A Community Energy Services Company to Support the Decarbonisation of New Homes

Final Feasibility Report
May 2022

Supported by:

Contents

1. Introduction:

Between April 2020 and June 2022 Plymouth Energy Community were supported by the Power to Change Next Generation Programme to develop a new innovative business model for the community energy sector.

The Next Generation Programme aims to create a step change in the development of genuinely sustainable, financially viable and innovative community businesses, helping to raise the profile of place-based community energy activity with policymakers and industry.

The initiative is funded by Power to Change, an independent trust that supports and develops community businesses in England. The Next Generation Programme worked with 11 organisations to develop and test new business models on behalf of the community energy sector in response to the withdrawal of the Feed in Tariff and the Renewable Heat Incentive subsidies.

Each project was provided with up to £100,000 of grant funding and the support of a consortium to develop their project ideas, test the real-world application of their business models, and share this learning to benefit the wider sector.

Community energy puts people at the heart of the energy system. It brings communities together to tackle climate change in a practical and democratic way by understanding, generating, owning, using and saving energy. It accelerates the transition to zero-carbon energy systems while increasing community resilience.

In England, Scotland and Wales there are over 420 community energy organisations, who have raised over a quarter of a billion pounds of investment through share offers and matched funding for low carbon projects and initiatives. Community-owned energy capacity in the UK currently totals 319 MW (2021 State of the Sector report). However, following the recent withdrawal of renewable energy subsidies, the community energy sector needs a new business model.

This report documents the work completed by Plymouth Energy Community to explore how a community-owned energy company could accelerate an area's journeyto Net Zero by packaging heat, power and transport services in a manner that could be integrated more widely into new developments.

2. About Plymouth Energy Community:

Plymouth Energy Community (PEC) is a multi, award-winning charity and a social enterprise, with a cooperative ethos. PEC's mission is to empower our community to create a fair, affordable, zero carbon energy system with local people at its heart. We are a family of community led organisations with a range of projects that: bring local people together to tackle fuel poverty and the climate crisis, increase local ownership and influence over local energy solutions; improve community confidence to engage in the zero carbon transition; and enable people to heat and power their homes affordably.

Since 2013 we have:

- Developed and generated 21 MWh of clean power from our community owned solar farm and 32 roof top arrays.
- Saved schools and community organisations over £0.5m from their energy bills through renewable power and energy efficiency improvements.
- Supported 21,000 households and delivered direct improvements to 2,400 homes visits saving each an average of £400 pa.
- Saved a total of 15,000 tonnes of carbon.
- Grown to a turnover of £1.5m pa with a dedicated staff team of around 24 full time equivalents.

PEC is working with local businesses to deliver over 14MWs of new solar arrays; trialling models for community owned renewable heat and providing a domestic energy advice service for those at risk of fuel poverty. In addition, it supports the local authority to administer Government grants to support households during the energy crisis and works closely with local creatives to give Plymouth a profile in Climate Action.

In 2019 PEC established a community led housing developer, to focus on the innovation required to deliver affordable homes in a way that is consistent with the UK's carbon reduction targets.

In March 2020, PEC established PEC Homes as an independent Community Benefit Society and Community Land Trust, to build community owned, net zero affordable housing developments in Plymouth.

PEC Homes, in partnership with Plymouth City Council is developing 70 community-led, zero-carbon, affordable homes on land in Kings Tamerton, Plymouth. In order to reach net-zero by 2050, we need to change the way we build new homes. This PEC Homes 'flagship scheme' sets out to use innovative approaches to deliver high quality, net zero homes at lower cost, and the opportunity to explore the role a community owned energy service company (ESCo) could play in furthering that ambition.

3. Next Generation Feasibility Study - Aims & Objectives:

PECs aim in this project was to explore the potential for ESCo business models to improve the energy and carbon performance of community led housing developments.

PEC objectives from any ESCo model were to:

- create an investable long-term proposition (using community shares and /or private lending);
- provide a 'sellable' service to the housing provider built around reducing their costs, risks or complication;
- offer a service to residents to meet their energy needs that is simple, and affordable;
- reduce carbon emissions from the development site as far is viable.

In 2019 the Government's interest in community-owned housing models highlighted an opportunity for the Community Energy sector to explore how existing community energy businesses can:

- Help deliver innovative sustainable new homes and communities;
- Diversify their asset base and revenue streams whilst still achieving their carbon reduction and fuel poverty goals;
- exert control / influence over the housing development process in a manner that allows testing of new energy service packages that could be marketed to the wider industry.

PEC operates in an area that will see over 26700 homes built over the next 15 years. The energy performance requirements in new build housing are currently too low to achieve the UKs 2050 carbon targets and therefore significant market innovation is required.

Through the development of its PEC Homes project, PEC was already exploring the concept of how a community ESCo could provide heat or power services to its c40 unit housing scheme, and had established collaborations with seven other community led housing projects across Devon and Cornwall that wanted to push for higher energy performance standards.

The aim of the Next Generation supported feasibility work was to use these projects as an opportunity to explore how a community ESCo could enable the delivery of low cost, low carbon affordable homes through some of the following:

- Highly energy efficient building fabric.
- Integration of PV and storage technology.
- Communal heat solutions utilising biomass or heat pumps.
- Electric car club and charging infrastructure with vehicle-to-grid functionality.
- A micro grid.
- A new affordable rental model encompassing comfort (heat and power) and transport charges (EV car club) into a single package.

- Long term, energy based performance guarantees on construction contracts.

Being in control of the development process on these housing sites will allow PEC to explore in detail how these technological innovations could be used to stack revenues to sustain the next generation of community energy projects. At the projects initiation, the following opportunities for revenue were identified:

- Sale of electricity to residents using the Ofgem class B exemption.
- Sale of heat to residents in line with new consumer protection regulations.
- Plymouth and the South Hams are two of the four areas where local district network operator, Western Power Distribution (WPD), are already procuring flexibility services.
- Provision of an electric car club will enable PEC to offer vehicle-to-grid services, and the batteries will further enhance the ability to provide additional flexibility to the distribution network. Controlling all storage capacity across the sites will enable time shifting and price arbitrage.
- Supply and demand for electricity will be balanced as much as possible behind one bulk supply point connected to WPD's network, avoiding network constraints. Engagement with WPD would allow exploration of the potential for larger scale housing developments to be viewed by DNOs as potential opportunities for integrating grid-balancing technology.

4. Context

4.1 The Housing Challenge:

The community in the wider Plymouth area face several challenges with regards to provision of local services:

- Access to housing – with 8,000 households seeking social rent accommodation, and supply failing to meet demand, Plymouth and the surrounding authorities have identified a need for 22,700 new dwellings.

- Quality of housing – 32% of homes in Plymouth are considered 'non-decent' (35% in the ward surrounding the PEC Homes development). This is significantly above national average of 27%.

- Access to energy and heat (fuel poverty) – Even before the pandemic and cost of living crisis, fuel poverty rates in Plymouth were above the national average, affecting nearly 12,000 people. Current price rises will transform this from a minority issue to something much more widespread.

- Carbon emissions – carbon emissions from housing make up 14% of UK total emissions, with each home releasing roughly 4 tonnes of carbon annually for heating and electricity. Recent building regulation changes have reduced carbon emissions in use by a third, however, to meet UK Government's Net Zero carbon emission targets, we must significantly reduce this further.

