Building local economic resilience though democratic local energy models

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forum for the future

Friends Provident Foundation

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We connect, fund, invest and share learning to shape an economy that works for all.

Forum for the future is an international non-profit working with business, government and civil society to solve complex sustainability challenges.

Building local economic resilience through democratic local energy models

This project, funded by the Friends Provident Foundation, has developed and will be sharing practical new business models and learning for community energy groups to enable them to adapt to the changes in government policy and continue their transformative role democratising the energy system, retaining economic value locally and supporting social justice.

When the energy supply chain is localised, local jobs can be created, energy spend can be kept in the local economy and community benefit funds can be created and reinvested locally to reduce community vulnerability and to create a more resilient financial system. However, changes in national support for renewable energy projects have made it very difficult for community energy groups to deliver projects.

This project has researched, developed and shared practical new business models for community energy groups to provide them with the support that they need to adapt to the changes in government policy. The learning and ideas generated throughout the project will be used to influence government policy and regulation to unlock the barriers currently restricting community energy models.

Cover image credit: Plymouth Energy Community

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Executive Summary

The UK energy system is undergoing a profound transformation moving away from a centralised fossil fuel dominated system of supply and towards a decentralised, low carbon, smart system.

The pace of change is rapid and exciting as renewable energy continues to drop in price, new technologies like electric vehicles and storage continue to develop and innovative new ways of matching supply and demand are enabled. This transition is opening up new opportunities to democratize our energy system by allowing communities to generate, distribute, sell and consume their own energy.

> **There are already 222[1] community energy organisations in England, Wales and Northern Ireland working hard to develop renewable energy and energy demand reduction projects that allow them to reinvest in the social, economic and environmental development of their local area.**

These groups represent a UK-wide, active, knowledgeable pool of potential facilitators, investment raisers, delivery partners and asset owners. They are the critical link between new markets and a truly locally owned energy system that is flexible and affordable.

However, over the last three years the sector has had to adapt to a changing policy landscape with subsidy support in the form of the Feed-in-Tariff being phased out and tax incentives for investment also being withdrawn. This has seen the number of new projects in development fall by significantly[2]. Community energy groups have great potential to facilitate greater democratisation, participation and plurality of ownership of our energy system but they cannot play this pivotal role without access to simple, viable and easily replicable business models.

With support from the Friends Provident Foundation, Regen, Community Energy England, Forum for the Future and 10:10 have been working with community energy groups to identify new business models that can help them to adapt to this new policy landscape and strengthen the role they can play in our transforming energy system focusing upon the areas of local supply, energy storage and community heat networks.

The priority was to identify models which could provide a route market for community energy groups, models that could be replicated, scaled up and rolled out across the sector to help to reinvigorate the project pipeline, or identify the key barriers to their development. In practice, the work undertaken by this project has highlighted how far community energy groups and the models they are developing have come in just a few years, exploring how they could play a role that brings local benefits as part of a national market that is changing rapidly.

The project has not resulted in identifying three readily replicable energy project models for community groups. The fragmented and complex landscape of the UK system means that most energy projects are a product of local conditions, assets and opportunities that are unlikely to be found in many other locations. However, the *journey* that most community energy groups undertake in exploring new models is similar throughout the UK, and indeed internationally. This project has gathered some key intelligence and learning about the barriers facing community energy groups during 2017 in pursuit of new business models, which it is hoped will be of value to groups up and down the country. In addition, undertaking this project has led to a clearer picture of the role community energy could play in the emerging new energy market, pre and post BREXIT and how this could be harnessed, leading to a truly decentralized, decarbonized and democratized energy system.

If only large scale incumbent players with capacity and development resource are able to capitalise upon the opportunities emerging in areas such as smart tariffs and flexibility we will lose the benefits that flow from having an energy system that enables the participation of a strong and active network of community groups.

To build a more democratic energy system community energy groups need to be supported, to have a seat at the table as the process of energy transition continues and in particular, we would recommend that:

- EU network codes are interpreted and translated in a way which enables community groups to participate in emerging markets around flexibility and aggregation;
- the Renewable Heat Incentive is continued beyond 2021 with a specific focus on heat pump lead schemes to allow community energy groups the time to develop viable models and the knowledge and expertise to become more involved in the deployment of renewable heat technologies
- Community energy groups are represented in discussions about the future of network charging, provision of flexibility services and not locked out of routes to market
- steps are taken to explore how platforms which seek to share anonymous demand data of various building types can be better supported to help community energy groups to more easily identify locations where subsidy free projects may be viable; and
- options are explored to support the development of community owned microgrids in new housing developments.

This suite of measures would help to create the conditions which support new business models for community energy groups in areas such as renewable heat, local supply and storage becoming viable. Doing so will allow community groups to play a more prominent role in new energy markets, tackling complex projects which bind in additional benefits such as engaging harder to reach demographics, addressing fuel poverty and raising money for local services.

1 https://communityenergyengland.org/pages/state-of-the-sector-report

2 44 of the 144 organisations interviewed for Community Energy England's 2017 State of the Sector Report had a project which are currently stalled or inactive

Identifying new business models for Community Energy

The community energy sector in England, Wales and Northern Ireland has delivered 171MW of renewable energy capacity over the last decade, generating enough electricity to meet the energy demands of 85,000 homes and now employs 85 FTE equivalent staff[3].

The growth of the sector has been supported by feed-in-tariffs for renewable energy technologies which made it easier for Community Energy groups to raise finance and generate income from their projects.

However, the rapid reduction in the rates of FiT available for new projects over the last 3 years has caused the pipeline of community energy projects in the UK to slow significantly. With FiTs being withdrawn altogether by 2019, there is an urgent need to support community energy groups in identifying new business models which enable them to continue playing an active role in the UK energy transition.

With support from the Friends Provident Foundation, Regen, Community Energy England, Forum for the Future and 10:10 have worked to identify new models emerging nationally and internationally with the greatest potential to be replicated and scaled up quickly.

The report contained in Appendix One to this document contains a comprehensive overview of potentially promising models with examples of where they are being successfully deployed. From that desk research three clear frontrunner models emerged in the areas of local supply, storage and renewable heat networks. These front runner models have then been testing in the field through projects being developed by Easton Energy, Plymouth Community Energy and South East London Community Energy (SELCE) to determine their potential to create new route to market for community energy groups. The key elements of each of those models and the outcomes of testing them are set out in more detail below

3 https://communityenergyengland.org/pages/state-of-the-sector-report

Local supply

Local supply arrangements have the potential to enable community groups to receive a better price for their power by reducing distribution and transmission costs and can, depending upon the model, also provide an extra source of revenue through providing demand flexibility or demand reduction services.

By linking local generation with supply there is also the possibility to impact upon consumption behaviours, enable engagement with harder to reach groups and set tariffs which could also reduce energy bills for consumers.

There are a number of different local supply models emerging with varying degrees of involvement from a licensed supplier. More details on the differing types of local supply model are provided in Appendix One.

The two local supply models considered most promising in terms of their maturity and potential ease of deployment in the UK are centered around demand side response and local balancing and microgrids.

Demand side response and local balancing

In this model, smart meters produce real-time consumption data which enable time of use tariffs and incentives to shift consumption to be used offering the potential for the whole community to make savings on their bills. Under the current regulatory structure it requires a community group to partner with a local supplier but offers the possibility of earning income from providing flexibility services that can either be aggregated and sold at scale or provided locally to a DNO.

Local balancing can also be incorporated into this model which creates a direct link between local generation and consumption.

Energy Local

The Energy Local Club[4] which is currently being piloted with some success in Bethesda in Wales is a good demonstration of the possibilities of this kind of model. Energy Local Clubs match the output from a local renewable energy generator to a local demand customer and can benefit both the generator and consumer. The generator or generators and community (the demand load/demand members) need to both be connected to the same electricity substation, and ideally to the low voltage network.

The output/demand match is assessed every half-hour (using Smart meters located with the generator and the consumers). The more closely the pattern of generation matches the pattern of demand, the more savings can be made.

The Club agrees a price that households will pay for the electricity they use when the local renewable energy is being generated. This price will be higher than what the local renewable generator would normally receive, but lower than what the households would normally pay. An energy supplier still needs to be involved in this model who will enter into PPAs with the generators and handle the back office/administration side of things with consumers.

4 http://www.energylocal.co.uk

Microgrids

A microgrid is a small-scale physical power grid that connects distributed energy resources, such as generation and storage, to end-users. It can either operate in parallel to, or independent of, the public network. Most remain connected to the public network to enable the export of excess generation or to top up when generation is low.

Microgrids enable a direct connection between generators and consumers and if the distributor is providing less than 2.5 MW of power to domestic customers (or 1 MW if grid back-up is required), it can be classed as licence exempt supply. This makes it possible to cut out the standard use of system charges and other obligations that apply to licensed suppliers. Therefore, it can help the generator get a better price, as well as lower bills for end-users. They tend to work best if the demand customer can use 100% of the electricity being generated. There is, however, a significant capital investment required in terms of cabling, metering and connections.

