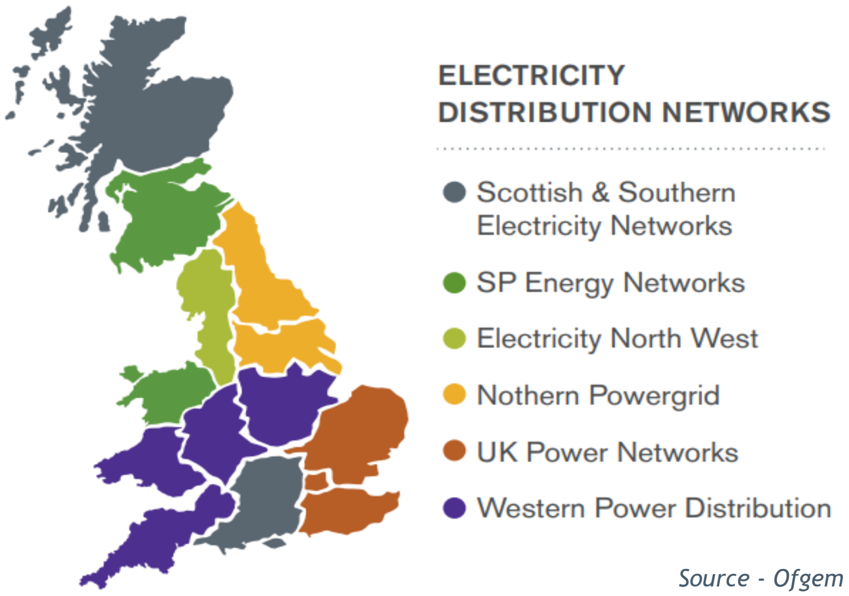
There are a range of bodies that act in the industry; to maintain the networks, buy or sell power, and physically manage the system. A high level summary is included below, but more detail on each of the roles can be found in Appendix B. These include:

- Generators – entities that own generating assets and produce electricity onto the public network for onwards transport to customers
  - This can be either be large scale generation (several hundred megawatt (MW) or more) connected to the transmission network, or smaller scale generation connected to the distribution network (known as ‘embedded generation’, ‘distributed generation’, and ‘decentralised energy’ interchangeably)
  - Examples of large generators include: Drax, Marchwood, EDF, Innogy, Uniper, Macqurie
  - Generators can also be small scale such as local or community assets (rooftop solar PV, community wind turbines, etc)

- Generation can be located as a standalone asset or collocated with demand "behind the meter". In the latter case the industry sees the generation as offset demand

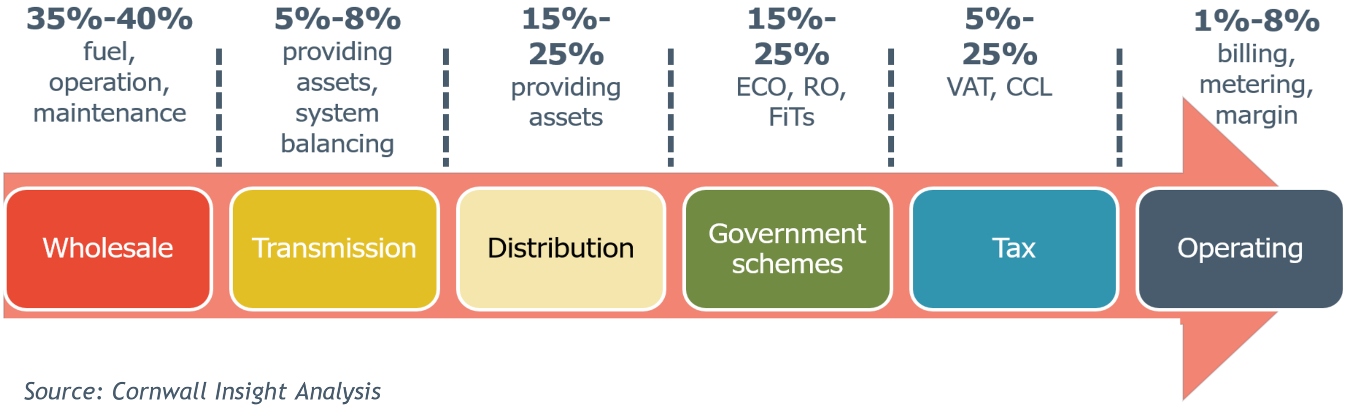
- The System Operator (SO) – a singular operator responsible for ensuring that the electricity transmission system is operating safely in real time and accounting for any over- or under-delivery of energy in order to keep the network in balance
  - This activity is currently undertaken in GB by National Grid Electricity System Operator (NG ESO)
- The Transmission Owner (TO) - an entity that owns and maintains transmission facilities.
  - The national electricity transmission network provides bulk transport of power up and down the country at high voltages: 400kV, 275kV, and – in Scotland – 132kV
  - The transmission networks connect large generation assets – currently around 68GW in total capacity – to the 14 distribution networks through Grid Supply Points to small scale generators and consumers. They also supply power to a few very large transmission-connected consumers
  - Three TOs are found in the GB system; National Grid Electricity Transmission (England and Wales); Scottish Power Transmission (Southern Scotland); and Scottish Hydro Electric Transmission (Northern Scotland)
- Distribution Network Operator (DNO) - a company licensed to distribute electricity in the UK, operating distribution networks via towers, cables and meters across 14 different DNO regions
  - Regional distribution networks step down voltage levels to those more appropriate for end consumption (132kV and below). DNOs connect most consumers, with larger consumers being connected at higher voltages and smaller consumers at lower voltages
  - The distribution networks also connect smaller generation assets, including a lot of renewable generation, totalling over 40GW of generation capacity in 2018
  - There are currently six DNOs across GB: UK Power Networks (UKPN); Western Power Distribution (WPD); Scottish Power Energy Networks (SPEN); Northern Powergrid; Scottish and Southern Energy Power Distribution (SSEN); Electricity Northwest (ENWL)
  - Figure 3 shows the DNOs and their areas of operation
  - As well as the six main DNOs, there are a number of independent distribution network operators (IDNOs). These IDNOs are small localised networks within the main DNO areas. There are 13 licensed IDNOs in GB, with each operating multiple networks.

Figure 3: Distribution Network Operation regions in GB



- Suppliers – companies licensed to retail electricity and gas to end consumers
  - An energy supplier agrees contracts to deliver electricity and/ or gas through to consumer premises, identified by their meters. Suppliers purchase energy in the wholesale markets and supply this to their customers, although many are "vertically integrated" and also own generation assets
  - There are over 100 licensed suppliers active in GB. Examples include: the six large suppliers (British Gas, E.ON, EDF, npower, Scottish Power and OVO Energy); large non-domestic suppliers (Haven, Smartest, ENGIE, Opus) and a range of smaller domestic and business suppliers (First Utility, Cooperative Energy, Octopus Energy)
  - There are also white label and licence lite suppliers that perform a slightly different function, serving customers in partnership with a fully licensed supplier. See Appendix B for more detail
  - Suppliers are important for local power generation as they typically buy power from small scale generators and interact with central industry data flows on the asset's behalf. This is typically done through an offtake agreement or Power Purchase Agreement (PPA) – more information can be found in section 3.2
- Figure 4 overleaf provides a high level representative cost breakdown of the electricity cost chain for a typical electricity user. Note that the exact proportions will vary by consumer, supplier and location within the country

Figure 4: Cost chain breakdown for electricity



Source: Cornwall Insight Analysis

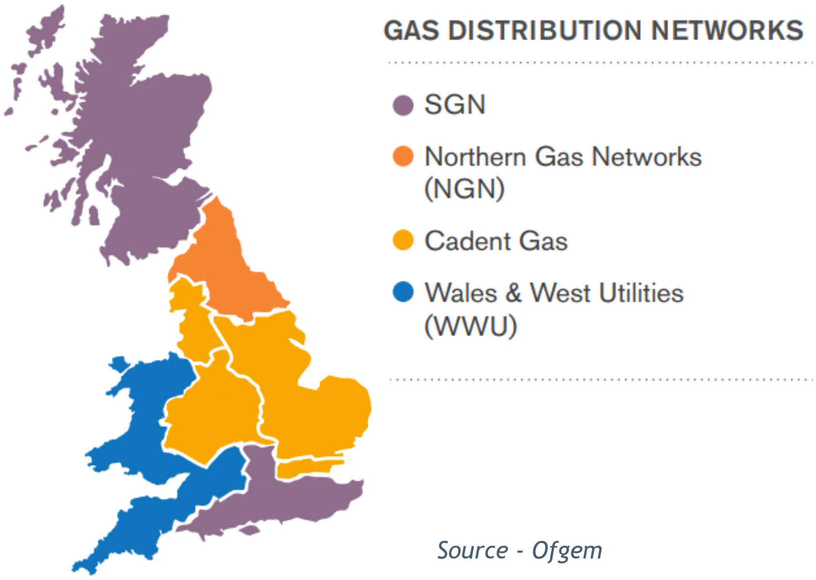
2.2 Key roles in the GB gas market

The GB gas market is similar in structure to the electricity market, although there are different terms for certain components or functions in the gas market. The transmission network flows gas to the distribution networks, which transport gas to the end user. The network functions are monopolies, as in electricity, with competition in the supply and production functions. A key differentiator however is the presence of significant gas demand at the transmission system from gas-fired power stations and heavy industry. Combined cycle gas turbines (CCGTs) and open cycle gas turbines (OCGTs) are typically responsible for around one-third of national gas demand.

Again, a more detailed summary can be found in Appendix B.

- **Producers** - entities that put gas into the system through entry points. These can be entry points from UK Continental Shelf production or via liquefied natural gas (LNG) terminals. In the future, biomethane and hydrogen producers may greatly multiply the number of entry points required for the system
- **The System Operator (SO)** – National Grid fulfils this role in gas as well. The gas network is balanced on a daily basis, with the SO taking actions within day to maintain the volume and pressure of gas in the pipelines
- **Gas Transporters** – otherwise known as GTs, these companies that own the gas pipelines and are responsible for moving gas around the country. Again, networks are split into transmission and distribution functions - Figure 5 shows the local distribution zones and their regions of operation
- **Shippers** – these entities are responsible for booking the capacity on the pipelines to move gas to end consumers. In the electricity market, the shipping and supply functions are both provided by the supplier. In gas they are distinct, and shipping function can be outsourced to a separate entity. Typically, most suppliers are their own shipper above a certain size of customer base
- **Suppliers** – Much as in electricity, suppliers own the end relationship with the consumer. Many of the same parties are also active in this space, as they typically offer dual fuel supply. However, some suppliers may offer gas or electricity only, particularly in the non-domestic sector

Figure 5: Local Distribution Zones in GB



Source - Ofgem

2.3 Regulation and Governance

There are a number of regulatory bodies involved in the regulation and policy setting of the energy market. Firstly, the Department of Business, Energy and Industrial Strategy (BEIS) is the government department responsible for ensuring that the UK has secure, clean, affordable energy supplies. BEIS sets energy policy and is responsible for making sure UK businesses and households have secure supplies of energy year-round. The Department for the Environment, Food, and Rural Affairs (DEFRA) also has a limited role in energy, responsible for implementing measures such as the Medium Combustion Plant Directive (MCPD).

The Gas and Electricity Markets Authority (GEMA) is the governing body of the Office of Gas and Electricity Markets (Ofgem). Ofgem is responsible for regulating the gas and electricity markets (and government is consulting on Ofgem regulating heat networks too[1]). Its role is to protect the interests of consumers, regulate competition between providers, and monitor social and environmental issues within the industry. It primarily focuses on the following areas:

- Making gas and electricity markets work effectively by promoting competition
- Ensuring companies in the sector fulfil their legal and licence obligations
- Regulating the revenues of monopoly businesses, such as network companies
- Ensuring social and environmental responsibilities on energy companies are met

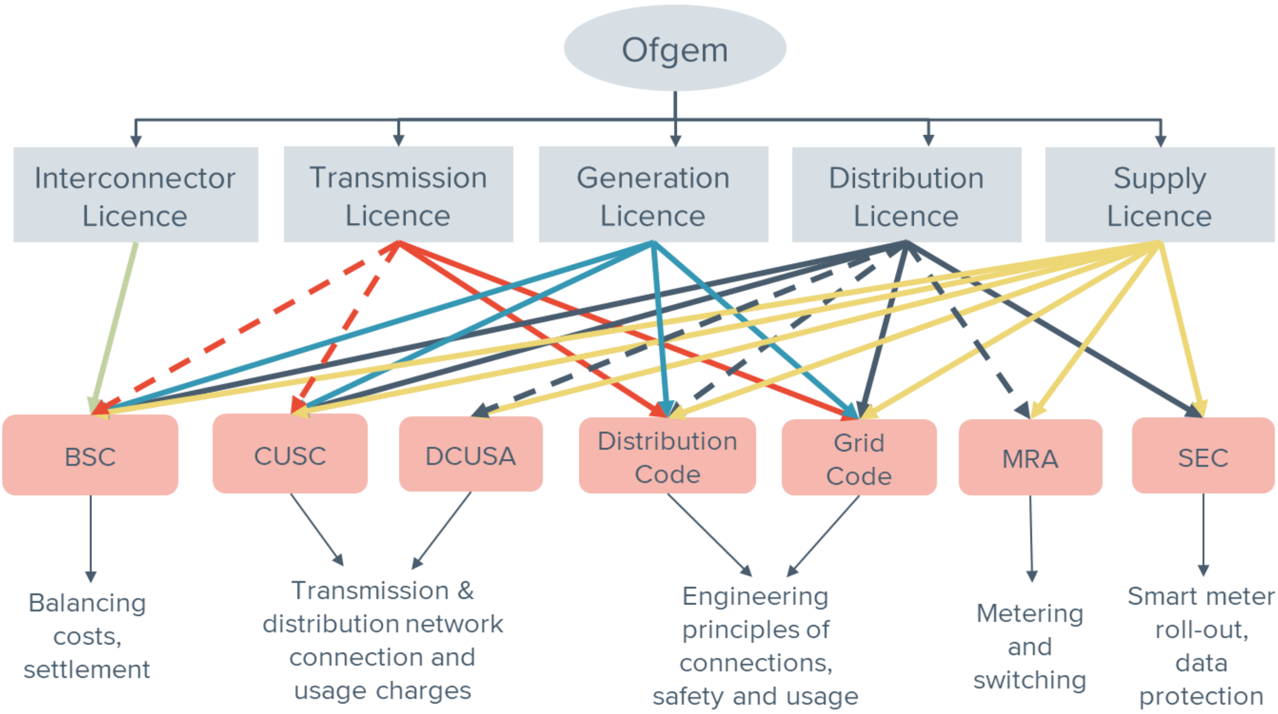
Ofgem is tasked with assessing market power, preventing predatory pricing, assessing the effects of inter-company agreements on competition, and ensuring compliance with legal requirements. The strategic direction of the UK energy sector is to a large extent set by government policy.

[1] https://www.gov.uk/government/consultations/heat-networks-building-a-market-framework

The majority of activities in the energy sector are licensed. Ofgem is responsible for allocating licenses and ensuring parties are compliant with the activities specified in the licence. These activities include abiding by the detailed industry rules contained in applicable codes, any modifications to which are ultimately decided by Ofgem. The electricity codes include the Balancing and Settlement Code (BSC), the Connection and Use of System Code (CUSC), the Distribution Connection and Use of System Agreement (DCUSA), the Distribution and Grid Codes, the Master Registration Agreement (MRA) and the Smart Energy Code (SEC).

Figure 6 sets these out, and indicates which parties are required to accede to which codes.

Figure 6: Electricity industry codes



Source: Cornwall Insight

In addition, the gas industry adds the Uniform Network Code (UNC) and the Supply Point Administration Agreement (SPAA), as well as having involvement with the cross-industry codes (the SEC and REC for example).

It has been confirmed that the REC will replace the previous metering codes, the MRA and SPAA, with these codes to be shut down in due course.

2.4 Energy Policy

2.4.1 2.4.1 Framing Policy

The GB electricity markets have seen increasing levels of intervention from policymakers over the decades since liberalisation. The “trilemma”, shown in Figure 7, has traditionally been used to present the inherent challenges in energy policy:

- **System security** –maintaining sufficient reserves of dispatchable generation plant and sufficiently robust networks to meet peak demand

- **Sustainability** – is expensive and relies principally on intermittent generation, threatening system security
- **Affordability** – would dictate the cheapest power, but this tends to be carbon emitting and inflexible

However, government declared the end of the trilemma in November 2018, in response to falling renewable generation costs, now viewing the energy sector in line with four key principles to inform policy:

- **Market** – using market mechanisms to take advantage of competition and innovation
- **Insurance** – to protect against intrinsic uncertainty and preserve optionality
- **Agility** – keeping regulation flexible and responsive to opportunities
- **No free riding** – all consumers should pay a fair share of system costs

2.4.2 Policy developments

Policy interventions initially focused on decarbonising the electricity supply, with renewables subsidies delivering significant investment in new assets. This subsidy provided additional revenues on top of wholesale market revenues or established a guaranteed a price for export of power to the system.

More recently, the provision of reliable, dispatchable generation to secure the system at peak demand has become an issue. Government subsequently introduced the Capacity Market, a subsidy mechanism that pays for capacity on a £/kW basis. This has helped spur investment in small, distribution-connected diesel or gas reciprocating plant. It is also credited with allowing existing plant to remain on the system for longer, supporting system security.

Finally, in recent years, rising energy bills have prompted politicians to introduce measures to prevent further price rises, by ending renewables subsidies earlier than planned, exempting energy intensive industries from renewables subsidy costs, and introducing caps on domestic tariffs.

Energy efficiency policies have been a theme throughout, as they are able – to a certain extent – to tackle all three elements of the trilemma simultaneously.

These interventions are outlined in this document because they are mostly additive and have made the energy sector more complex. Figure 7 overleaf sets out the key past interventions and possible future changes.

Figure 7: Policy interventions in GB energy markets, 1994-2022

dti	1994	EESoP, NFFO	Household energy efficiency and renewable contracts
	2001	Climate Change Levy/ CCAs	Tax carbon element of business energy and discounts for energy intensive industry
	2002	Renewable Obligation	Subsidies for large-scale renewables
	2002	Energy Efficiency Commitment	Household energy efficiency
	2005	EU ETS, EEC2	European carbon trading, household energy efficiency
	2008	CERT/ CESP, smart meters	Household energy efficiency
Department of Energy & Climate Change	2010	Carbon Reduction Commitment	Business energy efficiency
	2010	Feed-in Tariff	<5MW renewables subsidy
	2011	Warm Home Discount	Social tariffs, rebates for vulnerable households
	2013	Green Deal, ECO	Energy efficiency
	2013	EMR	Carbon tax, CfD, FiT, capacity market
	2014	RHI	Renewable heat subsidy
Department for Business, Energy & Industrial Strategy	2015	RO, FiT, Green Deal, CCL	Reduction of subsidies and relief
	2016	CMA, embedded benefits reform, coal closure	Whole market review by the CMA, review of network charging and coal closure
	2018	Price cap	Price caps on PPM and SVT tariffs
	2019	Offshore wind sector deal	Sector development
	2020	SEG, Green Homes Grant	Guaranteed market for small-scale renewables, grant for energy efficiency improvements
	2021	TCR, RIIO	Network charging reform, new price controls for gas and electricity transmission
	2022+	NAFLC, RIIO-ED2, RAB	Further network charging reform, electricity distribution price controls, new model for supporting new nuclear power
	2022	Green Gas Support Scheme, Clean Heat Grant	A levy on gas supply to provide subsidies to biomethane injection to the gas network, taxation-funded grant to support the installation of heat pumps and biomass heating

Sustainability | Security | Affordability

3 Routes to Market and Siting Considerations

3.1 Introduction

This section outlines two main considerations when establishing a local energy project:

- Where should the power plant be sited?
- How is the power sold once the site is commissioned?

The answers to the two questions are interlinked and relate to the relative values obtainable through each method, hence their presentation together in this section.

3.2 Public supply

The Feed-in Tariff and the Smart Export Guarantee

Small-scale renewables are currently limited in terms of market access as a result of high transaction costs and limited appetite among offtakers (mostly energy suppliers) for small parcels of intermittent power. Most small-scale generation assets (under 5MW) are achieving value for power via the Feed-in Tariff (FiT) subsidy scheme. Accrediting to the FiT removes the need to contract for power purchasing, as where power flows on to the grid generators are paid the FiT export rate by obligated suppliers. Generators >30kW are required to meter their export in order to gain subsidy, however, those below this threshold are paid the export rate for “deemed” volume of 50% of power generated by an installation.

Following consultation, BEIS put forward the small-scale export guarantee (SEG), which established a guaranteed route to market for exports from small scale generators by adding conditions in supply licences. Large and medium suppliers will be required to offer contracts to low-carbon generators under 5MW in capacity when the scheme is implemented.

However, under the legislation, while a tariff must be offered by each supplier there is no mandatory minimum price (so long as the price offered is always above zero) and it is not clear what level of pricing will be offered by suppliers over the long term. The licence conditions are now in place and came into effect in January 2020. At time of writing Social Energy has offered the most competitive tariff, at 5.6p/kWh.

PPAs and Corporate PPAs

As previously discussed, the closure of the FiT scheme removed the guaranteed route to market for small-scale generators. Instead, generators can access the market through auctions for short-term PPAs with durations of 6-12 months. Traditional PPA contracts typically take the form of bilateral agreements between generators and licensed suppliers, sometimes known as offtakers. Agreements usually stipulate that:

- 100% of the generator’s output is sold to the supplier
- The supplier has responsibility for trading, notifications and meter registration
- Responsibilities are agreed on forecasting with the appropriate communication protocol set up in the contract
- Responsibilities are agreed on imbalance exposure, when contracted volumes are different to actual generation, and who faces any cost of imbalance charges
- A benefit share is agreed before commencement on all revenue streams in the contract

Short term PPAs are negotiated through brokers or mechanisms such as e-POWER, Renewables Exchange and Zeigo's auctions. Value retention for generators smaller than 500kW tends to be lower than for larger generators, as generators will not produce sufficient power per annum to make directly trading financially viable and are too small to interest suppliers in negotiating a PPA for offtake. This makes securing long-term revenues to enable an investment decision difficult for generators of such a size. However, this is starting to change and small generators are able to access more value.

Furthermore, historically most lenders have required a minimum or floor price in PPAs, especially for sales of power eligible for support through the now closed Renewable Obligation (RO). But a changing wholesale market means that fewer offtakers have been willing to offer hard floors, and offtakers are unlikely to absorb the reduction when wholesale prices fall below the floor price. However, emerging structures are allowing floor prices to be included that allow offtakers to recoup losses when wholesale prices rise back above floor prices. The floor prices on offer are low, though, at only £10-20/MWh compared to the average wholesale price of £40-60/MWh.

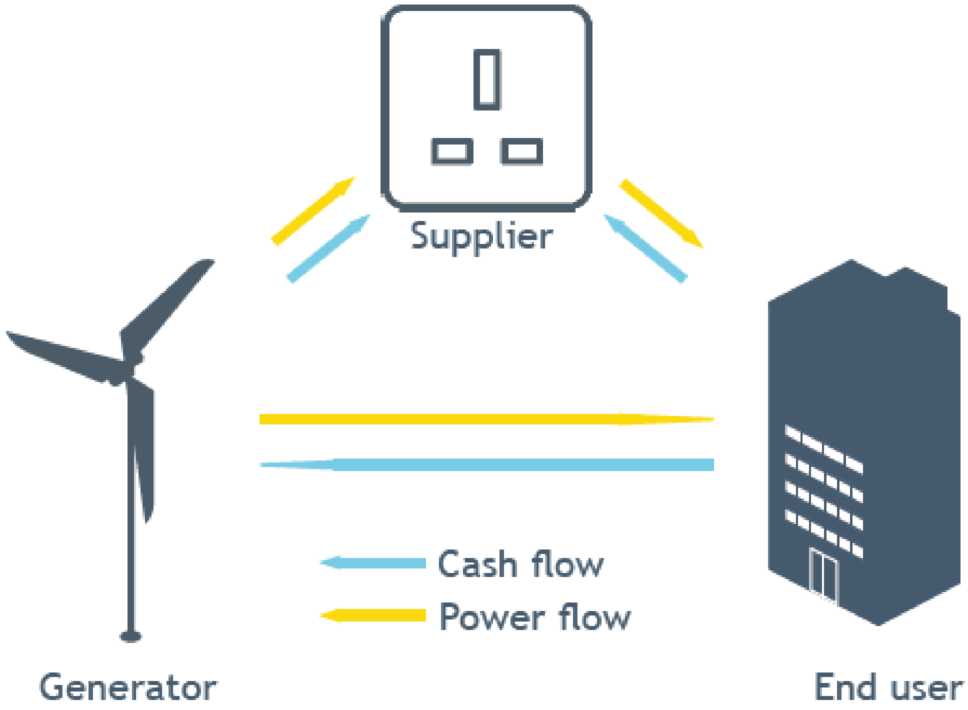
Corporate PPA contracts are tri-party deals between a generator, end user and supplier as shown in Figure 8. Typically, the generator and end user agree over a fixed price for a set duration for the power output. Most corporate PPA contracts tend to be a minimum of five years in length to ensure price certainty for the end user. Once the generator and end user have agreed on price, a linked agreement then needs to be signed with a licensed supplier.

Suppliers are mandatory in a corporate PPA agreement as there still needs to be a party nominated to manage volumes and transport the power to the end user. A supplier is also needed to ensure generation and demand volumes are managed. A supplier will take a fee for this service, usually as a fixed £/MWh or a percentage of the agreed power price. A wholesale power price will also need to be agreed for surplus generator volumes above the level of end user demand and for additional end-user demand above generator volumes. This price is usually at a fixed price level close or equivalent to the sleeved price to de-risk any deal.

