SHIELD
(Smart Heat and Intelligent Energy in Low-Income Districts)

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UKRI End of Phase Meeting

June 2023

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NES NATIONAL EQUALITY STANDARD

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Agenda

- Project summary
- Project highlights
- Project plan, outputs and deliverables
- Lessons learned
- Summary of each work package and deliverable
- Barriers, risks and issues identified and overcome
- How we have met the project specific conditions from the Project Direction
- Comms and engagement plans going forward
- Plans for Alpha/what is next

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Project Summary

SHIELD aims to identify and deploy new viable pathways that can be scaled to decarbonise heat and energy for vulnerable consumers and social housing tenants. SHIELD will replace existing heating solutions with distributed data centres serving as innovative low-cost low carbon heating in conjunction with smart energy generation and storage technologies that will help to balance demand and supply and reduce the upfront cost and running costs of consumers heating and energy.

In the Discovery Phase, we looked at the feasibility of the below:

New Heating Technologies and low carbon technology (LCT) combinations

- Using the heat produced from Thermify's distributed data centres to provide low cost and low carbon heating that replaces consumers gas boiler systems
- Integrating Thermify's distributed data centres with Kensa's ground source heat pumps to enable interseasonal storage and heat multiple homes/flats.
- Optimising onsite electricity generation sourced from rooftop Photovoltaics (PV) and/or new rooftop wind energy technology with electric heating and/or electric vehicle (EV) charging and battery storage by matching the heat demand and load profile to the generation

Smart Energy Management

- Using a social Energy Services Company model (ESCO) and aggregating the systems and households in local community areas to:
  - enable smart local energy system management
  - services to the grid, such as flexibility
  - reduce the cost to the consumer of heating and energy and
  - provide new revenues

Human-centred approach

- Tailored engagement to capture the needs and requirements of social housing tenants
- Identify a shortlist and criteria for suitable vulnerable customers for the above technologies and appropriate engagement plans

Project Highlights

- 19 out of 20 tenants surveyed wanted the solution installed into their homes in the near future
- The SHIELD solution could provide savings of up to ~40% on tenant's energy costs with the potential to provide even greater savings to the fuel poor through incentives made available by industry parties
- The SHIELD technology solution meets the scope of Challenge 1: Supporting a just energy transition

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Discovery Phase Project Plan & Outputs

April 2023	May 2023

WP1 Project Management

- All meetings, minutes, communications and records in place

WP2 – Site Shortlisting

- Housing stock analysis, Gas network comparison, Grid capacity scrutiny, Vulnerability assessment

- Assessment & Shortlist of SHIELD ready households completed

WP3 – Stakeholder Engagement

- Engagement and communication strategy, plus associated media

WP3 – Stakeholder Engagement

- Analysis of engagement complete

WP4 – Technical Specifications

- SLES, data centre, rooftop wind and GSHP technical specs produced

Technical specifications drafted

WP5 – Energy and Financial Modelling

- Summary reports from energy and financial modelling of technical solutions

WP6 – Discovery Learnings & Alpha Prep

Deliverable Summary

All deliverables have been completed and can be made available upon request.

Work Package (WP)	Deliverables	Responsible	Description
WP1 Project Management	• Discovery phase final meeting minutes	Essex County Council	To ensure the timely and successful delivery of the Discovery Phase of SHIELD
WP2 Site Shortlisting	• Shortlist of SHIELD ready households and flats • Grid capacity data	Power Circle Projects Ltd	To shortlist a site or sites containing property types and resident profiles relevant to SHIELD's proposed solutions
WP3 Stakeholder Engagement	• Engagement and communication strategy, plus associated media • Analysis of one to ones	UK Community Works	To design and trial an effective stakeholder engagement methodology
WP4 Develop Technical Specifications (SLES, distributed data centre, GSHP and rooftop wind)	• Report setting out indicative SLES assessment for generic locations • Identification of appropriate distributed data centre solution with heat/ hot water integration for each main house type • Identify appropriate standard GSHP solution in generic location • Identification of preferred integration option for heat pumps and distributed data centres • Outline specification of proposed rooftop wind system (s) or assessment of reasons for this option not being practicable or not being confirmable at this stage	Power Circle Projects Ltd	To provide outline technical specifications of SLES, distributed data centres, ground source heat pumps and rooftop wind
WP5 Outline energy and financial modelling	• Provision of summary reports from populated energy and financial model	Power Circle Projects Ltd	To provide outline technical specifications of SLES, distributed data centres, ground source heat pumps and rooftop wind
WP6 Discovery Learnings and findings & Alpha Prep	• Alpha Phase outline	UK Power Networks	To summarise discovery Learnings and findings and Alpha Prep