Many of these issues faced in the Plymouth area are exacerbated in Cornwall. In recent years the council have recognised the housing crisis, taking measures including establishing their own housing development arm. These measures have led to Cornwall being the local authority that delivered the highest number of affordable homes in the country in the 2017/18 financial year. With 61% of housing not connected to the gas grid and a substantial proportion of the population living in isolated towns and villages, access to heat and mobility is a very real issue for many households; 14.4% of households live in fuel poverty against a national average of 11.1%.

In response to this, Cornwall's community housing sector has risen to meet the challenge with Cornwall Community Land Trust delivering 230 affordable homes in Cornwall since 2007. As a result of a recent ERDF funded Cornwall New Energy project, a series of local community housing schemes have established that have begun to build energy standards into their plan.

4.2 Community Led Housing Schemes

Community led housing is about homes that have been built or brought back into use by local people. Community led housing is a growing movement of people developing and managing housing projects that build the decent and affordable homes that the country so desperately needs. Community-led housing is an umbrella term for a range of models that include cohousing, community land trusts (CLTs), cooperatives, self-help and self-build housing.

There are many synergies between community energy and community housing. The growth in interest in community housing models to meet the housing needs has mirrored the growth of community energy to meet energy needs. They come from a similar ideology of local solutions, are supported by a very similar community of interest and both sectors have secured support and funding after securing recognition for their track record. Within this, community housing and community energy businesses make for a natural partnership that draw the best from their shared community of interest and respective funding pots.

To explore this further, PEC engaged the following community led housing schemes in the Next Generation feasibility project:

- PEC Homes is an independent Community Benefit Society and Community Land Trust, established by PEC to build affordable, high quality, well-designed, cooperative and sustainable housing development projects that can:
    - Be local flagships for innovation;
    - Deliver community-owned, warm, affordable, desirable, net-zero homes;
    - Demonstrate a replicable cost model;
    - Deliver net-zero energy homes for which the total energy and maintenance costs are significantly less than business as usual.

- Millfields Trust is a social enterprise set up to help regenerate the Stonehouse neighbourhood in Plymouth. It provides employment opportunities for residents in the heart of Stonehouse by offering high quality, affordable business space for rental on flexible terms. In 2019, Millfields were proposing a mixed-use development including up to 45 affordable homes. The development aspires to be as energy efficient as possible and built to Passivhaus principles.

- Launceston Community Development Trust have proposed a development of 28 affordable homes. The development will include a tenure option where individual buyers will be able to purchase as little as 1% of the property and then on top of this pay rent, which will be 80% of market value rent. They can pay over this to increase their ownership up to a maximum of 80%. Their current plans are for each of the homes to have solar PV roofing and ground source heating. The housing plan layout is fixed for the site, however, there remains flexibility for the energy infrastructure; energy feasibility for the plot will be completed with different options of how to structure both PV and ground source heating.

- Mustard Seed Property is a Charity and Community Benefit Society. There is an acute lack of housing in Cornwall for vulnerable adults who are at risk of homelessness. Mustard Seed Property (MSP) offers an answer by purchasing homes in which vulnerable tenants can be supported into stable lifestyles. MSP are purchasing a disused property composed of 4 shop units, which will be converted into 3 studio flats and 3 full flats, each with a small kitchenette. Solar PV roofing and the addition of a ground source heat loop are within their current plan to be added to the property.

- Treverbyn Community Trust is a small Cornish charity based in the heart of Mid Cornwall. It runs different social and environmental projects that contribute to the health and well-being of all those that live in the area. TCT have proposed 6 homes, with a mix of different sized houses and 5 workshops, with social rent. The aspiration is to build houses to Passivhaus standard, with a heating system that includes heat storage and solar PV. Energy aspirations for the whole site include it being a microgrid and having EV charging infrastructure.

- South Dartmoor Community Energy are an established community energy organisation operating across south Devon. They plan to build 30 affordable rent houses and expect to partner with an Registered Housing Provider (RP) to manage the asset. They aspire to build to Passivhaus standards, possibly have a district heating network using a ground source heat pump and solar, have a V2G fleet of car club vehicles, all on a microgrid.

- Whitleigh Big Local is a Big Lottery funded partnership. It is proposing to develop 7 social rental homes due to low household income in the area. In terms of managing the asset they would like to find an RP to work with or register as an RP themselves. The houses will work towards being Passivhaus standards, utilising heat pump and solar,

- Cornwall Community Land Trust is recognised as one of the most progressive and successful community land trusts in England, as it has already delivered or enabled more than 260 affordable homes. It is currently aiming to build 15 homes, 10 of which will be affordable rent and 5 of which will be discounted sale/shared ownership. There will be a high level of air tightness and insulation, air source heat pumps and solar thermal are being considered, as well as provision for communal EV charging.

PEC's work on this project has mainly been focussed on PEC's and Launceston Community Development Trust's developments.

4.3 The Market Opportunity

Community led housing projects are increasingly looking to higher energy standards in their developments, but these standards often lost to value engineering because of wider project viability challenges.

The Next Generation supported feasibility work set out to explore whether a community ESCo can support the CLT by providing heat and/or power infrastructure that:

- Supported the CLTs low or zero carbon ambitions,
- Delivered capex and maintenance savings,
- Support the tenants by lowering their energy bill in comparison with market housing.

The competitive market for these services is not well established. The alternatives open to housing developments are:

- Wales and West/WPD - Paying for gas connection to site for gas central heating or installing electric heating. This approach does not achieve high environmental outcomes, exposes significant capital expenditure costs, particularly in bringing gas to site, and in the case of electric heating, is undesirable to tenants and buyers.

- Building in higher energy standards or renewable heating – this is a departure from the standard expertise of most housing developers. Both incur a higher capital expenditure cost with no option for reclaiming this additional cost

- Partnering with a commercial ESCo – companies like EON and Engie will deliver ESCo heat or power services, although typically only on larger developments. Others, such as Vital Energy, may deliver to smaller developments. Some of these schemes have faced criticism for high costs and poor regulation, as evidenced by the Competition and Market's Authority investigation into heat networks in 2018.

PEC believe the options above are not really competitors as they have a very different proposition. In offering a solution that works with developers to co-design a community owned solution to achieve higher standards while reducing costs to house builders and tenants, PEC are offering something unique.

Although initially aimed at CLTs due to the close ideological match, in excess of 30,000 homes are due to be built in Plymouth and the surrounding areas (including Cornwall) in the foreseeable future and there is significant opportunity to partner with small and medium sized developers to bring forward schemes on many more developments.

5. Work Completed Through Next Generation

5.1 Proof of Concept

In 2019, PEC developed a high-level financial model to begin testing the feasibility of this approach on c38 unit housing scheme being proposed PEC Homes Kings Tamerton site.