The responsibilities for each of the parties involved are summarised below:

- Generator – Volume forecasting and reporting to the supplier
- Supplier – Volume management and trading of excess generation alongside end user consumption
- End user – Consumption forecasting and reporting with regular payments to the generator

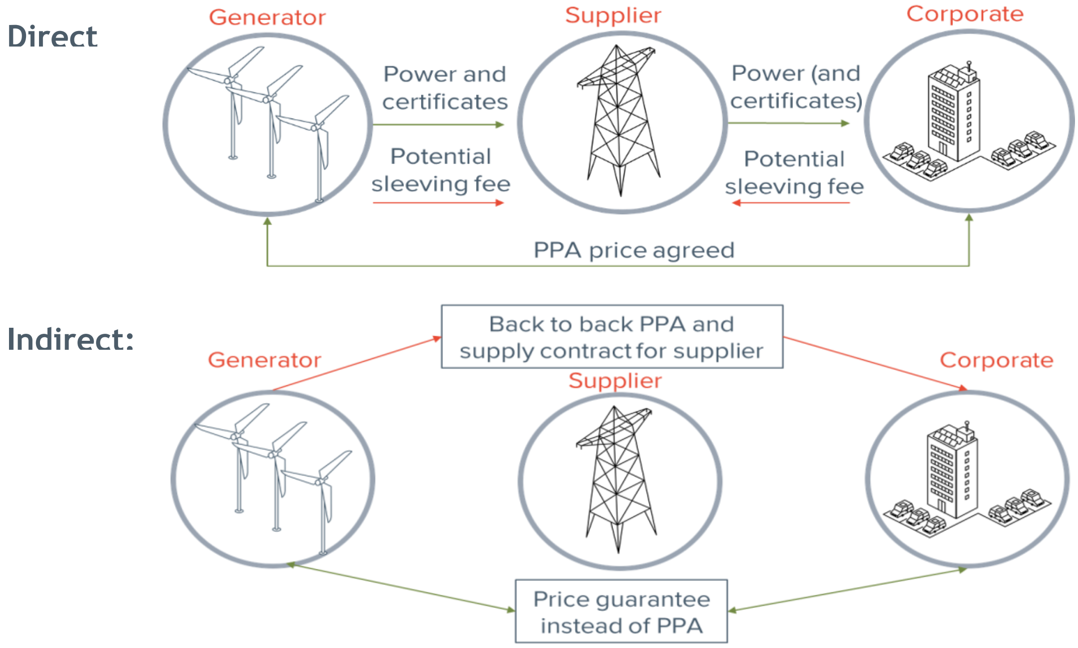
Figure 8: Typical corporate PPA contract structure



Corporate PPA arrangements can also be broken down into two different structures which are beneficial to different users:

- **Direct**
  - Most popular structure in GB aka corporate PPA– common for subsidised CPPAs
  - PPA between corporate and generator
  - Back-to-back PPA with corporate and supplier
  - Generator transfers electricity to supplier who sleeves to end user sites
- **Indirect (synthetic PPA)**
  - PPA between generator and supplier
  - Supply contract between corporate and supplier
  - Price guarantee agreement between generator and corporate
  - Can be packaged to more than one corporate and more than one generator

Figure 9: Summary of direct and indirect PPAs



However, corporate PPA arrangements tend to favour larger companies and businesses with set guaranteed revenues, forward looking strategies and the ability to agree to long term power purchasing. This means small-scale generators will often miss out on the ability to buy into these arrangements as the companies which benefit from trading have higher consumption values that these sized generators cannot match. Also, these arrangements are more complex than a traditional PPA, requiring more in-depth legal discussions, billing and paperwork to complete. Therefore, the process of acquiring this type of arrangement is likely to take more time, putting generators at greater risk due to the extreme volatility of the wholesale market before a contract is signed.

Peer-to-peer trading

Peer to peer energy trading is a relatively new power system operation procedure, where people can generate their own energy from Renewable Energy Sources (RESs) in dwellings, offices and factories, and share it with each other locally. This can be achieved with blockchain technology although these are only present in small scale commercial trials.

Selling electricity between producers and consumers across the distribution network is not yet economically feasible, with most projects currently ongoing in trial stages and regulatory sandboxes. GB has a national electricity market and there are currently no advantages to generating power close to the point of consumption, unless this power is being supplied directly to the consumer over a private network or from a location behind the same meter.

Various trials are ongoing to examine whether there could be ways to enable this. Some of the projects include:

- Verv and Centrica’s Community Energy Blockchain trial
  - Solar panels have been installed on 13 blocks of social housing flats in Hackney, London, to supply power to communal areas

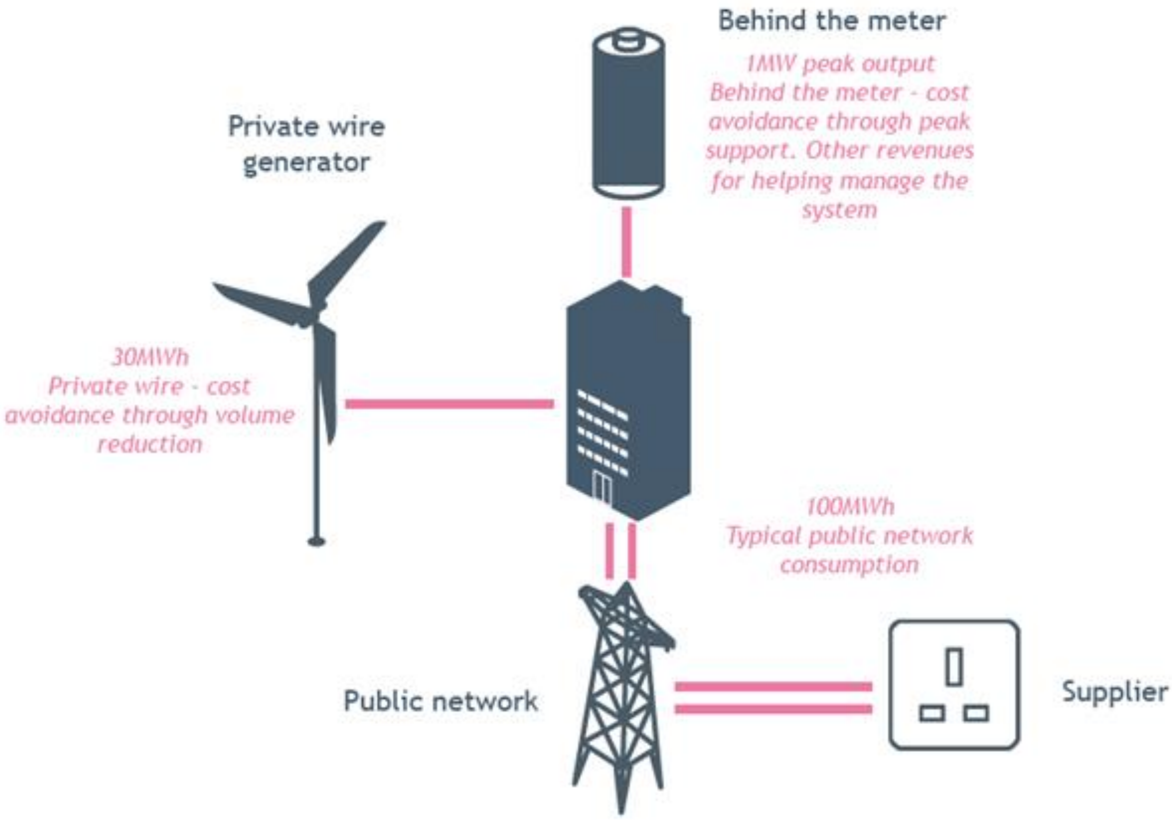
  - The project is examining how customers could be billed for energy if this was sold to residents, instead of to the grid, using a blockchain platform for settlement
- Centrica's Cornwall Local Energy Market is a £19mn project operating in the county, also using blockchain
  - The project is examining creation of local wholesale and flexibility markets, including peer-to-peer trading again using blockchain settlement tools
- Sero Homes has recently been funded by BEIS to implement a trial of its FLATLINE system
  - This project will put 58 new build energy-efficient homes behind a "virtual meter"
  - The virtual meter will be used for central industry purposes, allowing Sero to share local generation between homes, manage heat pumps and battery storage across the pilot homes, while offering balancing services to National Grid
- White label supplier Cooperative Energy is working with its licensed partner, Octopus Energy, and a range of generators to provide "energy local clubs"
  - These pair domestic consumers with local generators and offer cheaper power where consumers are able to match their consumption with the renewable generator's output
  - It is not clear how third party charges are treated under these tariffs, but in a previous trial of the same concept the costs were absorbed by the supplier

Despite these developing projects, open access peer-to-peer trading across the public networks remains at least several years away, requiring significant investment in terms of finance as well as policy changes to incentivise the use of the technology in local and community projects. There are also concerns around customer protection and distributional fairness, with rural consumers much more likely to be eligible for low-cost tariffs than city dwellers.

3.3 Private wire supply

Private wire systems are localised electricity grids, that although connected to the local distribution networks have privately owned central plant that produces electricity. This enables it to operate a stand-alone supply, providing cost avoidance through volume reduction as well as peak support with energy stored for peak demand periods. This provides localised energy security as well as the opportunity to sell energy to the public network, directly from power generated, or through demand side response (DSR) opportunities if storage is connected. Figure 10 outlines the typical private wire structure.

Figure 10: Typical private wire structure



3.3.1 Regulatory considerations

There are a number of regulatory considerations when developing a private wire or network arrangement. In defined circumstances, it is possible for supply to be made without the need for a supply licence. The primary benefit of unlicensed supply is that it avoids many of the complex regulatory compliance and set-up costs associated with becoming a licensed supplier, thereby allowing a private network to sidestep rules designed for larger suppliers looking to compete for customers directly connected to the public network. Significant costs can be avoided on an ongoing basis from third party chargers – perhaps as much as half of the retail electricity bill.

The details of the exemptions are set out in the *Electricity (Class Exemptions from the Requirement for a Licence) Order 2001*. Exemptions from the obligation to hold a supply licence fall into four categories:

- Class A: small suppliers that supply no more than 5MW of their own generation to customers, of which no more than 2.5MW can be sold to domestic consumers
- Class B (resale): applies to suppliers that sell on electricity sold to them by licensed supplier or persons that fall under a Class C exemption (below). A Class B resale must not in anyone year supply more than 250MWh of Class C electricity to domestic customers (this is approximately equal to around 60 to 80 households)
- Class C (on-site supply): where suppliers sell their own electricity generated on-site to consumers who occupy the same site and other supplies to groups of consumers (see below)
- Class D (offshore supply) is not relevant for this paper

On-site supply (Class C) exemptions are complex and cover a range of scenarios. They can apply if:

- The electricity supplied is self-generated with top-up purchased from a licensed supplier either by the exempt party or the consumer
- The electricity is generated on-site and supplied to users on-site or connected to a private network where demand is less than 100MW and no more than 1MW is supplied to domestic consumers

The licence exemptions regulations make it possible for entities to develop private wire arrangements that excuse it from having to hold distribution and supply licences. In effect this then allows the generator to also act as the distributor and the supplier, albeit the end consumer does retain the right to seek a third party supplier if it so chooses. We see that these exemptions significantly bolster the case for Local Authorities to assess private wire arrangements on a commercial basis where generation revenue (and certainty of demand) and on-site customer end prices may be better than those in the conventional market. Without the exemptions most projects would undoubtedly be a non-starter.

Examples of local authority initiatives that have included private wire supply are outlined in Appendix C.

4 Revenues

4.1 Introduction

This section outlines the potential value streams for energy generated from a power station. This is broken down into:

- Export via the electricity grid – traditional sale of power to an offtaker via the electricity network of the local DNO. Potential sources of revenue include wholesale power, embedded benefits, renewable energy guarantees of origin (REGOs), and potential balancing services
- Export via a private network or wire – sale of electricity to one or more local consumers to offset their consumption from the electricity grid

4.2 Export via the electricity grid

There are a range of potential value streams for exporting power onto the local network, including wholesale power, embedded benefits, and renewable energy guarantees of origins (REGOs). Flexible assets can additionally earn revenues through providing balancing services to National Grid ESO (or possibly the local DNO), although there are typically technical requirements and non-delivery penalties if these services are contracted for but not delivered. These services are typically secured through an **aggregator**.

For renewable assets, the new subsidy environment for small-scale generation is now negligible with the Feed-in Tariff (FiT) scheme closing on 31 March 2019 and the Contracts for Difference (CfD) mechanism being closed to small scale assets. Therefore, new projects must progress on a **subsidy-free** basis, and new projects are developing innovative models to mitigate this.

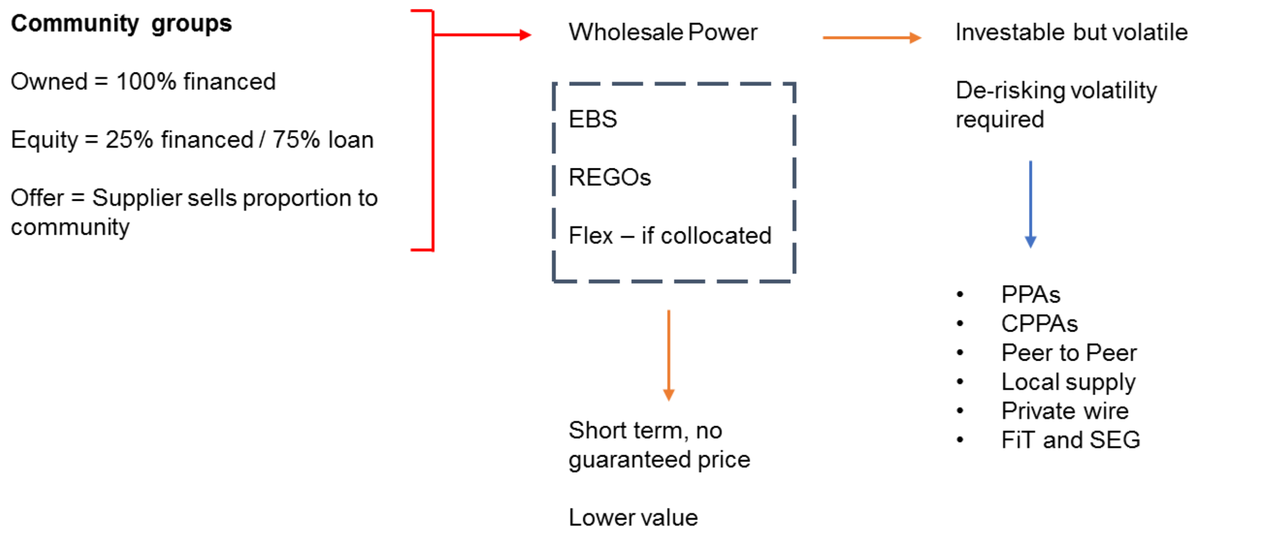
One of the key benefits of a subsidy is the long-term guaranteed revenue provided to renewable assets. Projects without subsidy are subject to **merchant risk** – i.e. the primary source of value from the generation (wholesale power) is subject to the market fundamentals of supply and demand. Given that the sun shines and the wind blows at similar times across most of GB, this is expected to be increasingly compounded by **price cannibalisation.**

Put another way, an intermittent renewable asset will be generating at the same or similar times as other similar assets, increasing power availability and therefore reducing the price per unit they might expect to receive during peak generation periods.

This combination of risks makes it difficult to create an investable business model based solely on a subsidy-free asset, due to power price uncertainties over the lifetime of the asset, which is typically in excess of two decades.

In order to manage this risk, long-term offtake agreements can be struck with a supplier or an end consumer that guarantees a fixed price for each unit sold. These options and overall process for decision are shown in Figure 11.

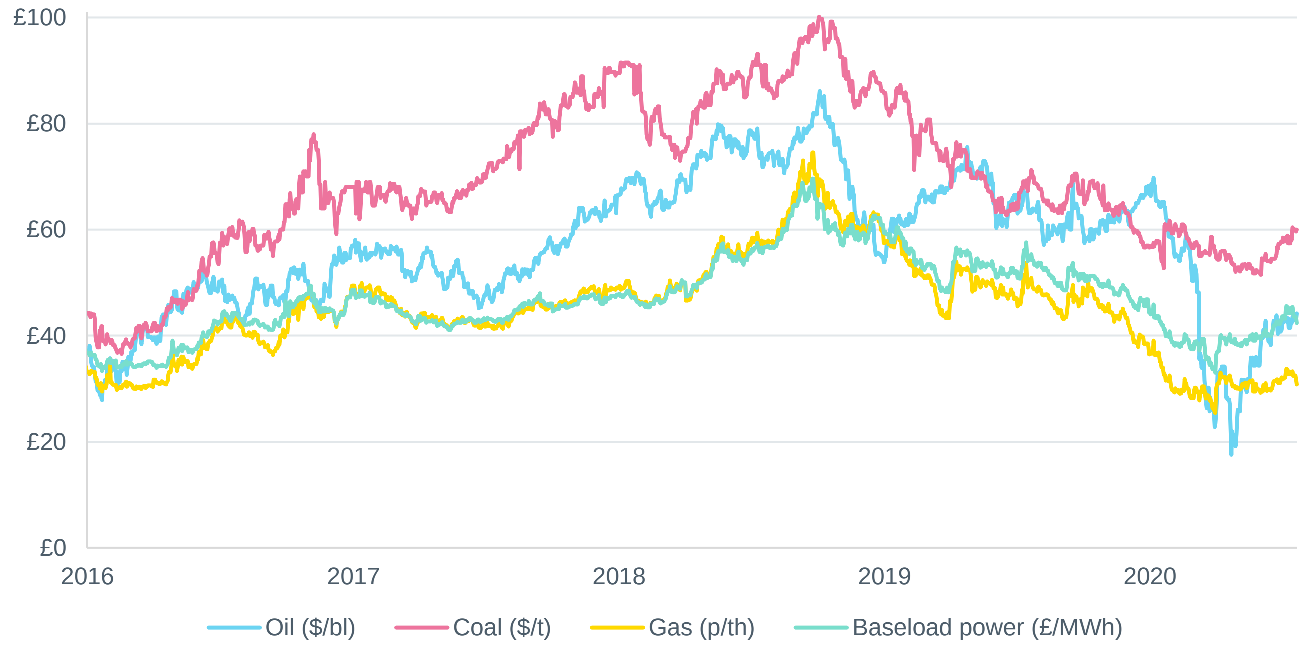
Figure 11: Ownerships, revenues, and trading options



4.2.1 Wholesale power

Wholesale power prices can be volatile and have numerous drivers, including commodity markets, renewables generation, demand, generator availability, interconnected power markets, and currency exchanges. Power prices are heavily influenced by oil, coal, carbon, and gas prices. As gas-fired power stations continue to make up the majority of the GB generation mix, the price of gas has the most notable influence on power prices. Furthermore, as many gas contracts are linked to the price of oil, oil prices can indirectly impact power prices through the gas market. Figure 12 illustrates this linkage, with the power price closely tied to gas prices.

Figure 12: GB wholesale market trends for oil, coal, and year-ahead power and gas



Source: Cornwall Insight

The market is bilateral, meaning that suppliers must buy all the energy their customers use by signing deals with generators or traders in the market to match their position, with trades open to different time frames and contract lengths. The day is split into 48 half-hour trading or settlement periods –a half-hourly settled market – although products traded in the wholesale market may include power in multiple trading periods. Parties can trade freely among themselves for the production or consumption of electricity at some point in the future at an agreed price. Routes of trading are not centrally prescribed and include a variety which are summarised in Figure 13.

Figure 13: Wholesale power trading options

Type of Trade	Explanation	Typical use and fuels	Examples
Over the counter (OTC)	Trading of set products of different maturities typically traded via a broker.	Prompt trading and medium to long term hedging	Baseload month ahead, peak day ahead
Exchange	Set products for short-term spot (within-day) and prompt (next day) markets. Allows parties to refine their contracted position.	Short term position management	N2EX, EPEX, ICE
Bespoke contract	Bespoke bilateral deals with prices negotiated at a fixed level or agreed to be set against a reference. Contracts designed to meet certain consumption profiles or requirements.	Specific requirement or trading need	GTMA, tolling agreement
Power Purchase Agreement (PPA)	Negotiated contracts usually between an embedded generator and "offtaker" (supplier). Maturity of 6 months to 15 years with contracts usually priced against a market reference	Purchase of green power, access to wholesale power for smaller parties	15 year PPA windfarm 1 year EfW PPA

At gate closure, the opportunity for market parties to notify physical contracts for bought or sold power closes. Following this, National Grid in its role as System Operator (SO) uses the Balancing Mechanism (BM) and a range of balancing service contracts to ensure the market is in equilibrium in terms of generation and demand. Actions taken by the SO can include:

- Paying power stations to turn up or down generation
- Rewarding DSR where electricity consumers actively reduce their demand at peak times, or increase their demand during periods of low consumption
- Activating flexible generators through contracts for a number of services to help manage demand at peak load

Following the end of the 30-minute settlement period, parties' physical positions (how much they actually produced or consumed in the period) are compared with notified positions (how much they informed the SO they would consume or produce). Where there is a difference between these positions, parties are subject to imbalance prices for the difference. Imbalance prices are linked to the costs which the SO incurred in taking actions to balancing the market. This process is known as Imbalance Settlement (IS).

4.2.2 Embedded benefits

Electricity network charges are levied to end users for their use of the electricity networks via suppliers on the principle that costs are recovered when they import electricity from the networks. In effect, electricity is assumed to be generated at a large central facility and travel down through the transmission and distribution networks to the meter at the site.

Distributed generation, embedded in the local networks is treated as negative demand, reducing the load on the network. This in turn reduces the bill from some network charges to suppliers, and also results in some credits for avoiding offsetting network reinforcement costs. These bills reductions are termed as “embedded benefits” and allows generators to receive significant additional revenue from plant operations.

The value of embedded benefits a generator may receive will be determined by the terms of the PPA with the supplier. The PPA will outline what value the offtaker will give the generator for every unit of power generated and also determines the proportion of embedded benefits that will be shared with the generator. Typically, suppliers will either pass through all the value from embedded benefits or will keep a small proportion of the embedded benefits (<5%). Figure 15 at the end of this section outlines available embedded benefits.

Embedded benefits are currently under review by Ofgem in its Targeted Charging Review Significant Code Review (TCR SCR) and the Forward-Looking Charges and Network Access SCR. More information can be found in section 6.4 but, at a high level:

- BSUoS embedded benefits will be lost (~£2.50-3.50/MWh) from April 2021. There is the potential for further reform that could result in it becoming a charge for embedded generation (an approximate £5-7/MWh swing) but this looks unlikely at this stage
- Benefits from distribution charging (termed generation distribution use of system (GDUoS) credits) may be changed, with charging on a more locationally granular and potentially cost-reflective basis
- Embedded benefits for transmission charges could be reformed further, including the potential removal of the triad charging methodology meaning generators would not be rewarded for generating at system peak

Overall, the changes represent a significant risk to revenues for embedded generation.

4.2.3 Renewable Energy guarantees of Origin

The Renewable Energy Guarantees of Origin (REGO) scheme provides transparency to consumers about the proportion of electricity that suppliers source from renewable generation. These guarantees now have some value attached to them, typically between 20p and 40p each (per MWh) in PPAs, and as such represent a small value stream to the local energy scheme.

4.2.4 Balancing Services and flexibility revenues

There are a range of potential balancing services that a flexible asset can bid to provide to the ESO or local DNO. These services are typically procured by National Grid ESO through auctions or tender rounds. The services include:

- Firm Frequency Response (FFR) can provide both dynamic and non-dynamic response to changes in frequency:

- Dynamic frequency response is a continuously provided service used to manage the normal second-by-second changes on the system
- Non-dynamic frequency response is typically a discrete service triggered at a defined frequency deviation
- There are three response speeds for frequency response. Providers may offer only one of these or a combination of different response times
  - Primary response - Response provided within 10 seconds of an event, which can be sustained for a further 20 seconds
  - Secondary response - Response provided within 30 seconds of an event, which can be sustained for a further 30 minutes

- High frequency response - Response provided within 10 seconds of an event, which can be sustained indefinitely
- Short Term Operating Reserve (STOR) is open to any technology with the ability to increase generation or reduce demand by at least 3 MW
  - Providers closer to high demand areas, including south east England and Wales, are more desirable
  - There are particular times of the day when the STOR service is more likely to be required. These are known as 'availability windows'
  - Providers are required to be available to operate at their contracted volume during these windows
  - Typically, the service is used over two pre-defined availability windows:
    - Morning window
    - Evening peak window
  - Payments are typically comprised of an availability fee, paid regardless of whether the asset is called upon or not, and a utilisation fee that is paid when called upon

A list of all balancing services, and a link to further information, is available here.

A summary of regularly available revenues for renewable generators can be found in Figure 14 and further detail on embedded benefits can be found in Figure 15.

Figure 14: Typical revenue values

Revenue	Further information	Typical values
Wholesale Power	Dependent on volatile wholesale markets. Typically indexed against day-ahead markets, although some fixed contracts do occur with significant risk premia included.	£40-60/MWh
Embedded benefits	Highly variable depending on region and type of asset, see Figure 15 for more information.	~£15/MWh
REGOs	See section 4.2.3.	£0.20-0.40/MWh
Balancing services	Highly variable depending on contract and utilisation rates.	Varies

Figure 15: Embedded benefits and how they arise

Charge/ benefit	Levied by/ for	The benefit/ fee	Basis of benefit	Quantum (representative £/MWh)
Embedded Export Tariff (EET, previously TNUoS or Triad)	The Transmission System Operator (National Grid) to recover the cost of maintaining the transmission network	Embedded generators may receive some value from Triads if they generate during the Triad periods (three half hour periods of highest demand over winter). The value is paid by National Grid to the offtaker in £/kW of energy provided (half hourly metered consumers are charged on the same methodology).	£/kW during system peak	Regionally variable and time differentiated, highly dependent on forecasting and hitting triad periods Average £0/MWh to £3/MWh
Generation Distribution Use of System (GDUoS)	Distribution Network Operators (DNOs) to recover the cost of maintaining the distribution network	Typically, a benefit dependent on the region and time of day, with generation over peak periods being rewarded more than that over lower demand periods. For solar PV connected at 11kV or below on the distribution networks this will result in a credit (benefit). Projects connected at 33kV or above will see a cost from the DNO.	Time and location of generation p/kWh	Regionally variable and time differentiated £3/MWh - £100/MWh, average ~£8/MWh
Balancing Services Use of System (BSUoS)	The Transmission System Operator (National Grid) to recover the cost of managing the system	The costs incurred by National Grid are levied on suppliers and transmission-connected generators. Distribution-connected generators, however, currently receive this as an embedded benefit. This benefit will disappear from April 2021 following review by Ofgem.	Half hourly £/MWh	£2.50/MWh - £3.50/MWh
Transmission losses	The National Grid to account for electrical losses on the transmission network	Embedded generators are deemed to avoid transmission losses and as such these are applied as a % uplift to the electricity production measured at the meter.	% uplift	Regionally variable and time differentiated Typically ~£0.50/MWh
Distribution losses	DNOs to account for electrical losses on the distribution networks	Embedded generators are deemed to reduce the losses on the distribution network and as such these are applied as a % uplift to the electricity production measured at the meter.	Time of use % uplift	Regionally variable and time differentiated Typically ~£2.00/MWh

4.3 Export privately

The differentiators between the cost components for private wire or behind the meter supply and traditional supply arrangements come down to:

- The costs of construction and maintenance of the private wire itself
- The avoided costs of the consumer consuming electricity supplied via a privately-run network (as opposed to the status quo consuming from the grid)

The costs of constructing a private wire can be substantial, especially if the network is lengthy and laying the cable involves digging up roads, pavements etc. In an urban setting these costs can escalate quickly, particularly if the private wire is an underground cable rather than overhead line – depending on the local topography this can increase private wire costs from around £200/m to around £1,000/m. Ongoing maintenance costs of the private wire are negligible[2], especially over the short timescales in which the installers of the private wire will look to make a return on investment. Therefore, the installation of a private wire requires significant upfront capital, which may be on par with the costs of connecting to the distribution network, but little ongoing operational cost.

The avoided cost of supplying through a private wire is substantial. Environmental levies and taxes are currently only levied on electricity supplied through the national electricity system. Therefore, the costs of subsidising the RO, FiTs, CfD and Capacity Market are avoided through a private wire arrangement where generation is offsetting the demand. As the consumer is not deemed to be using the national transmission or regional distribution networks, the costs associated with these are also avoided for any volumes supplied through the private wire arrangement. Depending on the technology and capacity on the private wire, the consumer will likely need to maintain connection to the grid in order to top up its demand requirements, so there remains an element of fixed and capacity charge in this equation. The costs of the CCL are also not levied on electricity supplied over a private wire arrangement although, depending on fuel source, the CCL may be levied on input fuels.