There are already examples of microgrids being used on a small scale in the UK by communities to supply the renewable energy they produce directly to consumers. For example, the WREN solar array in Cornwall provides power directly to sewage treatment works in Nanstallon through a private wire[5].

In Feldheim in Germany they have built their own electricity and district heating grid, ultimately making them an entirely energy-sufficient and climate neutral village in 2010. To date, the produced electricity and heat covers the energy demand of the village, allowing them to also be selling surplus energy generated.[6]

Local Supply Case Study: Easton Energy

Introduction

Easton Energy Group[7] is a social enterprise based in Bristol that helps local residents to reduce their energy use, assists those in fuel poverty and encourages community action against climate change.

At the start of 2017 Easton Energy Group (EEG) began investigating the potential to develop a local supply model that supported their goal of installing solar photovoltaics on as many domestic roofs as possible. They were investigating models in particular, for a project called TWOs which aimed to install 100 kW of solar over 120 homes on two streets in Easton (Bristol) and which had been negatively affected by changes to the feed-in-tarriff.

Objectives

EEG worked with Regen to compare two local supply models for doing the TWOs project that might provide a better financial return. Easton's objectives in trialing new local supply models were to ▶

5 http://www.wren.uk.com/news/100-community-energy-powers-sewage-treatment-works

6 http://nef-feldheim.info/the-energy-self-sufficient-village/?lang=en

7 http://www.eastonenergygroup.org

- enable enable more householders to have lower energy costs and take part in the installing renewable energy and tackling climate change even if they couldn't afford to install PV on their own homes and to get a better price for community-owned generation by selling to local households rather than the grid at the standard export price.

They compared the model of creating a Simtricity Community Microgrid with the organisation Community Energy Prospector with the model of creating a virtual private network with the organisation Energy Local. EEG have worked with Community Energy Prospector before when they installed a microgrid at the Easton Community Centre and the project was a great success and is greatly supported by the community. The Energy Local model is currently being trialed in Bethesda (Wales) and there are plans to roll it out in ten other locations in the near future.

Outcomes

The Simtricity Community Microgrid is an exciting idea that has never been tried in an urban area that is already connected to the public network before. This technology would enable exempt distribution and supply with freedom over the tariffs and use of system charges for power trading within the microgrid and therefore provide potentially significant savings on energy bills.

Critical to the success of the Community Microgrid model would be securing local buy-in and understanding of the model and the benefits. Easton have established strong local relationships due to the extensive community engagement work they have done and their history delivering successful community energy projects in the area. In other geographies where this strong track record and deep community engagement was not in place, it may be challenging to get the buy-in necessary to embark on an innovative project such as retrofit of a microgrid.

Although the microgrid retrofit model is innovative and different, researching this project has revealed that owing to the capital costs and upheaval associated with retrofitting a microgrid, this technology is more suited to new builds. Therefore, on balance, a virtual private network model, such as the Energy Local Club, would be more suitable for most community energy groups because they use existing infrastructure and have a slightly lower risk to the community-owned generation because the market for potential customers is not limited to a small area physically connected to the microgrid.

To assist communities in deciding whether a physical microgrid might be a viable option for them Regen have produced a decision tree which can be found in the which can be found in the output report for Easton Energy Group, hosted on the Community Energy Hub.

Policy recommendations

Enabling communities to become engaged in the local supply of the energy they generate offers exciting opportunities to create new and sustainable business models that would allow community energy to thrive in a post subsidy landscape after 2019 with the potential for them to receive not only a better price for the electricity they generate but to also play an important role in helping to balance local supply and generation to the benefit of the grid.

However, to capture the multiple benefits that may flow from these models, there is a need for a regulatory system which encourages and enables community groups to become involved in the supply market. The current costs associated with setting up and running a supply licence are prohibitive for community generators who are also ill equipped to navigate the complicated supply licensing regime. Whilst entering into partnerships with third party suppliers offers an alternative route negotatiating these partnerships is, in itself, a complex task and the balance of negotiating power is often not with community groups.

To maximise the income streams that could flow from a local supply model there is a need for smart meters and half hourly metering to become more widespread and standardised.

To address these issues we would recommend that:

- licence exemptions for the supply for sale of own generation (up to 5 MW) are enabled
- the roll out of smart meters continues to be supported and pushed forward, measures are put in place to allow domestic half hourly settlement
- Support is provided to community energy groups to help them:
  - raise awareness of the opportunities for smart homes
  - engage in the flexibility market in partnership with suppliers/third party aggregators

Storage

With 24.6%[8] of electricity production now coming from decentralised renewable sources, balancing the grid system is becoming increasingly difficult with daily peak demand also growing.

As we transition towards a further decentralised lower carbon system, battery storage will play an increasingly important role in enabling more renewables to be added to the grid by reducing the need for increased peak generation capacity enhancing grid reliability, minimising outages and reducing costs.

By allowing customers to manage their usage more actively, taking and storing electricity at times of low demand and prices and then using it at peak times it both reduces costs and helps to balance production and demand and offers opportunities to improve the economic viability of community energy schemes, the economic viability of which has been compromised by changes to subsidy support.

> **New potential revenue streams from storage are opening up rapidly as flexibility, capacity and demand response markets evolve and matures. Further details of different kinds of potential revenue streams are set out in Appendix One**

Internationally models already exist which combine storage with peer to peer energy supply through trading platforms which could potentially be replicated in the UK if the right regulatory framework and financial incentives were in place helping to increase the financial viability of installing solar and battery storage in the absence of support from a feed-in-tariff. For example, the Sonnen Community[9] in Germany is community of battery owners who are enabled, through a software trading platform, to share their energy surplus with other negating the traditional need for an energy supplier. For every kilowatt hour shared, battery owners receive financial compensation that is well above what they would receive for exporting the same electricity to the grid. The utility Salt River Project in Arizona[10] has enacted a new tariff for residential customers who choose to install rooftop PV systems. The tariff increase a customer's fixed charge and incorporates a residential demand charge. Under this new tariff, behind the meter energy storage systems are used to reduce demand charges, navigate time of use rates and offset the increased fixed charge by providing ancillary services to the utility.

8 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/633782/Chapter_6.pdf

9 https://www.sonnenbatterie.de/en/sonnenCommunity

10 http://arizonagoessolar.org/UtilityPrograms/SaltRiverProject.aspx

Storage Case Study: Plymouth Community Energy

Introduction

The revenue generating potential and rapid innovation happening around both battery technology and trading platforms mean storage has great potential to unlock new business models for community energy. However, storage options and models are still in their relative infancy in the UK and community groups are only just starting to explore the possibilities that storage offers.

Plymouth Community Energy[11] is a Community Benefit Society set up in 2013 with the aim of giving the people of Plymouth the power to change how they use, buy and generate energy. PEC now owns over 30 solar PV installations that are hosted predominantly on schools and public buildings across Plymouth. PEC currently sells power via Power Purchase Agreements (PPAs) to the sites on which it's PV is installed and exports any electricity that is not used to the grid. Maximising the amount of energy that can be used on a site would be beneficial to PEC as they receive a higher price than if it is exported to the grid. They were interested in exploring whether, financially, installing onsite battery storage would be a viable solution which would allow them to maximise on-site energy use.

Objectives

To support PEC in exploring the possibility of installing storage Regen developed a ready reckoner tool which took basic data about the sites, applied a set of assumptions about costs and finance to develop a high level illustration of what savings a battery co-located with solar pv on a particular site could generate. It helped to clearly illustrate how economically viable a certain mix of solar, demand profile and storage might be and modelled how much costs would need to come down by for viability to be improved. It was developed for particular application to secondary schools but could be adapted for use with demand profiles of other types of buildings such as hospitals, leisure centres etc

Outcomes

Unfortunately analysis of the data produced by the ready reckoner revealed that storage would not currently be an economically viable option for the size of projects that most community energy groups are developing at the present time owing to both the current price of both batteries and electricity. However, with cost curves for batteries expected to follow a similar trajectory as solar it is expected that this position may change within the next 18 months to 2 years although much will still depend on the alignment between the system power and storage capacity specification and the end user energy demand profile on a case by case basis.

As prices fall and storage becomes a more attractive option, there is potential for communities to not only generate income through increasing onsite energy use but by also being enabled to participate in the flexibility and demand response markets as these mature. Aggregating storage systems permits greater control over multiple demand profiles and can lead to increased revenues when combined with network signal technology.