The model was developed around the following assumptions and variables:

- Heating technology – was modelled for air and ground source heat pumps based on estimates provided by Kensa and Mitsubushi.
- Micro grid supply arrangements – was modelled based on two cases: installing PV only and installing PV with battery storage.
- Size of site – the PEC development of 38 affordable homes is within a wider development of 30 passive house market homes. We modelled providing heat and electricity services to the affordable development only and to the whole site.
- Fabric performance – the homes were modelled to use 20kWh/M^2/year. This is approaching the Passivhouse rate of 15kWh/M^2/year and far lower than the building regulations equivalent.
- Finance rates – the investment case was based on an interest rate of 5% and on the ability to sell electricity at 14p/kWh and heat at 4.5p/kWh. It was also assumed the scheme will receive RHI payments. All tariffs are assumed to increase with RPI.
- Excluded from the investment case:
    - The capital expenditure savings made by the developer. The estimated cost of installing gas or electric heating is estimated to be between £170k and £202k for the whole development. These costs are being entirely taken on by the ESCo provider
    - Ongoing maintenance costs savings for housing association by the ESCo provider.

Investment scenarios:

The table below outlines the scenario explored in this proof concept stage and the cumulative cost/benefit of the different scenarios at 20 years (and the breakeven year).

Heating and electricity option	38 Homes	70 Homes
GSHP, PV & Battery	-£50k (in 21st year)	£24k (in 20th year)
ASHP, PV & Battery	£127k (in 18th year)	£142k (in 19th year)
GSHP, PV only	£206k (in 16th year)	£397k (in 16th year)
ASHP PV only	£300k (in 13th year)	£503k (in 14th year)

These costs were to be investigated during the delivery phase (phase 2) and factored into the model. It was anticipated that some or all of these costs could be incorporated into a service charge for the CLT, in place of the ~£218k of maintenance costs they may have needed to pay had they been responsible for the heating.

The work outlined above gave PEC confidence that that model deserves further exploration, partnering with CLTs to further refine the business models.

5.2 Phase 1 Scoping

During the first phase of feasibility PEC coordinated the following:

- Advice on the legal and contractual landscape a community ESCo would need to operate within.
- Workshops and meetings with all the other Community Land Trusts to understand:
  - the details of their proposed / planned housing layout,
  - the size of the dwellings,
  - local grid constraints,
  - the anticipated building fabric standards,
  - any existing ambition around use of renewable / heat or power solutions.
  - design stage,
  - timeframes.

This discovery phase of work benefitted from match funding from the INTEREG funded SunPeople project, investigating the ESCo business case for heat pumps and solar in non-domestic settings.

This work allowed the exploration of the following questions:

- What are the contractual implications of integrating Power Purchase Arrangements (PPA) and Heat Supply Agreements (HSA) into an ESCo model?
- How can the ESCo avoid needing to be a licensed supplier as an ESCo?
- What are current and anticipated legal frameworks around the supply of heat?
- Whether the PPAs and HSAs should be combined as one agreement or kept separate?
- What contractual differences would be required to included battery storage?
- What difference would it make if PEC included thermal storage with the heat supply?
- What are the consumer rights regarding choosing energy suppliers?
- How will this impact a microgrid?

The project benefited from several advice notes covering these areas. These are appended to this report.

Exploratory work with partners identified significant variation in how far aspirations for improved energy outcomes on the housing schemes had been translated into specifically targeted design standards, or project costs being considered as part of viability testing. This impacted on the depth and accuracy to which PEC could model some sites and identified future needs to establish a more in-depth questionnaire for partners, that necessitated input from architects, project managers/viability consultants who are likely to have a clearer view of the detail of assumptions made in plans to date.

5.3 Phase 2 Modelling

Activities completed during this phase of the project included:

- Detailed meetings with design teams to establish necessary data and files regarding the planned housing development and explore the available flexibility on designs.
- Selection of two housing sites to focus more detailed modelling on.
- Exploratory meetings with technology providers, other community groups looking at microgrids, consultants experienced in delivering projects and other relevant parties to inform the scoping of the next modelling stage.
- More in-depth static model of both sites including comparison of 10 heat options, 3 solar options and multiple revenue streams. Adapted high level models to reflect end of RHI.
- Further investigation of legal opportunities and issues regarding the use of a comfort charge.
- Early feasibility work to check if the business model may be improved by adding broadband as a service to tenants.

A summary of the results of this work and, specific learning identified is recorded below:

- The approach that provided the best rate of return on these sites used roof mounted solar PV, a microgrid and heat pump assisted MVHR systems for heat and hot water, with limited provision for back up electric radiators. Heat pump assisted MVHR systems are only likely to be effective and efficient in homes with a high fabric standard and airtightness. This result is also based on the assumption that MVHR would be fitted in these homes regardless of the heating system.
- On a purely operational basis (revenue minus operational costs) the scheme could generate an operating profit equivalent to 4.3% of net capital spend. This scenario assumed tenants would be charged through a comfort charge (see section on contractual relationships below for more details), set at the highest-level PEC felt justifiable to tenants (£50pm for 1 bed, £103pm for 2 bed and £133pm for 3 bed).
- We concluded that there is a strong case for housing providers contributing to the capital costs of a scheme based on our analysis that the minimum they would pay for heating and ventilation (which would be provided by the ESCo) would be £3,300 per home. We modelled the net capital cost of this scheme to the ESCo based on the total capital cost minus this housing provider contribution.
- It is likely that a higher contribution than this would be needed to make a scheme viable. We concluded the sales pitch to community housing was an ESCo model would allow them to make an increased investment in energy systems deliver better outcomes than just investing in the technologies themselves.
- Several variables, chiefly the percentage onsite usage of solar and the energy import over time profile, were rough estimates but were crucial to the business case. While we were modelling to annual demand and solar generation figures, the reality is that these figures don't have a standard profile on an hour-to-hour basis. A site with all South facing roofs will have a sharp peak of solar PV generation at the middle of the day, whereas one with a range of East to West facing roofs as well as south facing will have more generation in the

morning and evening and a lower peak in the middle of the day. Similarly, the electricity profile for a house occupied by people who work outside of the home will be different than for a retired or unemployed household, with the latter likely to be using more electricity during the day. If we were to assume 50% of electric were to be used on site but, the houses all face south and will be occupied by working people, we may find the onsite usage is much lower. This would have a significant impact on the business case, as is explored later in this document.
- Other smaller lessons included:
    - The provision of broadband through a housebuilder/ESCo owned grid has the potential to provide a surplus creating income stream. This has been used by housing developers such as SERO.
    - The use of roof integrated solar panels to save the housing provider some costs of slate roofing was assessed. PEC's analysis indicated that up to £22k of roofing materials could be saved across a 28-home site. This would be offset by a £15k uplift in cost for a more expensive system and a loss of £3k per year of income through installing fewer, less efficient panels overall. Use of roof integrated panels may be a requirement of the housing developer for visual reasons, however if this is not the case our analysis indicated they would not benefit the business case.

5.4 Work Completed – Phase 3 and 4, Developing a Tool

Activities completed:

- PEC appointed Hydrock to complete the following.
    - Build on existing modelling work on the Launceston site, in order to build a more advanced view of demand and generation potential, identify the best available technology mix for the site and provide a basic assessment of the financial viability of the Launceston site. The main outcome for this work package is to have tested the viability of an ESCo as defined on a real-world site and to have defined the best available technology options, the financial viability of that ESCo and any key improvements to the site design that would benefit the ESCo. The project report serves as a case study.
    - Build a modelling tool for community energy groups to run initial viability appraisals of new sites. The purpose of this is to provide a simple to follow process for exploring the outline viability of a new site, including any key questions that need to be explored for a site outside of the model. The model will then use this key site-specific data to provide a basic financial model.
    - Support conversations with key partners, including WPD and car clubs, to inform model assumptions and explore key issues.