This effectively creates a cost saving of almost every component of the electricity bill bar the wholesale cost element. The non-energy components of a typical business bill, the majority of which can be avoided through a private wire arrangement, can account for up to 70% of the total retail bill, depending on wholesale costs.

A breakdown of a typical low voltage half-hourly (LV HH) customer's bill for the 2019-20 charging year and using a national average network cost can be found in Figure 16. This totals 15.03p/kWh, including all taxes and carbon tax.

However, there are a number of additional cost components that need to be taken into account when determining the actual savings that can be achieved from a private wire arrangement.

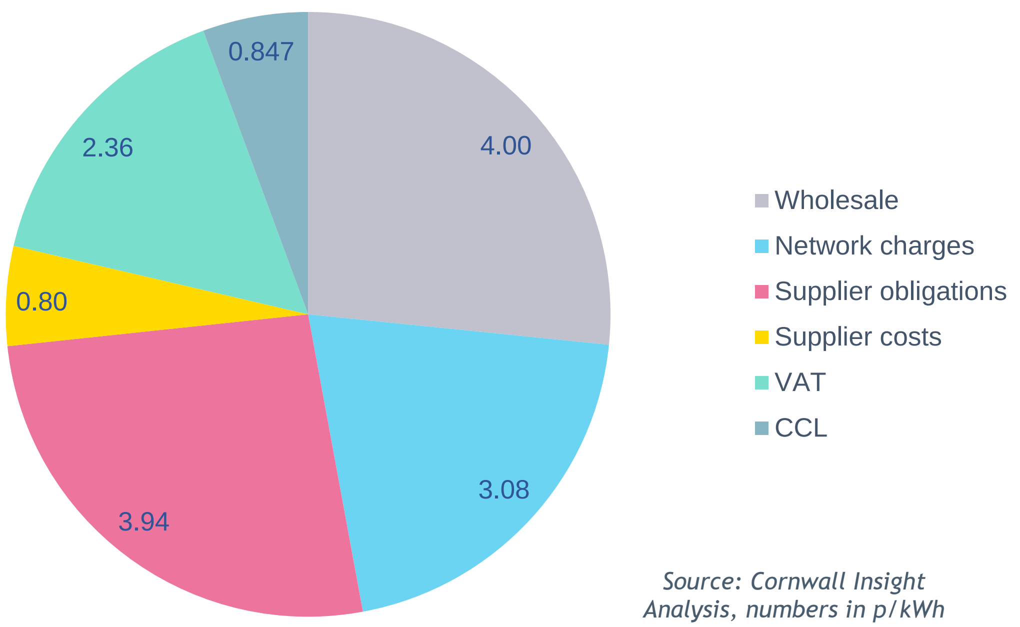
- Funding of the private wire arrangement – dependent on the cost of installing and maintaining the private wire arrangement, how any benefit is split between the consumer and generator (if they are separate entities), and the payback period over

[2] Some providers estimate ongoing running costs at the total cost of the network divided by its expected lifetime in years – typically one-fortieth or 2.5% of capital cost per annum

which the costs are recovered

- Losses over the private wire network –expected to be lower than the losses over the local distribution system due to the short length of the wire, however losses of a few percent of power will still need to be accounted for
- Data management and communications – generators and consumers in a private wire will need to track and assign generation and consumption in order to assess the value attributable to each party. This will involve metering and data validation and can either be done internally or outsourced to another company
- Embedded benefits – if an embedded generation asset connected directly to the distribution network, they would receive an income from embedded benefits. This income will not be achieved where a generator connects to a private network offsets demand behind the meter and thus any value share would need to take this into account

Figure 16: Cost of supplying an LVHH customer (average of all regions)



Source: Cornwall Insight Analysis, numbers in p/kWh

5 Mechanisms to Support Local Energy Investment

5.1 Introduction

This section outlines the potential mechanisms that local authorities and other local partners can leverage to support local energy investment, with the support of case studies where available.

5.2 Ownership structures

Local energy projects be backed by a range of different parties. This includes LA, community, and private investment in order to deliver these schemes. Where the community is involved, community energy schemes can typically be categorised into three distinct groups:

- **Community owned** – where 100% of the generation asset has been paid for by the community, usually through options such as:
  - A share option scheme whereby a proportion of the asset and the income is dealt to a member in proportion to their investment
  - Through raising money from community members
- **Community equity** - a proportion of the generating asset is owned by the community (for example, 25%) and the remained (75%) is funded from an investment partner such as a bank
  - Most community energy projects above micro-scale follow this model as delivering full funding for multi-million pound projects is beyond the reach of most communities
- **Community offer** – Suppliers own the generator and sell a proportion of the asset to a community
  - A related model is being delivered by community energy group Ripple, which is building a 2.5MW wind turbine and offering members of the community to purchase shares of power output, which will defray the wholesale element of their energy bill. This is facilitated by partner supplier Co-op Energy (Octopus Energy white label)

Otherwise projects are typically backed by one (or more) privately or publicly backed entities. This can be through a joint venture (JV), special purpose vehicle (SPV) or other such arrangement.

5.3 Financing

The provision of information on project financing can support the development of local energy projects through increased education and understanding of sources of funding and requirements. Projects can be equity or debt financed.

Equity finance is that provided by the project partners and can be found through a number of sources:

- Stakeholders, in return for some kind of share of the benefits from the operating project - this can take the form of money or the donation of effort as part of the development process (so-called 'sweat equity').

- Private sector venture' capital, typically in exchange for a large stake in the operating project.
- Local share offers supported by organisations such as Sharenergy, Communities for Renewables, Energy4All, and Microgenius.

Debt finance is that provided by a third party such as a bank. Most debt finance requires project owners to contribute as much as 30% of the total project finance. Banks and investment funds may loan money directly to developers of renewable energy projects with an increasing number, such as Triodos, having specialist renewable energy funds. Barclays and Close Brothers support 'Cleantech' investments. Other high street banks such as Santander also provide finance to viable renewable energy projects. The value of the loan sought will dictate if the application will be dealt with at branch level or by specialist central teams at the bank.

Other sources of funding specific to community schemes include, but are not limited to:

- Big Issue Invest
- The Charity Bank
- The Cooperative Bank
- The Community Generation Fund
- Social Investment Business
- Trillion Fund

A much more detailed and in depth description of project funding can be found in the Energy Saving Trust's Project Finance Module.

If a public body is involved in the project, other routes to finance are potentially available, but these typically require benefits to accrue specifically to the public body through reduced energy bills and carbon emissions. These include:

- Salix Finance provides interest-free Government funding to the public sector to improve building energy efficiency, reduce carbon emissions and reduce energy bills. Only public sector bodies which receive the majority of their income from public sources may apply for the loan, which is paid back over five years. Projects must include energy savings and benefits that are passed directly back to the public body, with projects to pay for themselves through energy savings within five years and costing less than £172/tonne reduced carbon emissions over the lifetime of the project
- Public Works Loan Board is operated within the United Kingdom Debt Management Office, an Executive Agency of HM Treasury. It lends money from the National Loans Fund to LAs at typically very low interest rates for a number of purposes which can include the development of energy generation and energy efficiency
- The Re:fit programme is a procurement initiative for public bodies wishing to implement energy efficiency and local energy generation measures to their buildings or their estate, with support to assist in the development and delivery of the schemes. These measures improve the energy performance of buildings, reducing carbon emissions and providing substantial guaranteed annual cost savings

- The Rural Community Energy Fund is available via the Local Energy Hubs and includes both feasibility and development grants, intended to support the development of community energy in a rural setting. It is covered in more detail in section 16.1 of this guide

5.4 Support

LAs, LEPs and Energy Hubs can support the deployment of local energy projects by providing information on the availability of grants, loans and public funding. This includes the necessary eligibility criteria, open and close dates, minimum and maximum grant sizes, and any support that can be offered in developing a funding bid. This could be in partnership with the public body.

Sources of funding for community energy projects include:

- The Industrial Strategy Challenge Fund: A fund to strengthen UK science and business innovation. The Prospering from the Energy Revolution component is most relevant for local power generators.
  - £10mn has been announced and awarded to support local community projects
    - Twelve projects from all across the UK are sharing £1.5mn to design ground-breaking, local, smart energy systems that are ready for roll out in the 2020s
    - £8mn has been awarded to establish EnergyREV, an energy revolution research consortium This will bring forward novel research in local energy systems to accelerate uptake, value and impact of local energy schemes
  - Detailed Designs for Smart Local Energy Systems
    - A total pot of £30mn is available to develop clean, cheap local energy systems that create prosperous, resilient UK communities. Up to £3mn is available in grant funding although this needs to be matched by a certain proportion of match funding
    - Local energy projects might want to see if the local LA, LEP or Energy Hub is developing or supporting a bid for the project, and to see how they might get involved
    - More information is available here
  - The UK Shared Prosperity Fund (UKSPF)
    - It is planned that the UKSPF provides regeneration funding to replace EU funding in a post-Brexit UK. While government has guaranteed funding for projects under EU structural funds until the end of 2020, it is intended that the UKSPF is its long-term successor
    - Exact funding and structure is yet to be determined

5.5 Increasing community involvement

Local Authorities and local partners can use their presence and support to increase local community engagement with energy projects. This typically includes prior contact with key regional stakeholders and in some instances LAs can leverage their knowledge of energy project developments and contacts in the wider value chain.

The Centre for Sustainable Energy (CSE) has a range of how to guides for initiating and developing community interest and engagement in local energy projects, exercises, videos, and meetings to facilitate engagement here.

Community Energy England provides a toolkit here, with a wide range of resources on topics from establishing a group to planning a project to engaging with LAs and DNOs. A similar set of materials is provided by Local Energy Scotland in the CARES toolkit here.

Be aware that many resources were published before the closure of the FiT in April 2019, when the outlook for local energy was very different. Community Energy England's 2020 State of the Sector report (here) notes that "The closure of the Feed-in-Tariff scheme had a dramatic impact on community energy project development, making the most prominent business model unviable and creating significant new challenge for community energy organisations to respond to when creating and implementing new projects."

The CSE has a number of case studies for renewable projects outlined here. However, many of these projects and the established businesses cases are reliant on subsidy that is no longer available.

Greater community engagement with and involvement in local energy projects may in turn improve the local planning environment for community energy projects.

5.6 The local planning and policy environment

By establishing a strong focus on sustainability and ownership of energy in a local area the local planning and policy environment can be improved for low-carbon and renewable energy projects. This could include the development of a local energy plan. This could include low-carbon neighbourhood planning as advocated by the CSE.

See section 7 for more information on the planning regime for local energy projects.

An overhaul for onshore wind planning in particular is believed to be in progress in Government, linked to the return of solar and onshore wind to the CfD subsidy regime.

It should be noted that in the framework decision of the new electricity distribution price control[3] (dubbed RIIO-ED2) Ofgem highlighted the potential role that Local Area Energy Plans (LAEPs) in supporting the DNOs in meeting the requirements of regional stakeholders. The regulator is keen for the new price controls, which come into effect in April 2023, to support decarbonisation targets and anticipatory investment in local areas. The regulator recognises that a localised approach to planning would be required and early progress on forecasting and planning would be needed to support this. Ofgem noted further detail would be provided in the sector methodology, which is due summer 2020.

5.7 Utilising Renewable Heat Incentive payments

The most accessible form of subsidy for local energy projects is the Renewable Heat Incentive (RHI). While this only supports the low carbon generation of heat, it is a

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[3] https://www.ofgem.gov.uk/system/files/docs/2020/01/riio-ed2_framework_decision_jan_2020.pdf

supportive subsidy for integrated energy projects or heat-only projects. It can also be combined, for public body buildings, with energy efficiency retrofits and some of the low-cost financing options noted earlier in this section for heat decarbonisation on a site by site basis.

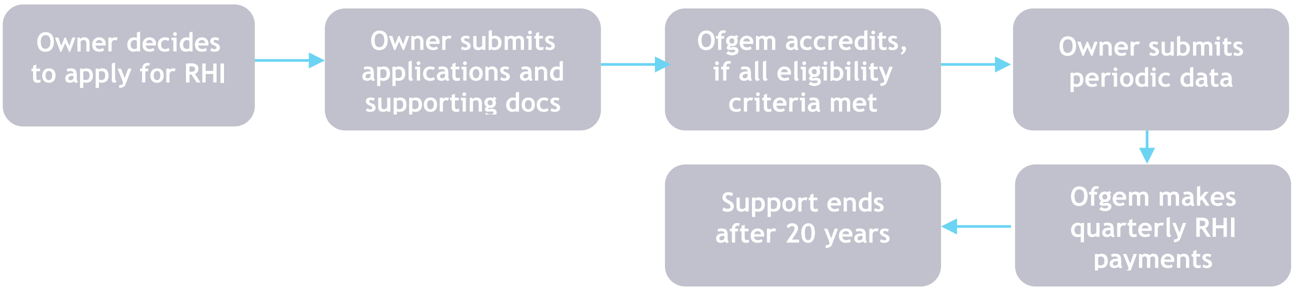
The RHI is a government incentive introduced by BEIS to encourage the roll-out of renewable heat. The Renewable Heat Incentive is split by application; domestic and non-domestic. The schemes have separate tariffs, joining conditions, rules and application processes. Ofgem administers both schemes in GB.

Domestic RHI subsidy tariff is paid to owners of renewable heating technologies for seven years. For non-domestic applications, payments are at a lower level but last for 20 years. Domestic payments are restricted to the first 30,000kWh (GSHP) and 20,000kWh (ASHP) of heat demand each year, assuming this is lower than the property's annual heat demand. They are calculated on a nominal basis, based on the building EPC at time of registration, rather than being metered.

For non-domestic accreditations, the heat output of the heat pumps will determine the banding by which the RHI subsidies are paid although there are no upper capacity limits.

Applications to the RHI are relatively complex, but your installer should be able to support you through this process. Ofgem provides guidance here, particularly in chapters two and eight. The process operates as outlined in Figure 17.

Figure 17: RHI application process



There are also ongoing obligations to provide information, for which Ofgem provides guidance here.

5.8 RHI replacements

The RHI is due to close to new accreditation in March 2021 (non-domestic) and March 2022 (domestic), with the domestic scheme having been extended for one year. BEIS issued a consultation in April 2020 setting out two proposed replacements for it. These are the Green Gas Support Scheme and the Clean Heat Grant.

5.8.1 Green Gas Support Scheme

The Green Gas Support Scheme is a proposed subsidy for the grid injection of biomethane. Initial proposals are for a Tier 1 subsidy for the first 60GWh/year of production of 4.9-5.5p/kWh, falling to 3.25-3.75p/kWh for the next 40GWh/year and thereafter 1.5-2.75p/kWh. These subsidies are proposed to be funded for by a Green Gas Levy on the retail gas bill. The scheme could commence in April 2021, running to March 2025.

A follow-up consultation has confirmed that costs will be passed on to gas consumers via suppliers. This will initially be as a £/meter/year flat-rate charge, moving later to a p/kWh volumetric charge. The charge is estimated initially at £1.40/meter/year, rising to around £6.90/year/meter at the end of the scheme.

5.8.2 Clean Heat Grant

The Clean Heat Grant was proposed in an April 2020 consultation issued by BEIS. This initial consultation suggested a £4,000 flat-rate grant on installation of an eligible heat pump or biomass boiler. The former could be air-source, ground-source or water-source, sized up to 45kW. Biomass installations can also be sized up to 45kW and must be located in properties not suitable for heat pumps. The Clean Heat Grant is proposed to be funded by the Treasury for up to £50,000,000/year or 12,500 installations. The scheme could commence in April 2022, running for two years initially.

5.9 RTFO

The Road Transport Fuel Obligation (RTFO) requires transport fuel suppliers to ensure that at least 5% of the fuel which they provide is renewable. Renewable fuels include bioliquids and gas, including biomethane. This means biomethane – production of which can benefit from RHI subsidy – has an added value to fuel suppliers, to meet their obligations. Government is currently considering the expansion of obligations, which could increase this value.

The RTFO is structured to minimise the amount of crop land used to produce biofuels, and therefore those producing biofuels from waste will be able to benefit more than those using energy crops. Bioeconomy consultancy NNFCC provides a free tool here to help calculate the relative benefits of RHI and RTFO payments arising from bio-energy feedstocks.

5.10 Other potential mechanisms

Other potential mechanisms for supporting local energy projects include:

- Energy Infrastructure Investment schemes can support housing or commercial site developers to provide the energy connections to a site. The rules for building new network assets give a significant disadvantage to first movers. However, a special purpose vehicle could pay for new assets and charge this out to developers on an equitable based
  - The first example of this in England was the Ebbsfleet Development Corporation, which built a £30mn substation in Kent near London, to enable the development of around 15,000 houses in the new Ebbsfleet Garden City
  - LAs or LEPs could take a similar role to the Ebbsfleet Development Corporation, enabling growth across their regions by unlocking development sites
- Sponsorship by local public bodies of community energy groups to build community support and awareness for these schemes. This could be on a financial or informational basis. It is likely that a group would need to be supported through to completion of its first project, after which it may become self-sustaining and be able to deliver further projects independently
  - Examples of these organisations include Plymouth Community Energy, which was provided a start-up loan and grant support by the City Council. It has since been able to develop several solar PV installations (including on schools and community

buildings), carry out domestic energy efficiency programmes and deliver retrofit LED lighting to local schools

- The issuance of green bonds for energy efficiency improvements, solar and storage or other technologies, where financial benefits can be shared with wider stakeholders. This could provide a ready pool of financing, supporting the development of projects which are already looking for financing. This could be limited to the local area, or look more widely across the country
  - Warrington Borough Council partnered with Newham and Thurrock Councils in 2016, investing in bonds based on a solar farm in Swindon. This allowed the Councils to make an investment with a minimum of effort (limited to due diligence) while also supporting the development of more green energy generation in England by joining with other councils, the due diligence work could also be shared, minimising this burden

6 Outlook for Low-carbon Technology Investment

6.1 Introduction

The outlook for local low carbon technology investment has a number of fundamental drivers affecting its roll-out. These drivers are discussed under the following headings in this section

- Underlying commercials
- Subsidy support
- Embedded benefits and treatment of behind the meter generation
- Other factors

6.2 Underlying commercials

The falling costs of renewable energy technologies and the availability of stable revenue streams are key factors impacting the outlook for new low-carbon power project investment.

6.2.1 Technology costs

The cost of building low carbon projects has fallen dramatically in recent years and is expected to continue to do so. The levelised cost of energy (LCOE) is a standard benchmark for assessing the costs of power generation over the lifetime of a scheme. BEIS defines levelised cost as "...*the average cost of the lifetime of the plant per MWh of electricity generated.* "[4] It is calculated by dividing the total lifetime construction and operational costs of the generation plant, by the total lifetime volume of electricity generated by the plant.

Note that the data for many available sources is based on utility scale installations. As a comparable benchmark, Lazard's latest annual LCOE (LCOE 13.0)[5] that also show a continuing decline in the cost of generation, particularly at a utility scale, are presented in Figure 17 below. We have also included data from the BEIS *Electricity Generation Costs* report, issued November 2016.

Figure 18: 2017 Benchmark LCOEs for renewable energy technologies at different scales[6]

	Lazard's 2019 (converted from USD)		BEIS (2016 forecasts for 2018)	
RET	Low £/MWh	High £/MWh	Low £/MWh	High £/MWh
Solar PV - rooftop residential	120.80	193.60	106	157
Solar PV - rooftop C&I	60.00	123.20	71	87

[4] https://www.gov.uk/government/publications/beis-electricity-generation-costs-november-2016

[5] https://www.lazard.com/media/451086/lazards-levelized-cost-of-energy-version-130-vf.pdf

[6] USD to GB rate = 0.80 as of 18 June 2020

	Lazard's 2019 (converted from USD)		BEIS (2016 forecasts for 2018)	
RET	Low £/MWh	High £/MWh	Low £/MWh	High £/MWh
Solar PV - community	51.20	118.40	71	90
Wind - utility scale	22.40	43.20	49	79
Wind - 100kW - 1.5MW	N/A	N/A	105	147
Wind - <50kW	N/A	N/A	179	269

Source: Lazard (2019) and BEIS data (2016)

In its publication *Renewable Power Generation Costs in 2019,* The International Renewable Energy Agency (IRENA) looks at the levelised cost of electricity (LCOE) for different utility-scale renewable energy technologies in the periods 2010-2019 and also projects forward from 2010-2020 for cumulative deployment of concentrating solar power (CSP), PV, onshore and offshore wind.[7] IRENA found that there are three main cost reduction drivers affecting renewable power:

- Technology improvements: These concern on-going technical innovation in manufacturing methods, installation costs and performance of different RETs. Also increasing scale will have an impact on the LCOE, for example a larger wind turbine will harvest more energy from the bigger swept area in a single installation. New PV cell designs offer better efficiencies and capture a wider photo-sensitive bandwidth, increasing output per area. Big data and real-time data offer better operational management and maintenance practices, including predictive interventions ahead of failure
- Competitive procurement: As RETs are now acquiring 'grid parity', or even lower in many parts of the world, their successful procurement competes with traditional generation and enables a further strengthening of the economics driving their progress. Positive regulatory and institutional frameworks will add to the competitiveness of RETs
- A large base of experienced, internationally active developers: A proven and growing track record of RET operation now offers savings in the cost of capital with reduced project risk

Analysing the trends in the LCOE of projects and the auction results out to 2020, IRENA suggested the average costs for **onshore** wind could fall from USD 0.053/kWh in 2019 to USD 0.043/kWh by 2020. Recent trends in auction results for **offshore** wind in the UK suggest that for projects commissioned in 2019 and beyond costs could be in the USD0.089kWh to USD 0.142/kWh range.

The attribution of Solar PV costs should be treated with some caution as the distribution of project data is concentrated in areas of the highest solar irradiance. Even so, if auction trends do accurately reflect global deployment, IRENA expect the LCOE for solar PV to fall below USD 0.039/kWh by 2021.

[7] http://www.irena.org/publications/2018/Jan/Renewable-power-generation-costs-in-2017

6.2.2 Revenues

With loss of subsidy support, revenues for power generation onto the electricity grid have become more volatile, as they are dependent on:

- Wholesale power price which are determined by international and local fluctuations in supply and demand, and the availability or underlying fuels in the power generation mix, as well as carbon pricing policy. This inherently makes them volatile, particularly in the shorter-term markets, being subject to market risk and policy risk (Brexit, carbon pricing policies, etc).
- Embedded benefits that are subject to ongoing policy and regulatory reform presently. More information on this can be found here.

Moving from a subsidy model, with guaranteed revenues, to a merchant model, with highly variable revenues, will increase the level of risk inherent in investments in these technologies. LAs should consider whether investment in utility-scale power generation is right for their portfolios.

More information on wholesale volatility and merchant risk can be found in section 2. Wholesale power prices have seen significant falls during the Covid-19 outbreak of Spring-Summer 2020 as demand has reduced. Notwithstanding the pandemic and the shape of economic recovery, wholesale prices for renewable energy are expected to be low, due to increasing cannibalisation of wholesale prices for intermittent renewables during windy and sunny periods, leading to lower realised value for these assets. This will only increase as more intermittent capacity is installed but could be offset through combined or retrofit deployment of electricity storage alongside the generation asset, allowing it to vary times of export and provide balancing services to the ESO.

Value for power consumed behind the meter or in a private wire arrangement will be subject to two conflicting factors:

- Detriment in the form of the Targeted Charging Review which, through moving more of the network charge to a fixed or capacity related basis will make more of the bill unavoidable for behind the meter generation (see here for more information)
- Improved value from increasing subsidy and other policy costs that are recovered through the electricity bill. For a low voltage connected half-hourly settled (LVHH) customer these charges are expected to increase by 15.5% from 2019-20 to 2023-24

6.3 Subsidy support

Over the past three years BEIS has removed accessible “build and accredit” subsidy schemes such as the Renewable Obligation (RO) and the Feed-in Tariff (FiT). These schemes were easy to access as applicants knew that certain projects and technologies were eligible for subsidy and so could build them to accredit to the subsidy scheme. The loss of the FiT in April 2019 marked the close of accessible subsidy to support renewable technologies.

BEIS has now implemented the Smart Export Guarantee (SEG)[8]. This provides a guaranteed route to market for small- and micro-scale renewable generation assets, mandating the offering of an export tariff by all suppliers with at least 150,000 customers.

However, the SEG does not set a certain price, only requiring that obligated suppliers “must offer an above-zero Export Tariff to all SEG Generators”. There are a series of prerequisites for the generation to be eligible for the SEG, including half-hourly metering and settlement of export, and for eligible generators to be under 5MW in capacity.

The SEG’s lack of price guarantee, at least from a regulatory or policy standpoint (recognising that commercial agreements may be struck between the generator and offtaker), impacts the bankability of a project.

Figure 18: Smart Export Guarantee supplier offers

Supplier	Price offer (p/kWh)
Social Energy	5.6
Octopus Energy	5.5
E.ON Energy	5.5
Bulb Energy	5.38
OVO Energy	4.0
ScottishPower	4.0
EDF Energy	3.5
Shell Energy	3.5
Green Network Energy	3.5
Octopus Energy Outgoing Agile	Variable (4-10 average)

Note: Offers on the market June 2020

Aside from the SEG, there are two further options:

- The Contracts for Difference (CfD) mechanism remains but is for larger generators only (>5MW). Award of a contract is also subject to entry into a competitive auction process and a series of criteria before a contract can be awarded. These factors make the scheme unsuitable for most local energy projects
- The Capacity Market is now available for renewables (albeit with large derating factors). However, any sites receiving any other form of subsidy will not be eligible

[8] Part B consultation: https://www.gov.uk/government/consultations/the-future-for-small-scale-low-carbon-generation-part-b

- It should also be noted that small-scale renewable assets may find that the costs of applying to and participating in the Capacity Market auction may outweigh the benefits, though several parties do offer aggregation solutions

6.4 Network charging reform

Ofgem has launched a Targeted Charging Review Significant Code Review (TCR SCR) and Forward Looking and Network Access Significant Code Review (FLNA SCR), which potentially have implications for network access rights and charging policies.

The TCR SCR focuses on the recovery of residual charges, which are those sunk costs of the network, and Ofgem's final decision will ensure that these costs are recovered on a fixed basis going forwards dependent upon:

- Agreed capacity for all half-hourly settled (larger) sites
- Annual consumptions for smaller non half-hourly settled sites

These charges can equate to 80% of the total cost of networks and are currently generally recovered through unit rate charges. Moving these costs to an unavoidable fixed charge will reduce the benefit of generation behind the meter. This will be implemented in April 2022 for distribution and transmission costs. Domestic consumers without rooftop solar are likely to see a decrease in network charges, especially those that consume a lot of electricity.

Separately two taskforces have been established to assess recovery of the BSUoS charge (and associated embedded benefit). Ofgem confirmed in its TCR final decision[9] that BSUoS embedded benefit would be removed from April 2021. The second taskforce could recommend that the volumetric BSUoS costs be levied on a fixed basis going forwards, noting that the first taskforce concluded "costs included within BSUoS should all be treated on a cost-recovery (fixed) basis". This would further reduce the value in behind the meter generation.