11 http://www.plymouthenergycommunity.com/about/story

Storage: recommendations for policy makers

Electricity storage is now a technically feasible option in the UK but for it to become financially viable for community groups to install and unlock new business models there is a need to ensure that regulatory frameworks are in place that enable community participation for example, in local balancing and flexibility markets. In particular:

- The current regulatory and policy framework has not been designed for energy storage. The definition of how storage should be treated (as an intermittent generation or demand asset) needs to be clarified as soon as possible
- In the short term at least, energy storage projects will require a higher degree of system architecture design and will carry higher levels of technology risk than more established generation technologies
- It will be important to ensure that the forthcoming reform of network charging takes an holistic view and ensures a level playing field for energy storage technologies, demand side response and other form of system flexibility
- Accelerating roll-out of smart meters and the uptake of time of use tariffs will enable more consumers, including community groups, to take advantage of price arbitrage opportunities
- Eliminating instances of double charging (demand and generation) for end user levies and other network charges and implement measures would ensure that energy storage can fully access network service revenues to assist in making storage more financially viable for community groups
- Policy makers should provide clarity on the scale and timing of the commissioning of future balancing and auxiliary services and adapt service specification to encourage competition from energy storage solutions but ensure a level playing field is created so that community groups are able to participate

Heat networks

Heat accounts for 47% of all UK CO2 emissions and 84% of domestic energy bills and only 6% of our heat is currently derived from renewable sources. Increasing the amount of heat generated from renewable sources is critical to the UK reducing it's carbon emissions and meeting it's Climate Change targets.

Whilst the Feed-in-Tariffs for renewable energy technologies such a solar, wind and hydro have been subject to significant recent reductions, the rates of Renewable Heat Incentive have, in comparison, remained relatively high to incentivise this shift. Two models of renewable heat which offer particularly interesting opportunities for community involvement are Community Heat Networks and Thermal Storage.

Community Heat Networks

In Scandindavian countries the switch towards renewable heating networks has already happened with community/customer owned decentralised district or neighbourhood CHP networks already well established. Denmark, for example, has district heating in almost all towns as the largest source of their heat supply.

The business model for these small-scale combined heat and power (CHP) networks would typically be:

- **Funding model:** Loan from (local) bank, with share in project as guarantee, partnerships with a private developer.
- **Revenue model:** Revenue from sales. Optimally used in combination with thermal storage models.
- **Governance model:** Different variations of cooperatives possible: in Denmark this is as forms of non-profit companies owned by consumer cooperatives and municipalities.

There are plenty of examples of successful community ownership and operation of CHP plant. For example, in Juhnde in Germany, a CHP plant is owned by a cooperative where 75% of the village residents are investor members. The 5.2MEuro scheme was financed through a combination of shares (0.5M), grant funding (1.3M) and bank loans (3.4M). The project has resulted in the provision of low-cost and low-carbon energy with a 60% reduction of carbon emissions. The Jühnde bioenergy project is unusual in that shareholder members of the cooperative are both consumers and producers of the energy. This has resulted, for example, in decisions to minimise returns to investors in order to keep the price of heating low.

Small scale CHP networks do already exist in the UK in urban areas but they have, to date, been deployed and owned by local authorities or private parties rather than developed and run by Community organisations. Although CHP projects require significant work and investment to get off the ground, the examples highlighted in Europe illustrate that, with the right support and access to finance, community models could be supported in the UK.

12 https://www.theccc.org.uk/wp-content/uploads/2016/10/Next-steps-for-UK-heat-policy-Committee-on-Climate-Change-October-2016.pdf

13 http://www.bioenergiedorf.de/en/home.html

Thermal storage

Combining local CHP with underground heat storage where heat is collected during the Summer to be used during the winter when generation is low offers further opportunities for community based heat models. It can work both from short-term energy storage and seasonal borehole thermal energy storage, often using solar collection.

The business model for thermal storage would typically involve:

- **Funding model:** Partnerships between local government, national government and companies (including housing developers).
- **Revenue model:** Depending on how model is structured, community owned renewable energy groups and also individuals could sell energy for thermal storage.
- **Governance model:** Not-profit organisation (company utility) of the partners can form, with a community group conceivably part of this partnership. Agreements and long-term plan can be made to increase ownership to one or more of the partners (e.g. the community energy group).

There are some interesting international examples of how these kind of heat models can work. For example in Canada, the Drake Landing Solar Community (DLSC) supplies 90% of the community's heat demand (52 single detached homes) using a seasonal underground thermal energy storage system. In the summer, heat is collected and stored underground in a borehole thermal energy storage (BTES) design and then returned to the homes as heat during the winter. 90% of each home's space heating requirements from solar energy[14].

Tackling the decarbonisation of heat, whilst using local generation to help lower bills has always been an attractive proposition for community groups, and having a government backed scheme such as the Renewable Heat Incentive that is based on kWh's of heat delivered should be a straightforward mechanism for driving local projects. But despite the RHI being seven years old, there are still only a handful of truly community energy based heat projects in the UK.

14 https://www.dlsc.ca

HEAT Case Study: South East London Community Energy

Introduction

Formed in 2014 South East London Community Energy are a not for profit co-operative working to bring more renewable energy to Greenwich and Lewisham. After successfully developing solar projects on local schools, in 2017 SELCE started considering in earnest the possibility of developing a community renewable heat project. They are probably typical of a large number of community energy groups in the UK, in that they:

- Have a track record in delivering solar PV projects and raising capital
- Have identified key heat demands in their local area, or areas of regeneration / new build
- Want to address fuel poverty and related health outcomes
- Were in position to consider taking more of a role in managing a system / supply

Objectives

SELCE started looking for suitable sites in 2017 and produced a shortlist of 5 local sites (all swimming pools) which then got narrowed down to 2. Working with a consultant, Carbon Smart, they then identified two preferred technologies for further investigation which were biomass powered by coffee beans and air source heat pumps. Regen supported SELCE to investigate the financial models for using these two technologies in their preferred locations.

Outcomes

Unfortunately, after putting significant work in to developing models for both technologies it became apparent that a biomass project would not be feasible within their urban location because of air quality regulations and that the scale of the air source heat pump project was simply not big enough to prove economically viable under the current subsidy support framework.

The key lessons that can be learnt from SELCE's experience are that:

- Biomass would be the most cost-effective route to generating low carbon heat. But this is not possible (or desirable) due to air quality issues. The last thing SELCE wanted to do is earn money by producing low carbon, but highly polluting heat
- Heat pumps are too expensive to produce the quantity of high temperature heat required by the high demand customer.
- The system could be viable, if it was expanded to nearby social housing as a heat network, but then there are two customers and a whole raft of extra risk and costs

Small heat solutions that feed one customer (i.e. a community owned boiler or heat pump) would seem to be the simplest route to market, using heat sales and RHI income to make the project pay. But as heat projects stand in 2018, Selling heat by the kWh requires high demand customers to remain high demand and disencentives energy efficiency. Small schemes could potentially work, but non-combusiton technologies remain largely too ▶

expensive for small schemes where high temperature heat is required. Large schemes are currently out of reach of many community energy groups, with the level of risk involved in undertaking them beyond what their boards are willing to accept. So we are left with what is probably a small, but significant number of potential projects that are in the middle. The challenge is to support groups to be pragmatic early on in the project selection process to ensure they are considering all the elements of whether the project is right for their situation, not just whether the finances stack up.

Policy recommendations

Finding the right way to incentivise the deployment of renewable heat remains a policy priority if the UK is to meet its Climate Change Act targets. Communities if properly supported, could play a key role in implementing district heating networks and in integrated new technologies such as thermal storage into those networks to make them work efficiently. At the current time the small scale schemes that community groups such as SELCE have been experimenting with could potentially work, but non-combustion technologies remain largely too expensive for small schemes where high temperature heat is required. Large schemes are currently out of reach of many community energy groups, with the level of risk involved in undertaking them beyond what their boards are willing to accept. So we are left with what is probably a small, but significant number of potential projects that are in the middle.

The challenge is to support groups to be pragmatic early on in the project selection process to ensure they are considering all the elements of whether the project is right for their situation, not just whether the finances stack up.

In order to support community groups experimenting with renewable heat models we would recommend that policymakers should:

- Proactively consider the regulatory, financial and technology pathway for the development of community heat storage technology deployment, taking measures to enable it to scale rapidly.
- Continue Renewable Heat Incentive is continued beyond 2021 with a specific focus on heat pump lead schemes to allow community energy groups the time to develop viable models and the knowledge and expertise to become more involved in the deployment of renewable heat technologies
- Engage directly with community groups. The primary mechanism for delivering low carbon heat, the RHI, has not resulted in the carbon emission reductions that were hoped for. Community energy groups are eager to utilise the scheme, and could be the stakeholder that unlocks greater uptake, but have been unable to find a model that is economically viable away from biomass. We would encourage Ofgem and BEIS to discuss routes to a more flexible scheme that more clearly supports a community group route to market.