Work Package 1

- Facilitating collaboration between project partners has been easy and simple to deliver
- Records of each meeting are saved within the Project Team workspace
- Essex County Council (ECC) will continue the project management role during the Alpha Phase of the project

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Work Package 2

- Houses that have good potential for SHIELD Beta Phase participation have been shortlisted based on:
  - **Location:** Focus on four main towns of Colchester, Braintree, Halstead and Witham – agreed in collaboration with the UK Power Networks Connections Team
  - Homes with an EPC rating of A, B or C (indicating suitable insulation level)
  - 'Wet' heating system: gas or oil – Thermify can use existing radiator system
- Using criteria above, the numbers of houses and bungalows shortlisted are as follows (from overall stocklist of around 12,000 homes):
  - Witham 1,155
  - Braintree 1,091
  - Colchester 558
  - Halstead 337
  - **Total** **3,181**
- This provides a good pool for Beta Phase trial selection

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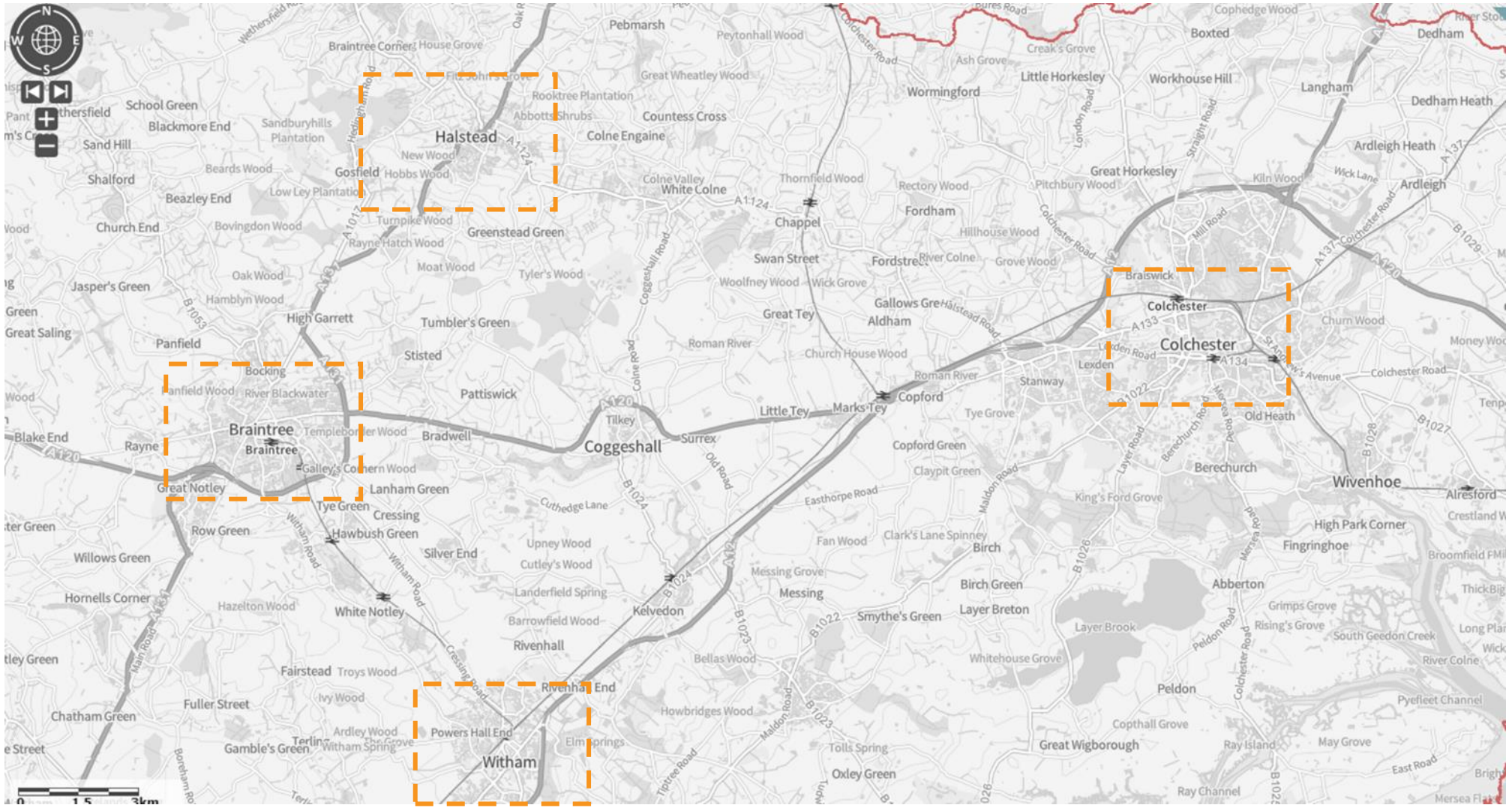
Work Package 2: Map showing four towns focus area



Work Package 2: Blocks of Flats

- For Beta Phase it is proposed to provide an integrated Thermify and Kensa Heat Solution in at least one block of flats
- Within the shortlisted areas, the numbers of blocks of flats shortlisted are:
  - Witham 864
  - Braintree 701
  - Colchester 386
  - Halstead 303
  - **Total** **2,254**
- From these, suitable blocks of flats will be identified by Eastlight, based on knowledge of likelihood of there being a suitable outdoor location at the site for siting a central Thermify installation integrated with Kensa GSHP solution.

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Work Package 3: Stakeholder engagement objectives

To understand:

1. Tenant concerns about energy costs and climate change
2. Tenant levels of interest or resistance to, new energy systems and services
3. Tenant willingness to have the SHIELD technologies installed next year as part of a pilot roll out

We engaged with Eastlight tenants via an online survey (400+ responses) and a series of one-to-one interviews.

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Work Package 3: Key findings

- Tenants are very concerned about energy costs – **average score 9.1/10**
- Tenants are also concerned about climate change – **average score 7.8/10**
- Tenants are interested in learning more about low carbon energy alternatives that can reduce energy costs and carbon emissions – **average score 8/10**
- Tenants are interested in learning more about the low carbon energy system being developed by the SHIELD project – **average score 7.8/10**

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Work Package 3: Interest in piloting SHIELD technologies

Among tenants responding to the survey:

- **68.3%** of tenants would like to try out these technologies in 2024
- **26%** are maybe interested in trying out these technologies in 2024
- **5.7%** are not interested
- **3** site surveys completed, all want to participate in a potential Alpha Phase pilot trial

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Work Package 4: Technical Specification SLES

Core to the technical specification is provision of a Smart Local Energy System (SLES)

- A SLES optimises local generation and storage to benefit energy users and uses grid flexibility to manage network constraints (an illustration for PV and battery is provided on the next slide)

The technical specification for homes has been identified in Work Package 4 to include:

- PV and battery with grid services capability
- Thermify Heat Hub
- Heat storage to meet heat and hot water requirements
- Smart thermostat system with tenant interface and control for grid services capability
- Separate electricity supply for Thermify through a separate boundary meter unless there is regulatory change e.g. a P379 style reform. Currently multiple suppliers are unable to compete for behind-the-meter energy volumes, measured via the same boundary Metering System.
- Comms for Thermify HeatHub, battery storage, heat storage and smart thermostat

Scope for comms to be met by shared solution will be explored in Alpha Phase

Scope for trialling rooftop wind at Beta stage will be explored in Alpha Phase

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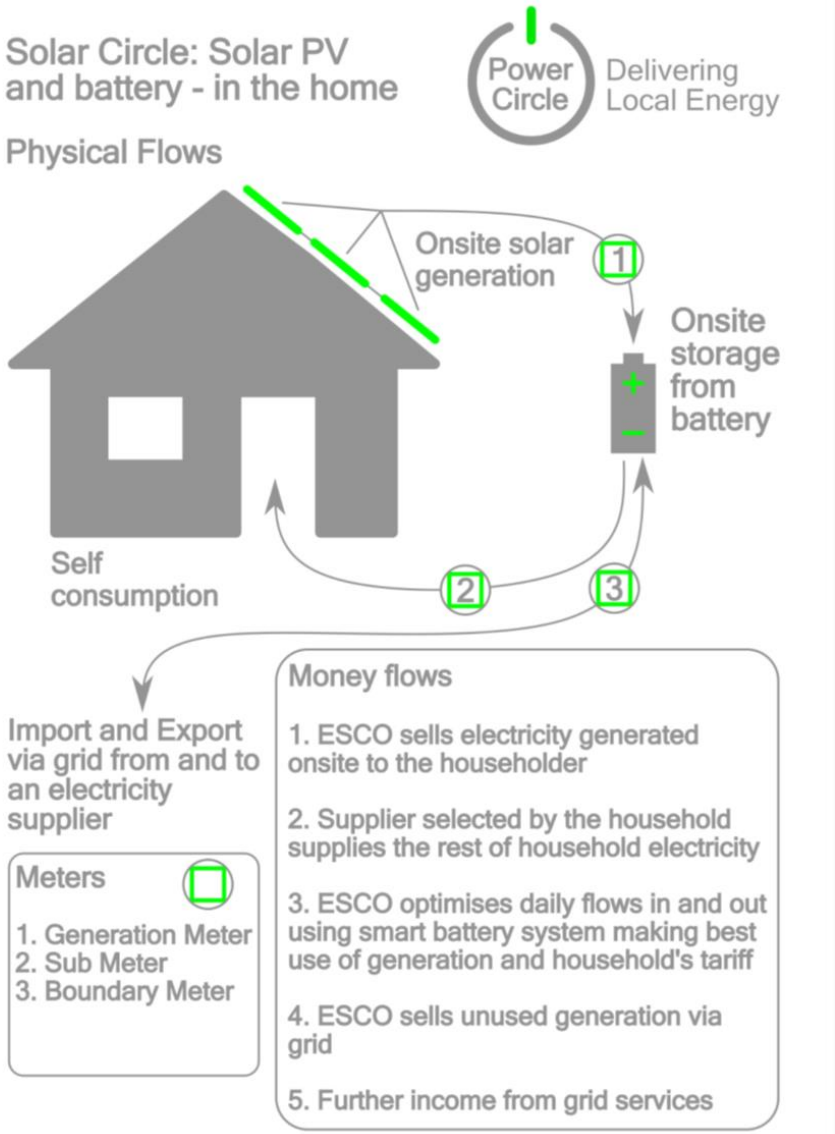
Work Package 4 Tech Spec SLES



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Work Package 4 Tech Spec. Kensa Integration

The use cases where integration of Thermify and Kensa solutions would add value are where installation of a Thermify heat solution on its own in each property is impracticable e.g. some blocks of flats.

In terms of space, this would be situations where:

- There is insufficient space for a complete Thermify solution per tenant household
- But space is available outside for a central Thermify installation which can feed heat into a Kensa borehole array to heat multiple flats/homes, reducing the running costs of the Kensa ground source heat pump (GSHP) heat solution

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Work Package 4 Tech Spec. Kensa Integration

Example of an externally sited battery

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Work Package 4 Tech Spec. Ridgeblade Integration

Example of a Ridgeblade rooftop wind installation, with solar PV

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Work Package 5

- Energy and financial modelling was carried out based on commercial rollout of a SHIELD deployment, once demonstration has been completed
- This indicates good scope for rollout, **subject to successful trial demonstration**
- Headline results: On current assumptions, a fundable solution can provide tenants with a **70% reduction** in heat and hot water costs against gas (£1,000+/year down to £300/year), with an overall energy bill **saving of up to 40%**

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Work Package 5

Modelling was undertaken to understand the costs and benefits for consumers.

Current Annual Costs	Current Costs	Costs after project	
Electrcity import			
Electricity use			
Rate 1	3100	232	kWh
Rate 2	0	0	kWh
Rate 3	0	0	kWh
Rate 4	0	0	kWh
Tariff			
Rate 1	0.35	0.1529859	£/kWh
Rate 2	0.35	0.5026091	£/kWh
Rate 3	0.00	0	£/kWh
Rate 4	0.00	0	£/kWh
Volumetric charge	£1,086	£36	
Annual Standing charge	£132	£147	
Total electrcity import costs	**£1,218**	**£182**	
Heating Costs			
Gas use	12000	NA	
Gas tarriff	0.11	NA	
Volumetric charge	£1,273	NA	
Annual Standing charge	£94	NA	
Thermify use charge	NA	618	
Total heating costs	**£1,367**	**£618**	

Costs for using PV electricity				
PV Electricity use				
Rate 1	NA	2876	kWh	
Rate 2	NA	0	kWh	
Tariff				
Rate 1	NA	0.2575	£/kWh	
Rate 2	NA	0.2575	£/kWh	
Volumetric cost	NA	£740		
Standing Charge/Subscription	NA	£0		
VAT	NA	5%		£37.02
Total PV use costs	NA	£777		
Total Cost	**£2,585**	**£1,578**		
Saving from project £		**£1,007**		
Saving from project %		**38.96%**		

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Work Package 5

Modelling was undertaken to understand if there is a business case for investment in BaU.

Setup	
Elec Load	Ofgem medium TDC
Install and costs	PV, Battery Storage, Thermify HeatHub & Sunamp thermal storage
Finance	Loan
Number of installers	300

Investment return	
Cost of capital	4.6%
Internal Rate of Return (IRR)	13.09%

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Work Package 6

- Following the successful completion of the Discovery Phase, the Alpha Phase bid was prepared by the bid team and was submitted in July

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Lessons learnt

- Social housing tenants were very engaged and provided a higher response rate to communications than we expected
- Tenants are interested in learning more about the low carbon energy system being developed by the SHIELD project and in general. However, they express concerns about energy costs and climate change.
- Where there is not space for a Thermify only solution in each tenant's property, instead Thermify's HeatHub will integrate and feed into Kensa's Ground Source Heat Pump (GSHP) borehole array to heat multiple homes or flats. Where there is space for a Thermify only solution for each house/flat, Kensa's GSHP solution does not add value to the customer.
- Ridgeblade rooftop wind at domestic scale is not quite ready for trialling in Alpha Phase. There is opportunity to re-evaluate this during Alpha Phase for consideration of trialling rooftop wind at Beta Phase.

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Barriers, risks and issues identified and overcome

- Space requirements of Thermify Heat Hub unit is a barrier to install in some homes. Sample onsite surveys of several homes of tenants who have expressed interest in SHIELD have informed understanding of space requirements and most suitable install locations.
- If Thermify pays for its electricity use directly instead of the tenant, this would require a separate electricity supply for Thermify through a separate boundary meter unless there is regulatory change e.g. P379 style reform. Currently multiple suppliers are unable to compete for behind-the-meter energy volumes, measured via the same boundary Metering System.
- Ridgeblade rooftop wind not ready for trialling in Alpha Phase. We will re-consider trialling in Beta Phase during Alpha Phase.

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Project specific conditions (Condition 4)

Condition 4: Prior to the completion of the Discovery Phase, the Funding Party must provide to the monitoring officer an explanation as to why the Project is focusing on Thermify systems and PV, rather than other opportunities such as wind or electric vehicles

Response:
Summary of SHIELD technologies: The SHIELD solution focuses on deploying onsite generation, storage and heat technologies integrated within smart energy systems which can deploy at scale for vulnerable and low-income households.
Selection of technologies:

1. SHIELD considers both PV and wind as onsite generation. PV demonstrates excellent performance in its ability to cut energy costs and is well established. Whilst there have been concerns with rooftop wind due to noise and vibration issues, SHIELD has been in discussion with a company called Ridgeblade who have an innovative solution. SHIELD intends to incorporate the Ridgblade rooftop wind solution alongside PV when the solution is mature and ready

2. SHIELD considers onsite storage. This is a key component to enable smart energy management, access to low-cost tariffs for tenants and provision of grid services

3. SHIELD considers low carbon heat solutions. The Thermify solution is an innovative heating solution which can provide low cost, low carbon and energy efficient heating for domestic homes. In the Discovery Phase, SHIELD has also worked on the scope for integration of the Thermify solution with ground source heat pumps and found that, for certain categories of property, this integration provides an optimal solution.

4. From discussions with Eastlight Community Homes during Discovery Phase, there is a low uptake of EVs amongst their tenants given the low income of most social tenants, and the high upfront cost of an EV. However, onsite generation and storage enhances readiness for EV adoption and EV charging can be accommodated within the SLES and SHIELD solution. EV charging for blocks of flats has been discussed at a high-level with Eastlight as a prospective SHIELD component.

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Project specific conditions (Condition 5)

Condition 5: Prior to the completion of the Discovery Phase, the Funding Party must engage with the team behind the SIF Project 'Net Zero Terrace' to discuss similarities and potential areas of overlap. The Funding Party must provide prior to the end of the Discovery Phase a summary of this discussion. Innovate UK can facilitate an introduction if necessary.

Please find a summary of the discussion below:
Date & Time: 25th April, 2pm - 3pm
Attendees:

- SHIELD: Jonathan Gilmour, Jon Cape, Carole Randall
- Net Zero Terrace: Helen Seagrave, Geraldine Paterson, Phil Proctor

Description: The discussion consisted of introductions, explanations of our respective projects and a discussion of the areas where there were similarities and opportunities for collaboration and sharing learnings between the projects.

Summary: SHIELD and Net Zero Terrace are both looking to deploy low carbon heating solutions in residential homes. However, SHIELD is focusing on social housing and vulnerable consumers and will be testing new innovative types of heating technologies such as Thermify's distributed data centre alongside low carbon generation. Net Zero Terrace is focused on deploying low carbon heating solutions and decarbonising terraced communities through an integrated and optimised community virtual power plant. There were some key areas identified that the projects could share learnings and collaborate on and have been listed below.

Areas for sharing learnings:

- **Stakeholder/Resident Engagement**
    - Net Zero Terrace could share with SHIELD the insights, learnings and recommendations that they find when conducting stakeholder engagement with households. In particular, SHIELD would be interested to understand how households respond to the Net Zero Terrace propositions.
    - SHIELD could also share learnings with Net Zero Terrace on the most effective ways SHIELD finds to engage with social housing tenants and the unique insights and results SHIELD receives from vulnerable consumers.
    - SHIELD will keep updated on the application/app that Net Zero Terrace is developing as this could be used by SHIELD in the future for customer engagement and data collection.

- **Technologies**:
    - Net Zero Terrace could share insights and learnings into the practicalities of implementing GSHP and complementary technologies in a terraced row of houses setting. This would be of value to SHIELD where we see clusters of social housing in a terraced row.
    - SHIELD could share insights and learnings on new innovative low carbon heating technologies such as Thermify and the best approaches for combining these with other low carbon technologies such as rooftop wind, solar PV, battery storage and EVs.
    - Both projects would be interested to understand how they overcome space considerations and constraints for homes.

- **Business model**
    - Both projects will share learnings and their proposed approaches towards local energy market structures and business model development

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Comms and engagement plans going forward

- All UK Power Networks' Discovery Phase projects will be uploaded to the Smarter Networks Portal and feature on the UK Power Networks innovation website with specific project learnings being disseminated at the UK Research & Innovation Show & Tell events.

- During Alpha Phase UK Power Networks will host an in-person event in London to disseminate the learnings and key outputs of all our SIF projects.

- Through UK Power Networks and Essex County Council's stakeholder networks, SHIELD will host an online event to share the learning and findings of SHIELD and share dissemination materials via local government networks and platforms such as the Energy Systems Catapult's Net Zero Go

- UK Power Networks will share project successes and discoveries via its social media channels with the possibility of publishing external press media where appropriate.

- Where practical, we will disseminate learnings to groups who may have an interest in SHIELD such as local authorities, housing associations and UK Power Networks' developer and connections forums

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Alpha Phase High-level Plan

Oct	Nov	Dec	Jan	Feb	Mar

Project Management

Tenant Engagement

- For shortlisted households, SHIELD will engage with and identify social housing tenants that are willing to participate in Alpha Phase and Beta Phase trials and gain feedback from them on the route to market and draft tenant agreements.

Commercial Agreements, Funding Structure & Energy Supply

- Route to market and beta commercial, funding and operating model defined
- Supplemental Beta tenant agreement drafted
- Half Hourly electricity supply and peer to peer trading contract options developed for Beta Phase

Technology and Modelling

- Detailed technology design, implementation plan, site survey's, connection assessments, updated cost benefit analysis (CBA)

Alpha Phase Pilot

- Deploy SHIELD pilot in 2 homes (HeatHub, PV, Battery and heat storage)
- Test Thermify integration with Kensa GSHP system in Kensa Test facility
- Gather tenant Feedback and monitor energy performance