The FLNA SCR will impact on embedded generation and demand tariffs, as well as fees for network access. This workstream was launched in December 2018 and Ofgem published an open letter[10] on its short list of policy options in spring 2020. The regulator has announced a wide-ranging reform of distribution charges and a focussed review of transmission charges, summarised below:

- Ofgem's review of distribution charges includes:
  - Explicit access rights with greater optionality for the user
  - Assessing the locational granularity for low voltage and high voltage connected consumers and generators
    - This includes the potential creation of demand-dominated and generation-dominated areas, affecting the level of GDUoS embedded benefits available
  - Reviewing the charge design for end users, including the proportion of unit based and fixed charges

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[9] https://www.ofgem.gov.uk/system/files/docs/2019/12/full_decision_doc_updated.pdf

[10] https://www.ofgem.gov.uk/publications-and-updates/electricity-network-access-and-forward-looking-charging-review-open-letter-our-shortlisted-policy-options

- The review of transmission charges includes:
  - A review of the transmission generation residual, potentially affecting costs for consumers
  - A review of whether the transmission charging TRIAD period is still appropriate going forwards for allocating demand charges and embedded benefits

More information on the FLNA SCR can be found here.

A summary of other changes in train that will likely impact the value of local energy projects can be found in Appendix D.

6.5 Other changes

Looking forward, the energy markets are subject to significant policy ambition, contributing to high levels of regulatory uncertainty and technological change. Ofgem and BEIS are undertaking a number of workstreams which could lead to fundamental changes in the GB energy markets. In general, these are looking to take advantage of improvements in technology to improve efficiency of industry processes alongside data quality, reduce prescription to permit greater freedom for suppliers, and ensuring the market and its regulations are fit for purpose moving forwards to allow for market innovation.

6.5.1 Supplier Hub

Firstly, Ofgem is currently considering if the supplier hub concept, which places the supplier at the heart of the market, is still fit for purpose moving forwards, with new actors and technology emerging in the market. Following a call for evidence the regulator has determined that the principle needs consideration and that it will assess, and where necessary, redesign the retail energy market to ensure the best consumer outcomes. The consequences of the supplier hub review could alter the range of counterparties which seek to contract for power, as well as opening opportunities for new counterparties to get involved. For the long term, this may allow for community or local energy groups to directly supply some power to customers, as well as enabling peer-to-peer trading and other innovative business models.

6.5.2 Code governance review

Ofgem is running a review on the process for managing and making amendments to the energy codes. Codes are managed in a number of different ways and it can be hard for market participants to keep track of code change and modifications, especially for smaller parties with limited resources. This can result in poor outcome for these parties, as their views and the interests of their customers are not represented. The code governance review aims to introduce reforms to standardise how codes operate and create oversight to help drive all codes in the same strategic direction.

6.5.3 DNO to DSO transition

Distribution networks are running projects to investigate and procure flexibility services to help them better manage their networks in a transition from DNO to DSO (Distribution System Operators) in which they would more actively manage the networks. They intend to reduce costs to consumers during the ongoing transformation of the networks by paying generators, consumers and storage providers to change the ways in which they use and produce energy.

Many network companies are already running commercial flexibility procurement exercises, such as Western Power Distribution's Flexible Power[11] programme.

6.5.4 Smart metering and HH settlement

Suppliers are responsible for the accurate metering of customer premises. As such they are responsible for installing smart meters in all homes and businesses across the country. The smart meter roll-out has stalled several times since inception, particularly around the move from first to second generation smart meters (SMETS1 to SMETS2), although in Q4 2019-20 (the most recent data available), 89% of meter installs were SMETS2.

At the time of writing 20mn, or 39%, of gas and electricity meters were smart or smart-type meters. The target of end-2020 for completion of the rollout will not be met, with Government considering how to extend the period of the rollout.

Smart meters will enable the half-hourly (HH) settlement of all electricity users in GB, enabling more accurate and faster settlement of electricity consumption for all users, and enabling suppliers to offer customers a smarter range of energy tariffs. These could include time of use pricing or dynamic tariffs that charge a different rate in each half-hourly period. A decision on the implementation of market-wide HHS was expected before the end of 2020, but this has now been delayed under 2021 at earliest.

[11] https://www.flexiblepower.co.uk/

7 Low-carbon technology planning regimes

7.1 Planning reform

Building decentralised energy plant above the micro-scale will often require planning permission. Most projects fall under the purview of the local planning authorities. The exception is Nationally Significant Infrastructure Projects (NSIPs), which are explained here. In summary, NSIPs include: solar, biomass or energy from waste generation larger than 50MW and offshore wind generation over 100MW.

There are tools to support planning considerations and applications. A good example is the Planning Portal, a joint venture allowing online submission of planning requests from TerraQuest and the Department for Communities and Government, which provides a series of high-level guides to many planning considerations here.

The current government position is that local people should have the final decision on renewable energy developments in their area. The latest guidance from government (the Ministry of Housing, Communities and Local Government) was issued in 2015 and can be found here.

7.2 Solar

Rooftop solar generators are considered "permitted developments" in many cases. If the installation is to be under 50kW, on a residential property or land, and the building is not listed, then no planning permission should be needed. Larger installations, particularly grid-scale installations, will require permission.

7.2.1 Permitted development

For installations attached to buildings, either building-mounted or small ground-mounted arrays, the following restrictions apply:

- If the panels are roof- or wall-mounted:
  - Panels should be below the highest point of the roof
  - Panels should project less that 200mm from the roof slope or wall-surface
  - If installed on a flat roof, the panels must be under one metre (m) in height and at least one metre from the edge of the roof or the border with another roof
  - If the building is in a conservation area or World Heritage Site, panels must not be visible from public areas
- If the panels are ground-mounted
  - Must all be under four metres in height
  - Must be at least five metres from the property boundary
  - Must be no larger than nine square metres
  - Only the first development on a site will be permitted
  - If the site is in a conservation or World Heritage Site, must be further from the highway than the closest part of the building

Building regulations and health and safety requirements will still apply to the installation, even if it is a permitted development.

7.2.2 Planning permission

Solar farms, if deployed sympathetically, can have a minimal impact on the landscape. However, the need to expose the panels to as much sun as possible may cause conflict with the desire to conceal the panels. Local authorities are suggested to consider the following when deciding on planning applications:

- The effect on protected areas like Areas of Outstanding Natural Beauty
- Encouraging solar on undeveloped land, or land or little agricultural value
- Restoration of land to original use when the panels are removed following decommissioning
- Visual impact in terms of glint and glare, particularly in areas where aircraft may be affected
- Additional impacts from solar panels which turn to face the sun
- The impact of security measures such as security fences and lighting
- The impact on heritage sites
- Potential for development of native hedging to mitigate landscape and visual impacts

Unlike onshore wind, discussed below, the chance of getting planning permission for solar panels in inhabited regions is much higher due to lower impact on the landscape. Projects may wish to consider using tools such as Lancaster Universities Solar Park Impacts Ecosystems Services (SPIES) package, which help to assess the environmental impacts of solar farms, and suggest measures to deliver environmental benefits around the installations.

7.3 Onshore wind

Some very small domestic-scale wind turbines fall under the permitted development regime. However, most developments will be larger than this. With the government currently opposed to onshore wind buildout, there is no national planning regime for small- and medium-scale onshore wind development – the Nationally Significant Infrastructure Project designation for onshore wind above 50MW was removed in 2016. The agenda is current set by local authorities.

7.3.1 Permitted development

The first installation of a wind turbine or an air-source heat pump on a property may count as a permitted development, assuming that the site is not safeguarded land. The following restrictions apply:

- The installation must be under 15m or three metres above the roof-height, whichever is lower, if installed on a building, or 11.1m in height if free-standing
- No part of the turbine, including blades, may be within five metres of the property boundary if mounted on a building, or the height of the installation plus 10% if free-standing

- The bottom of blades must be at least five metres from the ground
- The swept area of the blades may be at most 3.8m^2
- If in a conservation area, then the turbine may not be on the side of the property publicly visible

Building regulations and health and safety laws must be complied with.

7.3.2 Planning permission

Generation over the micro-generation scale is devolved to local authorities, which are advised to develop a strategy and allocate suitable areas in the local or neighbourhood plans for wind energy development. Particular points for consideration include

- Noise impacts
- Distance to buildings
- Presence of power lines
- Air traffic and safety
- Defence and radar installations
- The strategic road networks
- Electromagnetic transmissions (TV and radio)
- Risk to ecology, particularly birds and bats
- Effects on heritage sites
- Shadow flicker and reflected light
- Cumulative landscape and visual impacts
- Decommissioning and land restoration plans
- Pre-application consultation with locals

While it is not impossible to secure planning permission for onshore wind turbines, it should be noted that it is a length and often expensive process, especially for larger sites, and projects should take account of this in their plans. Consultation should be due early and may need to be repeated. It is unlikely that significant new onshore developments will be possible in inhabited areas.

7.4 Biomass and other fuelled plant

Plants which burn fuels of any type, including renewable fuels, emit particulate matter as well as sulphur and nitrous oxides which cause poor air quality. It is unlikely that any biomass plant will be able to secure planning consent in air quality management areas and there are several other sets of restrictions – conservation areas, sites of special scientific interest, areas of outstanding natural beauty and national parks.

Additionally, it is possible that changes to the Renewable Heat Incentive arising from Defra’s Clean Air Strategy may make biomass installations in urban areas ineligible, which would significantly damage the business case for urban biomass. A consultation, *Renewable Heat Incentive: Biomass Combustion in Urban Areas*, can be found here;

government is currently considering responses. The government proposed to restrict the RHI to sites which are not urban and do not have access to the gas network only.

7.4.1 Domestic plant

Domestic-scale biomass boilers do not require planning permissions, though if new flues and chimneys are required then permission for smaller plant may be required.

7.4.2 Large plant

Planning permission will be required for installations over 45kW where a new building is being constructed to house the plant, or new flues are installed.

Where significant deliveries of fuel will be expected by road, the project will need to consider the impact of this on local transport networks. Generally, this will only be important for plant over 1MW which is expecting frequent fuel deliveries, but if there are sites such as schools in the area this will require planning of deliveries to minimise impact.

Safe storage of fuel to avoid release of dust (as well as to prevent it getting wet) should also be considered. This may involve construction of storage structures which would require planning permission also.

7.5 Electric vehicles (EVs)

With the expected deployment of EVs in the UK to hit the millions over the coming decade, rolling out sufficient charging capacity to meet demand will be crucial. Given that charging times are expected to be longer than petrol forecourt fill-ups, a very different sort of infrastructure will be required. Many vehicles will constantly top-up batteries at owners' homes and places of work, but there will also be a need to provide in-journey charging and chargers for those who do not have access to off-street parking.

Aside from the requirements to obtain connection permission from the DNOs, planning permission will be required for some installations. There are also requirements being introduced into building regulations from EU Law, which will mandate the inclusion of charging infrastructure in the car parks of new and refurbished buildings.

7.5.1 Planning permission

Most public and private electric vehicle charging points will be classed as permitted developments. For wall-mounted chargers, no planning permission is required if the outlet is smaller than 0.2 cubic metres, must not face onto or be within two metres of the highway, and is not within a scheduled monument or listed building.

For free-standing charging points, the requirements are as follows:

- The unit must be under 1.6m above the surface used to park on
- Must not be within 2m of the highway
- Must not be within a scheduled monument or listed building
- Have more than one unit for each parking space

However, note that the government published a consultation response in May 2019 (found here) which indicates that it intends to amend the rules in the near future. This change would increase the height restriction for chargers to 2.3m, for on-street and car park chargers.

7.5.2 Requirement to install chargers

The EU Alternative Fuels Infrastructure Regulations were introduced into UK law in 2017. They set technical specifications for EV chargers and also require that publicly accessible charging points must be made available without the need to enter subscription or membership arrangements – i.e. with a “pay-as-you-go” option.

More recently, new EU rules on building energy performance were introduced, as part of the Clean Energy for All Europeans package. New and refurbished non-residential buildings with more than 10 car parking spaces will be required to install a minimum of one charging point, and to install ducting and conduits for cables to install a further charge point for one in five parking spaces. EU member states will be required to set a minimum number of charge points for residential buildings with 20 or more parking spaces as well, by January 2025.

LAs are also increasingly requiring that EV chargers are including in planning requests for residences and buildings with car parks. For example, Surrey County Council’s 2018 Parking Guidance states that all new homes must include a 7.5kW charger. Lancaster City Council’s 2017 guidance requires a charger for each house with a garage or driveway, 10% of parking spaces for flats should be equipped, and at least two bays in 50 in larger developments should have chargers, with a further 4% of over 50 bays. Edinburgh’s 2018 Design Guide includes a requirement that new houses must have a charger, and larger residential buildings and non-residential buildings must have chargers for 20% of parking spaces – non-residential buildings providing 50kW chargers.

With the UK’s future relationship with the EU an ongoing question, it is not yet clear that the EU requirements will be introduced to UK law. However, alongside LA planning updates they do indicate a clear direction of travel, that all car parks of significant size will be required to offer EV charging facilities in the near future.

7.6 District heating

In addition to a central heating plant, which being of significant size likely would require planning permission, district heating networks must also distribute heat to the surrounding areas. Typically, this is done via underground insulated hot water pipes. Installing these will mean excavating considerable lengths of the road network, which will cause disruption to local road users. This activity is therefore licensed by local authorities, which apply charges.

Telecoms, water, electricity and gas utilities may also be scheduling works or be able to plan works at a similar time. If the project can be flexible to develop its assets in concert with one or more other utilities, this will reduce the disruption experienced by road users and reduce the expense of obtaining licenses.

LAs may also have introduced lane rental schemes and the Street Manager tool, which supports digital planning of road works.

7.6.1 Other considerations

One of our case studies – Gateshead District Heating – used the opportunity of excavating the roads to simultaneously lay power cables, allowing it to sell power as well as heat to public buildings. While this was at additional expense, having its own power network allows Gateshead to circumvent the national electricity markets and offer lower-cost power to its customers (for power, these are mostly parts of the Council's own estate), while simultaneously earning more for the power. This additional revenue will more than covered the cost of the network.

Note that this is generally feasible only for non-domestic supply, due to regulatory rules on licence-exempt networks and supply.

7.7 Heat pumps

In general, domestic-scale heat pumps are considered permitted development. Large developments, at a commercial scale or to power district heating networks, will likely require planning permission.

7.7.1 Permitted development

Permitted development rights are available for both domestic and non-domestic installations. Assuming that the home is not a listed building, or located in a conservation area, water-source and ground-source heat pumps are considered permitted developments. The same is the case for air-source heat pumps, provided that the following conditions are met:

- The installation complies with the MCS certification planning standards, or equivalent
- The size of the heat pump is under $0.6m^3$ and it is at least one metre from the property boundary and/or the edge of a roof
- It is the first installation of a heat pump at that property and there are no wind turbines
- It is installed to minimise the effect on the external appearance of the building

For non-domestic installations, ground- or water-source units up to 45kW can be installed under permitted development rights, provided that the total area of excavation/ pipe-laying does not exceed 0.5 hectares, and – for ground-source – there is only one unit on-site.

Air-source heat pump installation on non-domestic sites is likely to require planning permission.

7.7.2 Planning permission

Larger community units will likely require full planning permission.

8 Useful links and resources

8.1 Local Energy Hub resources

Each of the Energy Hubs is leading on part of a national toolkit, producing a set of complimentary resources for the industry. These resources will share good practice for use by Local Enterprise Partnerships, Local Authorities, and other local energy project developers in England.

The Greater South East Energy Hub provides links to these resources on its website here.

8.1.1 South West Energy Hub (SWEH)

SWEH has sponsored this Local Energy Best Practice Guide, which provides insight into the energy industry and development routes for local energy schemes.

8.1.2 Greater South East Energy Hub (GSEEH)

GSEEH is working to create a geospatial energy and utilities mapping service, intended to support regional energy planning. This tool will enable users to understand the existing and forecast future energy landscape, with layers including:

- A base map including transport infrastructure and administrative boundaries
- Electricity, gas and water network assets
- Power network performance data
- Off gas grid properties and availability of gas connections
- Planned network upgrades and investments
- Future housing and commercial development sites
- Planned electricity and gas network connections
- Energy consumption data
- EV charging infrastructure
- Area-based emissions and air quality indicators
- Energy Hub projects
- Other useful data

This tool will be of use to energy and development planners. It is currently in development by the Energy Hub.

The GSEEH has also commissioned two reports to be produced:

- Energy Procurement and Investment Models for Local Authorities – created by Cornwall Insight, the report provides a summary of the key options available to local authorities to buy or produce their own clean energy. In presenting this information, Cornwall Insight has considered the strengths, weaknesses, opportunities and risks of each option to help inform local authority understanding, planning and decision-making
- Business Model Options for Developing Renewable Energy Infrastructure and Supplies – by Pinsent Masons provides outline legal advice about the different options available to local authorities for clean local energy procurement and infrastructure development

Both reports can be found here.

8.1.3 North East, Yorkshire and Humber Energy Hub (NEYHEH)

NEYHEH sponsored the creation of an Assessment of Potential Barriers and Routes for Decentralised Energy Schemes in Rural and Urban Fringe Areas. This project looked at the current energy industry and how it enables or blocks rural energy projects.

This included a high-level review of the GB energy markets, including the physical infrastructure and market structure. It also reviewed changing land use and income, routes to market and sources of value available, including the revenue stack for various generation types, and ownership models for decentralised energy resources.

8.1.4 North West Energy Hub (NWEH)

Local Energy North West Hub has created a set of resources for identifying and sharing information supporting the delivery of energy projects in England, for the benefit of local energy hubs and public sector organisations.

The REMINDERS project provides links to industry documents and policy reports, raising awareness of best practice and funding options. This can act as a starting point for researchers making the case for the projects. REMINDERs is an archive which provides links, to significant sources of data, ongoing research and industry news. It also includes links to methodologies for evaluating the impact of projects.

Those interested in contributing to or receiving the newsletter report can email team@localenergynw.org with REMINDERS in the subject line to participate. The team would currently welcome general comments on the report, links to relevant materials, topic areas of interest and major sources of industry information.

8.1.5 Midlands Energy Hub (MEH)

MEH produced an introductory guide to obtaining finance and investment in local energy projects, *Establishing Public-Private Joint Ventures and Partnerships for Investment In and Delivery Of Energy Schemes*. It introduces the opportunities for collaborative investment, designed for Local Enterprise Partnerships and Local Authorities.

The guide acts as a starting point for beginners in the JV world to outline steps required and questions to consider as to whether Joint Ventures are an appropriate route to take.

8.2 Other available resources

This section outlines other materials that community or local energy projects may find useful in supporting their business planning and financing.

Link	Summary	Focus material
Community Energy England	Toolkit for community energy	Guide to establishing a community energy group and thinking about a first project in energy or energy efficiency. Focused on grant or subsidy routes to market Also, a page on local authority energy considerations
Community Energy England	Toolkit for heat networks	Opportunities and challenges of a community-owned heat network; a broad guide to all considerations, though conclusions are now three years old and may be out of date

Link	Summary	Focus material
Community Energy England	Biomass toolkit	Guide to biomass energy projects for community energy groups
Local Energy Scotland	CARES Toolkit for local energy	Comprehensive guide to community- and locally-owned energy in Scotland, including technology options, business planning and ownership models, project development guides, and tools and materials to support project leaders through the full development process, including guides to contracting expert support. The guides are from the subsidised generation era LES also supports the Local Energy Marketplace, here, which supports collaborative progress towards renewable and low carbon projects with funding support, mentoring, shared ownership, and contractor frameworks
Energy Saving Trust	Energy efficiency information and analysis services	EST offers bespoke free services to support social housing groups to monitor domestic energy efficiency and alleviate fuel poverty
Energy Saving Trust	Fleet management toolkit	Guides to support fleet managers towards the EV transition, particularly with regards to clean air restriction zones
Centre for Sustainable Energy	Local energy toolkit	Range of case studies and guides to community and local energy; from setting up a group to developing and running a project Various dates, but generally out of date (2013 or earlier) In-date material includes a good guide to public concerns about onshore wind turbines in their area, here
Pure Leapfrog	Legal toolkit	A comprehensive toolkit of legal templates for project development by local energy groups It is provided free of charge to community energy groups and local authorities on application
Plan Local	Local energy toolkit	Now shut down, the Plan Local project gave guidance to local energy groups Materials on community engagement will remain useful
Regen	Local flexibility markets	Guide to what local flexibility markets are and how local organisations can get involved. A very up to date guide, but as these markets are still at an early stage information on value available is light
Regen	Guide to getting a network connection	A comprehensive and up to date guide to securing a network connection, produced in collaboration with England’s biggest DNO, Western Power Distribution. Includes step-by-step notes and decision flowcharts
Solar Trade Association	Guide to solar generation for local authorities	Includes case studies of successful projects and suggestions of future project types which could have profitable business cases, with sources of finance noted

Link	Summary	Focus material
Energy Systems Catapult	Local Area Energy Planning	Several papers on a whole-system model for energy thinking, including: supporting clean growth and the low carbon transition; for local authorities and energy networks setting out the case for local energy leadership; and case studies from three pilot areas
BEIS	Renewable and low carbon energy planning	Guide to planning considerations for renewables generation projects Note that this guidance is slightly out of date with regards to onshore wind farms
Welsh Government	Planning implications of renewables and low carbon energy	Broad multi-technology review for planning considerations on many different technologies including wind, biomass, hydro, solar, heat pumps, geothermal energy, CHP and district heating An additional toolkit is available here Note that although policy in Wales is not identical to English policy, many rules are the same. Both documents are somewhat out of date
Regen	Reinventing Retrofit	Report looking at ways to scale up the retrofit market in GB. Focuses on the Energiesprong system. As noted in the Nottingham case study, costs are expected to decrease significantly for the refit, but are presently, and in the short term, uneconomic
10:10	Riding Sunbeams	Case study on potential to provide electrical power to railways directly from trackside solar PV installations. This idea many be replicated across GB, in addition to the six sites on the Southern Rail network which 10:10 are studying

9 Case Studies

The following section outlines a range of case studies examining energy projects covering a range of disciplines, summarised below:

Document	Focus material
Warrington Solar	Advanced subsidy-free solar and battery storage.
Energise Barnsley	Rooftop solar community energy scheme.
Cambridge Mobilising Local Energy Investment	LA-led mobilisation of joint public and private sector funding.
Gateshead District Energy Scheme	Combined heat and power and private wire.
Nottingham Deep Retrofit/ Energiesprong	Energy efficiency improvement.

10Warrington Solar

An investment of £60mn to build 60MW of solar generation and a 27MW battery, Warrington Solar is an ambitious subsidy free renewable project led by Warrington Borough Council. It demonstrates what can be achieved in a post-subsidy environment by a local authority with ambition and the correct partners. The investment is forecast to produce significant returns to the Council over the project lifetime.

It is also notable that the solar farms are not in the same area as the Council, illustrating the fact that the national electricity market allows benefits from investment in generation outside of the immediate vicinity.

10.1 Summary

Warrington Solar is a commercial, subsidy-free grid-scale solar generation project, wherein two full constructed solar arrays, one paired with an electricity storage units, will be purchased by a Council with extensive experience of the solar generation and energy markets. Power will be sold to the Council via a sleeving deal, and to the open market, while the battery assets will be used to deliver grid services and time-shift generation to peak power consumption periods.

The project will cost in the order of £60mn, this sum being funded through the Council's capital budget by borrowing. Around £210mn is expected to be returned over the 30-hyear project lifetime, giving rise to a £150mn surplus which Warrington will invest in front-line services. Project partner Gridserve intends to deploy EV charging superhubs adjacent to each solar farm, providing clean, green and low-cost power directly from the solar arrays to EVs.

10.2 Description

Claimed to be the most advanced solar project in the country, Warrington Solar consists of two large solar farms, one of which will be paired with a battery storage system. The £62.34mn investment built a 34.7MWp solar farm with a 27MW battery near York, completed in December 2019, with a second phase consisting of a 25.7MWp solar farm near Hull. The farms will use partner Gridserve's single-axis tracking bifacial solar modules, in a UK-first for large-scale generation.

Figure 19: Warrington's York solar farm

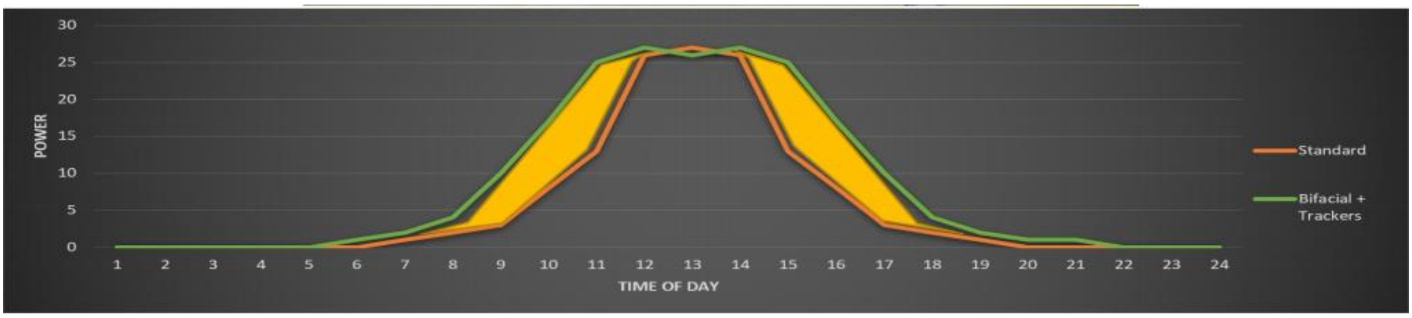
Source: Warrington Borough Council

The project, built in a post-subsidy environment, is anticipated to deliver £150mn in profits over a 30-year lifespan. Generation will initially be traded in the markets, with the Hull project intended to provide power to the Council itself through a sleeving deal, saving £2mn a year.

Gridserve intends to site two of its planned "Electric Forecourts" near the farms, as part of a £1bn development of 100 such sites across the UK. The Electric Forecourt will host 24 car chargers at capacities of up to 500kW, in addition to MW-scale chargers for buses and heavy vehicles. Batteries will support the delivery of power to all bays simultaneously when required. Construction is due to commence before the end of 2019.

Using the most advanced technologies available – bifacial and sun-tracking modules – is anticipated to deliver 20% more power. It will also reduce price cannibalisation effects, with more power produced outside of peak fixed-panel generation hours. Figure 20 shows expected generation from the panels compared to conventional fixed panels.

Figure 20: Generation profile of bifacial tracking panels vs standard fixed panels



Source: *Warrington Borough Council*

While no aspect of the project could be considered truly innovative on its own, it is the first time that this combination of high-production panels with batteries using modern commercial arrangements to sell power and low-cost public money to invest in assets has been seen, and the project shows what a local authority can do when motivated and enabled.

10.3 Participants

Leading the project is Warrington Borough Council. The Council has previous experience of solar generation through a project which installed solar arrays on 3,000 social houses owned by the Golden Gate Housing Trust and arrays on several schools, public and commercial buildings, including the Warrington Wolves Rugby League stadium. The Council also launched solar investment bonds in which several local authorities invested.