Conclusion

Community energy represents many of the attributes that are being pursued on a national scale in the UK currently in terms of:

- Investment in low carbon generation
- Local balancing, driving down infrastructure investment costs
- Democratising the system to encourage more buy-in from consumers
- Using a basic societal function (the generation and consumption of energy) to address wider social issues such as health and wellbeing related to poor housing

> **Community energy groups have managed to drive innovative, long-term energy projects in every type of settlement, rural farming communities, urban centres and suburban conurbations. In this respect, community energy groups deliver where energy supply companies, or DNO's alone fail. It is the fact that local issues are being addressed, over and above the purely economic, that has fuelled the huge growth in groups in the UK over the last five years. This mobilisation of local, motivated and capable groups is a huge asset to UK PLC.**

This project was undertaken to explore how community energy groups could be supported to deliver post-FIT business models, and to share the learning associated with them nationwide. As detailed earlier in the report, this work has identified that community energy does not have simple and replicable successor models at present. Certainly for electricity based projects, groups must pursue power purchase agreements with potential host sites as part of the existing market, or embark on complex behind the meter, or tariff based projects: both of which require substantial specific expertise and are very different to FIT based opportunities.

And yet despite the difficulties experienced by groups in searching for viable new projects, we have not seen a reduction in the appetite to progress. If anything, community energy groups are thinking far bigger in their project ideas than they have in previous years, and are using their collective expertise to explore ever more innovative models. As part of this, community energy groups are continuing to play a leading role in their localities, widening their remits to address the perennial issues of fuel poverty, energy ambivalence and sustainability. It is this connection to their communities, combined with their knowledge of the energy market that makes community energy groups a key stakeholder in the UK energy revolution. However, these types of more advanced projects such as microgrids, sustainable transport, and local tariffs or balancing are innovative and therefore take a long time to develop. This can be where community groups struggle to participate, with regulation or technology moving on faster than groups can respond to.

Community energy groups often hold the keys to unlocking improvements to the energy system that would be difficult for a private energy company, DNO or even local authority to achieve alone. This project has shown that groups have the appetite to drive ambitious projects, the willingness to ensure those projects are wanted and engaged with locally and the ability to participate in a market currently dominated by a few players. The role community energy could play in delivering successful local project and contributing to a truly democratic, decentralised and decarbonised future should not be underestimated.

The fact that this project has not pursued three business models to a point of wider replicability belies the fact that many groups nationwide are finding projects that stack up financially and deliver their local ambitions.

Appendix 1: Local energy models in the UK and abroad

Produced summer 2016

Introduction

With support from the Friends Provident Foundation, Regen is working with Community Energy England, Forum for the Future and 10:10 to help build local economic resilience through identifying new community energy business models.

This project will research, develop and share practical new business models for community energy groups to provide them with the support that they need to adapt to the changes in government policy.

We will draw on the latest research and practice nationally and internationally to identify the most promising business models to then test with community groups in the field. We have identified three areas to focus on:

1. **Local supply**
2. **Energy storage**
3. **Community heat networks.**

This report summarises our desktop research carried out in summer 2016 on the different models out there.

UK models

Local supply

Drivers and benefits

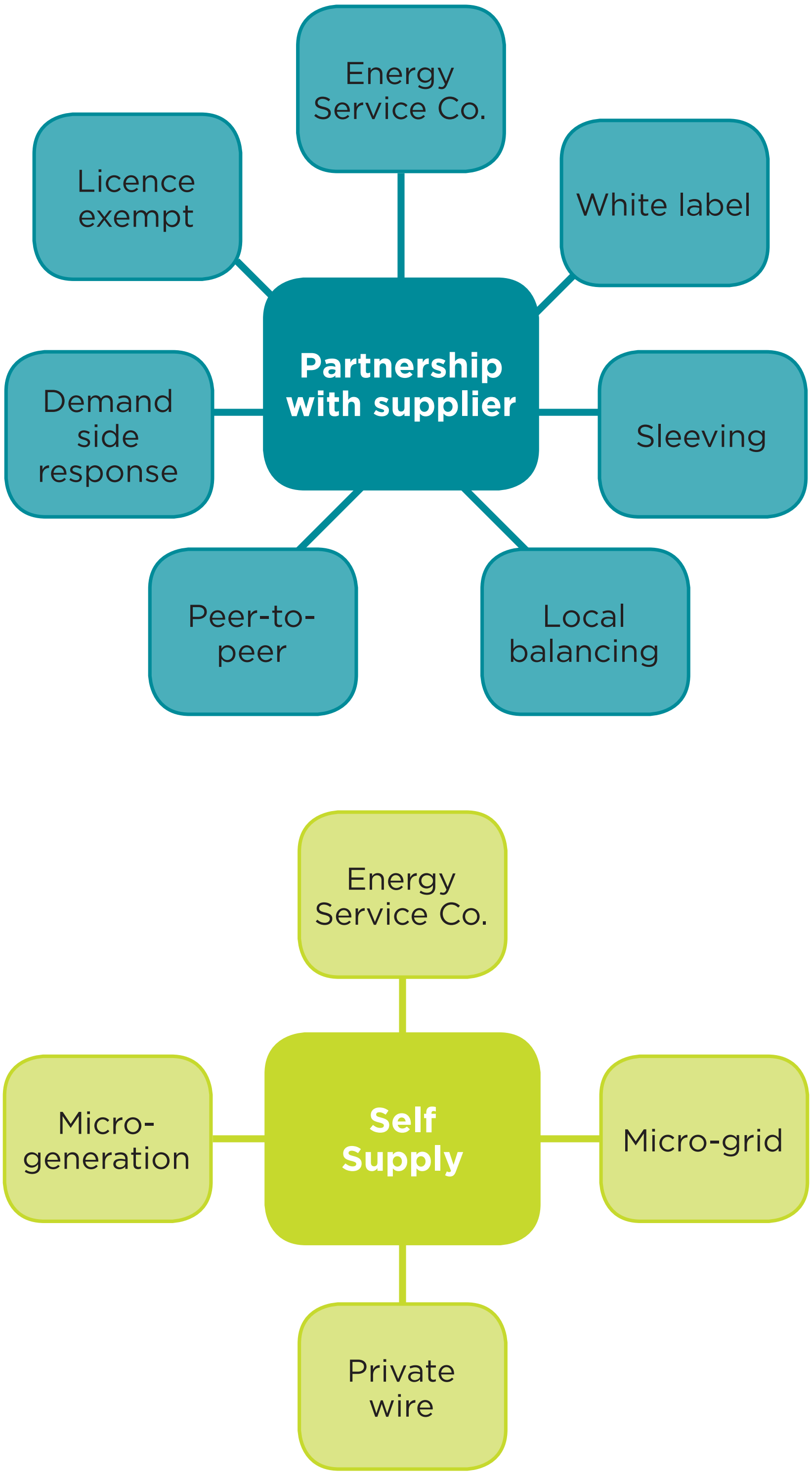
Potential benefits for community energy groups/generators:

- Help to secure finance when can guarantee long-term PPA with either supplier or directly with the end user
- Reduce distribution and transmission costs so generator gets better price
- Help build local support for projects
- Could provide extra source of revenue for demand flexibility or demand reduction

Potential benefits for wider community:

- Negotiate tariff that meets local objectives, including reducing fuel poverty, creating a fund to improve energy efficiency etc.
- Link local generation with supply with potential impacts on consumption behaviours
- Reduce distribution and transmission costs (and losses) so end user gets better price
- Enable engagement with harder to reach groups
- Demand reduction through information from trusted local supplier

Models


Energy Service Co.
Licence exempt
White label
Partnership with supplier
Demand side response
Sleeving
Peer-to-peer
Local balancing
Energy Service Co.
Micro-generation
Self Supply
Micro-grid
Private wire

Energy Service Company	Provides energy services, e.g. hot water, lighting or efficiency savings Provides model for investment in energy efficiency Requires a licence or private network to supply electricity Best suited to unregulated services, such as heat
Demand side response	Smart meters enable time of use tariffs and incentives to shift consumption Potential income from providing flexibility services Also potential for whole community to make savings on bills Example of trial: Low Carbon London
White label	Partnership with a licensed supplier to offer tariffs under a local brand Can negotiate tariff that meets some local objectives Some suppliers offer ability to combine with 'sleeving' options for own generation But limited scope with lowering price or linking directly with local generation
Sleeving	Variant of a standard PPA between a licensed supplier and generator Allows customer to purchase energy directly from generating plant via a licensed supplier, which manages the imbalance risk Can help finance for generator if can guarantee demand and negotiate long term PPA Not of great benefit for wider community
Local balancing	Smart meters enable real-time consumption data, time of use tariffs and incentives to shift consumption to match local generation Can achieve better price for generator and end user Can link consumption with local generation Trials include: Energy Local; Sunshine Tariff Potential to access further income streams as market evolves
Peer-to-peer	Alternative route to market for generators through trading platforms Generators can achieve better price, but unlikely that end user will as still use the public network Community owned generation may be more attractive and receive better prices Example: Selectricity
Licence exempt	Exemptions are available for suppliers providing electricity they have generated themselves of up to 5MW Contractual arrangement with an existing licensed supplier required for use of public network and balancing services Or private network is required, which has significant cost implications Government considers in most cases it is not appropriate to grant exemption from the requirements of a supply licence Very few examples: Thameswey Energy

