PETERBOROUGH INTEGRATED RENEWABLES INFRASTRUCTURE

SUMMARY REPORT

Learning from Smart Local Energy System (SLES) design: Peterborough Case Study

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This report is a summary of:

MSc thesis: Examination of learning opportunities from integrated energy design to power the Net Zero energy transition
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Summary

Integrated, smart, localised energy systems (SLES) offer a holistic and local energy service that aims to match supply with demand locally thus removing grid network complexity. Peterborough Integrated Renewable Infrastructure (PIRI) is one of ten smart local energy system design projects currently running under the Prospering from the Energy Revolution (PFER) challenge.

Through literature review and interviews with staff from the PIRI project, this research aims is to draw out learnings from the design process and make these project learnings available to future integrated energy projects. A review of recent literature shows there is an absence of structured learning from many local energy demonstrators, that much learning has been technically focused, and that there has been less focus on engaging stakeholders and consumers. This research highlights several factors that may help enable local energy system transitions. For the design team, the importance of planning, communication, collaboration, and data sharing were highlighted. Beyond that, stakeholder engagement, suitable funding arrangements, and knowledge transfer mechanisms are identified as necessary conditions to enable SLES.

The findings of this research are located within research documenting enabling conditions for SLES that also extend to establishing a facilitative regulatory environment, and developing capabilities in system design to balance supply and demand supported by smart data and an economic business case. The learning outcomes can be used to help facilitate similar projects in the future across the UK. Local transitions offer one pathway to net zero, however, local solutions need to be transferable and contribute to a just and equitable energy transition that does not benefit some communities with more abundant local resources over others, and thus SLES also need to be viewed in terms of the wider socio-technical transition.

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D. Goodwin	May 2022	Updated template. Draft.

1 Introduction

Smart Local Energy Systems (SLES) offer the integration of renewable energy assets, the balancing of energy generated across multiple vectors with local demand, and the reduction of transmission losses and dependence on the national power grid. UK Research and Innovation (UKRI) has funded the detailed design of ten SLES around the UK through the Prospering from the Energy Revolution (PFER) programme. The aim of PFER is to showcase the integration of technologies at scale are to demonstrate how the energy transition to net zero by 2050 might be achieved.

There is no common definition of a SLES. To begin with, ‘local’ might be defined as a single building or a geographic region such as a county (Walker et al., 2021). Local energy schemes tend to be run in conjunction with councils and existing energy providers with local members as consumers of reduced costs services (Ford et al., 2019). Similarly, ‘smart’ covers a range of definitions and might more simply indicate the provision of additional information for decision making, or include full automation (Ford et al., 2019). What SLES projects do have in common is their approach to services provision and, through the nature of their local, integrated nature, tend to share common challenges such as those posed by current energy market structures (Energy Revolution Integration Service, 2020). As such, SLES may be better defined by their common objectives of providing more resilient, cheaper and cleaner energy services (Wilson et al., 2020).

This work examines learning outcomes from the Peterborough Integrated Renewables Infrastructure (PIRI), one of the ten PFER projects. Through interviews with staff from the PIRI project, this research aims are to make the project learnings available to future integrated energy projects. The PIRI project incorporates the following properties:

- Integration of multiple energy vectors both in supply and demand with intelligent balancing locally via an ‘energy as a service’ system
- Re-use of redundant heat from an Energy from Waste plant and local industry, enhanced by heat pumps before distribution via a heat network
- The network is geographically set to a defined area in the centre of Peterborough and the businesses within (Figure 1). In later stages, the residential properties may have the option to connect.