Gridserve will build the assets and operate them once complete, on a develop-build-operate model. It has developed over 100 grid-scale renewable energy projects in the UK. As the Council will only buy and own the assets once complete, Gridserve has secured development finance from Investec Bank and Leapfrog Finance.

Warrington will purchase the assets through two special purpose vehicles, which it will own fully.

10.4 Financials

Warrington Solar is a completely commercial investment by the Council, which has not benefited from any grant funding or subsidies to develop.

While not the first subsidy-free solar farms in GB, when commissioned the York and Hull sites will be some of the largest. A subsidy-free model will expose the Council to long-term fluctuations in wholesale electricity prices. However, it will insulate itself from these effects by the deployment of a battery on the York site to time-shift generation, and by using the power from the Hull site itself.

This latter technique is often performed by large corporate power consumers, who are looking to insulate themselves from fluctuations in power price of 15-20 years, while also delivering green credentials. It is referred to as a corporate power purchase agreement in these situations. By investing in the asset directly, rather than simply agreeing to buy power from it, Warrington has shifted this model slightly, ensuring that profits remain in its hands.

Warrington is funding the purchases through loans attached to its capital programme, but has noted that the cost of this would be more than offset by the profits of the venture.

Figure 21: Costs and revenues of Warrington Solar project

Line item	York (no battery)	York (battery)	Hull
Capital cost	£37.3mn	£41.2mn	£21.1mn
30-year surplus	£79.3mn	£222.7mn	£71.3mn
Average annual surplus	£2.6mn	£7.3mn	£2.4mn
Internal rate of return	8.21%	16.28%	11%
1-5 year average annual surplus	£0.05mn	£2.9mn	£0.5mn

Source: Warrington Borough Council

Profits over 30 years from the project are quoted as £150mn, with additional benefits arising from a community benefit fund. Gridserve will contribute £100,000 to this, and Leapfrog Finance will add £85,000/year, for a total of around £2.25mn. The fund will be used to deliver social and environmental benefits in Warrington.

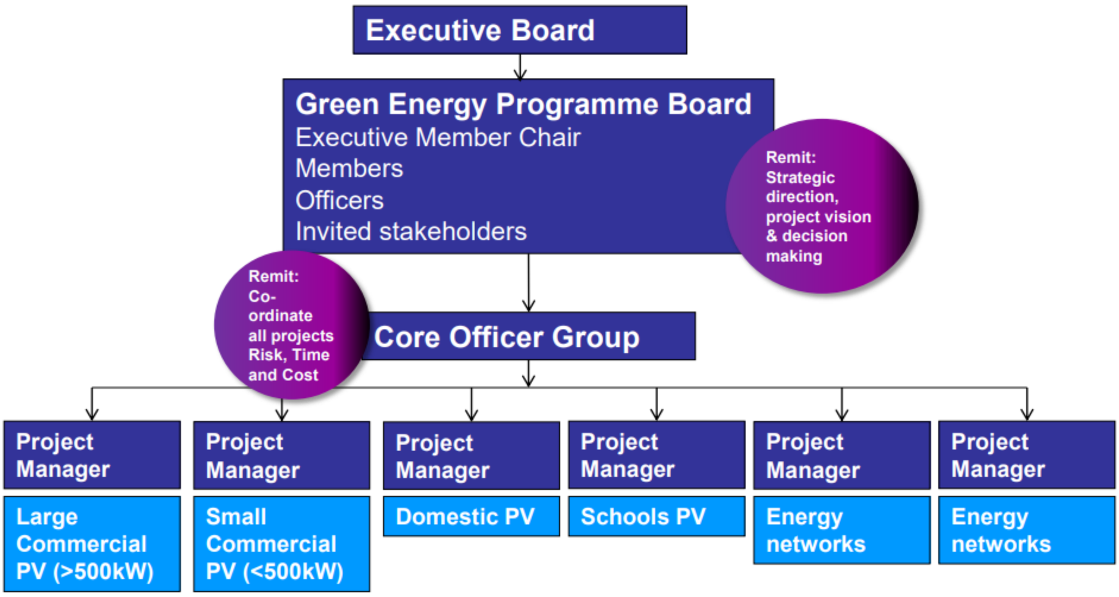
Profits will arise to the project from sale of electricity to the Council and to other offtakers through the national markets. The Council also forecasts a £1mn/year saving on electricity costs through its sleeving deal, though any cost savings which achieves below market rates will effectively cut the profits of the project by that amount, as it is selling power to itself.

Gridserve also notes that in its profitability assessments, it has set multiple potential revenue lines at zero in order to deliver conservative figures. It therefore expects to be able to overdeliver on its profit forecasts.

10.5 Replicability

Persistence has been key to the project, with the investment in the site near Hull coming after a deal to buy a similar site near Cirencester in Gloucestershire fell through due to connection issues. The council has come to the position of being able to make these investments following a period of capacity-building. Its previous projects and other energy investments have supported a team of energy-literate project managers (set out in Figure 22).

Figure 22: Warrington Borough Council internal delivery team



Source: Warrington Borough Council

Developing this capacity is a long-term ambition, and other Councils may be well-advised to follow a similar trajectory of engaging in smaller projects to build experience in solar generation development. Sustaining this capacity will also require ongoing development projects, and Warrington may look to partner with other local authorities or offer services in the future to deliver further investments.

It is also notable that the Council partnered with an experienced developer and experience bridging investors to deliver the project, adding additional expertise where required rather than attempting to bring all necessary capacity in-house.

Importantly, this project did not require any special conditions to implement: the Council was able to be flexible in terms of location. With between 1.1GW and 4GW of additional solar deployment expected in GB over the period to 2030 by SolarPower Europe, there is the potential for dozens if not hundreds of similar projects to be delivered by local authorities over this period. Depending on ambition, subsidy-free solar is believed to be viable in capacities of 6MW upwards in current conditions; integrating batteries is also expected to become more common as costs fall and the economics are better understood.

Gridserve also intends to roll out EV chargers near to the solar farms, connected directly by private wires. The economics of EV charging are again currently poorly understood, with the market still nascent at best. However, millions of additional EVs are expected on the road by 2030, creating a wider market for charging services. Generally, the economics of private-wire supply to consumers are far superior to selling power over the public networks; we therefore expect that similar projects should be viable in the near future.

Certainly, Gridserve and other companies such as Pivot Power believe that this will be the case, as they are undertaking substantial investments in these fields with Gridserve targeting £1bn investment to build 100 charging sites within five years; Pivot Power is targeting £1.6bn investment to build 45 sites with 50MW batteries and 100 EV chargers each. With these investments, and major programmes from oil majors such as BP and Shell, the public charging market may soon be saturated, but many local authorities own assets such as park and ride sites which could prove perfect for EV charging.

10.6 Future outlook

10.6.1 Falling costs

The business case for solar PV without subsidy has now been made, following rapid falls in the cost of equipment. The cost per kW fell by 99% from 1975 to 2015, according to a December 2018 study by MIT. The International Renewable Energy Agency (IRENA) forecast falls of a further 50% from 2015 to 2020. BEIS forecast in November 2016 in its Electricity Generation Costs report that grid-scale solar costs would fall to £67/MWh by 2020, £63/MWh by 2025 and £60/MWh by 2030.

More recently, the Solar Trade Association (STA) published statistics in December 2018 showing that costs had already fallen to £50-60/MWh; it forecast that the cost of grid-scale solar would drop below £40/MWh by 2030. With year-ahead baseload wholesale prices for power around £58-60/MWh (as of May 2019), this indicates solar will be increasingly economically viable once wholesale markets have recovered from the effects of 2020's coronavirus pandemic.

10.7 Grid congestion

With growing amounts of generation capacity connected to the distribution networks, many of these are becoming constrained and not able to accept new generation connections. While all six of the GB DNOs are rolling out smart technologies and initiatives to allow further generation to connect, the costs and timelines for new connections are generally lengthening. Developers will need to be flexible about where and when they connect new generation in order to minimise costs, and to seek opportunities to deploy projects including flexibility services.

GSEEH is currently looking to commission a tool which will allow developers to identify suitable locations for new generation assets.

10.8 Cannibalisation

With huge volumes of solar power on the market, and more expected to be rolled out, this could lead to extremely low power prices during times of peak solar generation. This phenomenon is known as price cannibalisation, and is described in greater detail in a free Insight Paper produced by our Cornwall Insight which can be found here.

In simple terms, the over-supply of solar power during the middle of the day reduces power prices to the point at which solar generation becomes uneconomic. The answer to this problem is being able to control when a generator exports power by storing in batteries or using power on-site (e.g. in electrolysers or EV charging points).

10.9 Storage

Similarly to generation assets, the cost of energy storage assets is expected to fall precipitously in coming years. IRENA forecast in 2017 that lithium-ion batteries, the most common of the new electricity storage technologies, would fall in cost to around $200/kWh by 2030; since then individuals such as tech entrepreneur Elon Musk (who runs battery, solar and car company Tesla) have forecast cell prices as low as $100/kWh 2018 and battery pack prices of $100/kWh by 2020.

Many other energy storage technologies are also in testing, ranging from “flow” batteries, which can store power for much longer periods, to compressed air or even gravity storage systems. This range of competition is likely to result in electricity storage costs which continue to fall over the foreseeable future, making it more economically beneficial to pair these technologies with grid-scale solar arrays.

10.10 EV rollout

There are currently over 300,000 EVs in the UK, at July 2020. National Grid projects in its Future Energy Scenarios that there will be over 11mn by 2030 and potentially 30mn by 2040. A substantial national rollout of EV chargers will therefore be required to keep them charged. Four types of charging are expected – at home, at work, during journey and destination. At home charging is not likely to be an avenue for energy investment, but at work charging for company vehicles may present an opportunity, driving additional power demand at distribution centres and vehicle depots.

During journey and destination charging both present additional opportunities for local authorities, either partnering with other organisations as in the Warrington Solar/ Gridserve project to rapid-charge on transit routes, as we discuss here, or at destination sites such as park-and-rides as we discuss further in the Cambridgeshire MLEI case study.

11 Energise Barnsley

Energise Barnsley is the largest local authority and community energy solar PV and battery storage project in the UK. The project, based in Barnsley:

- Installed 1.5MW of rooftop solar installations in 2016 and 2017 across 321 sites;
- Installed 40 domestic batteries in 2018; and
- Planned to install another 50 residential batteries in 2019.

The project is led by Energise Barnsley, a registered community benefit society, with Barnsley Metropolitan Borough Council a key partner and custodian trustee. It has the aim of reducing energy bills and promoting sustainability in vulnerable households. The £2mn project was funded with an £800,000 retail bond and a £1.2 million loan from ethical lender, Charity Bank. All solar PV installed to date has Feed-in Tariff support.

11.1 Project overview

Energise Barnsley is the largest local authority and community energy solar PV and battery storage project in the UK. The scheme, set up in partnership with Barnsley Metropolitan Borough Council, includes six interconnected segments to deliver the projects' goals.

- Solar photovoltaic (PV)
- Battery storage
- Demand-side response (DSR)
- Peer-to-peer (P2P) trading
- Asset management
- Community funding

The original project had a capital value of £20 million in order to develop community energy at scale in partnership with the local authority. However, launch day at the Town Hall, coincided with the government FiT review, and the project was reduced to the residential systems which could be installed before the end of the year, and the commercial systems which could be installed within twelve months The capital value of the project reduced to £2 million.

The initial project meetings started in late 2014, with the intention to deploy as much solar PV across the council portfolio through a community energy solar scheme as grid, rooftop survey and tenant consent would permit. 321 Barnsley council homes have been recipients of these solar PV installations so far, which equals approximately 900kWp of capacity (compared to the initial target of 2MW). Of these installations, more than 75% of homes were bungalows inhabited by elderly individuals, with 25% of all residents on pre-payment meters. Sixteen non-domestic properties such as schools and community buildings have also had installations completed.

40 Moixa batteries have been installed into homes owned by social housing providing Berneslai Homes in the Oxspring neighbourhood. 30 of these properties were already fitted with rooftop solar arrays. The homes are 70% occupied by retired consumers, half of which are living alone. Households are equipped with solar electricity monitors to display when solar panels are generating electricity, and so when the greatest largest savings can be made. Residents are free to select their own energy supplier, though Energise Barnsley has been working with tenants to

analyse the savings from the solar and battery to see whether switching to a ToUT would be beneficial.

Energise Barnsley took the concept of a P2P trading platform through the initial stages of the Ofgem Sandbox process but did not proceed to a full trial. The ambition is for the surplus power to be sold at an agreed discount to market rates to those tenants without suitable roofs for solar PV installation. The aim of this is to create greater benefit for both generating households and households in receipt of export spills, which would be able to sell and purchase at more favourable rates than if the energy was exported to the grid.

The trial area could be expanded in the future with additional batteries and solar arrays and replicated across the country. Areas for particular attention will include targets of future flexibility tenders from DNOs, where an additional revenue stream will be available.

While the project initially applied for a regulatory sandbox derogation, it has since rescinded the application, deciding instead to await the outcome of other similar trials.

11.2 Project partners

- Barnsley Metropolitan Borough Council – project partner and Custodian Trustee
- **Energise Barnsley** – lead partner and registered Community Benefit Society (CBS)
  - Owns solar PV assets
  - Signatory to the solar licence and lease, between Energise Barnsley and the Council. The Council has worked with the Energise Barnsley team to develop protections within the solar licence and lease, to give robust protection for the cash flow over the project lifetime

Figure 23: Solar PV Installation in Barnsley

Source: Energise Barnsley

- **Centrica/ British Gas** – solar asset installer

- Solar PV design, installation and ongoing operations and maintenance
- Performance guarantees and warranties for the solar PV assets

- **Northern Powergrid** – local distribution network owner (DNO)
  - Partner in securing Network Innovation Competition (NIC) funding
  - Continuously monitor the levels of voltage and generation at the substation local to the Oxspring battery installations
  - Collaboration partner for Energise Barnsley BEIS Domestic Demand Side Response project
- **Moixa** – battery installer
  - Provider of Gridshare flexibility services managed as virtual power plant (VPP)
- **Berneslai Homes** – arm's length Housing Management Housing Association and project partner
  - Recipient of assets
  - Leading tenant engagement
- **Generation Community Ventures (GCV)** – community developer and asset manager
  - Generations Community Ventures (GCV) is the development arm of Gen Community, with the purpose to promote, develop and deliver community owned renewable energy, energy efficiency and heat projects nationally. GCV initiated, developed and delivered Energise Barnsley
  - Energise Barnsley uses Gen Community's ''Community Energy Model Rules 2015' registered with the FCA
- **Ignite** – £2mn underwriting facility available to Energise Barnsley
  - Ignite is an impact investment fund with a focus on energy. It invests people and money into emerging and mature organisations that have a clear vision of how they benefit society. It made its largest investment to date by making a £2mn underwriting facility available to Energise Barnsley.

11.3 Financials

Project costs of £2mn were raised through retail bond of £800,000 and £1.2mn loan from ethical lender Charity Bank. Investors in the five year bond have received three years of interest to date of 5% per annum[12]. The bond, dubbed the 'Barnsley Solar Bond', raised the £800,000 target in under three months over the summer of 2016, allowing local residents to invest in the scheme to benefit from the returns. Local ownership in the community bond is in excess of 60%.

The full cost of the storage solutions was funded by local DNO Northern Powergrid through the NIC. Total cost of the project was circa £250,000 to cover the two year lifetime costs of all project participants and hardware. Of the 40 domestic batteries installed, half were 2kWh and half 3kWh units. The energy use reduction at the substation – noted as 30kW by Northern Powergrid – created by the VPP's flexible generation and consumption, enabling connection of the solar generation in a region which would not ordinarily have been able to accommodate the power. This will minimise future expenses in upgrading the network. Of the 40 batteries, 28

[12] https://www.ethex.org.uk/energise-barnsley_1377.html

were connected to solar PV arrays as only 65% of the solar PV was allowed to connect by the DNO.

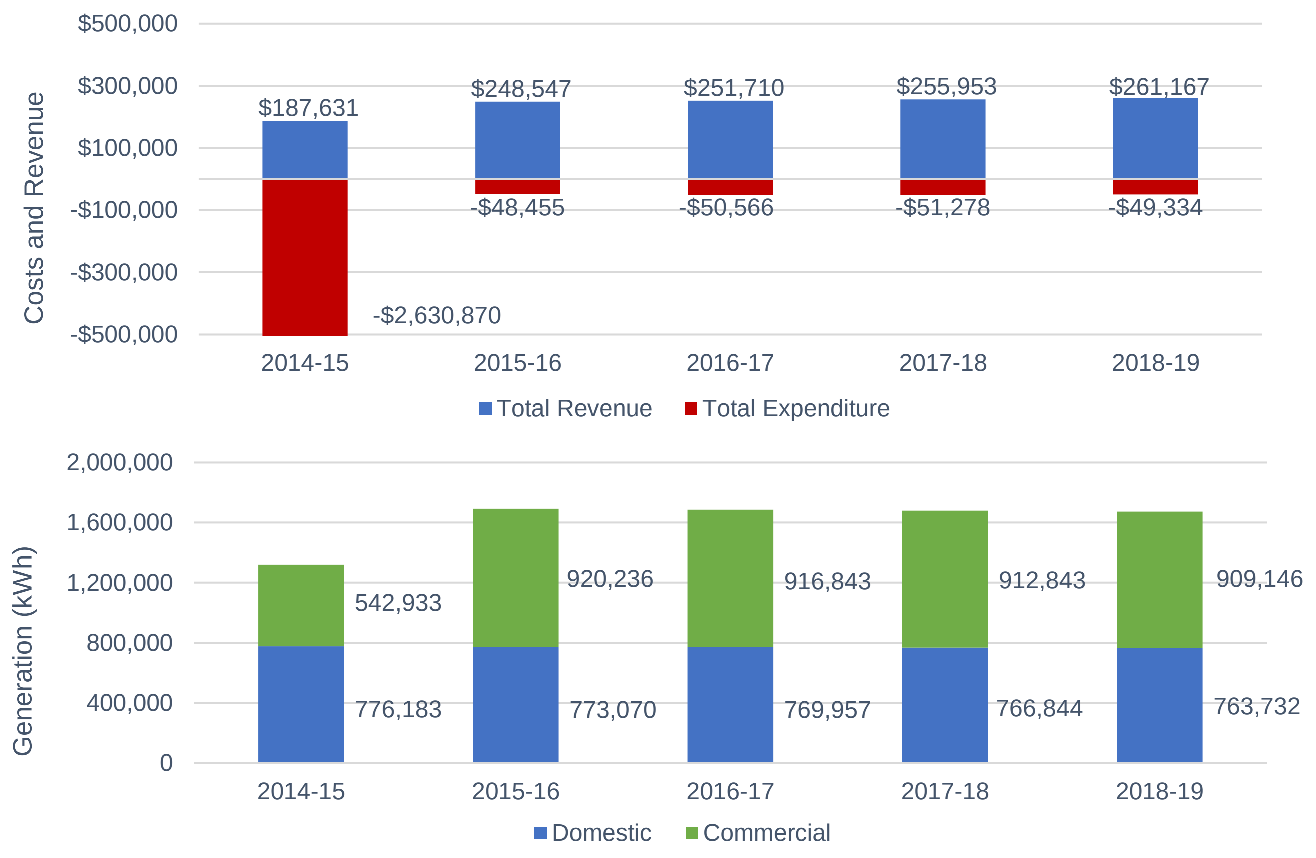
Moixa's Gridshare platform uses the batteries to maximise on-site use of solar energy, storing electricity during the peak of the daytime generation and using it to power homes when the solar panels are not generating. The batteries are also used to deliver various grid services, which are remunerated by National Grid.

The batteries used in this trial project cost approximately £6,250/unit, at the time of installation in January-March 2017, or £2,500/kWh. These costs have fallen considerably to around £1,000 plus VAT and installation for Moixa batteries as of Spring 2019. Other manufacturers have different prices but costs vary between around £800/kWh for larger units to around £1,200/kWh for smaller ones. These costs are forecast to reduce by as much as another 60% by 2030, improving the economics of similar projects.

Furthermore, Moixa currently offers £50/year payment for using the batteries as part of the VPP. The value and flexibility of VPP is expected to increase, meaning that payments to participants may follow.

In terms of revenue streams, the project has shown a continuing growth in overall earnings, and despite a slight fall in generation levels from 2015-16 to 2018-19 of 1.21% for both residential and commercial arrays, revenue from power generation rose by 5.08% overall (Figure 1). PPA offerings are generating 2.68% higher revenue as well according to the 2018 Directors Report.

Figure 24: Generation, revenue and expenditure per year of the project running time



Source: Ethex

11.4 Results

Participants in the trial saw energy bills fall around 30% as a result of the installation of solar panel, and 20% more as a result of the battery units. Over £40,000 of savings were made on electricity bills in the project's first year (2014-15), with more than 800MWh of low-carbon electricity generated during this time.

The Retail Investment Bond is providing 5% returns for investors.

11.5 Next steps

Energise Barnsley is planning to expand operations through provision of peer-to-peer and demand side response (DSR) activities to provide new commercial models in the face of a subsidy free GB solar market.

The Barnsley Domestic DSR project targets new build properties (Code 4 Sustainable Homes) with already installed dual purpose ASHPs and solar PV, adding a smart battery supplied by Sonnen and a smart control system to generate analytical household energy demand data. The project chose Sonnen for its established heat pump credentials in the German market.

A second set of households, built to post war standards, have been retrofitted with dual-purpose ASHPs and will provide an additional subset of analytical data to test the DSR model. This will in turn form the basis of a DSR commercial model engaging Norther Powergrid and Oxford Brookes.

Over 600 ASHPs have been installed in domestic dwellings, replacing gas boilers, through the tenant management company Berneslai Homes.

Energise Barnsley is also exploring a new business model to make use of the old mining assets within its community. Low carbon generated high yield hydroponic farming is at a point of raising at risk seed investment.

11.6 Replicability

The society's main income is generated through the Feed in Tariff (FiT), which was a UK government legislated mechanism which awards a guaranteed unit price for electricity generated and a second unit price for electricity exported from FIT-registered renewable generators. Additional income is generated through selling electricity from larger solar assets to Barnsley Council through a power purchase agreement (PPA).

With the closure of the FiT scheme on 31 March 2019 to new installations, a significant portion of the income which is generated from a project like Energise Barnsley is no longer available to new entrants, unless an asset had accredited or pre-accredited before the deadline. If this project were to be replicated, there would be two key hinderances: no payment of subsidies, and no guaranteed route to market for exported power. The latter problem has been solved by the new Smart Energy Guarantee (SEG), in place since January 2020 to provide a guaranteed route to export revenue for small-scale generation.

Prices offered under the SEG are not necessarily as generous as the FiT, the only limitation on price being that it must be in excess of 0p/kWh. The highest price on offer is Social Energy's 5.6p/kWh, above the FiT export rate. However, this is not guaranteed over the 20+ year life of the generating assets.

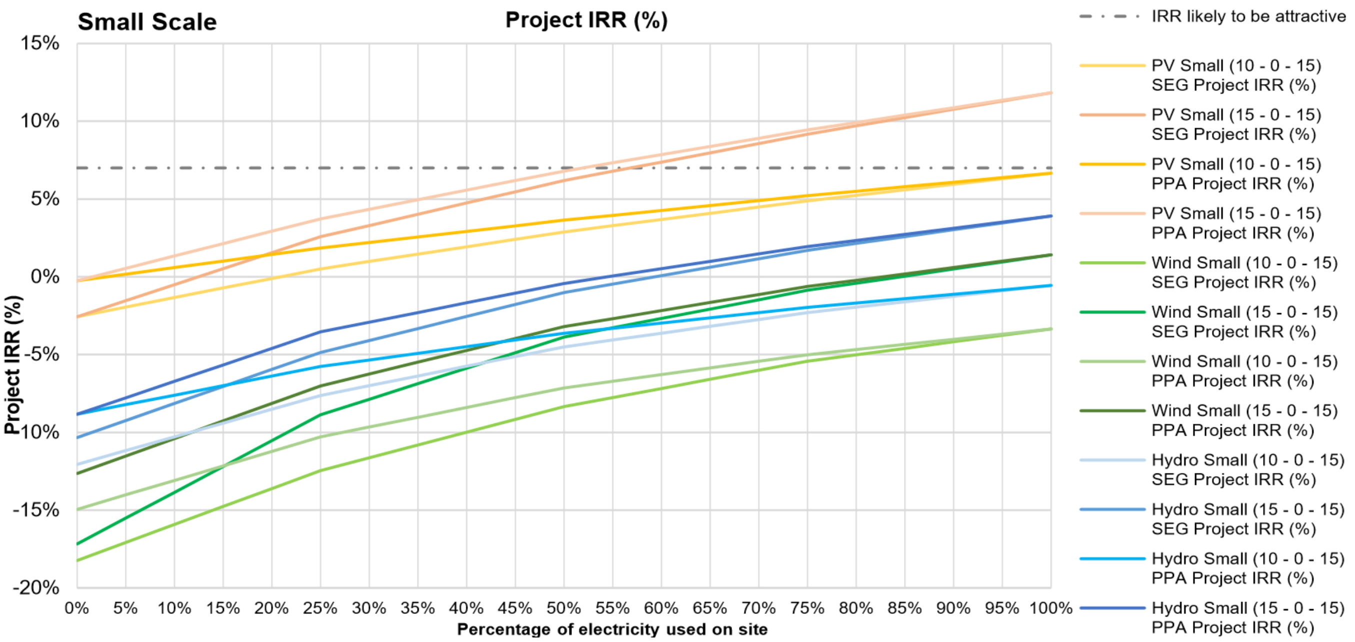
Analysis by CARES[13] illustrates that the feasibility of small-scale projects relies heavily on the utilisation of generated energy on site by offsetting the retail price. In the model, small scale scenarios are set with either a 10p/kWh or 15p/kWh tariff representative of whether or not the generator owner and bill payer are the same. The economic potential for investment with a suitable IRR starts at approximately 55% on-site usage, where it breaches the 7% IRR threshold as shown in Figure 2. However, this requires the higher base scenario tariff of 15p/kWh.

This concept is also explored further in the local energy guide.

As solar generation technology costs continue to fall and retail tariffs rise, the business case for behind the meter solar (combined with or without battery storage) is expected to improve.

The value of any power exported to the grid will be subject to market uncertainty. Electricity prices in the peak solar generation period may continue to fall due to the cannibalisation effect as more solar comes on the system, creating a generation surplus at peak times. As the SEG is in the early stages of formation, the business case for small-scale solar assets is unclear.