Licensed supplier	Full control over the purchasing and retail of electricity Beneficial for larger generation projects Exposed to high costs through the imbalance settlement High set up costs – over £1m Examples of local authority led initiatives: Bristol Energy, Robin Hood Energy Not currently suitable for community energy due to cost and complexity
Micro-grid	All energy is generated and balanced in a closed circuit Avoidance of use of system charges – better price for generators and end users Significant capital investment - requires a private network, balancing technology and a system operator. Prohibitive without grant funding Equity issues related to who pays for the public network Few UK examples – e.g. Centre for Alternative Technology
Private wire	Sell power to neighbouring premises without use of public network Can negotiate better price for both generator and end users Usually one large end user Significant capital investment for the cabling, metering and connections Requires guarantee that demand will remain over lifetime of generation plant
Micro-generation	Small scale generation can be consumed onsite or exported to the network No transmission or distribution losses or charges Bulk buying schemes done by many community groups Not as viable currently without subsidy

Frontrunners

Demand side response

- Smart meters enable real-time consumption data, which enables time of use tariffs and incentives to shift consumption
- Potential for whole community to make savings in bills
- Partner with licensed supplier
- Potential income from providing flexibility services – e.g. Aggregated and sold at scale or provided locally to DNO – which can be reflected in price.

Barriers and enablers:

- Requires smart meters and ideally half hourly settlement
- Switching customers can be challenging
- Requires some flexible load to benefit – storage is ideal but still costly
- Flexibility markets are not yet accessible for domestic customers

Case study:

- Low Carbon London time of use tariff linked to wind generation.

Local balancing

- Similar to demand side response but with a link to local generation
- Smart meters enable real-time consumption data, which enables time of use tariffs and incentives to shift consumption to match generation
- Can achieve better price for generator and end user. Potential long-term PPA for generator
- Potential for whole community to make savings in bills
- Partner with licensed supplier
- Potential income from providing flexibility services – e.g. Aggregated and sold at scale or provided locally to DNO – which can be reflected in price.

Barriers and enablers:

- Requires smart meters and ideally half hourly settlement
- Switching customers can be challenging
- Requires some flexible load to benefit – storage is ideal but still costly
- Flexibility markets are not yet accessible for domestic customers.

Case studies:

- **Energy Local** model creates a club made up of consumers and a generator and provides a cheap set tariff for the local generation. A supplier then provides another tariff for any top-up power required
- **Sunshine Tariff** model encourages customers to use electricity when a local solar farm is generating
- **ACCESS** model balances local hydro generation with demand by switching on electric heating.

Private wire

- Generator sells power to neighbouring premises without transmitting through the public network
- A solution for subsidy-free generation, as can negotiate better price for both generator and end users as not using public network
- No need for a licence or to partner with licensed supplier
- No need to use public network if demand customer can use 100% of generation
- Requires a customer/group of customers to purchase energy directly from generation

- Cost of private wire, route, land availability, planning and maintenance need to be considered
- Legal agreement established between generator and customer.

Barriers and enablers

- Can be challenging to find the right customer
- Significant capital investment for the cabling, metering and connections
- Requires guarantee that demand will remain over lifetime of generation plant.

Case studies:

- WREN solar array directly provides power to sewage treatment works in Nanstallon, Cornwall
- Local authority established supplier, Thameswey, has a private wire network in Milton Keynes providing power to businesses and households.

Summary of barriers

- Costs associated with setting up and running a supply licence
- Complexity of the supply licensing regime; compliance with codes etc.
- Difficulty setting up partnerships with third party licensed suppliers that put needs of community first
- Lack of replicable and tested business models
- Balancing variable renewables challenging when there is limited flexible demand, such as batteries
- New income streams relate to flexibility, which requires smart meters, flexible loads and often half hourly settlement. All of which are not yet commonplace
- One view is that local supply and balancing reduces pressure on the public network and therefore should not be required to pay the same use of system charges. However, this has not yet been trialled
- But equity issues of increasing network costs for those still reliant on centralised system
- Private networks/wires are expensive to set up and maintain.

Government recommendations

- Put more pressure on suppliers to provide smart meters and half hourly settlement for domestic customers
- Explore potential for lower network charges for local schemes that use a limited proportion of the distribution network
- Clarify the rules around licence exemptions and support community schemes to understand what is and is not possible.

Storage

Drivers and benefits

Drivers:

- Since 2006, average energy bills have risen 15% each year, representing a compounded 71% increase
- 2.35 million households in the UK are in fuel poverty
- 23% of UK energy production comes from de-centralised and variable sources, such as wind and solar PV, making balancing grid system increasingly difficult
- Average energy consumption levels have decreased by 9% for electricity compared to 2010, but the daily peak demand is growing.

Benefits:

- Facilitates utilisation of variable renewable sources, allowing for greater penetration of renewables and grid balancing
- Storage reduces the need for increased peak generation capacity, enhancing grid reliability, minimising outages and reducing costs
- As 'time-of-use' tariffs grow, opportunities for storage as a method of reducing electricity bills become increasingly attractive
- Allows customers to manage their usage more actively, taking and storing electricity at times of low demand and prices and then using it at peak times, which both reduces costs and helps to balance production and demand.

Models

Potential revenue streams include:

Firm Frequency Response (FFR)	Service to maintain overall grid frequency within a tolerance range of 50Hz Short term tenders – 1-23 months although most > 6 months 10 MW minimum but can be aggregated. Rough estimate £40-150k per MW per year depending on service and hours tendered.
Enhanced Frequency Response (EFR)	Similar to FFR but a faster response service to provide sub-second frequency response services National grid tender for 200 MW announced in August 2016 that 8 EFR bidders had been awarded 4 year contracts using battery storage Based on 2016 EFR auction outcome: annual Revenue £60-£105k per MW per year
Fast Reserve	Fastest reserve service, 2 minute response to unexpected demand increase or loss of generation Service utilisation for a up to 15 min (or as specified) unit but generally < 6 months Minimum capacity 50 MW but aggregation is possible Very rough revenue estimate £50- 70k per MW per year based on analysis of National Grid 2015/16 market data.
Short Term Operating Reserve	Short term and a slower reserve service 3 MW minimum but typically 10-15 MW Ramp up within 20 mins desirable to win contract, typically asked to maintain energy output for a minimum of 2 hours and a recovery within 20 hours 3 seasonal auctions, seasonal & daily time periods Combined annual potential revenues circa £20-35k per MW per annum (assuming availability).
Capacity Market	In return for capacity payment revenue, generators must be available to deliver energy at times of peak demand or system stress Annual auction tender for future year's capacity Duration varies – longer for new capacity £20-35k per MW per year, possibly higher, depending auction outcomes.

Transmission cost avoidance	Demand based charges are mainly recovered through the Transmission Network Use of System (TNUoS) & Balancing Services Use of System (BSUoS) Both are based on peak time demand – for TNUoS this is calculated using the 'triad' peak demand periods. There is a value in using storage to reduce net demand during the peak time and triad periods to avoid these charges Together TNUoS, BSUoS and transmission loss embedded benefits or cost savings could be worth £40-50k per MW per year.
Distribution cost avoidance	Energy storage and distributed generators can offset demand and earn a credit from DNO's, or offset high energy users costs Potentially attractive, depending on location and how energy storage is treated by DNO's Potentially £40-80k per MW per year in the south west of England
Generator 'own use' (domestic and non-domestic)	Located alongside variable generation such as PV and wind, energy storage could be used to store energy during peak generation periods and deliver energy during periods of user demand Value for the energy user comes from maximising their own use of generated electricity, avoiding the peak price for electricity during high demand periods Low relative value due to high storage capacity required
Generator Grid Curtailment	Time shift export of energy which would otherwise be 'lost' due to grid curtailment This opportunity has grown due to the increase in constraints in the distribution network Could work with either a standalone generator or when connected with 'own use' Combined with own use would deliver higher value but a relatively high storage capacity is needed to meaningfully time shift generation.
Price arbitrage (& peak shaving)	Storing energy during low price periods for delivery during peak price periods Wholesale price variance in the UK ranges from <£20 MWh during low demand periods to £80 MWh plus during the peak The challenge for energy storage is the capital investment required to store significant energy capacity.

Frontrunners

Generator grid curtailment

- Energy storage could be used to store and time-shift energy, which would otherwise be "lost" due to grid curtailment
- This opportunity has grown due to the increase in constraints in the distribution network especially in high renewable energy regions and the increase in constrained grid connection offers
- An alternative value would be avoidance of grid reinforcement
- This could potentially be combined with an "own use" high energy user or as a standalone application co-located with an energy generator.