A summary of the results of this work are provided in the report provided by Hydrock in the appendices. Some key points in brief are:

- Overall, the work supports the conclusion from Phase 2: that a microgrid based ESCo model is only likely to be viable in cases where the housing provider is budgeting to supply their 'share' of the services, ideally budgeting to supply gas central heating or heat pumps. It is not viable for an ESCo to reduce the capital cost to the housing provider of providing basic services such as heating and ventilation. The ESCo allows them to get better outcomes for their investment, not to reduce their costs.

- The cost of electricity connection would be lower using a microgrid (single point connection to the grid is substantially less than 28 individual connections).
- The lower cost of connection for a microgrid, in the example of the Launceston scheme, provides sufficient savings to fully pay for the cost of a microgrid, including any smart infrastructure.
- The use of a battery and a smart microgrid (one that intelligently controls energy flows across the site) appear to show a substantial improvement in outcomes both for the ESCo and the customer.
- Quantifying the benefit of a smart microgrid is not possible due to the lack of real-world data from an operational site, and the inability to access a proprietary programming logic that could be tested in a modelled system (point further explored below).

6. Reflections and Lessons Learned:

6.1 Working with Community Housing Groups

The challenge of working with community housing projects

In discussions around microgrid business models, there is often a focus on the technical challenges. However, this should not overlook the significant project and relationship management demands of this sort of business model. In providing the role of 'bolt on ESCo' to a housing project, community energy groups are signing up to work with housing developers to build projects over years; PEC Homes began housing development work in 2019 and are hoping to have 40 houses occupied by the late 2023/early 2024. These housing projects are often quite far into the design process before funders are approached and this stage can often drive significant changes, both to reduce risk and to value engineer. In addition to this, there is a substantial proportion of housing projects that do not make it to completion, for reasons of viability or the inability to hold together a group of volunteers to 'stick out' a long, complex and risky project. Community Energy groups need to engage strategically with the housing groups over a long period of time in order to obtain a successful outcome.

Even if the housing project does run successfully, ESCo business models are an anomaly on new housing sites and there are many real or perceived risks housing providers are absorbing by incorporating this approach. While community and not for profit housing providers often wish to meet higher energy and affordability standards, when faced with a final decision to commit to an ESCo or revert to a business-as-usual approach, community energy groups should bear in mind that their first objective is to supply decent housing that benefits their community and provides a reliable business model for their organisation. There are also likely to be ideas and judgements from the housing provider and their architect that will impact the ESCO, whether that is technologies they would like to explore or red lines around the wider construction and development of the homes. Facilitating these will, in some cases, critically harm viability and community energy organisations will need to be able to navigate these discussions carefully to obtain the right outcome for the ESCo and the community housing organisation.

Addressing the challenges of working with community housing groups

As with all projects, the key to holding the complexity of all these decision points together and engaging effectively with a third party, will be taking the time to be very clear internally on your aims and objectives before diving into the detail. This is particularly true in this case, due the complexity of ESCo models and the large (often competing) number of variables that can make or break financial viability.

Groups should be clear from the outset on what is a 'must have' and what is a 'nice to have'. This will set the tone and define what is most important to explore, and which areas of design are most important to have an influence over. A community group that has a strong focus on getting increased renewable uptake with minimal concerns on fuel bill impact, will likely take a different approach to a group that is keen to specifically decarbonise heat while keeping fuel bills low.

Community groups should also make an assessment early on as to whether the aims and outcomes they have identified are shared (or at least compatible) with the housing developer. A shared approach and appreciation of what is required to deliver the expected performance standards will be crucial. The more complex the measures delivered through any ESCo, the more important this will be. Both internal, and shared aims and objectives should be clearly thought out at the beginning of the relationship and reviewed at regular intervals through the feasibility testing, design and delivery.

A list of (potential) key points of contention identified by PEC, between a housing developer and a community energy group seeking an ESCo are:

- Visual impact of low carbon technologies and need to house an energy centre on site.
- Tenant energy bills, method of payment (potential for hassle) and handling of bill increases (committing to RPI) – Logically, while it is highly likely that the rate of energy bill increase will exceed the rate of inflation over the coming decades, the status quo is a system where the factors influencing energy bills are external and through incorporating an ESCo, the housing provider is taking the decision to commit to an inflationary increase. While it is likely that this will be better for tenants, the housing provider will place considerable weight on the low probability that this will be worse for tenants, and they will have actively agreed to it.
- Energy supply stability and maintenance – tenants being without heat, power or inconvenient maintenance requirements are likely to be key concerns that a designed system must address.
- Housing supplier contribution – for any housing development, a developer will have to provide grid connection, heating and hot water systems and ventilation. An ESCo will be seeking to take over some, or all, of these services, however PECs analysis indicates that there is no viable model if the ESCO is meeting the full cost of the technologies. The housing provider needs to be clear that this model isn't removing these essential costs, it is simply allowing them to invest the same money in a system that obtains far better outcomes. Still, defining what is a reasonable contribution, or split of responsibilities for budget lines, will be challenging.

6.2 Contractual relationships and how to charge for services

Business to Business Relationship (B2B)

The contractual relationships with customers and housing providers have important impacts on the risks associated with delivering an ESCo. A business-to-business (B2B) relationship with the housing supplier has always been PEC's preference. Within this relationship, PEC would lease the spaces for the energy system and then supply the housing provider with services and provide any relevant metering information for the housing provider to make onward charges to customers. The logic behind this approach is that the housing supplier has existing business-to-customer (B2C) relationships with the tenants and therefore is already dealing with the complexities of these relationships (unpaid bills, consumer rights). In practise, this proposition was not attractive to many housing providers PEC engaged with. The reasons for this were:

- Payment arrears are a significant risk for any housing association or community housing provider and providing further exposure to this risk was unattractive;
- While the housing provider will have a B2C relationship, this will be based around the supply of housing. This is an area of regulation they are clear on and have systems to work with. Supply of energy services has a separate set of regulations and there is limited appetite to engage with these;
- Many smaller organisations will be looking to contract out the management of the houses they are developing. That means their managing contractor will have to accept this as an additional deliverable, which some may not do or will charge a premium for.

A further issue with the B2B relationship option is regarding regulatory complexity. Although PEC's initial assumption was that the ESCo could avoid some more difficult regulatory constraints by supplying B2B, this was not possible. Even if the housing provider were happy to take on the B2C relationship, they would require the ESCo to ensure the right infrastructure, terms, and conditions are in place. Furthermore, in the case of heat supply, the regulation would automatically pass back to the upstream supplier. PEC concluded that any ESCo supplying electricity or heat to households should expect to comply fully with the laws and regulation regarding to B2C relationships, even if they do not have a direct relationship with domestic customers.

Business to Customer (B2C)

From a legal and regulatory perspective, PEC have provided several advice notes within the appendices. PEC's conclusions from this, and other research, is that the supply of electricity to residents under an Ofgem exemption (class C being most likely applicable) does not appear to pose a significant risk to project viability, provided the requirements are made clear to those designing the infrastructure and legal agreements required.