Figure 25: Internal Rate of Return for small scale projects with different site usage



Source: CARES

11.7 Key learnings

The key learnings from this project were as follows:

- Developing past the original Energise Barnsley model will require focus on DSR and flexibility provision, as well as ongoing subsidy from the Renewable Heat Incentive (RHI) to develop a commercial model post-FiT
- Solar with connected batteries provided the best value for household compared to solar or batteries alone. This value was enhanced substantially if self-consumption was priorities with

[13] CARES Project Viability Modelling: Post Feed in Tariff (2018) - https://www.localenergy.scot/media/110533/local-energy-scotland-guide-post-fit-viability-modelling.pdf

levels of 85% or higher

  - Encouraging self-consumption among households was challenging, requiring appropriate communication and assistance
  - Possible reassessment of a tenant liaison program needed

- The duration of the project is key, allowing enough time to engage parties early and secure their interest in the project
- Overcoming the psychological influences of installing renewable technologies need to be considered. Newly installed solar PV reduces tenant bills, which strongly motivates existing tenants to support the project. New tenants do not recognise the benefit (their status quo includes the reductions from the solar panels) and therefore are typically more ambivalent to the project
  - Improving the relationship and communication with tenants will help to counter this in future projects

12Mobilising Local Energy Investment

Cambridge County Council has been leading the Mobilising Local Energy Investment (MLEI) project, an award-winning local authority energy investment programme including four other LAs. MLEI has invested over £20mn in energy generation and energy efficiency, working with 40 schools, seven Council own sites, and has also delivered a 12MW solar farm built on Council-owned land.

The project uses tested solutions with new approaches to replicate delivery, working across electricity and heat production, building energy efficiency, and moving into the transport sector. The original project ran 2012 to 2015 with an aim of delivering €17mn (£15mn) of local energy investment, a target which was met in September 2015. MLEI continues, with new focuses on transport and heat.

It provides an example of how grant funding – in this case from the EU – can be leveraged into an ongoing and much broader project, attracting further public and private sector investment and building capacity over the medium term in an example of “learning by doing”.

12.1 Summary

The Council has leveraged funding provided by EU’s Intelligent Energy Europe (IEE) fund into a considerable and diverse ongoing pipeline of work, including dozens of MW of generation capacity, energy efficiency investments, a heat network and EV charging points. This work continues nearly four years after the completion of the original project. The developers have not been constrained by technology, though all projects are geographically in the Cambridgeshire or adjacent area, and the projects are currently only on Council-owned or affiliated sites.

Figure 26: Local Authority role in enabling low-carbon growth

Source: Cambridge MLEI report

12.2 Description

MLEI was targeted by the IEE to make investments of around £17mn into energy generation and efficiency projects, between commencement in March 2014 and completion in August 2015. A total of £18mn was invested, with pipeline completion bringing this to over £20mn currently. Installations used the Re:fit framework developed by Local Partnerships to provide clients with guaranteed energy bill savings, part of which could be used to fund the installations.

The project has deployed assets at 40 schools. Typical assets include solar PV generation, LED lighting upgrades, building energy management tools, insulation, and boiler upgrades. All upgrades were costed to establish that they were financial beneficial to the host and therefore the investment would pay back. Typical payback periods are in the 10-15 range.

Seven Council-owned buildings were also upgraded: Shire Hall, Amundsen House, Awdry House, Speke House, Scott House, March Library and Huntingdon Library. Energy conservation and generation measures included 183kWp of solar PV arrays, LED lighting and controls saving £10,000/year, insulation of exposed pipework, and building energy management systems. This programme cost £480,000 to undertake and will payback in 8.5 years.

In addition to these behind the meter investments, the project also developed a 12MW at Triangle Farm in Soham. This covers 70 acres of grade-3 agricultural land, and provides the council with income of around £1mn/year, with £10mn profit expected over the project lifetime and a payback period just over 11 years. The site achieved a subsidy under the Renewables Obligation regime.

Since achieving its £17mn target in August 2015, the project has moved on to look into many wider investments. Some are listed below.

- Babraham Park & Ride: Solar and Storage
  - Three sites under consideration – St Ives, Babraham and Trumpington
  - Solar carports with EV charging and battery storage, operated as an on-site mini-smart grid which will also store energy for lighting
  - £24mn returns over lifetime expected for the Babraham site
  - Avoids problems with the local distribution grid, which is at capacity in many places
  - Provides 100% renewable green energy to vehicles, while owners take public transport into the city
  - 25 year lifetime, though projected that the solar carports will remain at 80% efficiency at the end of this period

Figure 27: Babraham Park & Ride concept design

Source: Cambridgeshire County Council

- Swaffham Prior Community Heat Scheme
  - A heat network deployed in a Cambridgeshire village, providing low-cost, low-carbon heat. 70% of existing buildings use oil boilers – eligible in the village are 280 houses, primary school, swimming pool, two churches, pub, youth club and village hall
  - Replacing conventional heating with a district heat network running on renewables, probably ground-source heat pumps, but possibly water source heat pumps with plus gas backup or another technology
  - There will be no up-front costs for residents to join the project, with monthly bills including the capital cost of connections
  - A £20,000 feasibility study has been completed and more in-depth detailed technical economic feasibility studies are in progress
- Closed Landfill Energy Projects
  - Five County Council owned landfills which are now closed. Two near to Peterborough are considered the best for solar PV generation projects, being close to customers and electricity substations
  - 25-year project lifetimes over which £36.9mn profits will be realised
  - Stanground – 2.25MW solar array plus 10MW battery for DSR
  - Woodston – 3MW battery on a much smaller site
  - At the public outreach stage, very early in development
- North Angle Farm is close to the existing Triangle Farm in Soham and is being examined for an expansion of the existing solar development

12.3 Participants

The lead partner on this project was Cambridgeshire County Council. It partnered with four other regional local authorities: Cambridge City Council; Peterborough City Council; South Cambridgeshire District Council; and Huntingdonshire District Council.

Other key parties are Local Partnerships, which provided third-party governance, review, assessment, and supervision. Local Partnerships manages the Re:fit framework, which has provided a structure for assessing the economic merits of investments and provided guarantees to minimise participant risks for both investors and hosts.

Bouygues was selected as the Energy Service Provider through an OJEU-approved procurement process under the Re:fit procurement framework. It designs and installs the energy generation and efficiency assets for host organisations, as well as providing support for the Soham solar farm and various other projects. By securing a long-term (15-year) framework agreement, the Council could minimise re-procurements and work with a partner consistently. Energy Performance Contracts (EPCs) were provided to partners, meaning that savings or income was guaranteed, or Bouygues would be liable for the difference.

Savills Energy also provided support on the Soham 12MW solar array project. It provided technical support, including reviewing the Bouygues Investment Grade Proposal; line by line cost assessments; negotiation support with the client; advice on call-off contracts; development and enhancement of specific terms; technology analysis; helping to meet challenging timescales; and ensuring performance guarantees could be met without undermining the business case not. This ensures the ability to alter the operation and maintenance arrangements in the future without impacting the guarantees on output and income.

Cambridgeshire was able to work with large numbers of small project partners through delivery, with low levels of knowledge. This would normally entail high transaction costs if managed at individual project level. By running many projects simultaneously and using frameworks for delivery, Cambridgeshire managed these costs and kept them to an efficient level while remaining within EU procurement rules.

12.4 Financials

The project was supported by grant funding from the European Regional Development Fund's (ERDF's) Intelligent Energy Europe scheme for a total of £840,000. This paid for 75% of the cost of running the project, alongside funding from the partner councils, for a total of £1.1mn. This supported an investment programme of £17mn (around £13mn) during the term of the project, which has since increased to over £20mn with additional projects completing.

This is forecast to return £1.7mn in profit over the lifetime of the project, with some this income earmarked by the Council to support an ongoing energy unit. This unit now gives the Council the technical and engineering skills to pursue further projects going forwards.

The investments themselves – around £20mn in total – have been underpinned by low-cost borrowing through the Council's capital budget. Public Works Loan Board funding can be obtained for 15-year terms, at a 3.05% rate. The low cost of capital reduces the hurdle rate, allowing more marginal projects to go ahead than would be allowed by commercial finance. Alternatively, the low cost of borrowing allows shorter payback periods.

The concept of taking on debt was new to some organisations, particularly schools. Their budgetary constraints also meant that the investments had to be cash positive from day one, which require structuring finance around this requirement. The EPCs provided also reassured partners that the projects would provide the forecast returns.

MLEI also provided the opportunity for host organisations to provide some of the funding themselves and thereby profit from the installations as well; this option was primarily of use to academy schools.

12.5 Replicability

The legacy of the MLEI project has been the EIU at Cambridgeshire County Council. This was commissioned to deliver further projects in the period since the end of the EU funding in 2015. It recently applied to the Council for nearly £1mn to continue and transform its work for the next three years and in this application noted that its annual costs were around £100,000.

However, the income derived from the work of the EIU is much higher than this cost (£1.7mn over project lifetimes or £155,000/year). Its transformation budget will enable it to deliver £100mn of income to 2040, and provide funding for the EIU to be flexible in undertaking and delivering projects, rather than seeking approval for each project individually.

This multi-vector project is really more about building capacity in local authorities to deliver energy projects than any specific investment which the Council made through the project. By using small projects on sites primarily owned by the Council and its partners, the Council was able to use income from these successful projects to pay for growing capacity, allowing it to tackle larger projects over the longer term. The Re:fit framework would also support wider roll-out through the LA community.

All of the over 400 UK local authorities have access to low-cost long term finance, as well as significant estates in terms of offices, schools, libraries, leisure centres and other public buildings which would be suitable hosts for small-scale generation or energy efficiency projects. This means that will an initial investment to "prime the pump", and sufficient political will to make investments, similar Energy Investment Units could be established at many other local authorities to replicate this model. Consideration should also be made of the potential for local authorities to develop capacity to support other regional LAs, as Cambridgeshire County Council has done in this instance. This concentrates financial benefits in one authority but reduces total costs and allows more LAs to access cost-savings as a result of being host to energy projects.

12.6 Future outlook

The Council noted that development costs were high risk, with a high level of projects dropping out before investment, wasting time and resources and requiring a large pipeline to result in consistent delivery. It also highlighted the need to remain flexible and make changes iteratively as partners and the market develop. It is also important to start small and develop capacity over time to deliver bigger solutions.

With LA budget tightening and energy bills rising, many authorities are turning to energy investments in order to reduce bills and to derive income to spend on front-line services. the falling cost of many renewable generation and energy efficiency assets also points to greater potential in this area. Investors should however be cautious that Ofgem's ongoing TCR and NAFLC SCRs are expected to change network charges by 2022. This may adversely affect the business case, especially for marginal projects or ones which rely principally on avoiding or minimising network charges for viability.

12.6.1 Lessons learned

In addition to delivering an experienced Energy Investment Unit, key lessons learned were:

- An "energy vision" is not sufficient to pull together stakeholders; linking the energy agenda into transport, housing and digital agendas provide broader influence and buy-in
- Investable projects with a solid business case are the most important part of the strategy; potential projects are not the same
- Project development costs are an investment risk and there is high dropout risk for partners. Understanding when and why partners drop out will help to mitigate this risk – mostly drop outs occurred due to lack of institutional capacity, knowledge, and commitment of decision-makers, rather than poor economics of projects
- Start simple and refine later on an iterative basis, as projects and the evolving market dictate. Being open to change and adapting the model is crucial to ongoing success
- Equally, routemaps to success will not be apparent at the beginning of a programme, no matter how much programme managers wish them to be. Professional input can help here
- Accessing finance is not a major hurdle for LAs, despite initial perceptions. Equally, investment decisions should not be made solely on a financial basis. Investment can be delayed due to perceptions of falling technology costs, more profitable ways to invest capital, and lack of public understand of goals

13 Gateshead District Energy Scheme

The Gateshead District Energy Scheme is an award winning project owned by Gateshead Council which supplies heat and electricity to consumers from gas-fired Combined Heat and Power (CHP) engines. It connects to public buildings via a heat network and also a network of private wires, and provides heat only to council and social housing. The project also includes a 250,000-litre hot water thermal storage facility and a 3MW battery. It is innovative in the sense that it stacks revenues and trials new products, such as plastic heat network pipes.

We selected this project because of its district heating and private wires elements. It is ambitious both in terms of scale and in ambition to add battery storage and thermal storage at scale. It is also an early example of accessing multiple revenue streams ("revenue stacking"), in this case through the CM and frequency response. The project also has a strong element of urban redevelopment associated with it.

13.1 Summary

The Gateshead District Energy Scheme utilises two 2MW gas CHP engines to supply heat and electricity to public buildings in Gateshead. Heat and power are supplied to consumers via heat and private wire networks, offering the services at 10% and 5% discounts on grid prices. It also incorporates a 250,000-litre hot water thermal storage facility and a 3MW battery, which were installed and are managed by Centrica.

The scheme is financially viable due to the use of private wires installed by Gateshead Council – the scheme owner and funder – and the establishment of a wholly owned Energy Services Company (ESCo) to supply utilities to customers. The scheme stacks revenue by also providing grid services to National Grid and through cost avoidance (e.g. Triad avoidance).

The scheme has the potential to act a blueprint for similar projects across GB although some local conditions are necessary to do so. These include the establishment of an ESCo, purchase of private wires and a large enough captive consumer base.

13.2 Description

13.2.1 Features of the scheme

The Gateshead District Energy Scheme was initiated in 2011 by Gateshead Council with plans and scoping completed in partnership with WSP I Parson Brinckerhoff Ltd, a district energy consultancy.

The scheme is based on two 2MW gas fired Combined Heat and Power engines located on Quarryfield Road in the Baltic business quarter, known as the Gateshead Energy Centre. The gas-fired CHP generates electricity and waste heat in a process around twice as efficient as a conventional power station. There is also 7.5MW of gas boilers, to provide backup to the main engines.

Connected to the engines are 3km of district heating pipes and high-voltage private wire networks which provide low cost heat and electricity to a range of public buildings, including the Gateshead Civic Centre, the Sage Gateshead, BALTIC and Gateshead College as well as homes managed by the Gateshead Housing Company (350 social housing customers).

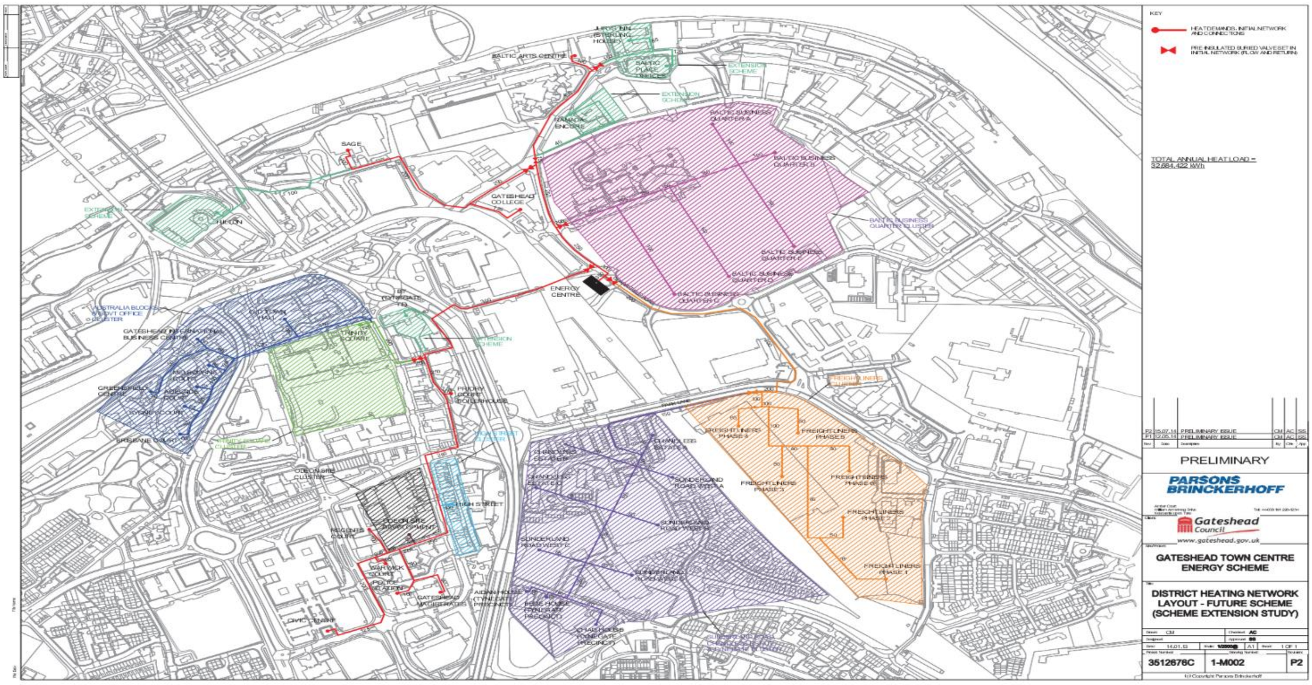
The project is owned and funded by Gateshead Council, with initial investment of £18mn. The Gateshead Energy Centre opened in March 2017. The CHPs are operated as "heat-led" for the majority of the time, but the thermal storage unit allows it to run as “power”-led during winter peak periods. This means that the CHPs usually run to produce heat as-need to meet heating demand (heat-led), but sometimes run to produce power when it is especially valuable, with excess heat being stored (power-led).

Figure 28: Gateshead District Energy Centre

Source: CK21

A map showing the scale of the scheme, which connects the town centre with Gateshead Quays can be seen at Figure 11, which also shows the masterplan for potential expansion of the scheme to further neighbourhoods.

Figure 29: A map of the Gateshead District Energy Scheme and potential areas for expansion



Source: Gateshead District Energy Scheme
NB – Areas marked in red lines and blue-green hatching are already connected, other coloured areas are under consideration for expansion of the network

100% renewable electricity is imported into the private wires from the scheme's own grid connection when the CHP engines are not running or when demand is greater than supply. This safety net makes the scheme resilient, potentially more so than a conventional building with a gas boiler and electricity grid connection. It also saves on some network costs as less of the public networks are being used to deliver power (though this must be set against the cost of the private wires themselves).

From the initial development, the network has been extended twice – the second 1.5km extension coming after a £0.9mn grant from the European Regional Development Fund (ERDF) – to include a 3MW battery storage facility, and there is a 250,000-litre hot water thermal storage facility at the main energy centre. This last feature allows the 10MWe thermal load to be supplied by the 4MWe CHP engines, reducing the cost of investment and demonstrating the scheme's flexibility.

The 3MW/ 3MWh battery storage facility was installed by Centrica. It can respond to demand fluctuations in under a second, using this capacity to deliver a frequency response contract with National Grid. Centrica will manage the battery under a 10-year contract to provide these flexibility services. The site was also awarded a 15-year Capacity Market contract, at a clearing price of £18/kW in the 2015 T-4 auction. This was brokered through aggregator Flexitricity, and pays the Council £60,000 per year.

The Gateshead District Energy Scheme has developed into a major infrastructure project that will underpin the future redevelopment of the town centre while stimulating investment and job creation and offering the Council a trading opportunity to improve its financial position.

13.2.2 Why is the Gat eshead District Energy Scheme unique?

Gateshead Council won the Visionary Project Award from the Association of Decentralised Energy (ADE). This award is given to projects that seek to change the energy industry for the future. One unique feature that contributed to the award was the fact that it provides peak power generation to help balance the grid though a combination battery storage and CHP with heat storage.

It also offers significant technical impacts including carbon emission reductions of between 2,900-6,100 tonnes per year (dependent on how the scheme develops and expands in the future). Customers are also guaranteed cost discounts, starting from 10% on heat costs and 5% on electricity costs.

- Innovation has been critical to the scheme. Specifically, the use of private wires has made the initiative commercially viable. This was achieved through the purchase of high-voltage assets from the DNO to enable the connection of the private wire network to existing buildings. This has in turn opened up opportunities to replicate the blueprint across the UK

With heat rejection plant and controls, the 4MW CHP engines can provide peak power generation, participate in Grid Services (e.g. STOR), and have enabled the scheme to win a 15 year Capacity Market contract, supported by Flexitricity. The addition of a 3MW battery has also allowed the scheme to provide peak power and triad avoidance as well as frequency response to the grid via Centrica.

To reduce disruption and time of heat network installation, the Council has secured £0.9m EU grant, to install the UK's first plastic district heating trial, that can replicate temperatures and pressures of a steel system, aiming to stimulate a new supply chain, which could revolutionise heat network construction.

Overall, the Gateshead scheme has set a benchmark for what can be achieved through direct generation and distribution of heat and electricity. This shown through the use of private wires, new commercial models with DNOs and the commercial viability of decentralised energy.

13.2.3 Project enablers – clear objectives, benefits and local buy-in

The primary driving force behind the initiative is Gateshead Council, which has outlined a number of objectives for the district energy scheme. They are as follows:

- To provide low cost heat and power to existing homes, organisations and businesses in the urban core of Gateshead, reducing their running costs and improving their competitiveness
- To create business growth in Gateshead, by offering low cost, low carbon heat and power to new commercial development
- To reduce Gateshead's carbon footprint, by providing heat and power with lower the carbon emissions of grid energy supplies; the scheme is expected to reduce carbon emissions by nearly 3,000 tonnes/year in phase 1, up to over 6,000 tonnes/year in phase 3
- To reduce the cost of heating for the public estate, commercial buildings, and fuel poor households

The project has been enabled by the set of clear and agreed project needs. These include the realisation that energy efficiency measures could reduce building costs and carbon emissions no further, highlighting the need for a larger scale low-carbon energy generation scheme. Developers were also found to be constrained in providing sustainable, low-carbon development, due to low land values in the area and construction cost premiums.

Gateshead Council has also aimed to make it cheaper for developers to build low carbon developments. Budgetary pressures have pushed the Council to seek new investment opportunities to deliver revenues to support front-line services. Local generation and supply through an Energy Services Company (ESCo) offered an opportunity to retain revenue from heat and energy sales.

A significant number of project benefits were identified and articulated by the Council to developers with regards to connecting to the district energy scheme, these include:

- Cheaper connection construction costs than conventional utilities plus heat plant, as well as allowing developers to meet building regulations, Code for Sustainable Homes, BREEAM and Zero Carbon Homes standards more cost-effectively
- Buildings also avoid ongoing heat and plant maintenance, servicing and replacement costs. This ties in with the higher resilience of the heat and energy network system
- Reduced plant space requirements in developments allows greater lettable floor area
- Reduced heating and power costs for building occupants, of at least 5% and potentially more, compared to prevailing market rates of heat and power costs
- Flexible energy supply contracts, offering dual fuel, heat only or power only connections
- Through the process of public engagement and clear communication to the project aims and benefits, local consumers have engaged with the scheme as they were able to appreciate the benefits of low-cost, low-carbon heat and energy. The buy-in from the consumers as well as councils, universities and developers have combined to make this a strong location for the scheme.

13.3 Participants

Figure 3 outlines project participants, their roles and details about their project activities.

Figure 30: Project participants

Organisation	Role	Details
Gateshead Council	Owner and funder	Owner and funder having set out initial plans in 2011. Initial investment of £18mn Objectives are to reduce carbon emissions and energy bills for consumers whilst strengthening its financial position as the project is expected to make an 8% return over a 40 year period
Gateshead Energy Company	Operator and profit making entity	Gateshead Council established and wholly own the Gateshead Energy Company – an Energy Services Company (ESCo) Act as the scheme operator and supplies customers with energy and heat
European Regional Development Fund	Funder	Granted the scheme £0.9mn for a second 1.5km extension as part of the European Structural and Investment Funds Growth Programme 2014-20.
WSP I Parson Brinckerhoff	Consultancy and profit making entity	District energy consultants - partnered with Gateshead Council in 2011 to perform the early design and procurement work for the energy centre and the wider heat and private wire networks
Balfour Beatty Construction	Construction contractor and profit making entity	Main contractor for the construction of the scheme
Clancy Dowcra	Construction sub-contractor and profit making entity	Sub-contractor to construct the underground heat and power network which commenced in January 2016
d3associates	Designer and profit making entity	Commissioned by Clancy Dowcra to design the underground networks

Organisation	Role	Details
Edina UK	CHP engine supplier and profit making entity	Supply, maintain and install MWM CHP engines for 15 year life Edina will continue to maintain the engines under a long-term service and maintenance contract
Centrica	Supplier and profit making entity	Installed the 3MW battery storage facility Centrica will manage the battery under a 10 year contract to provide flexibility services to the grid
Flexitricity	Aggregator and profit making entity	Brokered a deal for the site for a 15-year Capacity Market contract at a clearing price of £18/kW in the 2015 t-4 auction, yielding £60,000 per year.

Source: Pixie Energy

13.4 Financials

The main funder is Gateshead Council which invested £18mn in the scheme under phase 1. The project has received £0.9mn in grants from the England European Regional Development Fund (ERDF) as part of the European Structural and Investment Funds Growth Programme 2014-20. No other grants or subsidies have been received.

- The project has a 40 year lifespan, with total investment to reach £25mn by phase 3. Investments were £18mn for phase 1, which included the Energy Centre and initial connections; £3.5mn for phase 2 and £1mn for phase 3, which are extensions of the network. The battery storage unit cost £2.5mn.
- Project payback is expected 16-17 years after commissioning. Energy is sold at a discount of 5% and heat at 10%; around 5% heat losses in the network are expected. The projected rate of return is 8% over 40 years. However, the network is estimated to have a 50-100 year lifespan, giving rise to future possibility of replacing carbon-emitting CHP engines with low-carbon technologies.

There are a number of revenue streams in this project. The ESCo established by Gateshead Council earns money through the sale of heat and power to consumers. The 4MW CHP engines are also used to participate in grid services (e.g. STOR) and enable the scheme to participate in the 2015 T-4 Capacity Market auction where Flexitricity successfully secured a 15 year contract at a clearing price of £18/kW yielding £60,000/ year.

The engines also avoid costs by enabling Triad avoidance. Centrica manages the 3MW battery which has a 10 year contract to provide flexibility services to National Grid. Overall, the Gateshead scheme can arguably be said to have a revenue stack.

Figure 31: Key metrics under the Gateshead District Energy Network

Energy type	Phase 1 (2017-18) (GWh/year)	Phase 2 (20118-19) (GWh/year)	Phase 3 (2019-20) (GWh/year)
Heat	11.1	15.5	21.6
Electricity	13.7	14.0	19.6
CHP heat output	11.0	15.3	20.9
CHP electricity output	10.9	14.4	19.6
Gas boiler heat output	0.7	1.0	1.8

13.5 Replicability

The project has been scaled up from its initial development to including an extension to the networks as well a 3MW battery.

The scheme was been designed from outset to expand to meet the energy needs of future developments planned for Gateshead town centre, including commercial developments at Gateshead Quays and Baltic Business Quarter and major housing developments at the former Freightliner site and the new Exemplar Neighbourhood – an area where up to 1,000 new homes are planned.

Other key future milestones are to demonstrate how existing commercial customers can be integrated technically and commercially into heat/power networks. The model will then be tested and proven for new developers, providing a working example of how district energy can actually reduce the development and operating cost on new, low-carbon development. Generation sources will continue to develop and will offer connections to energy generators, as well as consumers, for combined grid connection/ power purchase agreements to electrical generators. There are also discussions to include local biogas producers indicating that this type of project can be flexed to include additional technologies.

Overall, there are a number of requirements needed to make the project work and therefore replicate it:

- Establishment of an Energy Services Company to supply power and the purchase of network assets from the DNO
- Diverse incomes and avoided costs contribute to the stacked revenue of such a scheme and therefore make it commercially viable
- Consumer buy-in through the identification and communication of objectives, needs and benefits
- A safety net to ensure the system is resilient so that consumers have a secure supply of heat and electricity

There is potential for this scheme to act as a blueprint for future energy and heat provision in the UK. Opportunities are likely to be found in most LA areas for heat networks of various sizes, from village upward. Projects with as many elements as this exemplar scheme many be reserved to large municipalities, but as has been demonstrated on the continent, heat networks can be viable in many physical locations and conditions.

13.6 Future Outlook

Decarbonisation of heat provision will be one of the big carbon-emissions reductions targets over the next decade, and government has not yet clearly set the policy direction. However, one key aspect is likely to be heat networks. While this example is gas-fired and therefore not carbon neutral, a biomass-fired or heat pump based energy centre could provide zero-carbon heat.

Gateshead's large thermal storage tanks and battery make it eminently suitable to conversion to heat pump operation in the future. With a major river nearby, it would also be possible to establish water-source heat pumps to provide additional capacity as the scheme expands. Heat pump technology continues to develop and installation costs are forecast to fall around 5% from 2018 levels by 2020, or 20% by 2030. The learning rate (cost reduction from doubling roll-out) was projected at 35% so costs may fall more sharply if the technology is more widely deployed.

Using renewable fuels and technologies would also give access to RHI subsidies, though it should be noted that these may be available only for the short term, especially if deployment starts to rise sharply. Cutting of renewable energy incentives has already been seen in the FiT scheme.

With network and other third-party charges rising, providing power off the main electricity grids will become increasingly economically viable. This especially applies to "smart" grids which can help their customers to avoid using power at peak charging times. With drivers for businesses to reduce their carbon intensity also increasing, this reinforces the case for combined heat and power networks.

Discussions around the future of heat network regulation also continue, though again government has not yet set a clear policy direction. However, a heat regulator to protect consumers may be introduced in the next few years; it has been suggested that either Ofgem or a new utilities super-regulator would take on this responsibility. Increased regulatory burden is likely to add operations costs to running a heat network but may also engender additional consumer trust and willingness to connect to a heat network. A clear set of standards and guidelines might also make it easier to develop heat networks and promote deployment.

14 Deep Retrofit Energy Model (DREeM) and Energiesprong

14.1 Summary

The Nottingham Deep Retrofit Energy Model (DREeM) programme follows the Energiesprong approach to full-house retrofitting. This approach has been widely utilised and formulated in the Netherlands.

An Energiesprong retrofit consists of a full-house upgrade including a thermally efficient façade, solar PV roof and in-house ‘energy hub’. Currently the scheme is focused on the social housing stock as a sector receiving efficiency investment, often single installation, already.

The scheme is reliant on initial funding, partially from the EU, to kickstart initial retrofit of housing. An ‘energy plan’ is then set up with the homeowner, paid to the landlord (in this case Nottingham City Council), and reinvested into other Energiesprong retrofits. Over time a domestic and international supply chain is expected to develop, reducing costs of the model.

In the case of a UK exit from the EU, a large proportion of funding to carry out the retrofits would need to be sourced from elsewhere with loss of access to EU funding pots. This may be in the form of a Shared Prosperity Fund proposed by the UK government.

14.2 Description

14.2.1 Overview

The Energiesprong scheme is a highly successful approach to energy efficiency upgrades across the Netherlands, implemented by the Dutch Government. It sets standards to achieve net zero energy homes. Typically this involves a 3-D scan of a pre-existing house, to appropriately install a new thermally efficient façade, solar PV roof and ‘energy hub’ which includes air or ground source heat pumps and optional batteries. Across the Netherlands, over 1,000 Energiesprong retrofits are now carried out every year.

Nottingham City Homes was the first housing association in the UK in December 2017 to use the Energiesprong approach under an initial ten house pilot project (see Figure 1), although up to 400 homes are expected to be retrofitted in this way. The bulk of the extended rollout is to fall under the Deep Retrofit Energy Model (DREeM) programme, which is a project backed by the European Regional Development Fund to improve energy efficiency in homes and public buildings in Nottingham. The DREeM programme is a scalable demonstration project, which tests the roll out of financial and commercial model of retrofits to homes and public buildings to increase energy efficiency and renewable energy generation. The aim is for the amount of energy used by a building annually to be equivalent to the amount of renewable energy created on site.

Nottingham City Homes and Nottingham City Council procured Melius Homes Ltd to deliver Energiesprong retrofits. The scheme saw installation of new outside walls and windows, a solar roof and efficient heating system including ground source heat pumps and battery and thermal storage within 15 days. As of 12 June 2017, Melius House Ltd was granted executive approval to extend the Energiesprong roll-out to 155 homes across Nottingham. The delivery of more retrofits was awaiting grant funding which has been partly secured through £5mn courtesy of the ERDF on 8 January 2019. As of April 2019, Moat Homes and Engie became the second developers of Energiesprong retrofits to 5 houses in Essex.

Figure 32: Nottingham pilot houses before and after retrofit

Source: Melius Home

14.2.2 Key Points

The scheme is particularly unique in the way its funds are recycled. The occupier of the household pays a flat rate tariff for hot water, heating and electricity outlined in their 'energy plan'. This income is less sensitive to fluctuating energy prices due to lower energy consumption which provides the occupier with a more cheap and secure energy plan. The fees under the energy plan are paid to Nottingham City Homes as the landlord, which is then able to reinvest such income into other similar developments. An energy guarantee of 30 years associated with Energiesprong retrofits, covered by high indoor climate and energy performance standards, also helps to maintain certainty in a fixed cost payment plan.

The whole-house retrofits were carried out within fifteen days meaning that residents did not need to move out during the makeover. This is possible through an integrated supply chain and the construction of tailored building parts in advance through the use of 3-D scanning for each individual property.

Another important aspect is emphasis on comfort and aesthetics, not cost savings. In previous UK approaches, such as the Green Deal, there has been a narrow focus on carbon dioxide savings leading to damp properties with insufficient ventilation. The new focus on an energy service agreement model and energy efficiency improvements allows for a zero-carbon house with increased comfort and aesthetic value.

In facilitating the scheme, Energiesprong UK acts as an intermediate (much like the market development team in the Netherlands) and not a deliverer of the retrofits. It is a consortium of 14 organisations including Nottingham City Homes and Melius Homes. Its role is to influence and facilitate change with industry stakeholders, Refurbishment Solution Providers (RSPs), the supply chain and government. Example changes in the Netherlands include changes to law to allow for energy service contracts to be combined within rents, and introduction of mortgages which can be classified as 'green'. This intermediary role is deemed as critical to the success of Energiesprong retrofits.

14.3 Participants

Participants of Nottingham City Council: Energiesprong

The following parties are responsible for the retrofits in Nottingham:

- Nottingham City Council is the district council covering the unitary authority of Nottingham and is responsible for authorising planning consent and allocating state funding
- Nottingham City Homes is a not-for-profit Arms Length Management Organisation (ALMO) and a partner in Energiesprong UK, and is responsible for managing Nottingham City Council's social housing stock. It selected the ten homes part of the Energiesprong retrofit and is a partner of the wider Energiesprong UK organisation
- Melius Homes is a contractor and partner of Energiesprong UK that was procured for retrofitting the Nottingham City social housing stock. It has been announced that Melius homes will continue to carry out future retrofits across Nottingham City in the future
- The European Union provided funding through its REMOURBAN strand of its Horizon 2020 scheme. REMOURBAN is a smart city project to improve overall town and city sustainability. Nottingham is one of the cities chosen under the scheme, and as a result Nottingham City Council could contribute some of this towards the Energiesprong retrofit amongst other sustainable improvements. Its funding provided to the wider Energiesprong UK consortium also under the Horizon 2020 scheme but under its Transition Zero strand, meant that the Energiesprong UK team was able to contribute expertise to the Nottingham retrofits as well
- Energiesprong UK leant valuable expertise and guiding throughout the project, as well as contributing a proportion of its funding to the Nottingham City retrofits.
- Interreg Europe is an EU funded organisation that helps to facilitate change in policy across local and regional governments. In Nottingham City's Energiesprong venture, it contributed funds towards its development

Participants of wider Energiesprong UK organisation

This includes the other 12 members of Energiesprong UK, and those not directly involved in the retrofits in Nottingham, but a part of the wider Energiesprong movement and influence in the UK.

- Accord Group
- Clarion Housing Group
- Moat
- Optivo
- Your Homes Newcastle
- Beattie Passive
- Engie
- Mears
- Sustainable Group
- Wates
- Energy Saving Trust, and
- National Housing Federation

14.4 Financials

Funding for Nottingham City Council's Energiesprong retrofits was included within a finance package to create 155 retrofitted homes. As a result, funding for the 10-house pilot demonstrated in 2017 was taken as a proportion of this package.

Financial information is displayed in two forms. Proposed funding breakdown before the 10-house pilot in December 2017, and funding breakdown after actual costs incurred from the 10-house pilot were accounted for in October 2018.

Figure 33: Capital expenditure and funding breakdown

Capital expenditure split	Approved budget (2017)	Revised budget (2018)
Nottingham City Council	£5,286,000	£5,922,000
ERDF DREeM	£4,214,000	£4,425,000
Interreg	£0	£580,000
Total	£9,500,000	£10,927,000

Source: Nottingham City Council

Approval for allocation of funds for the 155 Energiesprong retrofits was given on the following grounds:

- Resulting additional investment into Nottingham City Council properties through grant of £626,000 leading to a total grant for its housing scheme of £4,840,000;
- Despite a rise in the cost per property, this is offset by saving in 30-year housing revenue account;
- Evidencing a reduction in costs during the programme which shows transformation and long-term impact;
- Allows for development of a business model that will make DREeM more affordable and sustainable;
- Leads to regeneration of entire area;
- An expected significant reduction in fuel poverty; and
- A commitment of the contractor to invest in a Nottingham-based factory to employ via the Nottingham Jobs Fund.

The total cost of Energiesprong retrofits for 155 homes is now anticipated to be £10,700,000.

Nottingham City Council was able to increase its contribution through match funding proposed and included within the energy budget line of the Housing Revenue Account, outlined as part of its 30-year business plan in June 2018.

The project is expected to deliver a 20% saving between current costs of retrofits and those at the end of the project.

14.5 Replicability

General requirements

The UK (along with France and the Netherlands itself) was chosen after an Energiesprong initial analysis of 10 EU countries. The research found a number of factors contributing to its suitability. These include

- The socio-economic setting;
- Political support – the UK has a target to ensure all fuel-poor homes achieve an energy efficiency rating of C by 2030;
- Available financing – EU funding and LA budgets for increasing the efficiency of households; and
- Technical characteristics – examples include limited district heating, sufficient stock volume with some homogeneous characteristics and climatic circumstances.

These were all deemed to increase the likelihood of success for the Energiesprong approach across the UK. The consortium of 14 participants of Energiesprong UK is also considered a key sign of its potential success.

Scope

At least 11mn UK homes are suitable for Energiesprong retrofits. This consists of 2.3mn social homes, 7mn privately owned homes in England and 1.8mn homes in Scotland, Wales and Northern Ireland. The total UK social housing stock is equal to 4.9mn homes. This is split at 2.1mn (34.7%) provided under Local Authorities (such as Nottingham City Council) and 2.8mn (56.3%) by housing associations. This creates a substantial opportunity for the Energiesprong scheme to be rolled-out nationwide.

Scalability

A key feature of the Energiesprong initiative is an increase in cost savings over time one an integrated supply chain is established. Cost reductions under scale are shown in Figure 16.

Figure 34: Cost reduction trajectory

Housing units	Price per house	Total investment
100	£70,000	£7,000,000
400	£62,000	£25,000,000
500	£55,000	£27,500,000
4,000	£47,500	£190,000,000
Total		
5,000	-	£249,500,000

Source: Transition Zero

There are plans to scale-up Energiesprong internationally which will further drive down costs. Currently (May 2019), there are retrofit plans across the Netherlands (14,400), France (6,550) and the UK (225) primarily with but with intentions also to replicate across Germany (26) and Italy (5).

14.6 Future outlook

14.6.1 Policy and funding

The current approach to Energiesprong retrofits in the UK is heavily reliant on EU funding, which accounted for over 40% of funding in this case. With the UK set to exit from the EU on 31 December 2020, access to funding for Energiesprong retrofits to the social housing sector may prove more problematic and, with the private branch of Energiesprong retroffiting still in its infancy, the success of the scheme may be undermined.

An alternative route to success in the case of an EU exit may be the Shared Prosperity Fund (SPF). The SPF is a UK replacement to the structural funding from the EU. It would work in a similar way to EU funding where funds would be allocated to different regions, likely on a by-need basis. Any consultation on the fund is yet to be published lending uncertainty as to how it would operate. Likely themes of the consultation will include; its priorities and objectives, the amount of money to be allocated, the way in which it is administered and who will be administering it.

14.6.2 Energy savings

Energy efficiency is becoming a key element of the UK’s strategy to tackling emissions from the domestic sector. With a traditionally single-installation approach to upgrading the UK’s housing stock becoming increasingly exhausted, there will likely be a look towards more DREeM focused retrofits in the future. This may lead to a greater funding availability and support towards Energiesprong retrofits in the future.

15Glossary

Term	Acronym	Definition
Active Network Management	ANM	Generation connections offered by DNOs at a lower cost and/or on a shorter timescale, in return for being able to reduce the amount of power a generator is allowed to export at times of network stress Also known as Flexible Connections, Active Connections, Managed Connections, Connect and Manage, and other names
Balancing Mechanism	BM	The primary balancing service which National Grid uses to balance electricity supply and demand close to real time
Balancing and Settlement Code	BSC	Code covering balancing and settlement processes by which the electricity system is kept stable and the correct parties are charged for energy use
Behind the meter	-	Location of generation or batteries on the demand-side of the customer's meter, usually an investment to minimise third party charges for power
Capacity Market	CM	The CM is designed to ensure that there is sufficient generation capacity available to the system to maintain supply, paying generators an annual fee to be available
Carbon Sink	-	A carbon sink is anything that absorbs more carbon than it releases as carbon dioxide, for example trees
Committee on Climate Change	CCC	Independent advice to government on building a low-carbon economy and preparing for climate change
Common Distribution Charging Methodology	CDCM	A set of principles set by Ofgem, used by the DNOs to set distribution charges fairly amongst all user types
Competition and Markets Authority	CMA	The government department responsible for business competition and preventing and reducing anti-competitive activities
Contract for Difference	CfD	The current support scheme for large scale low carbon generation. Suppliers are required to make payments on a £/MWh of electricity supplied basis. Large generators are top-up up - or repay down - to an agreed payments value per MWh generated
Connection and Use of System Code	CUSC	Code covering transmission network connection and usage charges
Department of Business, Energy, and Industrial Strategy	BEIS	The government department responsible for GB's energy policy
Distribution Code	-	Code covering engineering principles of connections, safety and usage on the distribution network

Term	Acronym	Definition
Distribution Connection and Use of System Agreement	DCUSA	Code covering distribution network connection and usage charges
Distribution Network Operator	DNO	Own and maintain the distribution networks: regional mid- and low-voltage networks which serve most customers and growing amounts of generation. There are 14 distribution regions in GB
Distribution Use of System charge	DUoS	Recovered by DNOs to pay the costs of maintaining the distribution networks
Domestic consumer	-	A household customer
Embedded generation	-	Generators connected to the distribution, as opposed to transmission, networks. Typically, small in size and often renewable
Energy Company Obligation	ECO	This scheme obligated suppliers with over 250,000 accounts to install energy efficiency measures in domestic premises
Energy Networks Association	ENA	Trade body for the GB energy networks
Electric Vehicle	EV	Car, van or truck fuelled by electricity rather than fossil fuels. Zero tailpipe emissions, offering fume and noise emissions reductions, and if charged with low-carbon electricity, carbon emissions reductions also
Extra High Voltage	EHV	The highest voltage level of the distribution network (33kV and 66kV)
Extra High Voltage Distribution Charging Methodology	EDCM	A set of principles set by Ofgem, used by the DNOs to set distribution charges fairly amongst users connected to the EHV network
Feed-in Tariff	FiT	The FiT scheme supports small scale (sub 5MW) generation by providing a guaranteed price for electricity generated.
Gas and Electricity Markets Authority	GEMA	See Ofgem
Generator	-	Producers of electricity, typically either thermal (coal, oil, gas, biomass etc), nuclear, or renewable (solar, wind, hydro), though other technologies exist
Generation Distribution Use of System charge	GDUoS	Recovered by DNOs to pay the costs of maintaining the distribution networks
Grid Code	-	Code covering engineering principles of connections, safety and usage on the transmission network
Half-hourly settlement	HHS	Using actual meter reads to settle the market, rather than profiles based on assumed consumption. Currently in place for most non-domestic customers and likely to arise for small non-domestic and domestic customers in the next 3-5 years. Introduction will expose suppliers to the full underlying costs of their customers power use

Term	Acronym	Definition
High Voltage	HV	The mid-levels of the distribution network, 1kV and over
Imbalance charges	-	Charges levied on industry parties (including suppliers) for the difference between traded electricity and gas volumes and the volume delivered to customers
Imbalance Settlement	IS	The process of comparing notified and actual volumes consumed or generated in a settlement period and allocating the costs of balancing to each party, in proportion to their imbalance
Industrial and Commercial	I&C	Cornwall Insight definition defines electricity I&C contracts as: NHH (>10 meters/contract), HH <1GWh (>10 meters/contract), HH >1GWh (all)
Independent Distribution Network Operator	IDNO	Small localised distribution network, typically for a campus, housing development or commercial development
Interconnectors	-	Large, high voltage connections to other national markets for the trading of electricity. Typically for GB these are undersea cables using direct current, as alternating current performs poorly in these conditions
Licence-exempt	-	Generators, distribution networks and supply businesses can all be operated outside of the usual licencing requirements, by meeting the criteria set out in the *Electricity (Class Exemptions from the Requirement for a Licence) Order 2001*
Load factor	-	The amount of power a generator produces, compared to the theoretical maximum
Low voltage	LV	The lowest level of the distribution network, under 1kV
Master Registration Agreement	MRA	Code covering metering and switching
Non-domestic consumer	-	A customer who uses energy supplied for business purposes
Office of Gas and Electricity Markets	Ofgem	The gas and electricity market regulator
Offshore Transmission Owner	OFTO	Owners and operators of the large high voltage connections to major offshore wind farms
Offtaker	-	A purchaser of power from a generator, mostly but not exclusively an energy supplier
Over-the-Counter	OTC	A set product for wholesale power, typically traded via a broker
Peak period	-	The time when electricity consumption is highest. This leads to wholesale prices and network charges being highest during these times, and creates addition value to generation producing power, and consumers reducing consumption, during peak periods Peaks on the GB system are winter evenings, 4-7pm

Term	Acronym	Definition
Peer-to-peer trading	P2P	Sale of power directly from a generator to a consumer, outside of the normal market structures. Usually envisaged over the local networks, but currently not economically possible under market rules
Power Purchase Agreement	PPA	An agreement between a supplier and generator to buy the electricity output of the generator
Private network/ private wire	-	A network which is not part of the public, licenced networks. May connect one or more generators and customers. Often used to connect generators to nearby consumers to minimise exposure to third party charges
Renewables	-	A blanket term for “green” or “low-carbon” generation technologies. Typically include solar, wind, hydro, wave, tidal stream, biomass, and biogas. May also include green hydrogen
Renewables Obligation	RO	The Renewables Obligation was the main scheme to support large scale renewable generation. Suppliers are obligated to present a certain number of Renewables Obligation Certificates (Rocs) each year for each MWh of electricity supplied.
Revenue = Innovation + Incentives + Outputs	RIIO	Price control framework for networks, operated by Ofgem
Settlement period		Any of the 48 half hours each day used as windows over which electricity is traded, balanced and settled
Significant Code Review	SCR	A large and wide reaching review of the operation of an area of the electricity industry. Run by Ofgem to look into perceived faults, allowing it to introduce sweeping changes in relatively short timescales of 2-3 years
Small and Medium Enterprise	SME	Cornwall Insight defines the following electricity contracts as SME: non-half hourly meters (up to 10 meters/contract) and half hourly meters with <1GWh demand and up to 10 meters/contract
Smart Energy Code	SEC	Code covering the smart meter rollout and data protection
Smart Export Guarantee	SEG	Proposal from BEIS to require electricity suppliers over a certain size to offer tariffs to renewables generators under 5MW for exported power, where this is metered
Supplier	-	Energy retailer
Supplier of Last Resort	SoLR	The mechanism used by Ofgem if a supplier fails to transfer its customers to another supplier
System Operator	SO	The party responsible for ensuring the safe operation of the transmission system and balancing the system where it does not deliver
Tariff	-	An energy supply contract
Third party charges	TPC	The elements of an energy bill other than wholesale costs, tax and supplier margin

Term	Acronym	Definition
Time of Use	ToU	An energy tariff where unit pricing depends on the time of day of consumption. This may be static/fixed, or dynamic where prices change for each half hour, each day
Transmission Owner	TO	Own and maintain the transmission network, the high-voltage, long-distance energy network. There is one transmission network in GB, with three TOs
Transmission Network Use of System charges	TNUoS	Charges for using the transmission network. Location and time sensitive. Can give a benefit to embedded generation
Triad	-	See TNUoS
Warm Home Discount	WHD	A social scheme which requires suppliers with over 250,000 accounts to identify vulnerable customers and provide them with an annual rebate payment
Wholesale	-	The commodity price of electricity. Various prices exist, through indexes and markets. Wholesale costs make up about 35-40% of the typical electricity bill

16 Appendix A – BEIS Local Energy Hubs

The Local Energy Hub initiative was launched by BEIS in 2018, following its successful Local Energy Programme which offered all LEPs funding to develop regional energy strategies. The five Local Energy Hubs were financed with a £4.8mn grant to set up, in their region, a coordinator backed by teams with technical, legal and financial expertise in the energy sector. They are tasked with providing practical support to LEPs and LAs to support the development of priority energy projects, up to the point of financeability.

The five regions are:

- South West, led by the West of England Combined Authority
- Greater South East, led by the Cambridgeshire and Peterborough Combined Authority
- Yorkshire, Humber and North East, led by Tees Valley Combined Authority
- North West, led by the Liverpool City Region LEP and Combined Authority
- Midlands, led by Nottingham City Council

Each Energy Hub has the same overarching objectives: to increase the number, quality and scale of local energy projects being delivered; raise local awareness of opportunity for and benefits of local energy investment; enable local areas to attract private and/or public finance for energy projects; identify a working model for teams to be financially self-sustaining after the first two years. The Hubs have regional representation in each of the constituent LEPs, with project managers to develop initiatives in each area.

Each hub has a self-determined role suited to the region in which it operates, so that activities reflect local contexts, supporting delivery of priorities identified by LEP energy strategies, and agreed collaboration with the other Hubs. Here, we introduce and discuss these differences based on interviews with the leadership of each of the Hubs.

16.1 Rural community energy fund

The five Energy Hubs will be managing the rural community energy fund as well as their other responsibilities. This fund offers grants of up to £40,000 towards feasibility studies, and up to £100,000 business development and planning grant to progress projects to investment readiness. These grants can be awarded to established community energy groups for the development of renewable generation projects or low-carbon district heating schemes with community benefit.

In order to access this funding, in the first instance projects should contact the Energy Hub teams. Each of the Hubs has already commenced assessing applications, working with projects, and distributing funding.

16.2 South West Energy Hub (SWEH)

Though there are conurbations of significant size, the South West region is characterised by rural areas, with a high penetration of renewable energy and a strong community energy presence. Challenges across the region include:

- Increasing grid constraints preventing the rollout of further renewable generation and requiring grid and flexibility investment
- A large volume of energy inefficient and hard-to-treat housing which is off the gas grid
- The rural nature of some parts of the region with consequent weak grids and consequent connectivity issues
- Planned housing development causing considerable strain on existing energy networks

SWEH has developed a long-list of 130 projects with a potential investment value of £226mn. 22 of these projects are currently shortlisted for support, with support of four projects completed. These have an investment value of £107,183 and the Hub has calculated potential carbon savings of 34,195t/year if they are implemented.

The first completed project is a site appraisal and early-stage business modelling for a LA, helping it to understand the case for solar + storage investment in order to support decision making. The Hub has also worked with a group of Academy Trusts to create a business case for around £0.5mn investment by an LA in 600kW of solar PV generation on 10 Academy School rooftops, including creating a route to market to sell power to the schools. This model is now being replicated in a second stage, to another tranche of schools. The Hub has also worked with an LA to create a business case for £20mn of energy efficiency retrofits on its estate, including delivery of pilot sites.

The live projects include elements of rooftop solar generation, solar + storage options, whole estate solar and solar car parks, EV charging solutions, both new biomass and returning mothballed biomass to functionality, providing advice for new zero carbon developments, and working with CHP. It is also creating a market in energy efficiency retrofit business models and supporting ESCOs for renewables expansion, primarily on new development sites. SWEH is also working with local LEPs on early-stage hydrogen projects.

SWEH has developed relationships with the local DNOs to help progress projects in the face of the high levels of constraint on the distribution network in the south west region. These links allow projects to engage with DNOs to get an early look at feasibility and costs.

Another project is supporting work by LAs towards incentivising higher levels of energy efficiency by adjusting council tax and business rates. This scheme has the objective of incentivising new investment in higher energy efficiency without leaving LAs out of pocket by reducing income and without increasing bills for vulnerable (e.g. low income) residents.

SWEH has received interest in the RCEF from 108 groups and has awarded three rounds of stage one funding grants to 16 projects, totalling over half a million pounds. Round four of awards is now ongoing, with the Hub hoping to make further awards in July.

16.3 Greater South East Energy Hub (GSEEH)

The Greater South East region is by geography and population the largest of the five Hubs, containing 11 LEP areas. It will provide support to projects up to the point at which an investment decision can be made, working with LEPS, LAs and other stakeholders. With extensive urbanisation across much of the region, challenges are facilitating clean economic growth in housing and commercial site infrastructure, and supporting existing users to manage their energy demand, against a background of increasingly constrained energy networks. This is balanced with extensive rural areas, with associated issues of fuel poverty and off-gas grid properties.

The Hub has 48 projects on its shortlist, with an investment value of around £270mn. 17 projects have been completed, looking at solar deployment and battery storage on public sector land assets, rooftops and carparks, energy efficiency upgrades, EV charging, and infrastructure and an options analysis for business park. The Hub has funded two local authority feasibility studies, evaluating a smart grid in Colchester and a net zero enterprise zone development in Stowmarket. The Hub is currently working on a portfolio of public sector energy efficiency projects, solar and storage deployment and the decarbonisation of transport. the latter includes a partnership with the government Knowledge Transfer Network's innovation challenge on fleet replacement.

GSEEH's region is host to a considerable number of existing energy projects in development and has three of the Prospering from the Energy Revolution, Innovate UK demonstrators. Other cases studies include: creation of low-carbon energy delivery frameworks for councils seeking to deliver on climate emergency declarations, options appraisals for future housing and commercial developments for the Herts Innovation Quarter and Hornbill Business Park and locality; identification of sites for solar farms and other energy generation technologies in Oxfordshire, Suffolk, Waverley and Winchester; and energy efficiency and carbon saving surveys and assessments for a borough council and a parish council.

The Hub considers it important to use its work as an evidence base to influence central government policy. It is keen to encourage partnerships and create collaborative networks of energy stakeholders, for example through its Green Finance event in June. This will allow it to group similar projects and provide benefits from joint working, sharing common priorities and best practice.

It has also developed a series of toolkits to support local authorities and provide template documents to support them in delivering their own energy projects; these are provided through its website. They include a guide to energy procurement and investment models for LAs, legal advice on business model options for developing renewable energy infrastructure and supplies, and a partnership with UK100 to provide a green finance report.

GSEEH has awarded 10 stage one RCEF project feasibility grants, for around £400,000. Two stage two grants have also been awarded, to realise projects. These projects are for the decarbonisation of a village in Brighton & Hove via use of a shared heat pumps, and for the implementation of the Riding Sunbeams project which is deploying solar farms to provide traction power to Network Rail.

16.4 North East, Yorkshire and Humber Energy Hub (NEYHEH)

The North East region is one of the most geographically diverse of the five Energy Hubs. The region is made up of both rural and industrial areas, including significant amounts of energy inefficient properties. Some 8% of housing is off the gas-grid, and therefore presents economic opportunities for low-carbon heating. There are common challenges of domestic retrofit and decarbonisation, and a wide opportunity to establish a common and more efficient procurement framework. NEYHEH benefits from being able to work with a single DNO – Northern Powergrid – across its entire region.

It has adopted a fully federalised model, with the six constituent LEPs (Humber, Leeds City Region, North East, Sheffield, Tees Valley, and York, North Yorkshire and East Riding) each being funded to employ their own local project manager. These Hub Officers will develop pipelines of low-carbon projects in partnership with the LEPs, which will then be developed. The Hub will provide oversight and support assessments for prioritisation of projects, with development taken forwards by public-private partnerships.

Opportunities identified at an early stage are smart, flexible microgrids, building the energy supply chain, improving domestic energy efficiency, facilitating decarbonised transport, and supporting the growth of community energy groups in the region. Also ongoing in the region are nationally signify cant infrastructure projects including at least two large-scale CCUS projects, development of the hydrogen economy, a pipeline of heat networks projects including using geothermal heat from mine water, and a major supply-chain build-up for the offshore wind economy.

The Energy Hub has a pipeline of £300mn of energy projects under assessment, with many arising from the regional Local Energy Strategies. It is running a pilot of a tool which can provide an early assessment of project feasibility for low-carbon generation with a number of Local Authorities. Another ongoing project concerns the potential for mine-water in the region to provide heat sources for low-carbon heat networks. In the future, plans include supporting the deployment of energy efficiency on the domestic front, both private and social rented.

The RCEF managed by the Hub has supported 17 projects to date, including projects looking at solar generation, battery storage, low-carbon heat through solar thermal and heat networks, biogas production and wind generation.

16.5 North West Energy Hub (NWEH)

Local Energy North West Hub has the most concentrated geography of the five regions. It spans a more rural north and a more urbanised and industrialised south. This presents twin challenges: to decarbonise and localise energy across both a largely inefficient and hard-to-treat rural housing stock; and to decarbonise and reduce the energy bills of a significant amount of industry.

Part of the Northern Powerhouse, the region already boasts a strong offshore wind sector, with some of the largest offshore turbines in the world maintained from Liverpool, a burgeoning hydrogen economy, and a broad existing engineering and conventional energy supply chain including nuclear, coal and gas generation. Its local authorities are recognised as some of the most ambitious in the country in terms of local energy projects.

Local Energy North West Hub has team works together to help public sector organisations to develop projects across the constituent five LEP areas. The team is structured on a thematic basis, with expertise in decentralised generation, heat in buildings and housing. Over 100 strategic projects have been provided with some support, and 25 projects have had intensive support to undertake feasibility studies and prepare business cases.

Successes to date include a Climate Emergency checklist, for Local Authorities, helping them understand how to move past the declaration of an emergency to take real action to address carbon emissions in their region. A significant solar project pipeline programme has so far unlocked funding support for £17M of council led solar schemes. Activity to support heat networks provides Local Authorities with a vital “critical friend” when applying for feasibility funding and entering the Heat Networks Investment Programme. Aside from the team has also supported industrial decarbonization, energy masterplanning and urban development funding activities. The team has helped raise awareness and supported bids for national funding available from ERDF, Salix and BEIS Industrial Heat Recovery. The local Energy North West Hub plays a Technical assistance role supported with ERDF, and have worked with social landlords to develop housing retrofit proposals.

One early case study promoted by the hub is the Wirrel Met College project, which has deployed solar generation, gas-fired CHP, electricity and thermal storage units into a smart heating system for a college campus.

Local Energy North West Hub is aligned with pan-regional activity to deliver energy infrastructure, supporting Northern Powerhouse NP11 LEPs, the Borderlands Growth Deal (in Cumbria) and the Net Zero North West Industrial Cluster. This allows it to focus on delivery of tangible projects, while it uses expert knowledge to support other organisations to deliver their energy strategies.

16.6 Midlands Energy Hub

The Midlands region stretches across the middle of the country, including a number of urban and industrial areas. The MEH Regional Energy Team is provided with a central structure and network by Nottingham City Council, which allows its nine project managers to work together to deliver objectives, while being located across the nine LEP areas.

The nine Midlands LEPs produced seven local energy strategies (six single-LEP and one tri-LEP). These highlighted the following common challenges and development opportunities, which MLH intends to target through its work:

- Innovation
- Secure, affordable, low carbon & renewable energy
- Decarbonisation of heat
- Energy Storage
- Hydrogen
- Energy efficiency & renewable energy generation in existing & new properties
- Commercial and residential development in grid constrained areas
- Sustainable transport systems
- Smart energy systems
- A lean, resilient clean growth economy
- Local economic growth and employment
- Fuel Poverty reduction

- Increasing grid capacity
- Developing the low carbon supply chain

The Hub is currently providing support to 53 projects, with a £180mn pipeline. Its projects include renewable heat networks – importantly, some of these will use sewer or mine water heat reclamation – assisting the development of EV infrastructure with the identification of one site for a EV charging hub and an ongoing project to identify further hub sites, both small and large-scale solar PV, and supporting the development of new low-carbon garden villages in the region.

One early project which is progressing through planning at present is the Bowman's Harbour solar array. This 7MW solar farm, to be constructed on a landfill site, will provide low-cost, low-carbon power to a local hospital. Others include support for a substation upgrade to enable a large deployment of solar generation and battery storage, rooftop solar installation, and support with gas connection to enable a new CHP. 22 desktop feasibility studies on leisure centres have been completed, showing potential for 1.8MW of solar generation.

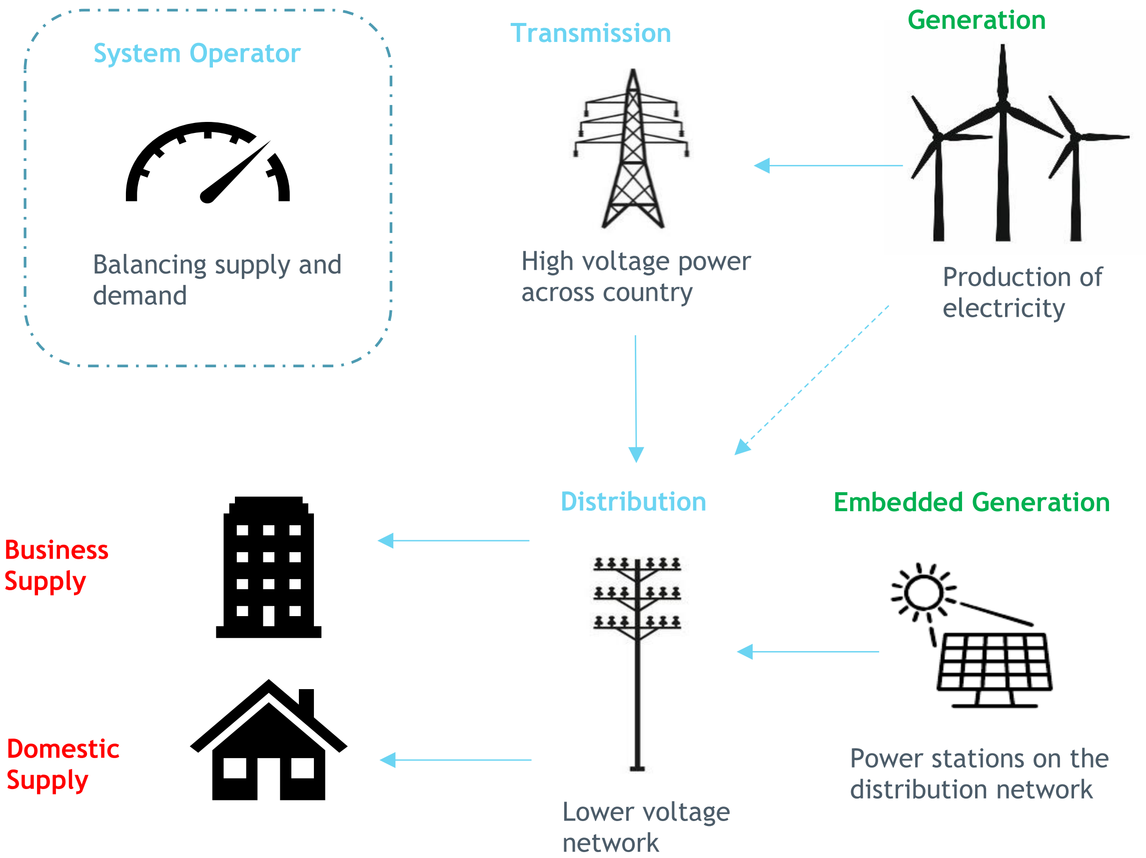
The Hub has built a project testing model, which allows calculation of an early look at financial viability of a specific investment. This will support the Hub and partners to understand which concepts will reward further support. It is developing a tool for Parish Councils, to help them calculate their carbon footprint and to understand how this can be decreased. It is also engaging in a supply-chain mapping exercise to help its partners understand the options and resources available to deliver projects from the local area and supporting social housing bodies to apply for funding to decarbonise their housing stock – this latter to be supported by recruitment of a dedicated fuel poverty officer.

Midlands has provided a dedicated officer to deliver its RCEF responsibilities. It has received 150 enquiries, with 12 applications successful to date. These projects have looked at vertical wind turbines, solar generation, solar + storage, a holistic energy scheme using generation and community support including an e-minibus, improvements to Church energy efficiency, the restoration of a world heritage water wheel and its conversion to electricity generation, a refit of a town hall to add a heat pump and large-scale solar generation. Most projects combine multiple energy vectors (electricity, heat and transport) and provide direct community benefits beyond simple revenue.

17 Appendix B – Detailed Summary of Electricity and Gas Functions

The GB electricity and gas markets have numerous roles and functions encompassing infrastructure, competitive activities, and regulatory and policy authorities. A simplified overview of the electricity market roles is shown below in the figure below The physical infrastructure of the GB electricity market is made up of sources of energy input (electricity generators) and networks (transmission and distribution) to transport the energy to where it is consumed by final users (demand).

Figure 35: GB electricity physical infrastructure



There are a range of bodies that act in the industry; to maintain the networks, buy or sell power, and physically manage the system. These include:

- **Generators** - entities that own generating assets and produce electricity onto the public network for onwards transport to customers
  - This can either be large scale generation (several hundred megawatt (MW) or more) connected to the transmission network or smaller scale generation connected to the distribution network (known as 'embedded generation', 'distributed generation', and 'decentralised energy' interchangeably)

- Examples of large generators include: Drax, Marchwood, EDF, Innogy, Uniper, Macqurie

– Generators can also be small scale such as local or community assets (rooftop solar PV, community wind turbines, etc)

– Generation can be located as a standalone asset or collocated with demand "behind the meter". In the latter case the industry sees the generation as offset demand

- **The System Operator (SO)** – a singular operator responsible for ensuring that the electricity transmission system is operating safely in real time and accounting for any over- or under-delivery of energy onto or off of the network

– This activity is currently undertaken by National Grid Electricity System Operator (NG ESO)

- **The Transmission Owner (TO) -** an entity that owns and maintains transmission facilities

– The national electricity transmission network provides bulk transport of power up and down the country at high voltages: 400kV, 275kV, and – in Scotland – 132kV

– The transmission networks connect large generation assets – currently around 68GW in total capacity – to the 14 distribution networks through Grid Supply Points to small scale generators and consumers. They also supply power to a few very large transmission-connected consumers.

– Three TOs are found in the GB system; National Grid Electricity Transmission (England and Wales); Scottish Power Transmission (Southern Scotland); and Scottish Hydro Electric Transmission (Northern Scotland)

- **Distribution Network Operator (DNO) -** a company licensed to distribute electricity in the UK, operating distribution networks via towers, cables and meters across 14 different DNO regions

– Regional distribution networks step down voltage levels to those more appropriate for end consumption (132kV and below). DNOs connect most consumers, with larger consumers being connected at higher voltage, and smaller consumers at lower voltages

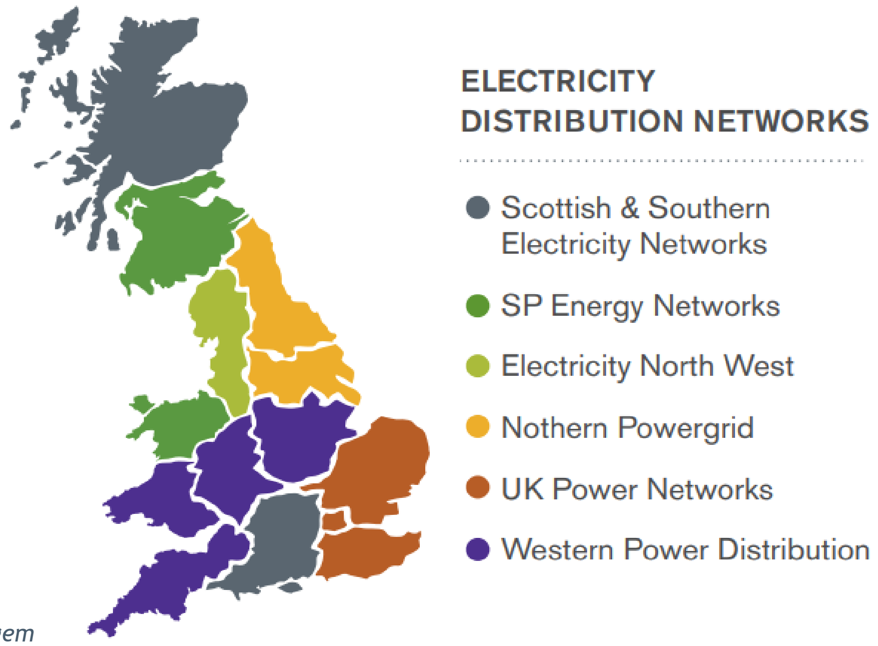
– The distribution networks connect smaller generation assets, totalling over 40GW of generation capacity in 2018

– There are currently six DNOs across GB: UK Power Networks (UKPN); Western Power Distribution (WPD); Scottish Power Energy Networks (SPEN); Northern Powergrid; Scottish and Southern Energy Power Distribution (SSEN); Electricity Northwest (ENWL)

– The figure overleaf shows the DNOs and their areas of operation

– As well as the six main DNOs, there are a number of independent distribution network operators (IDNOs). These IDNOs are small localised networks within the main DNO areas. There are 13 licensed IDNOs in GB, with each operating multiple networks.

Figure 36: Distribution Network Operation regions in GB

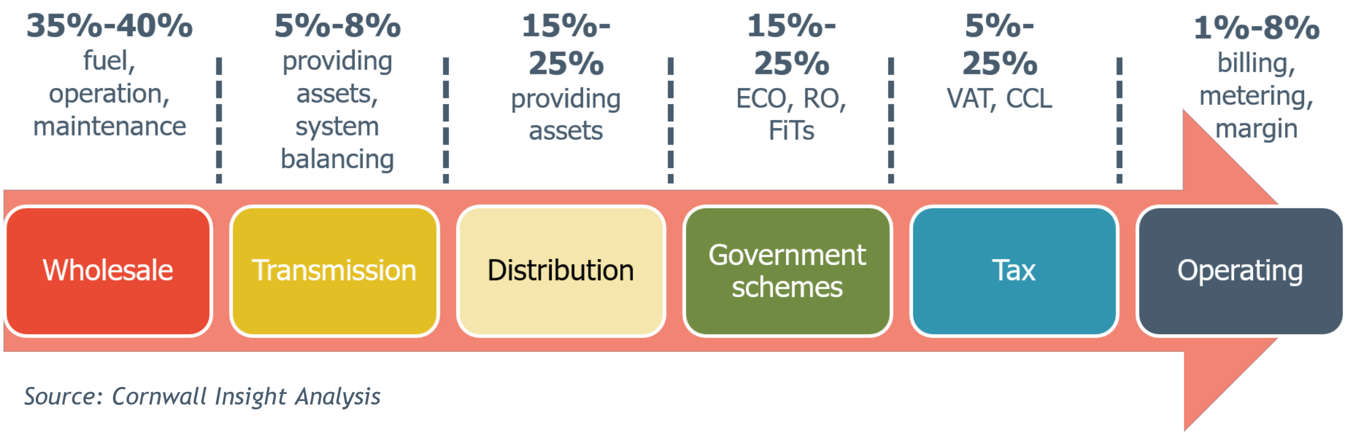


Source - Ofgem

- **Suppliers** – companies licensed to retail electricity and gas to end consumers
  - An energy supplier agrees contracts to deliver electricity and/ or gas through to end customers, identified by their meters. Suppliers purchase energy in the wholesale markets and supply this to their customers, although many are "vertically integrated" and also own generation assets. Suppliers also pay the range of costs associated with the delivery of the energy to the end consumer, including network charges, government policy programmes, smart metering, and other factors. These costs are ultimately passed on to the end consumer through their bills. Suppliers are responsible for the following activities:
  - Providing the commercial point of interface between the consumer and the energy system – the retail part of energy supply
  - Paying for (and recovering from customers) all costs incurred from the electricity system, including network charges, wholesale costs, system operator costs and policy costs
  - Metering electricity consumption, including providing of meters, and appointment of agents to install and maintain meters. Suppliers are also responsible for the smart metering programme and obligated to offer smart meters to all domestic and small non-domestic customers by the end of 2020
  - Delivery of government energy policies (such as payment of the Climate Change Levy, Renewables Obligation, Feed in Tariff, Contracts-for-Difference, and Capacity Market)
    - There are over 100 licensed suppliers active in GB. Examples include: the six large suppliers (British Gas, E.ON, EDF, npower, Scottish Power and SSE); large

non-domestic suppliers (Haven, Smartest, ENGIE, Opus) and a range of smaller domestic and business suppliers (First Utility, OVO Energy, Cooperative Energy, Octopus Energy)

- There are also white label and licence lite suppliers:
  - White label suppliers are those where a brand uses its image to sell to customers, but a trusted energy supply partner provides systems, trading and customers service. Examples include pairing with a well-known or trusted brand, like a supermarket (e.g. Sainsbury's Energy, a white label of npower) or a local authority (e.g. ROAR Energy, a white label of Engie). In reality there is a sliding scale of responsibility that the white label can choose to keep in-house, for example providing the customer service function
  - Licence-lite suppliers are essentially a halfway house between a white label and fully licensed supply. The supplier needs to apply for a licence-lite licence with Ofgem, and maintains much of the supply functionality in-house. However, they must firstly draft and agree a Supplier Service Agreement (SSA) and Netting Off Agreement (NOA) with a fully licensed partner supplier. The concept hasn't gained much traction as the obligations are almost as significant as becoming a fully licensed supplier, and there is little incentive for a fully licensed supplier to partner to provide services. However, the Greater London Authority (GLA) estate received kudos for pioneering the first licence lite supply
- Suppliers are important for local power generation as they typically buy power from small scale generators and interact with central industry data flows on the asset's behalf. This is typically done through an offtake agreement or Power Purchase Agreement (PPA).



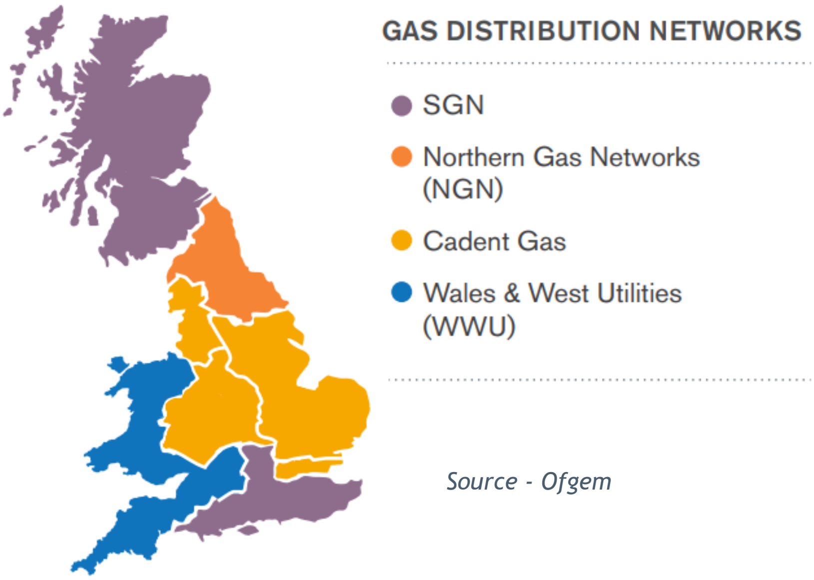
Source: Cornwall Insight Analysis

17.1 Key differentiators in the gas market

The GB gas market is similar in structure to that of the electricity market, although there are some different terms for certain components or functions in the gas market. The transmission network flows gas to the distribution networks, which transport gas to the end user. The network functions are monopolies, as in electricity, with competition in the supply and production functions. A key differentiator however is the presence of significant gas demand at the transmission system from gas-fired power stations. These combined cycle gas turbines (CCGTs) and open cycle gas turbines (OCGTs) are typically responsible for around one third of national gas demand.

- **Producers -** entities that put gas into the system through entry points. These can be entry points from UK Continental Shelf production or via liquefied natural gas (LNG) terminals
- **The System Operator (SO)** – National Grid fulfils this role in gas as well. The gas network is balanced on a daily basis, with the SO taking actions within day to maintain the volume and pressure of gas in the pipelines
- **Gas Transporters** – otherwise known as GTs, these are the companies that own the gas pipelines and are responsible for moving gas around the country
  - The TO is National Grid Gas Transmission, responsible for flowing gas through the national transmission system (NTS), a series of very high pressure gas pipelines that run from the north of Scotland to the southwest
  - The local distribution zones (LDZs) flow gas through lower pressure tiers from the transmission network to end consumers. These companies include Wales and West Utilities (WWU), Cadent, Scottish and Southern Gas Networks, and Northern Gas Networks
  - There are also a series of interconnectors with European neighbours including the Bacton-Balgzand Line (BBL) to the Netherlands, IUK to Belgium, and the Moffat interconnector to the Republic of Ireland
  - Figure 37 below shows the LDZs and their regions of operation
- **Shippers** – these entities are responsible for booking the capacity on the pipelines to move gas to end consumers. In the electricity market, the shipping and supply function are both provided by the supplier. In gas they are distinct, such that the shipping function can be outsourced to a separate entity. Typically, most suppliers are their own shipper
- **Suppliers** – Much as in electricity, suppliers own the end relationship with the consumer. Many of the same parties are also active in this space, as they typically offer dual fuel supply. However, some suppliers may offer gas or electricity only

Figure 37: Local Distribution Zones in GB



Source - Ofgem

18 Appendix C - Examples of LA Initiatives Involving Private Wires

There are a number of publicly available examples of where Local Authorities have concluded that private wires are in their interest to develop.

Gateshead

The Gateshead Town Centre District Energy Scheme[14] development commenced in 2011. Gateshead Council was supported by Parsons Brinckerhoff to establish a district energy network to serve the town centre and Gateshead Quays area. The gas fired CHP energy centre will export both heat and power for sale directly to customers via an underground heat network and high voltage private-wire funded and owned by the Council through a new ESCo.

The Council's stated objectives for the scheme are:

- To provide low cost heat and power to existing homes, organisations and businesses in the urban core of Gateshead, reducing their running costs and improving their competitiveness
- To create new business growth in Gateshead, by offering low cost, low carbon heat and power to new commercial development
- To reduce Gateshead's carbon footprint, by providing heat and power with half the carbon emissions of grid energy supplies
- Reduced heating and power costs for building occupants, of at least 5% and potentially more, compared to prevailing market rates of heat and power costs—this is stated as business occupants we see reduced exposure to green/ carbon taxes and levies

More information about this project can be found in the associated case study on the Gateshead project.

Harrow

The London Borough of Harrow issued its energy masterplan[15] in January 2016. Arup was appointed by the Council to undertake a district heating energy masterplan study for the Harrow & Wealdstone Opportunity Area and the Grange Farm housing estate regeneration area, located just outside the opportunity area.

One of the conclusions is that where the gas (or biomass) fired CHP energy centre is located next to a large new development then it may create an opportunity for private wire supply. However, the report also noted that "if energy centres are mainly sited at large residential development sites where realising private wire is not likely due to individual supply agreements and complexities herein."

[14] http://www.gateshead.gov.uk/Building%20and%20Development/Regeneration/GatesheadCentre/Gateshead-Town-Centre-District-Energy-Scheme/District-Energy-Scheme-benefits.aspx

[15] http://www.londonheatmap.org.uk/Content/uploaded/documents/Harrow_EMP_Final_Issue_RevA_2016-01-26.pdf

Greenwich

The Royal Borough of Greenwich published its energy masterplan[16] in November 2014. The Council's aspiration is "to unlock low-carbon, cost-effective heat provision that will not only serve new developments, but also help to decarbonise energy supplies to existing properties. This opportunity is most easily realised whilst these areas are in their early development phases, and it is therefore imperative to act in line with the timescales of regeneration, thereby helping district energy (DE) to unlock growth, employment opportunities and poverty reduction".

The masterplan, developed by Parsons Brinckerhoff, noted that "the value of electricity generated through a decentralised energy scheme equipped with CHP can be maximised through the use of private wire networks. Whilst the wholesale price of electricity to the grid is around 2-5p/kWh, a private wire network – whereby an electricity network is installed between an energy centre and nearby electricity users – is able to maximise the value of energy generated by enabling retail values to be obtained (e.g. around 8-12p/kWh)." The report also stressed that Parsons Brinckerhoff "would strongly recommend that electricity private wire sales are pursued for the Royal Borough of Greenwich schemes identified wherever possible."

Nottingham

The Nottingham District Energy Network[17] is made up of 68km heat network used to provide heating and hot water requirements to over 5,000 dwellings and over 100 commercial premises. Customers include the National Ice Arena, the Broadmarsh and Victoria shopping centres, the Inland Revenue offices, the Nottingham Town Hall, Capital One's UK headquarters and Nottingham Trent University.

At its core is a 14.4 MWe CHP EfW plant (the Eastcroft incinerator) which produces 60GWh of electricity annually. Export is supplied to large commercial customers through a private wire network, with the excess spilled. The generating asset also provides Short Term Operating Reserve (STOR) to National Grid and provides flexibility for peak transmission charging avoidance during winter peak periods.

[16] http://www.londonheatmap.org.uk/Content/uploaded/documents/Greenwich_EMP.pdf

[17] http://www.publicsectorenergy.co.uk/project-showcase/150-articles/project-showcase/465-project-showcase-nottingham-city-council