Barriers and enablers:

- The current regulatory and policy framework has not been designed for energy storage
- High cost of technology
- Relatively low value. But could combine with 'own use' to deliver higher value but a relatively high storage capacity (and therefore capital cost) is needed to meaningfully time shift generation
- If the network is reinforced and the risk of curtailment removed, the business model would need to change.

Case study:

- **Gigha trial** – A flow battery stores excess power from a wind farm and discharges when the wind drops and the capacity on the grid is available.

Generator 'own use'

- Located alongside variable generation such as PV and wind, energy storage could be used to store energy during peak generation periods and deliver energy during periods of user demand
- Value for the energy user comes from maximising their own use of generated electricity, avoiding the peak price for electricity during high demand periods
- An example would be charging batteries linked to solar PV during the day, and time-shifting the energy to the early evening peak when costs are highest. This will be facilitated by the roll-out of smart meters and time of use tariffs (TouT)
- Potential sources of revenue and/or cost avoidance might include:
    - Peak shaving – reducing demand during peak energy price periods
    - Transmission and distribution grid cost avoidance targeting triad (winter 5-7pm) and peak 'red zone' periods 4-7 pm
    - Demand side response services associated with Fast Reserve, STOR, Capacity Market and Frequency Control by Demand Management (FCDM)
    - Capacity Market Supplier Charge (CMSC) avoidance, which is set to significantly increase as the UK capacity market develops.

Barriers and enablers:

- The current regulatory and policy framework has not been designed for energy storage
- High cost of technology
- Low relative value due to high storage capacity required to store variable

generation and capture revenue from daily price variance between wholesale and retail tariff

- The effectiveness of a behind the meter energy storage solution will depend on a close alignment between the system power and storage capacity specification and the end user energy demand profile.

Case study:

- **Isle of Eigg Renewable Microgrid** – Eigg is not connected to the mainland electricity supply, it runs on hydro, wind and solar PV and is supported by a bank of batteries to ensure all power generated is used.

Domestic aggregated storage

- Aggregate domestic batteries to reduce peak energy demand and help balance electricity networks
- Aggregating storage systems permits greater control over multiple demand profiles and can lead to increased revenues when combined with sophisticated network signal technology
- Potential income from providing flexibility services and price arbitrage
- Innovations, such as the German based 'sonnenBatterie Community' platform, also allow owners of storage to trade excess energy through online platforms with the members of the Community through aggregated sleeving arrangements.

Barriers and enablers:

- The current regulatory and policy framework has not been designed for energy storage
- High cost of technology
- Requires development of aggregation software to enable localised communities to offer grid services
- Complexity of regulation required to provide grid services and market is not yet available.

Case study:

- **Moixa GridShare** platform provides payments of between £50-£75 per year to each battery owner in return for allowing some remote control of when the battery charges and discharges.

Summary of barriers

- The regulatory and policy framework is still going through a period of change to support this new technology
- As with any new market, the industry faces a number of commercial risks, including the potential of the market for new storage services becoming over-heated in the short term, leading to higher costs, unsustainable competition and unrealistic auction outcomes
- Without the benefit of long term fixed price contracts, storage investors must look to combine successive revenue streams over time to create a sustainable business case
- In the short term at least, energy storage projects will require a higher degree of system architecture design and will carry higher levels of technology risk than more established generation technologies
- As with any high growth technology, the energy storage sector needs to be mindful that it applies the highest environmental, employment, safety and ethical standards.

Government recommendations

- Accelerate roll-out of smart meters and the uptake of Time of Use Tariffs to enable more consumers to take advantage of price arbitrage opportunities
- Ensuring that the transition towards a Distribution System Operator model supports the development of local network balancing using energy storage and other flexibility services
- Ensuring a coherent and consistent approach to the procurement of network services (National Grid and DNO/DSO services) allowing services to be appropriately bundled to create longer term revenue streams.

Heat networks

Drivers and benefits

Drivers

- Almost all residential and commercial buildings have a requirement for either hot water or space heating or both
- This requirement for heat is a significant cost for consumers: on average 17% of the energy bill is for water heating and around 60% is for space heating. For the average domestic UK energy bill (£1190 in 2015), this gives a total average UK domestic heating bill of £916.30
- In addition, individual heating systems need to be maintained, repaired and replaced at the homeowners cost – not normally factored in to energy costs
- Consumption of energy for heating is actually slowly reducing over time, but energy bills are continuing to rise, 88% in real terms after inflation since 2004.

Benefits

- Heat networks can offer system efficiencies that can reduce customers' bills
- Heat networks remove the burden of boiler maintenance, repair and replacement from home owners
- Heat networks can offer a route to improving security of supply to customers and help 'even out' energy price volatility
- Heat networks can offer an opportunity for local ownership or investment
- Heat networks can provide the means for lowering heating related CO_2 emissions, both through use of renewable energy technologies which may work better at scale and through better system efficiencies than individual boilers
- Providing a heat supply is largely unregulated, so community groups, housing associations have significant freedom to generate innovative business models to fund heat network installations.

Models

Small-scale retrofit	Single building or campus. Tends to be one owner Any savings seen by the owner of the buildings and or system Potential to benefit wider community if finance to implement the system is raised by the local community, or if local community supplying fuel (if it's a biomass system)
City-scale retrofit	Often linked to regeneration or some key customer loads 'Anchor' loads could be social housing blocks, public buildings or non-domestic demands, but offer the ability to connect others (potentially residential) too Require major financing and take years to implement
New build	Some local authorities require developers to consider heat networks Tend to be very big schemes, and the only route for local communities to become involved is to help influence and support strong planning policies from the local authority, possibly through neighbourhood plans

Frontrunner

Small scale new build

- Focus on new build development of around 20-50 homes, with or without any local community building loads
- Community support for a heat network to be demonstrated, ideally through a local plan.
- Funding for the network to be delivered through:
    - House builders contributing to the network rather than individual boilers
    - Local share offer paying for some of the assets
    - Multi-Utility Service Company (MUSCo) or Energy Service Company (ESCo) bringing longer-term finance to some of the long term assets, possibly as part of a portfolio of schemes
- Community groups should partner with an existing MUSco or ESCo who is able to handle the O&M of the system on their behalf, reducing setup costs and risk and sharing the revenue over a long time scale

Barriers and enablers:

- Encouraging house builders to incorporate heat networks in their smaller developments is key, as they are unlikely to take the initiative on their own
- The MUSCo or ESCo may have to undertake a portfolio of these projects in order to get a return on their investment
- This model hinges on the ability for the MUSco or ESCo to acquire cheaper finance over a longer period than a community group could do on their own.

Summary of barriers

- There are no regulatory drivers for the retrofit of heating systems to explore heat network options
- Not many communities have sought to encourage the inclusion of heat networks in new developments (via neighbourhood plans for example)

- Heat network capital costs are higher in the UK than in comparable markets on the continent (Some 20% higher according to DECC studies)
- General awareness of, and confidence in, delivery heat network projects is very low amongst communities, which makes encouraging upfront commitment to connect very difficult
- Due to the low levels of regulation there is a perceived fear of being 'locked' into heating bills with no ability to switch supplier, or even that the heat will fail if the supplier experiences difficulties
- Upfront costs and risks are high. In particular, small heat networks struggle to be economically viable
- Large heat networks can be economically viable for both new-build and retrofit, but the local authority has to be fully committed in both cases (either supportive in a planning capacity or actively looking to develop energy services itself)
- Assets are expensive and long-lived: long paybacks so only places like pension funds might interested. And they are not interested at such small scales and low margins.

Government recommendations

- Continue to encourage the use of local plans
- Clarify how local plans can be used to help enable local sustainability initiatives and grow local economies
- Clarify the position on building regulations and the routemap toward low carbon housing development.

International models

Local supply

Community owned microgrids/ distribution grids

Summary description

Local governments/regions/municipalities - and potentially communities – are able to establish and operate local grids independent of larger networks.

Business model summary

- **Funding model:** Combination of funding from the local residents/ community; a private renewables developer, EU and Government
- **Revenue model:** Microgrids can be used for electricity, gas, heating and/ or cooling. Potential income from flexibility services. Where there is local generation, PPA can be set up with supplier to link supply and demand. Potential additional revenue through surplus energy generated
- **Governance model:** Ownership of the grid as partnership between the collective municipality/citizens.