From a financial perspective, the risks of non-payment can be managed by a smart prepayment meter, which can provide a convenient method of payment for households. These meters do carry a risk of self-disconnection and as such, any responsible ESCo supplying to low-income households must consider this risk and work to mitigate it. Options for this would include:

- Ensuring a core objective of the microgrid is to supply affordable energy;
- Applying a generous emergency credit allowance and setting up meters to not disconnect within antisocial hours;
- Including a small fund to cover emergency top up grants for households in financial emergencies;
- Only consider the use of them in houses built with a high fabric standard. This will vastly reduce the seasonal variation most households on prepayment meters experience which makes them difficult to budget on.

The right to switch

Special consideration must be made for right to switch energy providers. This is an area of legislation that is unexplored in the courts (with relation to grid tied microgrids), however the best practice and lowest risk response appears to be to design the microgrid to be adoptable to the DNO (Distribution Network Operators) system. In the circumstance where a resident wants to switch, they could be supplied by an energy supplier through the ESCo's distribution system. As the distributor, you can recover some of your costs from the energy supplier (provided your charges are transparent, reasonable, and agreed with Ofgem). In practise, if this situation were to occur, further legal advice would be required alongside a significant amount of work to justify a case to Ofgem which would be costly and would still impact the ESCo's long-term income (as it would not be able to recover all costs). At this stage, PEC would view this as a significant risk but that is highly unlikely to occur, for two reasons:

1. A core objective of any ESCO business model PEC would look to deliver would be to offer lower bills, therefore it is unlikely that any customer would wish to switch to the grid to pay more.
2. It is likely that a tenant looking to switch would struggle to find an energy supplier who would be willing to supply them, if it requires establishing a new relationship with a micro distributor.

Supplying Heat

The supply of heat is less regulated, however there is growing concern from regulators regarding this, see the Competition and Market's Authorities conclusions here. Given the regulatory uncertainty, the perceived technical complications heat metering appears to pose, the low price of gas as the "business as usual" option (although this may be worth revising considering recent changes) and the conclusions from PECs own modelling that a district heating option is unlikely to be the best way to supply heat, PEC view the heat supply model as being heavily disfavoured as a way of generating income.

Comfort Charge (Energy as a service)

One further income generating opportunity considered is a comfort charge. This would be an agreement with the occupier that they would receive a property of a certain temperature, a reasonable amount of hot water and could include provision of an electricity allowance also. If their usage exceeded these allowances, there would have to be a clear charging regime which would be for excess kWh used, excess degree hours used (1 hour where house is heated 1 degree more than allowance would be one degree hour) or excess litres of hot water. This method of charging could be applied alongside an electricity supply agreement (providing the heat) or to encompass all services. Crucially the comfort charge is not currently affected by any of the regulations applied to supply of gas or electric.

A significant advantage of this model is that it can be used to recover the costs of fabric improvements as well as technology. Consider two developments both with solar microgrid, batteries and the same electric heating, one is built to Passivhaus standards with a solar microgrid, and the other is built to building regulations standard. In both cases, the ESCo is restricted to charging a rate per kWh that is competitive with the electricity market to remove any incentive for the consumer right to switch. With the Passivhaus development, the consumer will be buying less than half the electricity. Consequently, a housing development that is performing better in terms of cutting energy bills, better environmental outcomes and lower load on the power grid will be generating less than half of the revenue for the ESCo. The comfort charge allows the ESCo to add an additional revenue to recover the extra cost of the fabric improvements over a 20-30 year lifespan. In the comparison above, the total bill to the tenant would be significantly lower for the Passivhaus development than it is for the building regulations one, but the housing provider would not be out of pocket.

Potential issues with a comfort charge model include:

- Underperformance of the fabric and energy system could severely impact tenant's costs or the ESCO's financial model. This is because tenants aren't being charged a unit rate, they're being charged for the ESCO to deliver warmth. If this costs more because the houses are less well insulated, either the tenant will pay an excess usage fee (that would be unfair) or the ESCO will have to buy more energy to heat the homes.
- Expected tenure can make a big difference to the legal agreement used to levy the charge. A standalone contract is good in most cases where the housing provider will retain the freehold, whereas a service charge may be more applicable in developments with any element of sale.

6.3 Optimising on-site usage of solar generation

There is some evidence from community energy projects in development (Appendix 1) that a simple microgrid linking solar panels from multiple homes would be viable. The intention of this project was to explore the viability for a more complex system. An ESCo on a housing site has the potential to offer far more services, that include supporting the decarbonisation of heat, further energy bill savings, the avoidance of the need for grid reinforcement and a better overall business case. PEC constructed a static model (based on annual usage figures) to test viability using a range of technologies to provide heat and power. This model demonstrated a business case that, without the cost of capital, delivered a meagre profit but would not reliably pay for the cost of capital. Given the complexity and risk associated, PEC felt this model had a high risk of business failure.

Importance of on-site usage of solar generation

One significant risk and opportunity within this modelling regards the level of onsite solar usage and how this relates to the quantity of electricity imported. The model assumed 56% of solar energy generated onsite would be used onsite, this was a broad assumption but an important one. As the table below demonstrates, using more generated electricity on site will reduce energy imports, the savings of which far outweighs the lost income of the export rate. In addition to this, time of use can have a significant impact on costs. If most energy import is occurring during peak times, this imported electric will cost more than assumed, whereas if it can be pushed into off-peak times, this will cost less than assumed.

Table – impact of onsite usage of solar on overall business case	Imported electricity as % of operational costs	Exported electricity as % of income	Operating profit % (assuming no cost of capital)
40% onsite usage	49%	6%	3.9%
56% onsite usage	45%	5%	4.3%
70% onsite usage	41%	3%	4.6%

How to increase on-site usage of solar generation

There are multiple approaches to reducing the amount of expensive, imported electricity, including:

- Installing more solar panels.
- Adjusting orientation of solar – on a microgrid, panels pointing in a range of directions, including a sizeable portion pointing west to catch evening sun, can be beneficial for evening the generation curve over the day rather than having a spike of generation around noon.
- Smart appliances – dishwashers, fridges, heat pumps, washing machines and more can be controlled to adjust usage to reduce usage at peak times and shift usage into off-peak times. Some appliances are being built with the intelligence to interact with control systems to do this. There are also retrofit products that have been developed that could power off devices for short periods in response to usage spikes.
- Heat battery – excess electricity is used to create heat, usually in hot water tanks, which (a) front load any hot water demand and (b) (in some systems) can be used as a heat source by a heat pump to heat the house with extremely low energy usage.
- Battery – these can be installed in each home or as a whole-site battery. Batteries can both store excess solar and off-peak electricity when the rates are lower. Subsequently, this can feed into the microgrid when usage is high and the grid would otherwise be importing electricity.
- Electric vehicles- Price incentives for when residents charge cars can help to shift usage away from peak times and vehicle to grid charging could allow car batteries to feed back into the grid at peak times.
- Behavioural change – by signalling to occupants when there is excess generated electric and when the grid is importing, occupants can choose to adjust their usage in order to benefit from reduced or avoid increased rates.

These technologies and approaches can be combined with a smart grid control system that uses complex algorithms feeding in weather data, usage data and operator preferences to drive the best outcomes.

Smart grids

While there is some variation in the levels of maturity of the individual technology approaches above, they are individually relatively well understood and have been piloted across multiple sites. Whilst the interactions of these with a smart control system are untested in a real-world scenario at this scale, at least in the UK, PEC learned the following:

- Conversations with Easy Smart Grid, Schneider, Smart Klub and Emergent regarding their technologies to optimise grids indicated a consensus that an increase of onsite usage to 70% was possible and that it was realistic to achieve tangible benefits on unit rates through management of time of import.
- This was the same conclusion Hydrock reached in their modelling of the Launceston Community Development Trust site which showed an uplift in on site usage from 38% to 73% and a potential reduction in peak load of 50%. While provision of a battery was responsible for most of this uplift in on site usage the change from 'dumb' to smart microgrid was responsible for a 9% increase in onsite usage. It should be said, Hydrock were not able to model the decision-making algorithm of a smart grid and were only able to apply a general uplift based on feedback provided by consultants SNRG.
- A German project (SoLAR) has explored smart grids in a computational model across 25 proposed dwellings. This project did model a decision-making algorithm and how it interacted with the modelled system, identified that controlling heat pumps, solar, thermal storage, and batteries together on a smart grid could shift self-consumption rates from 50% (modelled value on a 'dumb 'grid) to 80%, reducing peak load by 36%.

Smart grids and minimising grid impact

A further opportunity for any smart grid would be the realisation of lower electricity grid connection costs. There is increasing need for grid reinforcement as part of any housing project, driven by policy changes that are increasing the number of heat pumps, electric vehicle (EV) charging points and three phase electricity supplies. With this reinforcement comes an additional cost. For PEC Homes, the quote for grid connection to their housing site (individual connections to each dwelling, not for a microgrid) rose from £25k to £250k as a result of introducing heat pumps and EV charging points. For WPD, these changes necessitated a new sub-station. While any quote for a single connection point into the microgrid will be substantially lower than the supplied quote for individual connections, this quote will be equally as impacted by WPD's perception of the peak electricity demand,

When investigated this further, PEC found that WPD's base assumptions for the site included an anticipated 12KVa of peak usage per property. PEC's calculations estimated the expected peak usage to be more like 4KVa. Understandably, any DNO will be highly conservative about the need for network improvements, they cannot risk cutting off hundreds of households. However, there is a significant issue of DNOs lacking the necessary data to justify a less heavy-handed approach to network reinforcement for low or net zero energy buildings. PEC's conversations with WPD have demonstrated that they are actively seeking to update and improve their data, particularly regarding low energy buildings which will help to improve their policies.

Another approach to this problem, explored with WPD during the project is to change the connection application process. Currently, developers are expected to submit information about their scheme's electricity requirements and then the DNO designs the infrastructure needed to support that development. An alternative approach would be for WPD to identify the available capacity and for housing developers to design a system that operates within these parameters. This approach may require a new form of grid connection that is similar what a generator would sign up to in a capacity restricted area. With this agreement, WPD could restrict maximum import or export or even take the microgrid off supply and the ESCo would have to design a system that could continue to supply in these eventualities.

The Next Gen Project learning has clearly shown smart grids have the potential to significantly improve an ESCo business model, and /or realise a significantly reduced cost of grid reinforcement. Both PECs modelling and similar work by others have demonstrated a theoretical benefit that could suggest a viable business model but, the approach is currently untested and the uncertainty over key assumptions is currently too large to attract finance.

6.4 A viability testing tool for community energy groups

Currently, a community energy group seeking to establish a microgrid ESCo is likely to go through the following stages:

1. Scoping – having discussions with housing developer and with other projects to understand what might be possible.
2. Feasibility/viability testing – this is often funded by a grant, such as from RCEF (Rural Community Energy Fund).
3. Design – also grant funded.

Conversations with other community energy groups as result of the Next Generation programme indicate many groups spend a lot of time scoping projects and that resource constraints for this stage mean they aren't in the position to test the viability of multiple projects /sites to be able to select better prospects. In some cases, this means significant time and energy is being used pursuing projects that will not be viable.

To respond to this need, PEC and Hydrock have created a viability testing tool. The user guide for this tool and a case study for its use are in the appendices. The tool allows community energy groups to input basic information about prospective housing developments and test energy strategies to understand their viability. Crucially, the tool uses hourly data sets to produce demand and generation profiles that provide the level of dynamic modelling that was missing from PEC's early viability testing.

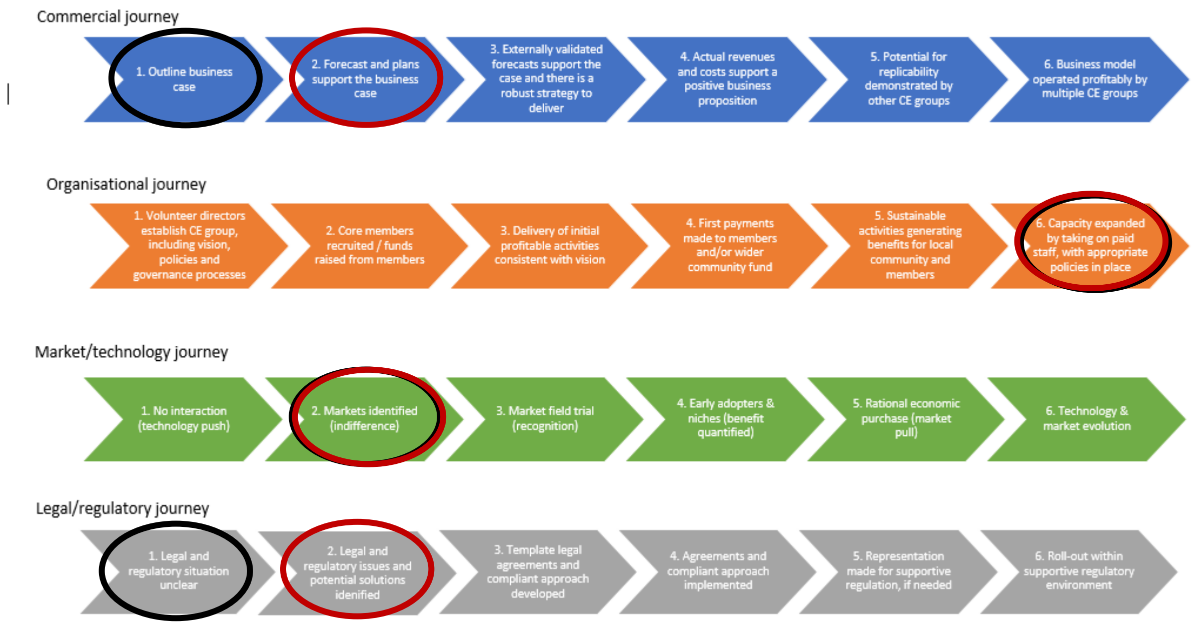
By using this tool, community energy groups will be:

1. Provided with a clearer structure for early conversations with housing providers (the tool provides a clear list of information required from housing providers and their design teams) and will then provide clear data outputs to aid early discussion of aims and expectations;
2. Supported to make decisions about which projects to put resources into;
3. Able to respond to early design iterations with informed feedback about the needs and preferences of any ESCo business model;
4. Able to provide a more informed and convincing case for advanced feasibility testing on a site, and tdo this with less work and cost from a consultant.

7. PEC's ESCO Business Model

7.1 How much progress has been made?

PEC began the Next Generation project with an outline business case that was largely untested. Their work had established some outline viability for a heat and power grid, but it also highlighted the elevated level of technical complexity within this area and the lack of precedence of similar projects. As such, the progress made within the business case has been slow and the commercial case requires further work.



Work completed to better inform the outline business case has been utilised to create a tool for community energy groups to use to move more quickly into a similar stage as PEC are at currently.

7.2 Business Model Description

The business model description as it stands:

Value proposition(s)

The model has two customers, the housing organisation and the resident.

The housing organisation receives:

- Higher standards – this increases pride in the development and can address key organisational objectives like sustainability or affordability.
- Reduced long term cost – while PECs work has established that an ESCo may not be able to reduce capital costs for a housing provider immediately, higher standards are likely to

negate any need to retrofit homes to meet carbon targets, leading to long term savings against a business-as-usual development.

- Happier tenants with stable energy prices, for the reasons listed below - this can have a knock-on impact on voids and arrears.
- Reduced maintenance costs and needs.

The tenants receive:

- Cheaper bills.
- Stable bill prices – with bills rising at rates likely to be lower than the electricity market.
- Environmental benefits – most people feel better to know they are living more sustainably.

Key partners

The housing provider is the most significant relationship. Learnings from this are summarised above.

There are various microgrid solution providers on the market. Many of these companies have invested heavily in research and development to build their understanding of viability and capacity to design effective microgrids or control systems. Whilst well placed to support projects, community energy groups should keep in mind that these are companies looking to design and implement a solution rather than provide an informed and modelled open book examination of the business model.

Key activities

The practical activities needed are as follows (although procurement activities could be combined as a single procurement):

- A key step is for the community energy group to use the viability testing tool to explore feasibility and develop an outline business case.
- The community energy partner would tender for someone to design the ESCo technology, working closely with the housing provider.
- The community energy partner would tender for someone to operate and maintain the ESCo technology, working closely with the housing provider. This contract or contracts would include:
    - Operations and maintenance of low carbon technologies.
    - Operations, maintenance and active management of the Smart Grid.
    - Delivery of billing and metering on site.
    - Delivery of any smart performance management to analyse performance against the comfort guarantee (if used).

- The community energy partner would tender for legal advisors to support agreeing a structure, establishing an SPV (Special Purpose Vehicle – either a joint venture, independent or wholly owned) and draft agreements between the entities.
- The community energy partner would seek investment in the project, likely including community shares.

Key resources

Community energy groups seeking to implement a business model for a smart microgrid need the capacity and expertise to understand and manage projects that contain significant risk, including appropriate governance structures.

Community groups will also need to seek significant investment and capital to complete this work.

Customer segments and relationships

PEC set out to work with community housing organisations, based on a perceived shared community of interest and willingness to co-develop. This hasn't changed and there remains significant appetite in this sector to deliver high quality housing that achieves better environmental and social outcomes. The creation of the viability testing tool, in part, came out of a lesson learned around it being, at times, difficult to get specific details from community housing organisations when working with a volunteer board. Having a clear target list of information needed that can drive a specific meeting with their design teams can help to facilitate a more effective relationship.

PEC Homes have worked extensively understand the appetite for innovative business models among housing associations. This has demonstrated that there is significant interest in building homes that drive up standards. However, this sector is more professional in its approach to risk and viability and is less likely to be involved in a project at the pioneering/exploratory level of innovation. It is also a sector that remains a little scarred and jaded by gearing up for zero carbon homes standards before having these standards pulled. Individuals driving this agenda within housing associations often greatly support these projects but need to see pilots and clear information to provide suitable assurances to the decision makers they would appeal to.

Cost structure

The analysis tool breaks down cost structures of different ESCo models, which will likely be different for each site. The components of this are supplied within the case study within the Hydrock Report in the Appendices.

In general, capital costs of these systems are very high. Most of these costs being renewable energy infrastructure and, if present, batteries. The microgrid itself, and smart controls for it, will be a minority cost in comparison.

Almost half the operational cost is likely to be imported electricity. Operations, maintenance and insurance will make up the remainder.

Revenue streams

Early in the project, PEC completed analysis to establish a target price for households for the different house types on the PEC Homes Development. This was set as the cost of gas and electric, if a house of the same floor area was built to 2022 building regulation standards. Across the PEC Homes site, this equated to £740 per year on average. This was used as a maximum cost, ensuring that any solution would offer households bills that were the same or less than any other newbuild house.

This exercise has been repeated, based upon an estimation of the winter 2022 price cap level. The equivalent result (£1964 per year) would put the lowest income households into fuel stress. As such, PEC have revised the approach to a target energy bills. Now they aim to ensure the lowest income households (those dependent on social security) pay a similar proportion of their incomes on energy as middle-income families do across the country (6% of income). In practical terms, for the PEC Homes site, this equates to £1,134 per year.

As outlined above, this may be charged as a comfort charge, an electric bill, or a combination of the two.

Exported electricity will be another income source, however rates for this are typically low and PEC's analysis shows it is likely to be around 5% of total revenue. PEC have been unable to obtain a figure for the impact of further revenue streams, like flexibility services or car clubs, however the qualitative analysis obtained indicates these are likely to make minimal overall impact on the business case.

7.3 Analysis of potential for replication.

PEC's analysis through this Next Generation project strongly indicates that an ESCo would be viable based around a smart microgrid on the specific site modelled for this project. Key conditions for any other housing project to replicate this would be:

- The right sized site. Fewer than 25-30 houses will be more challenging, more than 100 houses and you begin to approach the restrictions of Ofgem exemptions.
- The right site designs. This will have many variables and is complex, however the Hydrock tool enables any community energy organisation to work with housing organisations to assess this.
- A housing provider that is committed to investing in low carbon technologies, ideally having committed to investing in heat pumps and solar. In this circumstance an ESCo on site would

be likely to reduce capital costs for the developer and deliver better social and environmental outcomes.

- In addition to this, smart grids may be particularly valuable in grid constrained locations, where they have a potential to avoid the need for reinforcement through new substations or similar.

Although on a headline level this appears positive, the level of uncertainty within this business case is very high. In general terms this is because a smart microgrid is a complex system with many variables and without existing systems to study, the risk bands for many of these variables is individually significant and collectively alarming. Currently, the impact of this uncertainty is that it is unlikely that a community group could bring forward a project without some form of grant or investment on non-commercial terms. Key areas that need to progress to reduce this barrier are:

- Better half-hourly data to feed into modelling. The key to this is metadata. A half-hourly data set of 1m homes is not very useful unless it comes with further information about these homes, such as where they are, what socio-economic class are the inhabitants, what is the energy performance of the home etc. This metadata allows consultants to select only data that is representative for the homes being modelled. Hydrock were able to find a useful data source, however there is a significantly better data source that is available only to universities that would improve the model. Further information is in their report in the appendices.
- Better understanding of the impact of smart grids. This point is expressed above, but this would be best achieved by having demonstration sites that data can be analysed from.
- A process mapped out with DNOs that unlocks the potential for smart grids to minimise the need for grid reinforcement in constrained areas and realising a capital saving for this.
- A better understanding of the impact of EVs. This hasn't been explored above but there are similar issues around it being difficult to find reliable data from similar sites to understand their usage and how they will interact with the site wide system.
- A less volatile energy system. The cost of imported electricity is a significant expense to an ESCo and setting a cost for a smart grid operating from 2023 is hard enough but then plotting forward this price for 30 years is a huge area of risk. This risk would have to be passed to the customer but how this is structured could impact on the right to switch and on the housing providers appetite to partner with the ESCo.

A further barrier for this model being replicable by community energy groups is the demands of a project such as this. As outlined above the length of time it takes from early engagement to developed system could be up to 5 years or more. During this time the community energy group will need to maintain a high technical knowledge of the project and its viability, manage and structure a key strategic relationship to fruition as well as managing a complex risk profile. In response to this challenge, PEC commissioned the viability tool from Hydrock. This will help community energy groups better select projects, build a technical understanding of the project and its viability and engage partners with greater clarity. It should also help to move projects to a more advanced stage before requiring grant funding for feasibility studies. However even with this tool, any community group operating without experienced professional project management support and an engaged board or higher executive to provide strategic direction would struggle to deliver a successful project of this nature. There is capability within community energy to deliver successful smart grid ESCo projects, but it should not be assumed that groups that could deliver a Feed in Tarif subsidised rooftop solar project can graduate to delivery of a complex ESCo project.

If these barriers can be navigated, smart grids ESCos have the potential to solve many issues currently facing the decarbonisation agenda for new build homes. Over the next decade, building regulations standards for homes will push housebuilders towards building net zero homes, which will drive up the cost of building. Increasing levels of low carbon technologies and electrification of both heat and mobility will exacerbate pressures on the low voltage distribution network, requiring expensive upgrades that further increase the cost of housing development. Finally, as new houses increasingly adopt heat pumps, residents of these homes will become highly sensitive to volatility in the electricity market. Smart grids could mitigate many of these problems and are one of very few solutions we have available currently that could do this.

It's important to say the issues raised above are not siloed concerns of energy specialists. In 2021 PEC undertook a programme of consultation to assess the appetite of the supply chain and social housing providers to seek innovative new business models. The model we were consulting about specifically is the Energiesprong approach being taken by PEC Homes. While the approach is different, the problems it seems to answer and the lack of any precedent in the domestic market are very similar. Through the pilot project PEC Homes are working towards delivering in 2023, the enthusiasm of the supply chain (in a busy market) to be involved has surpassed all expectation. Moreover, our events with social housing providers have flagged more than 20 housing associations that were keen to deliver an Energiesprong project, with a common thread of feedback being that while they understood and really believed in the value of the proposed approach in terms of how it addresses some of the challenges they are seeing, they felt they could not take a proposal to the board without further information about how it could be delivered in practice without excessive risk. They needed another organisation to pilot it before they could follow.

Conclusion

Through the Next Generation programme, PEC have not been able to demonstrate a viable business case for an ESCo on a community housing site. However, the analysis we have completed does suggest that there could be a viable business case and that this would deliver positive outcomes for multiple parties. At present, the most significant barrier to community energy groups replicating that approach is the lack of any precedent. This is a complex business model, and it needs piloting in the spirit of innovation rather than comercial reward to move forward. If it can move forward, the model does, relatively uniquely, have the capacity to address significant issues that will hold back the decarbonisation and housebuilding agenda. It also is unlikely to require much time to reach a maturity as many of the individual technologies are relatively mature, it is simply the interaction of these technologies that is complex. It is for this reason that PEC's conclusion is that if some of these barriers are successfully navigated through a pilot, or a small number of pilots, smart grid ESCos could provide a successful business model for larger or better-established community energy groups which would drive substantial social, economic and environmental benefits.

Appendix 1 – Examples of ESCO projects

This list has not sought to be exhaustive.

Community Microgrids

1. Trent Basin Microgrid – 500 homes are being supplied through a microgrid sharing solar energy and using Europe's largest community owned battery. For more information see here.
2. Owen Square – Bristol based Owen Square Community Energy are seeking to establish a virtual microgrid across the Owen Square substation and a physical electricity network for one road. The ESCo will provide solar panels and an air source heat pump if houses sign up for their tariff. They are working with existing housing rather than newbuild.
3. Harberton & Harbertonford - The Harberton and Harbertonford Community Land Trust is developing a 12-home site with planning permission for the installation of a series of solar panels. The Trust are exploring feasibility of setting up a community-owned 'micro-grid', meaning that energy from the panels could be used to supply the homes directly rather than via the national grid. The houses themselves are constructed to be 'Passivhaus'.
4. TRESOC – Clay Park – TRESOC have been invited by Transition Homes Community Land Trust to own, install and operate 180kW of solar PV on their Clay Park Eco-Housing Development. TRESOC will become the energy supplier for the mini-grid providing the site with 100% green electricity.
5. South Dartmoor Community Energy - Exploring feasibility of community owned microgrid to support a small development of passivhaus homes.
6. Bristol Energy Cooperative - In 2019 BEC, together with Chelwood Community Energy and tech start-up CEPRO, set up the Microgrid Foundry. This joint venture is now developing microgrids that offer sustainable and efficient solutions for powering homes. The first is in Bristol, the second in Dorset. The Water Lilies housing development in northwest Bristol is being developed by Bright Green Futures BEC is funding the battery and the microgrid infrastructure at the site. spaces..
7. Bridport Cohousing - This community project will host 53 affordable homes using the same interconnected methods adopted at Water Lilies. It is one of the first of this scale in the UK, so offers an exciting model for new housing developers. BEC is funding the battery, PV and microgrid elements here.
8. FRECO - Frome Renewable Energy Co-op (FRECo), working in partnership with Frome Town Council is working with the Microgrid Foundry and the development team to explore opportunities for a net zero carbon heat network and microgrid at Saxonvale in Frome.

Community Heat Networks

1. Tamar Energy Community (Mount Kelly Heat Network) - Mount Kelly School and Tamar Energy Community are conducting a feasibility study to assess how a carbon neutral district heating system can be achieved on a local school
2. Brighton and Hove Energy Services Co-operative (BHESCo) – BHESCo is working at Firle in East Sussex on construction of ground source heat pump based heat network, and

associated ‘heat as a service’ agreements with Firle residents, to pay for the energy efficiency and renewable heat provided

3. Swaffam Prior Community Land Trust - Swaffham Prior, a village of around 300 homes in East Cambridgeshire, is seeking to install Ground Source and Air Source Heat Pump based heating network to service existing homes.

Significant projects or companies outside of the community sector

1. SmartKlub – ESCo operators for the Trent Basin Microgrid.
2. Emergent – Emergent work with housing owners to optimise renewable energy and other systems between properties, this can be through a microgrid or not.
3. SNRGY – Centrica owned company providing an end to end smart grid service to housing developers. This includes design commissioning and management of the system.
4. Microgrids foundry – Partnership between Bristol Energy Community and microgrids specialists CEPRO. Seeks to provide turnkey solutions for community owned microgrid projects.

Further appendices including the Microgrid viability testing tool can be found in a OneDrive folder here (or email Justin@plymouthenergycommunity.com for a link).