Figure 1 PIRI project boundary

The technology demonstrators run in the past have focused on the technology learnings with less focus on the broader societal context or policy impact (Frame et al., 2016; Rae et al., 2020). Moreover, recent reviews recommend that SLES should have more engagement with consumers (Energy Revolution Integration Service, 2020), particularly as public awareness is currently low (80% of those surveyed were unaware of SLES, Energy Revolution Integration Service, 2021). In a meta-analysis of 122 local energy projects implemented between 2009 and 2018 in the UK, only 20% of the projects had community energy group participation and, of those, engagement was largely one off with no studies to compare the impact before, during and after (Gupta & Zahiri, 2020). A number of recommendations have emerged for engaging stakeholders with SLES, including involving the local community, collaboration with stakeholders, and documenting evidence so that outcomes can help influence policy & regulatory reform to deliver net zero for people & communities (Bridge, 2021; Kelly, 2021).

2 Methodology

The methodology involved a number of steps summarised in Figure 2. The primary research method was a series of semi-structured interviews with the PIRI team leads, each lead representing a different project role.

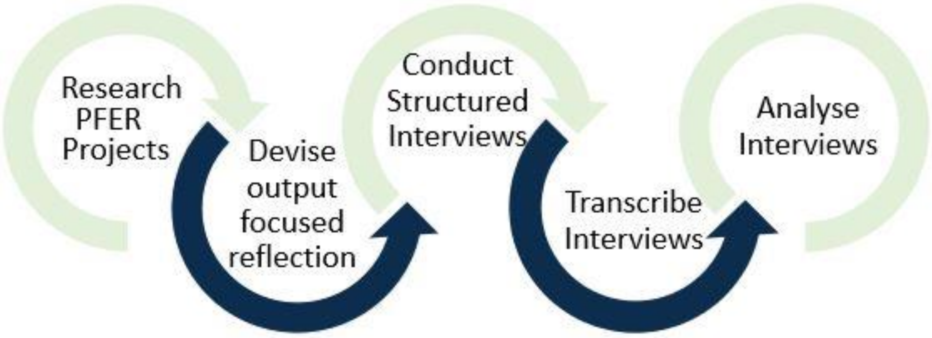

Figure 2 Summary of methodological approach

A semi-structured interview was selected to give the interviewees more flexibility in their answers than a questionnaire. To inform the researcher of the broader background on other PFER projects, background research on Project Leo (Oxford) and GreenScies (Islington) was performed prior to writing the questions for the interviews. The Community Energy England Innovation Conference was also used to get background on other PFER projects, their current status and the challenges they face (Bridge, 2021). The initial interview questions were based on the project aims and objectives and the five PFER project objectives (Richardson, 2020) and then refined to focus on project outputs. The interview questions were sent to the interviewees in advance to allow them time to prepare. The interviews were conducted over a two-week period, via Microsoft Teams. Each interviewee provides consent for recording prior to the interview and could modify or withdraw content post-transcription, as agreed in the ethics application. The interviews were automatically transcribed via Microsoft Teams except for one which was manually transcribed. The auto-transcriptions were manually edited, and all respondents were sent copies of the transcription to check. The transcripts were coded into tables and analysed thematically, guided by the question topics.

3 Results

The themes describing learnings that emerged from the interviews are summarised in Figure 3 and elaborated on in the following paragraphs relating to (1) design team learnings, (2) innovation, (3) stakeholder engagement, and (4) information inputs and outputs.

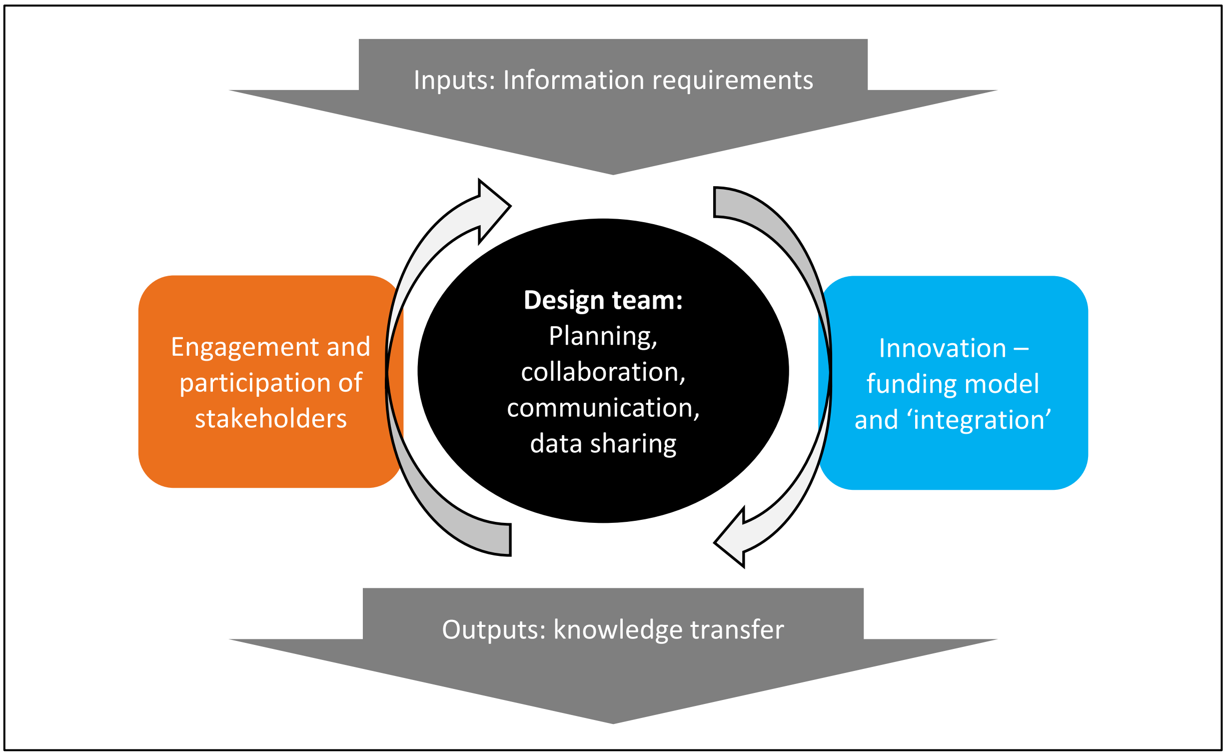

Figure 3 Summary of thematic learning opportunities

3.1 Design Team

Interview participants recognised the value of planning in future projects. Some of the benefits mentioned included ensuring greater clarity around project roles and responsibilities, the level of required detail for deliverables and to confirm that the designs would meet the user requirements. A clearer definition of requirements and scope could help minimise costs. However, conversely, when it came to less developed areas requiring project innovation, participants felt tight scope control could restrict innovation and increase cost by attempting to gather data when requirement changes made the data obsolete. Thus, there can be a fine balance when defining the scope such that it aids the design process but does not stifle innovation.

Intra-project communication arose on several occasions in the interviews. When meshing expertise from different legal entities, each working in different technical areas, formal and informal project communication was described as essential to ensure team members felt engaged, informed, and able to access the information they needed. The importance of collaboration was also raised by the interviewees in several aspects. These included ensuring division of labour, reducing handover time between project phases, standardising project-wide working (including consolidating software), and collaborating on data policies (particularly covering Intellectual Property Non-Disclosure Agreements, NDAs) to help share data needed for the design.

3.2 Innovation

Participants agreed that while each of the technologies have previously been deployed in isolation, the key innovation of PIRI was the integration of energy vectors and the speed of deployment.

Funding was a theme in the interview and, more so, that the type of funding model could constrain project innovation. Multiple participants gave examples of where the PFER matched funding model constrained innovation, by restricting project scope. Matched funding means that any budget changes need to be matched by commercial partners with associated approval delays. This was seen as particularly influential on integrated infrastructure projects where innovation opportunities are discovered that need a relatively small amount of budget increase to exploit a much bigger gain.

3.3 Stakeholder Engagement

A requirement for stakeholder contact lists, both to help discover their system requirements and to help foster a sense of community, was discussed in the interviews. Thus, communicating within and outside the design team was a cross-cutting theme. Interviewees agreed on the importance of stakeholder engagement, albeit for a variety of reasons. Interviewees stated the effort required for stakeholder engagement had been underestimated and suggested dedicated resources were necessary and that there was intangible value to engaging stakeholders and the community. Moreover, interviewees expressed that the project should be promoted to the local community and to other communities interested in completing SLES projects in the future.

Designer stakeholder engagement requirements were often driven by the requirement for data. For example, the importance of electricity network constraint information from District Network Operators (DNOs) was highlighted as important for making data informed decisions. Many of the participants expressed the belief that some stakeholder segments may not be that interested in the utilities beyond their bills and whether the lights came on. However, for businesses and industrial stakeholders, where they have made public net zero commitments (or want to trade with organisations which have), there was greater recognition of the value of low carbon energy, providing the disruption to businesses is minimal. In summary, communication was a cross-cutting theme relevant to the project team and also to wider stakeholders and the community. Moreover, the method, detail and intensity of communication and engagement might need to vary depending on the stakeholder’s interest or level of involvement with the project.

3.4 Information requirements and knowledge transfer

Information is required by the project team as inputs into the design and the project generates information as outputs that can provide iterative feedback for design development as well as for wider knowledge transfer. Suggested information requirements included:

- Program metrics e.g., Project objectives, approach, duration, cost, funding sources, consortium structures
- Detailed technical requirement gathering e.g., equipment location and properties, DNO network congestion data
- Financial Metrics: Capital Expenditure (CAPEX), Operational Expenditure (OPEX), Payback Period, Return On Investment (ROI), Internal Rate of Return (IRR)
- For End users: focus on the cost savings and comfort/ease of use, although opinions on the information which would be useful in future projects diverged.

For knowledge transfer, outputs from the project need to be communicated to other stakeholders. Methods for communication and knowledge transfer that were identified in the transcripts included:

- Utilising project relationships with stakeholders
- Interactive technical workshops with future designers to avoid time writing up lengthy documentation which isn't necessarily appropriate, becomes out of date or "gathers dust". These workshops would be run as part of each project and could be recorded for future review.
- Video interviews. Although, people may need to follow-up conversations for more detailed questions on how the change directly impacts their circumstances.
- Blogs to describe what is happening/why and when
- FAQs to give people answers to common questions

4 Discussion

The findings from this research can be located within frameworks describing enabling conditions for SLES (Figure 4). The geographical framing of SLES is discussed in Walker et al., (2021), whilst Ford et al., (2021) describe the interactions of SLES with other related systems. In terms of enabling factors, Britton, (2016) summarise a number of factors, some of which overlapped with the findings of this research. In particular, the engagement of stakeholders, and the characteristics of the funding such that innovation is maximised and the project can develop a robust business case.

4.1 Design coordination

Many of the findings relating to the design team around planning, collaboration and communication are common to infrastructure projects. For example, Patanakul & Omar, (2010) summarise the benefits to project delivery for collaboration, strong teams, and involvement of stakeholders. Flyvbjerg et al., (2009) highlight the importance of planning to reduce the risk of underestimating the time and budget needed to deliver a project. Moreover, Koppenjan, (2005) recommend the early engagement and interaction of stakeholders to build trust, reach common gains and develop partnerships that can enrich projects. Sharing data is fundamental for SLES, firstly, to locally balance energy demand from multiple vectors, and, secondly, to achieve the energy system flexibility necessary for a net zero transition. However, organisations that own secondary (thermal) energy generating assets can be reluctant to share data which may impact their commercial interests. Moreover, the PFER shared funding model challenges the sharing of design data with both collaborators and future SLES projects, as the investing organisations have an obligation to their owners/shareholders to protect IP created when designing such energy systems. Thus, there are several factors inhibiting data sharing, collaboration, and potentially constraining local energy transitions.

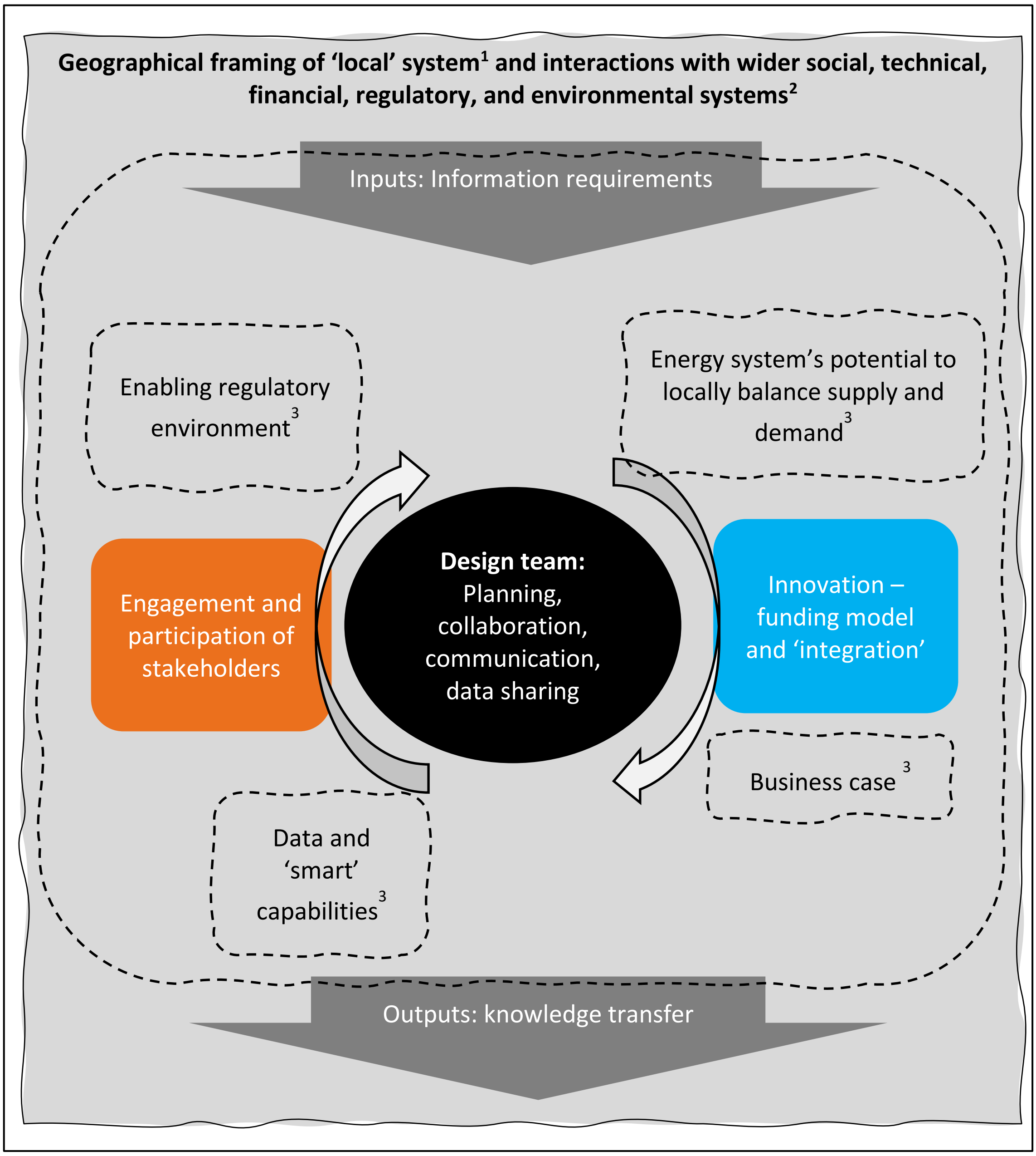

Figure 4 Summary of enabling conditions for SLES derived from literature with additions from the research. [1]Walker et al. (2021), [2]Ford et al. (2021), [3]Britton (2016),

4.2 Innovation

Infrastructure heavy projects which innovate as change is made rather than as requirements change need a more flexible funding model which allows them to take advantage of innovation opportunities. The matched funding model may constrain innovation by fixing the budget ahead of the project and slowing down implementation if approval for budget changes is required. Research also supports a need to develop innovative public and private financing mechanisms to enable SLES and low carbon transitions (Energy Systems Catapult, 2020).

A primary innovation for PIRI is how the different energy services are brought together. Yet consumers may not be interested in the detail and just expect services that work (Hall et al., 2021). PIRI builds on this with its energy as a service model where participants select heat as a service rather than needing to be concerned about the number of power units, the source of the heat/power or balancing losses. This also shifts the incentive to implement capital works for insulation to reduce the longer-term operational costs, as the service provider will benefit from the savings. Innovation can also come through how the project interacts with the public and stakeholders. Examples of social innovation relevant to PIRI could include integrated human centric design and “living labs” (Energy Systems Catapult) to test functionality and acceptability.

4.3 Stakeholder Engagement

The requirement for stakeholder engagement was clear in this research with multiple information requirements including comprehensive contact lists, frequent touchpoints throughout the project. Project promotion was seen as an important way to keep stakeholders informed about the project as well as a mean for them to interact with it.

Much of the current learning in academic literature is technology focused. However, the transition to net zero may bring substantial change to everyday lives, and previous experience suggests building stakeholder (including public) acceptance may take time (Moss Kanter, 2012). To foster acceptance, energy transitions needs to happen with communities, not to them, and there is a need to therefore focus on the human elements of proposed system change (Bridge, 2021). Yet, despite the recommendations that the UK’s transition to net zero be underpinned by education, choice, fairness and political consensus, reviews of central government progress state that “Government has not adequately communicated to the general public the changes that individuals will need to make in the transition to net zero emissions” (Public Accounts Committee, 2021).

An advantage of SLES is that local government has more knowledge of local issues and may be better positioned to communicate local transition ambitions. Integrated infrastructure programs such as PIRI have an opportunity to engage with the local community and get them to understand how they can make a difference to both their bills, comfort and the environment. PIRI offers an example of visible, local change and also an example of how individuals can make a difference, as the more people support local schemes, the more successful they will become.

4.4 Information requirements

Information requirements of SLES stakeholders may vary but there will also be considerable overlap. Information should be made available in different media types (text, audio/video, in person, interactive) and presented in ways that can maximise the likelihood the message will be understood and have the desired impact. A range of interactive information sources are available to help engage consumers including stories, visuals and games (Devine-Wright, 2019; Morganti et al., 2017). Using independent, trusted information sources is important. There are already current, good quality, free materials on climate change and the necessary actions e.g., the Climate Change Assembly website. Where possible, these should be linked to rather than duplicating content.

Without means to transfer learning from similar innovative demonstration projects, further projects are likely to suffer from duplicating less desirable features (Gupta & Zahiri, 2020; Hampton & Fawcett, 2020). Clarity is required on roles and responsibilities for knowledge transfer, as various organisations begin to develop toolkits to support local authorities developing SLES (Schmidt, 2021).

Conclusions

Through literature review and interviews with staff from the PIRI project, this research aimed to draw out learnings from the design process and make these project learnings available to future integrated energy projects. A review of recent literature shows there is an absence of structured learning from many local energy demonstrators, that much learning has been technically focused, and that there has been less focus on engaging stakeholders and consumers. This research highlights several factors that may help enable local energy system transitions. For the design team, the importance of planning, communication, collaboration, and data sharing were highlighted. Beyond that, stakeholder engagement, suitable funding arrangements, and knowledge transfer mechanisms are identified as necessary conditions to enable SLES. The findings of this research are located within research documenting enabling conditions for SLES that also extend to establishing a facilitative regulatory environment, and developing capabilities in system design to balance supply and demand supported by smart data and an economic business case. The learning outcomes can be used to help facilitate similar projects in the future across the UK. Local transitions offer one pathway to net zero, however, local solutions need to be transferable and contribute to a just and equitable energy transition that does not benefit some communities with more abundant local resources over others, and thus SLES also need to be viewed in terms of the wider socio-technical transition.

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