Case studies

- In **Germany**, local governments are enabled to establish and operate local grids independent of larger networks. Local energy network and supply is a unique element of local self-government, guaranteed by the German Constitution. This authorises local governments to decide whether to take control of local network and supply, either as a public enterprise under direction of the local government, or through a contract with another private enterprise.
- **Feldheim, Germany:** Feldheim have built their own electricity and district heating grid, ultimately making them an entirely energy-sufficient and climate neutral village in 2010. To date, the produced electricity and heat covers the energy demand of the village, allowing them to also be selling surplus energy generated.
- **Schönau, Germany:** A group of citizens of a small German town near the border with Switzerland fought and won a long campaign to win concession to their local distribution grid. In 1997 this was the first German citizen takeover of a distribution grid.
- **Hamburg, Germany:** The results of a successful referendum meant that in 2014 the citizens of Hamburg were able to buy back operation of their local electricity grid.
- **The Brooklyn Microgrid, USA:** It operates in parallel to the public network and gives participants more choice in where they buy their power from. It provides a peer-to-peer energy market, made up of a combination of software and hardware that enables members to buy and sell energy from each other using smart contracts and the blockchain.

Barriers to deployment in the UK

- Distribution grids are owned and operated at a macro regional scale by District Network Operators (DNOs). This makes it challenging to bring a local section of grid into local ownership. It would need to be sold off to the community by the commercial DNO from its assets. There is no mechanism to force a DNO to do this against their will such as the German referendum system (e.g. Schonau)

- The Feldheim case study was only possible through substantial grant funding to retrofit the local grid to the village.

Enablers of deployment in the UK

- It is possible for a new grid created for new developments to be owned and operated by a community organisation as an Independent District Network Operator (INDO)
- Mutualisation of public infrastructure is becoming increasingly culturally normal in the UK. e.g. broadband networks, libraries, post offices.

Transferability to the UK

- A retrofitted microgrid to an existing networked place is technically and regulatory feasible, but largely uneconomic
- The lack of powers to purchase existing infrastructure from incumbent DNOs makes local grid buy outs largely unworkable in the UK
- Local build, owning and operating of a new grid for a new development is broadly feasible under the INDO regulations. But this is a much smaller sector of the grid than existing grids.

UK Government recommendations

- Consider extending the community right to bid / buy powers to energy networks
- Consider trialling local grid buy-outs with pilot communities and DNOs.

Community generation and supply

Summary description

Community ownership of both generation and supply of renewable energy.

Business model summary

- **Funding model:** Cooperative shareholders.
- **Revenue model:** Through sales to customers. Reduced spend through not having to pay energy distribution costs.
- **Governance model:** Cooperative - members purchase shares and through this are able to gain return on investments, buy lower cost electricity, and take part in decision making.

Case studies

- **Ecopower, Flanders, Belgium:** this cooperative is unusual in that it generates renewable energy, but it also distributes and supplies energy to approximately 50,000 households. The cooperative generates about half of the energy that it supplies by means of 20 wind turbines and 320 solar PV installations. The cooperative also owns a wood pellet factory and a co-generation plant supplying heat for a municipal building.
- **Som Energia, Gerona, Spain:** Som Energia, which is Spain's first renewable energy supply co-operative, began operating in 2011. It aims to generate 100% of the renewable energy that it sells to its customers through projects owned by the co-operative. Som Energia started by purchasing a solar installation, and it has continued to purchase projects that already have planning permission. It also intends to start developing its own projects. Four co-operatives have since been

established, which also aim to sell renewable energy. One of these is **Goiener**, which also produces some of the energy it sells.

Barriers to deployment in the UK

- Difficulties for smaller suppliers to enter the market as a supplier (e.g. licensing requirements)
- Savings from using little of the district network are largely not able to be captured by a local integrated generator-supplier due to network usage charging rules
- Concern due to some political positions that the power market will be forced to 'unbundle' and separate generation from supplier, making it more difficult to have a local generating energy company

Enablers of deployment in the UK

- Reducing consumer bills is a large drive politically so support is likely
- Major cities are pushing to be able to do this at a municipal level, e.g. London, Bristol
- It is becoming culturally more normal for local organisations to enter the supply market, e.g. Robin Hood Energy in Nottingham
- Currently there are no plans to break up / prevent vertically integrated energy companies
- The Conservative administration is largely in favour of increased competition and innovation within the energy market

Transferability to the UK

- The regulatory conditions are currently against cost reflective local generation and supply charging for network usage.
- Barring this change, the UK efforts to reduce the burden on new suppliers has significantly reduced the barriers to entry and led to many more small suppliers than most European countries have seen.

UK Government recommendations

- Greater support/more open playing field needed for smaller suppliers to become licensed, with special provisions made for where these are community owned. Facilitory rather than prohibitive
- The local/direct supply working group chaired by Ofgem made clear recommendations in their report that the Government should take up to facilitate this business model.

(Virtual) trading platforms

Summary description

A virtual trading platform that enables a two-way exchange with local renewable energy customers, via a blockchain based transaction system.

Business model summary

- **Funding model:** Until now operated by a private company, with investor
- **Revenue model:** Subscribers pay monthly fee to participate. Company may/may not take a charge of the transaction. Utility margin eliminated, allowing cheaper energy prices at greater income for the producer
- **Governance model:** Ownership of company could be run by a community energy group. Allows for individuals unable to host their own renewables equipment (e.g. solar) to pay for a portion of the solar energy generated by a host's system, and for this get a reduction on their utility bills. Potential for crowdsourcing from local community/community share offer.

Case studies

- **The Brooklyn Microgrid, USA:** this spans parts of the Gowanus and Park Slope neighbourhoods in Brooklyn, and will be the first to run off the TransActive Grid platform, which will tie local green energy providers and customers to Ethereum, a blockchain-based platform.
- **Yeloha, US:** This virtual trading platform recently had to close, but aimed to enable a digital, two-way exchange with customers producing, consuming and sharing affordable clean energy (solar)
- **Vandebron, Denmark:** currently has more than 38,000 subscribers. Consumers pay a monthly fee to contract directly with suppliers of clean energy for a set amount of power over a set amount of time. Consumers get to choose their specific energy supplier; producers get to name their price. Examples of 'sellers' include farmers. than they might with a traditional feed-in tariff or off-take agreement

Barriers and enablers of deployment in the UK

- Consumer protection is a high priority of energy regulation. The use of alternative currencies or trading platforms could therefore be regulated out of action if they are perceived as a risk to vulnerable customers
- The supply and trading codes are largely governed by the current industry. They will be reticent to make changes that threaten their current business model
- Currently the UK regulation does not support virtual net metering.

Enablers of deployment in the UK

- Crowdfunding and peer-to-peer business models are increasing rapidly in the UK
- The Conservative administration is largely in favour of increased competition and innovation within the energy market
- More public are wanting to take control of their own needs and so a model with more direct relationships with suppliers enables this.

Transferability to the UK

The transferability is currently high. However, there are threats that as a model emerges in the UK in practice, that regulators become cautious and heavily regulate it or prevent its use whilst consumer protection is reviewed and strengthened.

UK Government recommendations

- Proactively prepare to appropriately regulate new platforms and forms of commerce in the energy sector
- Learn from the regulators of overseas examples
- Consider enabling virtual net metering as other jurisdictions have done

Direct green power trading

Summary description

Community projects partner with local/regional supplier to control the process from production to marketing of renewable energy, bypassing the grid. Known in Germany as 'Grünstromvermarktung'

Business model summary

- **Funding model:** Key purpose of this was to achieve a model not dependent on FiTs. Partnership with private supplier.
- **Revenue model:** Revenue from sales to the supplier. Agreement can be achieved with supplier for higher rates. Exemption from tax/grid fees. Potential to establish a regional green tariff
- **Governance model:** As per agreement between community group and private supplier.

Case studies

- **Rittersdorf eG Thuringia, Germany:** The solar co-operative has partnered with Grüstromwerk, which has agreed to buy electricity produced by the cooperative for a slightly higher rate than what EEG payments would offer. Grüstromwerk then directly markets 25% of the power produced from the solar farm within 30 km of the installation. Model based on local and direct sale of electricity using either a private or limited use of the public grid.

Barriers to deployment in the UK

- Criticised by some for lack of support for the grid and allowing financial incentive without contributing to the system - challenge of how to best incentivise self/direct consumption
- The model in Germany requires alternative forms of support to be profitable - levy breaks on energy consumers buying the power. This could be more challenging if the economy enters recession. However, these are justified by the low distance of network utilised
- The consumer cost of FiTs in Germany is many times higher than in the UK, therefore removal of this cost from UK consumers would have much less financial benefit and is unlikely to make direct power as cost effective as it has been in Germany

Enablers of deployment in the UK

- There is cynicism from consumers on the origin of green power and whether being on green tariffs has a real effect. This 'hyper-local' direct version could overcome this.
- There is scope for this model to support economies in disadvantaged communities in cities and rural areas, which is a major political driver.

Transferability to the UK

Similar context to 'local supply', with a direct relationship between generators and consumers. Consumer protection concerns of regulators will be greater than in that model, making it more challenging to deploy

UK Government recommendations

- Proactively prepare to appropriately regulate new platforms and forms of commerce in the energy sector
- Learn from the regulators of overseas examples
- Consider piloting the removal of FiT costs and grid costs for similar contracts as in Germany.

Storage

Domestic storage with peer-to-peer trading/flexibility services

Summary description

Trading platform for individual producers and users, using smart storage (individual) and manage supply and demand.

Business model summary

- **Funding model:** Private company operates the trading platform; German government provided an incentive additional to FiTs for excess energy traded into the community
- **Revenue model:** Individual revenue from sales, reduced tariff prices, and potentially FiTs from energy supplied to the 'community'
- **Governance model:** Under current model, no community participation in decision making.
- **Community benefit:** Community groups generating energy could be a part of the trading platform; Increases financial viability of installing solar and battery storage systems without FiTs.

Case studies

- **Toronto, Canada:** A consortium has unveiled the first energy storage system installed directly into an urban community. Fully charged the CES system could provide electricity to a typical community centre, a light industrial complex or small residential street. In future, this storage unit can be used to help alleviate stress on the grid during peak times. In 2015, Toronto Hydro unveiled Hydrostor, the world's first underwater compressed air energy storage system. This "underwater battery" stores electricity when the demand is low and can be released when the grid needs a boost.
- **Moosham, Bavaria: Energy Neighbour:** The local grid transformer is operating at it's limit, blocking further development of solar systems in the village (currently at about 50%). The 'Energy Neighbour' project has recently launched (late 2015), consisting of 8 tonnes of battery cells, with 250kw electrical power and 200kwh of storage capacity. This is an example of the community middle-ground for battery storage between individual households and businesses, and large grid-based systems installed by utility systems.
- **The utility Salt River Project in Arizona** (privately owned): enacted a new tariff for residential customers who choose to install rooftop PV systems. This tariff increases a customer's fixed charge and incorporates a residential demand charge. Under this new tariff, behind-the-meter energy storage systems can be used to reduce demand charges, navigate time-of-use rates, and offset the increased fixed charge by providing ancillary services to the utility.
- **SonnenCommunity, Germany:** A community of sonnenBatterie owners in Germany who can share self-produced energy from solar PV. When someone has a surplus of power, instead of it being fed into the grid and bought by a licensed supplier, it goes into a virtual energy pool that serves other members.

Barriers to deployment in the UK

- The regulation on shared storage across properties via the public grid will be the same as for shared generation assets - i.e. needing cover of a supply license and being charged for network usage. That coupled with the earlier stage of storage technologies to solar will make it more risky and challenging for community organisations
- There may or may not be cultural barriers to sharing an asset that is inside homes from householders and

concerns over data sharing and privacy that exist for smart meters. This needs to be investigated

- The revenue model for communities from storage is not as stable or secure as it is under FiTS, e.g. the capacity market is not necessarily easy to participate in.

Enablers of deployment in the UK

- The technology is reaching scale in a number of settings
- Larger companies are increasing their exposure in the storage market including vehicle manufacturers interested in vehicle to grid business models.
- The community energy model for generation is readily transferable to storage technologies as 'quasi generation'

Transferability to the UK

Electricity storage is technically feasible in the UK and reach low levels of scale in home installations, and demonstration at a grid scale. This operates largely behind the meter supplying the property with power when demand exceeds the attached generation source. The challenge is finding a community business model to have grid scale storage or share in home/community building storage across a number of households/organisations. The barriers to this are largely the same as for local supply models, as the power from the storage will be regulated in the same way as a grid connected generation source. The cultural support is also likely to be similar to community renewables too.

UK Government recommendations

Proactively consider the regulatory, financial and technology pathway for the development of community heat storage technology deployment, taking measures to enable it to scale rapidly.

Heat networks

Small-scale combined heat and power (CHP) networks

Summary description

Community/customer owned decentralised district or neighbourhood heating/CHP networks.

Business model summary

- **Funding model:** Loan from (local) bank, with share in project as guarantee; Partnerships with a private developer
- **Revenue model:** Revenue from sales. Optimally used in combination with thermal storage models.
- **Governance model:** Different variations of cooperatives possible: in Denmark this is as forms of non-profit companies owned by consumer cooperatives and municipalities.

Case studies

- **Denmark** has district heating in almost all towns, as the largest source of their heat supply.
- **Bioenergy Village, Juhnde, Germany:** The plant is owned by a cooperative where 75% of the village residents are investor members. The €5.2 million scheme was financed through a combination of shares (€0.5m), grant funding (€1.3m) and bank loans (€3.4m). The project has resulted in the provision of low-cost and low-carbon energy with a 60% reduction of carbon emissions. The Jühnde bioenergy project is unusual in that shareholder members of the cooperative are both consumers and producers of the energy. This has resulted, for example, in decisions tominimise returns to investors in order to keep the price of heating low.

- **Samsø' Island, Denmark:** These district heating systems are owned in different ways. The cooperatively owned regional utility, NRGi, owns and operates the straw based heating plant in Tranebjerg and the combination woodchip/solar heating plant in Nordby/Mårup on normal commercial terms. The straw-based plant in Ballen/Brundby is a consumer owned heating system owned exclusively by the consumers themselves. The district heating system is run by a locally elected committee. Every consumer is eligible for election and the elected members are the governing body for the heating plant. The heating plant in Onsbjerg is organized as a limited company owned by the local contracter, the Kremmer Jensen brothers. The plant is run by a local committee with consumer and municipal representation. The former have two seats, while the island municipal council has one seat.
- **Kronsberg, Hanover, Germany:** Part of a big social and environmental development project, including a range of housing types (private and social). The district is served by two decentralised natural gas CHP (combined heat and power) plants, enabling further carbon reductions.

Barriers to deployment in the UK

- CHP projects require significant work with planning departments to lay networks across communities and other infrastructure. That can make this easier for a local authority to navigate than a community organisation.

Enablers of deployment in the UK

- There are a number of examples of urban areas deploying CHP that is wholly or part owned by local authorities showing that it is feasible for a community organisation of sufficient scale to undertake the same
- Access to capital through a large energy user, e.g. hospital, hotels, commercial office centres, and to secure future demand

Transferability to the UK

- This model is moderately well established in the UK already but through local authorities rather than community organisations. Therefore the key is transferability from a LA-led model to a community one.
- Technically the inclusion of cooling services would be more and more important in the future as a service due to greater extremes of temperature

UK Government recommendations

Support community organisations to lead CHP projects with appropriate access to planning support and financing.

Thermal storage

Summary description

Underground heat storage (renewable, collected during the summer) to be used during winter when generation is low. Preferably combined with local CHP. Can work from short-term energy storage and seasonal borehole thermal energy storage, often using solar collection.

Business model summary

- **Funding model:** Partnerships between local government, national government and companies (including housing developers)
- **Revenue model:** Depending on how model is structured, community owned renewable energy groups and also individuals could sell energy for storage
- **Governance model:** Not-profit organisation (company utility) of the partners can form, with a community group conceivably part of this

partnership. Agreements and long-term plan can be made to increase ownership to one or more of the partners (e.g. the community energy group).

Case studies

- **Drake Landing Solar Community, Canada:** In operation since 2007, Canada's Drake Landing Solar Community (DLSC) supplies 90% of the community's heat demand (52 single detached homes) using a seasonal underground thermal energy storage system. In the summer, heat is collected and stored underground in a borehole thermal energy storage (BTES) design and then returned to the homes as heat during the winter. 90% of each home's space heating requirements from solar energy
- **Kronsberg Hanover, Germany:** 104 social housing apartments are heated from around 1350m of solar collectors, that also feed into a sunken thermal storage tank, meaning that solar energy can be used from spring through to December, covering around 40% of the total heating needs of the homes.
- **Great River Energy, Minnesota:** An umbrella cooperative for 28 smaller cooperatives, serving 1.7million people. Uses water heaters as batteries – most only charge at night, and they're piloting a program in which these also help provide grid frequency regulation services by slightly altering how much electricity they use.

Barriers to deployment in the UK

- As a new technology for the UK that isn't yet at scale and is without a simple, low risk business model, communities may not be the appropriate initial scaling vehicle for thermal storage, it may also make it difficult to finance
- Environmental standards are likely to be a critical consideration if heat is being injected into open aquifers. Similar concerns to that of 'fracking' would be in minds of local people and other stakeholders.

Enablers of deployment in the UK

- The technology group has already been deployed in the UK at commercial sites
- The thermal profile of the UK is similar to that of Canada, which is one case study.

Transferability to the UK

- The technology is working already in the UK. The challenge will be finding the appropriate stage of its development for community groups to be involved and lead its further innovation. It is likely to need public and/or private support before we reach that stage
- There are also questions around environmental protection of groundwater, which is strictly regulated in the UK.

UK Government recommendations

Proactively consider the regulatory, financial and technology pathway for the development of community heat storage technology deployment, taking measures to enable it to scale rapidly.

This project was delivered in partnership with: