SONNET – Social Innovation in Energy Transitions

Co-creating a rich understanding of the diversity, processes, contributions, success and future potentials of social innovation in the energy sector

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Research report on local electricity exchange in the UK

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About SONNET: SONNET is a research project that aims to develop an understanding of diversity, processes, contributions and future potential of social innovation in the energy sector. It is co-funded by the European Commission and runs for three years, from 2019-2022. The SONNET consortium consists of 12 partners across Europe, including academics and city administrations. For more information, please visit our website: https://sonnet-energy.eu

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1 FORWARD

SONNET (Social Innovation in Energy Transitions) brings diverse groups together to make sense of how social innovation can bring about a more sustainable energy sector in Europe. The project aims to co-create a rich understanding of the diversity, processes, contributions, successes and future potentials of social innovation in the energy sector (SIE). We define SIE as combination of ideas, objects and/ or actions that change social relations and involve new ways of doing, thinking and/ or organising energy. As part of this work, we make use of an embedded case study approach to build a better understanding of the development of diverse SIE-fields (e.g. participatory incubation and experimentation, framings against specific energy pathways, local electricity exchange) over time. Our research questions that frame the case study work are:

- How do SIEs and SIE-fields emerge, develop and institutionalise over time?
- How do SIE-field-actors and other field-actors interact with the 'outside' institutional environment and thereby co-shape the SIE-field over time?
- What are the enabling and impeding factors for SIE-field-actors and other field-actors to conduct institutional work and change the 'outside' institutional environment?

A SIE-field is an arena/space that includes a specific SIE as well as SIE-field-actors working on it and other field-actors enabling and/or impeding it. In this arena/ space these actors take one another and their actions into account and have a shared (but not necessarily consensual) understanding of a SIE and of their relationship to other actors. They recognise (but not necessarily follow) shared norms, beliefs and rules. SIE-fields are often not homogenous but are composed of actors with diverse and contradictory aims and interests. An example: The UK cooperative energy field includes SIE-initiatives and SIE-field-actors (e.g. Brighton Energy Co-op, Cooperative UK, Community Energy England, UK Government, City of Brighton), who have a shared understanding of an SIE, which exists as 'organising under cooperative principles to generate renewable energy'.

The structure of this report is as follows. Section 2 provides a summary of the SIE-field relevant for this report and lists some key insights. Section 3 outlines the boundaries of the SIE-field, shows how it has been studied in the country context and provides a list of key field actors and their roles. Section 4 shows a timeline of the SIE-field. Section 5 tells the historical development of the SIE-field over time, including analytical/ interpretive reflections from the SONNET researcher and quotes from the actors involved in the field developments. Section 6 outlines key research findings, providing answers to the three research questions. Section 7 outlines recommendations for policymakers based on the findings. Finally, Section 9 outlines the methodological approach and includes a more detailed timeline of the SIE-field and its actors.

2 LOCAL ELECTRICITY EXCHANGE IN UNITED KINGDOM

In SONNET we investigate the development of social innovations in energy (SIE) and the SIE-field called 'local electricity exchange' (LEE) (initially – local peer-to-peer (P2P) electricity exchange). This includes discourses and activities derived from the production, consumption, distribution and trading of renewable energy locally (i.e. close to its point of generation) over time. We study this SIE-field in France, Switzerland and the United Kingdom (UK). The study of this SIE-field is important for understanding some of the changes around renewable energy, consumers and communities' involvement, and evolving energy markets, instigated by energy transitions, decarbonisation and decentralisation of the energy system. The SONNET investigation started with exploring 'local P2P electricity exchange' for domestic energy consumption; then the boundaries of the SIE-field were expanded to include SIE-initiatives that claim to have some elements of local P2P electricity trading or to be representative of local electricity exchange. Local electricity exchange as a broader concept allows including some of the innovative approaches that aim to match local renewable energy generation with local consumption resulting in new business models and new forms of collaborations that also allow engaging people in energy transitions.

The SIE-field is defined as 'local electricity exchange' that includes multi-actor collectives (including multiple non-traditional energy players) experimenting with and implementing novel financial, institutional, technical (digital) and business model innovations to enable grid-connected local/regional renewable energy exchange (which includes production, consumption, distribution and sometimes trading of energy). The aims of the initiatives and other activities related to LEE is to achieve a greater penetration of renewable energy into current energy systems and to reform an electricity market, which used to be seen, at least in the UK, as a field monopolised by big industry players.

The emergence and development of SIE-field in the UK is discussed in this report with three foci in mind: (1) models that are currently used or being developed (e.g. some types of 'sleeved' Power Purchase Agreements (PPA) and Energy Local clubs); (2) experimental projects (i.e. Ofgem's[1] sandbox P2P trials), as well as new concepts and approaches to organising local electricity exchange (e.g. local energy markets and smart energy communities), to discuss the latest developments and the future of the SIE-field; (3) the policy context, the changes of the regulatory framework and the institutional work carried out by key actors in the SIE-field (e.g. the Local Electricity Bill and multiple suppliers proposition).

[1] Ofgem (the Office of Gas and Electricity Markets) is a non-ministerial government department and an independent National Regulatory Authority. https://www.ofgem.gov.uk/

Key insights

For the SONNET project, local electricity exchange as a SIE-field is particularly interesting because through exploring the approaches to local electricity exchange and interactions between various SIE-field actors it reveals a number of important issues for social innovation in energy transitions. It is an emerging SIE-field which hasn't been institutionalised yet, and the study allows observing how the SIE-field is being shaped and the institutions 'in the making'. In particular, it illustrates that:

- Local electricity exchange (LEE) and peer-to-peer (P2P) electricity trading are ambiguous terms. What constitutes these phenomena, what models can be labelled as LEE and what is qualified as 'local' in electricity exchange is subject to interpretations, although the overall aim (to maximise local usage of locally produced energy) is less contested.
- The electricity system (including electricity supply) is a highly regulated field. The policy and regulatory framework defines the rules and actors' responsibilities. Although policy context is evolving, there are still significant regulatory barriers for LEE and P2P trading.
- The new arrangements for electricity exchange/trading have a potential for changing the power relations between actors in the electricity market. It is likely that power will be concentrated in the hands of technology companies (providers of trading platforms) and large players (e.g. Distribution System Operator (DSOs)). This also raises a question of governance for an emerging phenomenon embedded in a highly regulated field.
- Development of different models of LEE is driven by different types of actors, who arguably have slightly different aims/objectives (e.g. communities, tech companies and energy suppliers). It is not clear which models/approaches will be most successful and more widely adopted. There is a need for flexibility in design and implementation of LEE for a particular community/locale.
- Local electricity exchange, local energy markets (LEM) and P2P trading rely on multi-actor collaborations. For most community actors and local authorities' partnerships with energy supply companies and DSOs would be essential for implementing local electricity exchange models.
- P2P electricity trading represents the level of complexity that can surpass its potential benefits and may be too complex for ordinary consumers. P2P electricity trading is likely to be a 'niche' solution, at least in the nearest future; it can be part of large developments/projects such as local energy markets.

3 Introduction to local electricity exchange in the UK

In SONNET we investigate the development of social innovations in energy (SIE) and the SIE-field called 'local electricity exchange' (LEE). This includes discourses and activities derived from development of production, consumption, distribution and trading of renewable energy locally (i.e. close to its point of generation) over time. We study this SIE-field in France, Switzerland and the United Kingdom (UK).[2]

The study of this SIE-field is important for understanding some of the changes around renewable energy, consumers and communities' involvement, and evolving energy markets, instigated by energy transitions. It is argued that some degree of decentralisation of the energy system is inevitable; future energy systems are likely to be a mix of centralised and decentralised resources (Linberg et al. 2019). The change is also driven by the vision employed by the European Union (EU) of (active) consumers playing a greater role in the future energy systems,[3] where e.g. peer-to-peer energy trading could be one of the solutions. This is also finding its way into national policy discourses that discuss decarbonisation, decentralisation and digitisation as directions for transforming the energy sector and meeting climate change targets (the three Ds for the energy sector in transition), resonating with the energy democracy concept (Szulecki 2018).

Definitions and boundaries of SIE-field

In the UK the research started with exploring 'local P2P electricity exchange' for domestic energy consumption as the foci of the case study. As it became apparent that there is no working P2P electricity exchange/trading models and P2P markets in the UK (except for a few trials), the boundaries of the study were expanded by including SIE-initiatives connected to the national grid that claim to have some elements of local P2P electricity trading or to be representative of local electricity exchange. Local electricity exchange as a broader concept allows including some of the innovative approaches that aim to

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[2] In this report we are discussing Great Britain (England, Wales and Scotland) rather than the UK. This is due to the framework for electricity grid in the country. For consistency the term 'UK' is still used here unless the documents or interviewees explicitly referred to 'Great Britain'.
('Northern Ireland operates a separate wholesale electricity market with a pool system, the Single Electricity Market, which is integrated with the wholesale electricity market in the Republic of Ireland.' https://uk.practicallaw.thomsonreuters.com/1-523-9996?contextData=(sc.Default)&transitionType=Default&firstPage=true)

[3] The EU Renewable Energy Directive (RED, RED II) and Renewable Energy Communities (requires countries to implement and enabling framework for locally owned energy projects).
'The recast of the European Union Renewable Energy Directive (RED II) entered into force in December 2018, followed by the Internal Electricity Market Directive (IEMD) and Regulation (IEMR) as part of the Clean Energy for all Europeans Package. The RED II, that the 28 Member States have until June 2021 to transpose into national law, defines "Renewable Energy Communities" (RECs), introduces a governance model for them and the possibility of energy sharing within the REC. It also provides an "enabling framework" to put RECs on equal footing with other market players and to promote and facilitate their development.' (Lowitzsch et al. 2020)

match local renewable energy generation with local consumption.[4] They result in new business models and new forms of collaborations that also allow engaging people in energy transitions.

The SIE-field 'local electricity exchange' is defined as multi-actor collectives (including multiple non-traditional energy players) experimenting with and implementing novel financial, institutional, technical (digital) and business model innovations to enable grid-connected local/regional renewable energy exchange (which includes production, consumption, distribution and sometimes trading of energy). The aims of the initiatives and other activities related to LEE is to achieve a greater penetration of renewable energy into current energy systems and to reform an electricity market, which used to be seen, at least in the UK, as a field monopolised by big industry players.

The boundaries of SIE-field are defined by existing initiatives (i.e. microgrids, community self-consumption models, some forms of Power Purchase Agreements (PPAs)) and initiatives that are being developed and technologies being tested (virtual platforms) – e.g. new models trialled through regulatory 'sandbox' schemes. They are embedded in a wider context of electricity market reform, and largely shaped by trends for digitisation, deliberations about future energy scenarios, climate change, community energy, community cohesion and fuel poverty, anti-monopoly and consumer choices, citizen involvement, consumer-centric electricity markets, diversity of business models, a greater penetration of renewables into energy system. As the policy and regulatory context for LEE in the UK is extremely important (the field is highly regulated and the main contestations are happening around regulatory change), the SIE-field also features lobbying initiatives and campaigns for or against particular policy and regulatory changes (e.g. the Local Electricity Bill, Ofgem regulations or codes for electricity market in the UK).

There is no one single definition of either LEE or P2P electricity trading[5] in the literature. These are emerging themes in the sharing economy and appear to be national context-specific to some extent (due to regulatory framework and electricity system design). P2P is commonly viewed as based on collaborative economy principles and rooted in energy prosumerism – a transformation of a share of electricity consumers into prosumers who are proactive in managing their energy consumption, production and storage (Sousa et al. 2019). It is also induced by increasing engagement with community energy initiatives and a desire of more flexibility in energy exchange arrangements. One of the arguments in support of the P2P electricity trading concept is its potential to enable a local matching of supply and demand (van Soest 2018). Market participants engaging in P2P trading are usually prosumers, and a transaction is qualified as P2P if undertaken by two nonprofessional actors (i.e. prosumers rather than professional energy suppliers) (van Soest 2018). P2P electricity markets rely on consumer-centric and bottom-up perspective and allow prosumers to share their energy and investment; it implies

[4] It is important to note a different usage and interpretation of 'local' in relation to energy: 'The concept of local can be ambiguous; to some people, local means their neighbourhood, village, town or county. To the energy industry, it can mean the distance from the generation site or connections on the same network.' Open Utility (2016) https://piclo.energy/publications/piclo-trial-report.pdf

[5] The terms are also used along P2P energy sharing, energy sharing in local energy markets and transactive energy in literature.

multi-bilateral agreements between parties (Sousa et al. 2019); auction-based mechanism is another way of organising electricity trading (Liu et al. 2019).

It is useful to note the physical side of the electricity trade: once electricity is put into the grid, it becomes indistinguishable, which means that it is impossible for a buyer to receive the exact same electricity as the seller put into the grid (unless there is a 'private wire'). The parties do not actually exchange electricity; the supplier commits to putting a certain amount of energy into the grid, while the buyer commits to extracting a certain amount of energy from the grid, making it primarily an accounting transaction (van Soest 2018, Park & Yong 2017). The expression that a particular user buys electricity from a particular power plant is an expression derived from a market clearing perspective (Park & Yong 2017). The key role is played by technologies that enable sharing of energy between prosumers within connected communities: distributed ledger technology (e.g. blockchain); Internet-of-things; artificial intelligence; responsive or grid-efficient buildings; controllable distributed energy resources; design innovation; high speed communication (Tushar et al. 2021). It is admitted that there is still no extensive implementation of such models in today's electricity markets (Tushar et al. 2021).

In the course of conducting the empirical work in the UK, it became clear that those identified as the SIE-field actors find the concept of P2P electricity trading very ambiguous and open to interpretations ('[P2P] *it's where there is a mechanism which allows consumers and producers to enter into bilateral or multi bilateral arrangements. And so it may be prosumers but it might well be that it's a generator entering into very specific spheres of relationships with one or more customers and that that trading arrangement is facilitated. […] Maybe it's less classic electricity trading*.' (LEE_UK05)). Besides, the boundaries of the SIE-field are being actively negotiated and re-drawn in the last few years as new actors are entering the scene forming alliances with traditional players (e.g. Distribution Network Operators (DNOs) or local authorities) and newcomers (technology companies e.g. digital platform providers). As a result of this, new propositions for local/regional production, distribution and trading of electricity are being discussed, tested and in some cases implemented. This report therefore highlights those models and activities related to more recent developments, such as those labelled P2P[6] electricity exchange/trading which are seen as most innovative and controversial. It is important to note that the focus of the report is on domestic consumers/prosumers (and regulatory sandbox propositions in GB tend to be about domestic consumption), although some models explored here are being used by businesses including business-to-business (B2B) trials.[7]

The period covered in the report is approximately 5 years (2015/2016-2020). From a historical perspective, it would be possible to find examples of schemes that were based on principles similar to LEE and P2P electricity trading. However, it has been admitted that only in the last four-five years that e.g. the potential P2P trading in the electricity market became 'a serious consideration', instigated by development of digital technologies (the potential of using blockchain distributed

[6] Sometimes the participants used P2P electricity exchange/trading and LEE interchangeably.

[7] For instance, Piclo P2P marketplace for renewable electricity for commercial customers; online business platform Selectricity offers UK businesses choice over their electricity supply i.e. allows business customers to choose how renewable energy is generated, and where it is generated.

ledgers) and smaller scale prosumer based activities (LEE_UK05). The most significant SIE-initiatives that are widely discussed and referred to by various SIE-field actors (and used in this report as illustrative examples) also happened during this period.

The electricity system, key actors and their involvement in LEE

For exploring the phenomenon of P2P electricity trading and development of local electricity exchange in the UK more broadly it is useful first to gain an understanding of the electricity system design, the complexity of electricity market, the roles of key actors involved and the evolving context. This helps us to understand the outside institutional environment and the developments that influence LEE in the UK and why the phenomenon under study might look different in comparison with two other countries (France and Switzerland). The description of the context in which LEE and local P2P electricity trading are embedded would also shed light on the barriers/difficulties that SIE- field actors face when trying to operate in this highly regulated field. Understanding the range of actors, their roles and relations also helps draw the boundaries of the SIE-field.[8]

Traditionally, the electricity system was characterised by vertical integration and centralisation (Soest 2018). The electricity system in the UK was designed around a centralised market, where large power stations generate energy, national suppliers buy and sell this energy and the whole system is balanced on a national scale.[9] Although the UK has pursued a centralised approach to energy for many decades, there is an intention to develop decentralised energy and storage systems and replace significant volumes of large, transmission-connected fossil-fuel power stations by smaller, often distribution-network-connected, renewable generation technologies such as wind and solar. This fundamental shift will have implications for how the system is operated.

The electricity industry consists of three main parts: generation (making electricity); networks (transporting it from where it is generated to where it is used); and supply (selling electricity to consumers).[10] Generators produce electricity using different fuels and technologies, including renewable energy sources. The companies in the electricity generation sector range from large multinationals operating a diverse generation portfolio to small, community projects or even generated by households.

As the GB electricity system is undergoing a period of significant change (a transition from a large-scale conventional fossil fuel dominated generation mix to intermittent renewable generation), there has been a marked increase in output from wind and solar farms over the past few years. According to the latest data about electricity generation mix from Ofgem, in

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[8] There is a variety of field actors that are deemed important/influential for SIE-field who are also mentioned throughout the report. The list is based on data collected for this study; it doesn't claim to be exhaustive but rather illustrative of types of actors active in SIE-field.

[9] https://www.stephens-scown.co.uk/wp-content/uploads/2015/07/Local-Energy-White-Parper-with-Regen-Updated-version-March-2016.pdf

[10] About the BSC and the electricity industry https://www.elexon.co.uk/about/#about-the-electricity-industry

Q2 2020, 42% of the electricity supply within the UK was produced by renewables (mainly driven by high volumes of wind generation).[11] In this study we only consider renewable energy generation used in local electricity exchange, which is usually represented by community energy[12] initiatives and can involve individual or collective prosumers.

Since privatisation in the late 1980s the GB electricity retail market operates on a 'supplier hub' model; this means that electricity suppliers are the primary interface between electricity consumers and the electricity system (Ofgem 2020).[13] Suppliers buy electricity from generators, traders and power exchanges in the wholesale market and sell it on to end consumers. Suppliers operate in a competitive market where customers can choose which supplier provides them with electricity.[14]

The current market arrangements have evolved and developed around the 'supplier hub' principle, and the supplier's role is now entrenched in regulatory frameworks, including licensing arrangements and industry codes (Judson et al. 2020). Some of them create barriers for local electricity exchange and P2P trading, e.g. the existing rules about customers being able to contract with only one licensed supplier at any one time. These legal arrangements block P2P electricity trading (which implies multiple, non-licensed suppliers/generators) and makes the P2P proposition between generators and customers impossible to enact independently, since all transactions must be made through a third-party licensed supplier (Judson et al. 2020).

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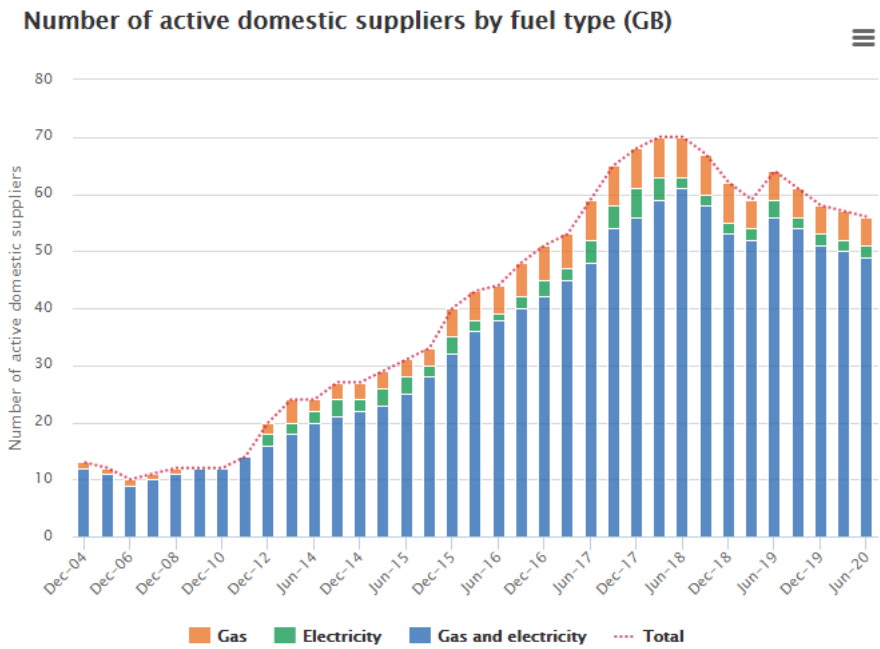
[11] Ofgem (2020) Electricity generation mix https://www.ofgem.gov.uk/data-portal/electricity-generation-mix-quarter-and-fuel-source-gb

[12] According to the guide produced by Department for Business, Energy & Industrial Strategy community energy 'covers aspects of collective action to reduce, purchase, manage and generate energy.' It is also describes community energy projects as having 'an emphasis on local engagement, local leadership and control and the local community benefiting collectively from the outcomes.' https://www.gov.uk/guidance/community-energy

[13] Ofgem (2020) Guidance: Selling Electricity to Consumers: What Are Your Options? https://www.ofgem.gov.uk/system/files/docs/2020/02/selling_energy_to_consumers_what_are_your_options_feb_2020_final_v0.23.pdf

[14] About the BSC and the electricity industry https://www.elexon.co.uk/about/#about-the-electricity-industry



Source: Ofgem analysis of distribution network operator (DNO) and Xoserve reports.
Information correct as of: October 2020

As of June 2020, there were 56 active suppliers in the domestic gas and electricity retail markets.[15] These consisted of 49 suppliers active in both gas and electricity, 5 in gas and 2 in electricity only. However, the UK electricity supply market is dominated by the 'Big Six'[16] major suppliers; the supply market structure is operated at a national level, and the licences and industry codes mandate fully licensed suppliers to be party to the national Balancing and Settlement Code (BSC), and to offer services to all customers regardless of geography (Hall and Roelich 2016).

[15] https://www.ofgem.gov.uk/data-portal/number-active-domestic-suppliers-fuel-type-gb

[16] Britain's largest energy suppliers are known collectively as the 'Big Six'; they are also the UK's longest running private energy suppliers, having all formed during the 1990s following the passing of the 1989 Electricity Act, which paved the way for the privatisation of the energy sector. https://www.ukpower.co.uk/the-big-six-energy-companies (British Gas, EDF Energy, Eon, Npower, Scottish Power and Scottish and Southern Energy)

There has been a search for business model innovation in the supplier market, particularly in relation to local electricity supply and local energy markets. Energy companies/suppliers started offering some new models recognising the role of local communities; some local actors (such as local authorities, community energy groups and housing associations) also became more active in the local supply market exploring options for LEE and P2P trading. Energy suppliers partner with community projects, involved in trials and local energy market projects. Partnering with licenced energy supplier is a way for energy community groups to enter into an agreement with a third party, without having to obtain their own license and at the same time complying with industry standards.[17]

The energy companies that are active in LEE and P2P trading (to different degree) and are involved in recent developments include Good Energy, Octopus Energy, OVO Energy, Tonic Energy, EDF, Centrica, BP. For instance, Good Energy, the UK's first 100% renewable electricity supplier,[18] offered UK's first Local electricity tariff in 2013 to reward households near its wind farms with lower electricity bills (a 20% discount on its standard electricity prices).[19] Later Good Energy was involved in the SMART Fintry project (2016-2018) which aimed to balance electricity generated by local renewables with energy consumed by local households. Moreover, the project also aimed to demonstrate a replicable means of trading and charging for electricity to allow UK consumers to buy their power direct from nearby renewable energy generators.[20]

Another example is OVO Energy who launched OVO Communities in 2014,[21] a new energy platform aiming to enable local community groups to become energy suppliers. OVO Communities was presented as an 'out of the box' solution for communities which want to cut out the middle man and become an energy company themselves – from supply and generation, to smart technology and energy efficiency.[22] Cheshire East was the first local authority in the country to launch a local energy supplier using OVO Communities model, and the first council to sell energy in the UK since the energy markets were nationalised in 1948.[23] In 2015 OVO Energy also announced partnerships with Plymouth Energy Community and Community Energy South.

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[17] Local Supply: Options for selling your energy locally (2016) https://www.stephens-scown.co.uk/wp-content/uploads/2015/07/Local-Energy-White-Parper-with-Regen-Updated-version-March-2016.pdf

[18] Good Energy https://www.goodenergy.co.uk/about-us/

[19] Good Energy: UK's first local electricity tariff. 'Customers who live within two kilometres of the company's flagship 9.2MW Delabole wind farm in north Cornwall, will qualify for its new Local Tariff, offering a 20% discount on its standard electricity prices.' https://www.greenhousepr.co.uk/good-energy-announces-uks-first-local-electricity-tariff/

[20] SMART Fintry. The Aims of the Project http://smartfintry.org.uk/about-smart-fintry/the-aims-of-the-project/

[21] https://www.ovoenergy.com/ovo-newsroom/press-releases/2014/april/ovo-communities.html OVO Communities: Empowering Everyone https://www.ovoenergy.com/binaries/content/assets/documents/pdfs/ovo-communities-brochure.pdf

[22] OVO Energy. Second Community Energy partnership announced https://www.ovoenergy.com/ovo-newsroom/press-releases/2014/november/second-community-energy-partnership-announced.html

[23] First local authority-led energy supplier in over 60 years https://www.ovoenergy.com/ovo-newsroom/press-releases/2014/december/first-local-authority-led-energy-supplier-in-over-60-years.html

Among most recent initiatives are Ofgem's 'sandbox' trials related to P2P electricity trading which involved EDF, British Gas/Centrica, BP and Tonic Energy.[24] Local energy market projects often involve energy suppliers as key partners or even leads. For instance, Centrica, the vertically integrated energy producer and retailer, has developed the Cornwall Local Energy Market project (2017-2020),[25] jointly funded with the European Regional Development Fund, as an experiment in intelligent management of demand, generation and storage in a constrained part of the distribution network in order to overcome the lack of network capacity (Judson et al 2020). EDF, a gas and electricity supplier, is involved in Local Energy Oxfordshire project (started 2019) which is a smart grid trial that would help 'understanding of how opportunities can be maximised and unlocked from the transition to a smarter, flexible electricity system and how households, businesses and communities can realise its benefits'.[26] EDF's role is to offer innovative energy services to customers.

The majority of interest in local supply market innovation comes from new actors in the supply space, including community groups, social enterprises and municipalities, which can be referred to as 'local actors' (Hall and Roelich 2016). The value proposition for entering electricity supply markets for local actors include: better routes to market for local generation; fulfilling the potential of the demand side (local supply models could play an important role in balancing generation and demand at a local level); demand side response and participation (ability of consumers to reduce their electrical consumption in response to signals from suppliers or network/system operators); time-of-use tariffs (encourage consumers to use electricity at times when renewable generation is high or shift demand to less expensive, off-peak periods); opportunity to re-localising energy value (Hall and Roelich 2016).

The models for local actors that are looking to sell electricity to consumers can be based on one of the following options:

- Licensed supply (a full license allows doing the most in the market; can be restricted, by geography or premises type);
- Licensed Light supply (allows a licensed electricity supplier to enter into an agreement with a third party licensed supplier to take care of complying with some of the more costly and technically-challenging elements of the supply licence);
- Licence exempt & supply[27] (supply without a licence up to certain thresholds and in particular circumstances, e.g. supply of up to 5MW of self-generated electricity, but no more than 2.5MW to domestic premises, can operate across the public network; or supply of self-generated electricity, exclusively or in combination with power procured from a licensed supplier, to consumers that are on the same site);

[24] These trials are discussed in more detail in section 5 of the report.

[25] For details see: Bray et al. 2018

[26] https://project-leo.co.uk/about/leo-partners/

[27] The Electricity Act 1989 allows organisations who meet certain criteria to be exempt from having an electricity supply licence.

- White Label (partnering with a licensed supplier to offer electricity using its own brand, without a need to apply for a licence or deal with the industry codes);
- 'Sleeving' (the licensed supplier provides commercial peer-to-peer services, allowing to trade energy over the public network);
- Non-supply activities (selling electricity but this does not involve supplying electricity via electrical wire to premises, e.g. electricity is sold via Electric Vehicle charging points) (Ofgem 2020).

In relation to licensing and the regulation framework for electricity market in general, the most important actor is Ofgem. *Ofgem (the Office of Gas and Electricity Markets)* is a non-ministerial government department and an independent National Regulatory Authority, recognised by EU Directives. Ofgem regulates the monopoly companies which run the gas and electricity networks. Its role is declared as to protect consumers now and in the future by working to deliver a greener, fairer energy system.[28] One of the responsibilities of Ofgem is to determine the content of gas and electricity licences.[29] Licences contain conditions that licence holders must comply with; this includes conditions in relation to becoming a party to, and complying with, industry codes and standards. The industry codes underpin the electricity and gas wholesale and retail markets; they establish rules that govern market operation and the terms for connection and access to energy networks.[30] For example, *Elexon* oversees the strategic operation and day-to-day management of the Balancing and Settlement Code (BSC).[31] The BSC is a multi-party contract that is signed by the companies that operate in Great Britain's wholesale electricity market. It sets out the ground rules for the electricity system in which suppliers can purchase electricity from the generator of their choice, and consumers can choose which supplier provides them with power.[32]BSC contains the governance arrangements for electricity balancing and settlement in Great Britain. The energy balancing aspect allows parties to make submissions to National Grid to either buy or sell electricity into/out of the market at close to real time in order to keep the system from moving too far out of phase. The settlement aspect relates to monitoring and metering the actual positions of generators and suppliers (and interconnectors) against their contracted positions and settling imbalances when actual delivery or offtake does not match contractual positions.'[33] Another industry code that has a direct bearing on P2P electricity trading is the Smart Energy Code (SEC).[34] SEC is a multi-party agreement which defines the rights and obligations of energy

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[28] https://www.ofgem.gov.uk/

[29] Under the Gas Act 1986 and the Electricity Act 1989 certain activities concerning gas and electricity may only be carried out with a licence (or under a relevant exemption or exception). https://www.ofgem.gov.uk/licences-industry-codes-and-standards

[30] Industry codes https://www.ofgem.gov.uk/licences-industry-codes-and-standards/industry-codes

[31] https://www.elexon.co.uk/

[32] https://www.elexon.co.uk/about/#about-the-electricity-industry

[33] https://www.ofgem.gov.uk/licences-industry-codes-and-standards/industry-codes/electricity-codes/balancing-and-settlement-code-bsc#:~:text=The%20Balancing%20and%20Settlement%20Code%20%28BSC%29%20contains%20the,for%20electricity%20balancing%20and%20settlement%20in%20Great%20Britain

[34] https://smartenergycodecompany.co.uk/

suppliers, network operators and other relevant parties involved in the end to end management of smart metering in Great Britain. One of the main objectives of SEC is to facilitate the efficient provision, installation, operation and interoperability of smart metering systems at energy consumers' premises.

Another important function of Ofgem is innovation support. Ofgem's Innovation Link offers support on energy regulation to innovators looking to trial or launch new products, services, methodologies or business models, helps understand Ofgem rules supporting existing sector players and new arrivals, start-ups, established businesses, public and third sector bodies.[35] Innovation Link was set up in 2016 as 'an operational team' in Ofgem. As part of Innovation Link, the Energy Regulation Sandbox helps innovators trial or bring to market new products, services, business models and methodologies without some of the usual rules applying. The sandbox trials related to local electricity exchange are discussed in the report.

The third important component of the electricity system is networks that transport energy to customers. In GB electricity network system is divided into a national high-voltage transmission network and a number of regional, lower-voltage distribution networks. It is owned and maintained by regional transmission companies, while the system as a whole is operated by a single System Operator (*National Grid* plc) which is responsible for balancing the system. Electricity networks are regulated (regional) monopolies; these companies make their money by charging electricity producers and suppliers to use their wires.[36]

Distribution Network Operators (DNOs) are companies licensed to distribute electricity in the UK (e.g. Western Power Distribution (WPD); Scottish & Southern Electricity Networks; SP Energy Networks; Electricity North West; Northern Powergrid; UK Power Networks).[37] The role of DNOs is no longer only to maintain the network and to keep the power on. As energy systems are evolving to include more distributed sources of electricity generation (large commercial and community owned solar farms, wind farms and hydroelectric sites, smaller scale electricity generation), more power is being connected at the distribution level. This means a growing role of DNOs and a shift from Distribution Network Operator to Distribution System Operator (DSO),[38] which is enabled by new smart technologies, e.g. platforms for flexibility trading.[39] DNOs are actively involved in local energy market projects collaborating with other field actors. For example, Western Power Distribution (WPD) is a partner for Cornwall local energy market (LEM) project[40] (2017-2020) which was to create a local

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[35] https://www.ofgem.gov.uk/about-us/how-we-engage/innovation-link

[36] https://www.elexon.co.uk/about/#about-the-electricity-industry

[37] https://www.ofgem.gov.uk/regulating-energy-networks/what-energy-network-and-who-runs-it

[38] https://www.regen.co.uk/wp-content/uploads/The-shift-to-DSO-FINAL.pdf

[39] Green energy is intermittent; adding more renewables to the grid means the grid needs to be even more flexible; more balanced and flexible grid requires more control over energy demand to better match it with supply. https://www.ovoenergy.com/blog/green/the-future-of-renewables-where-to-from-here.html

[40] https://www.centrica.com/innovation/cornwall-local-energy-market

marketplace for flexible demand, generation and storage via a new virtual marketplace/LEM platform. The abundance of renewable energy generation in Cornwall put the local electricity grid under severe strain; one of the key aims of the trial was to overcome system constraints in order to increase the amount of renewable energy that can be deployed by managing the electricity network more efficiently (Bray et al. 2018). Another example is Scottish and Southern Electricity Networks, which manages two distribution networks and one transmission network. The company leads Local Energy Oxfordshire (LEO) project which is community centric and takes a DSO approach to implementing new energy projects across Oxfordshire. It aims to create a local energy marketplace which will enable virtual aggregation of electricity loads, their flexible dispatch and local P2P trading.[41]

Local government/Local Authorities (LAs)[42] are important actors in developing LEE and LEM. One of the priorities for LAs concerned with the wellbeing, economy and future development of their communities should be ensuring that citizens and local communities benefit from the energy transition.[43] One of the key roles for district and borough councils concerns 'planning the built environment' which also means planning permissions for community renewable energy projects; LAs also provide services around housing.[44] LAs can develop their own strategies in line with national policies, sometimes they can even be more 'advanced'/ambitious. For example, carbon reduction targets announced by Bristol City Council are more ambitious than the nation-wide – to achieve Net Zero by 2030.

One of the most interesting endeavours in the energy provision field by LAs is the establishment of municipally owned energy companies. First local authority-led energy supplier in the UK since nationalisation in 1948 was Fairerpower that was set up in March 2015 by Cheshire East Council as a 'White Label' supplier.[45] They also partnered with Preston City Council and collectively delivered energy to Cheshire and Lancashire residents.[46] In order to supply energy LAs had to partner with a

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41 https://www.energy.ox.ac.uk/news_items/project-leo-local-energy-oxfordshire/

42 There are four types of local authority, with some differences within each typology: County Councils, District and Borough councils, Metropolitan Councils, London Boroughs. In addition, within more rural areas a lower tier of council exists – the Parish and Town Council. The systems and patterns of local government are not consistent across the UK due to the devolution arrangements for Scotland, Wales and Northern Ireland. Local authorities receive money from central government and raise money locally through taxes and charges.

43 Haf, S. and Robison, R. (2020) A just and inclusive energy transition – what can local authorities do to ensure more people are involved? 19 August 2020, UKREC https://ukerc.ac.uk/news/a-just-and-inclusive-energy-transition-what-can-local-authorities-do-to-ensure-more-people-are-involved/

44 Understanding Local Government https://www.local-government.org.uk/

45 https://www.cheshireeast.gov.uk/council_and_democracy/council_information/media_hub/media_releases/previous_media_releases/media_releases_december_2014/fairerpower_to_residents.aspx#:~:text=Cheshire%20East%20is%20the%20first%20local%20authority%20in,energy%20in%20the%20UK%20since%20nationalisation%20in%201948.

46 https://powercompare.co.uk/fairerpower/

licenced energy supplier, OVO Energy;[47] the partnership ended in June 2019. Two other well-known examples are Bristol Energy (was owned by Bristol City Council) and Robin Hood Energy (Nottingham City Council). Both were founded around the same time (2015) and have become suppliers of 100% green energy but were sold off in 2020 (sometimes seen as a mistake[48] or a 'failure' of LAs to deliver these kind of services). Both aimed to differentiate themselves from traditional energy suppliers in the market supporting local and social 'public', rather than private, shareholder value (Brinker & Satchwell 2020). Robin Hood Energy enabled several other local authorities to offer energy retail under their name, with Robin Hood operating in the background ('White labelling'), for instance for 'Islington Energy' (ibid.). These municipally owned energy companies had a full supply licence and had to operate nation-wide. As a way to avoid the complexities associated with a full supply licence, a new form of licence was introduced in 2009, Licence Lite. Ofgem granted Licence Lite to the Greater London Authorities (GLA) in 2017.[49]

Some LAs are currently exploring options for LEE as part of a wider local energy market concept in partnership with various actors/stakeholders. There are several examples where LAs are involved in local energy market projects (e.g. Cornwall LEM, Local Energy Oxfordshire, Greater Manchester LEM). According to the recent study delivered as part of EnergyREV,[50] LAs are the key to realising the societal benefits from resilient local energy systems, energy efficiency retrofit, green district heating networks, EV charging infrastructure etc. (Tingey & Webb 2020). These often come as part of bigger net zero carbon strategies developed by LAs who declared climate emergency[51] (see, for example, Bristol City Leap programme[52] or Norwich Net Zero Strategy[53]), although it is admitted that 'austerity in public finances, and lack of clear strategic direction from UK government, has limited their ability to plan and invest in net zero carbon localities' (Tingey & Webb 2020).

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[47] 'White Label supply involves an authority partnering with an established supplier. This partner will therefore already possess a licence and the relevant statutory and compliance infrastructure required. The local authority then offers energy to consumers through this third party, using its own brand. The exact nature of the relationship between the two parties varies for each arrangement.' https://localpartnerships.org.uk/wp-content/uploads/2016/12/Local-Energy-options-guide-web-version-1.pdf#:~:text=With%20local%20generation%20on%20the%20rise%2C%20the%20way,system%20to%20local%20distributors%20and%20finally%20to%20consumers.

[48] Bristol's mayor, Marvin Rees, said the decision to enter the energy market, taken under his predecessor, was a mistake. Bristol Energy sold £76m of gas and electricity in the UK in the year to 31 March 2019, but running costs led to a £10m loss. https://www.bbc.co.uk/news/uk-england-bristol-53723717

[49] Discussed in more detail in section 5.

[50] EnergyREV is one of the three key components of the UK Industrial Strategy Challenge Fund's Prospering from the Energy Revolution programme https://www.energyrev.org.uk/

[51] 'Since Bristol City Council declared a climate emergency in November 2018, almost three quarters of the 408 UK Local Authorities have followed suit. Most set 2030 net zero carbon targets for their own operations and aim to extend outward to Net Zero Carbon Localities covering the whole local authority area.' (Tingey & Webb 2020)

[52] Bristol City Leap https://www.energyservicebristol.co.uk/cityleap/

[53] https://www.norwich.gov.uk/info/20195/council_policies_and_strategies/3606/environmental_strategy_2020-25/4

For instance, Norwich City Council has set a target of 2030 to become net zero for carbon emissions, and unveiled its environmental strategy for the next five years, covering 2020-2025 (the city council's 'operational carbon emissions net zero by 2030').[54] Smarter Norwich is the umbrella project that will coordinate and integrate other Norwich projects in pursuit of a longer-term vision called Smart Energy Norwich 2030 (SEN2030). At the moment, there is no city-wide distributed energy resource (DER) integration for coordinated development for a local flexibility market. The aim is to create a local energy market, which can be used to support Norwich and the wider networks, address fuel poverty through community benefit and cheaper power, and attract inward investment to the Norwich and Norfolk area. As part of the SEN2030 vision, Norwich Virtual Energy Community will trial the implementation of real-world assets using a 'multiple supplier' model – the ability for more than one energy supply company to provide service through the same registered meter. Originally targeted at domestic households, the project is being expanded to include non-domestic buildings as well.[55]

Local Enterprise Partnerships (LEPs)[56] can also play a role, e.g. providing funding for energy projects. New Government funded programme on local energy hubs linked to LEPs aims to increase public sector capacity to bring forward energy schemes, with flexibility to agree objectives that align with local needs.[57]

LEE as a SIE-field under study is closely linked with a *community energy* phenomenon. According to the guide produced by Department for Business, Energy & Industrial Strategy (2013/2015), community energy 'covers aspects of collective action to reduce, purchase, manage and generate energy.' It also describes community energy projects as having 'an emphasis on local engagement, local leadership and control and the local community benefiting collectively from the outcomes.'[58] In literature community energy is seen as a rather ambiguous concept. It can range from 'strong' to 'weak', e.g. involve bottom-up energy initiatives with strong citizen participation, local ownership and collective benefit sharing, but also decentralised energy provision with relatively little public participation or sharing of benefit with local residents (Devine-Wright 2019). One can also find two common types: 'communities of place' (based on geographical/locality principle) and 'communities of interest' (formed around particular project/activity and not necessarily of local residents).

It is argued that there are some differences between community energy phenomenon in the UK (which is more about communities, investments and different types of models) and similar movements in other European countries (more of 'citizen energy' and 'cooperative energy' developed on trading basis). The types of projects are also different in terms of

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54 https://www.norwich.gov.uk/news/article/376/norwich_city_council_publishes_ambitious_environmental_strategy

55 http://www.pixie-energy.com/about/our-projects/ea-emip/norfolk/

56 LEPs are voluntary partnerships between local authorities and businesses; were set up in 2011.

57 Johnson, J. Local Energy Hubs – An update (15th March 2019) https://www.apse.org.uk/apse/assets/File/Local%20Energy%20Hubs%20-%20APSE%20v2_0%20140319.pdf

58 https://www.gov.uk/guidance/community-energy

who is involved, how it has been delivered; in the UK there has been a recent trend towards more 'big projects' happening. (LEE_UK14)

Community energy movement in the UK has been growing for the last 10 years inspired by 'a desire to generate energy and provide sustainable energy services locally' (LEE_UK01). The rise of community energy in the UK was largely associated with government support for renewable energy installations (Feed-in-Tariff[59]). Community Energy England[60] and Community Energy Wales[61] providing the review of the state of the sector 2020 reported the results of the community energy survey 2019 that found a total of 300 community energy groups developing low carbon projects, supported by 263 full-time equivalent employees (across England, Wales and Northern Ireland). Community organisations installed 15.4 MW of new electricity generation capacity in 2019, bringing total UK community-owned capacity to 264.9 MW.'[62]

Community energy initiatives in the UK have diverse characteristics which often depend on the engagement of local residents, type of community, location, business models, type of RE, scale, resources and expertise available, collaborators and partnerships. Depending on the use of public infrastructure (grid connection) for locally generated renewable energy, two approaches have been used for community projects: the first involves the use of public infrastructure, when generated electricity is supplied directly into the National Grid; the second represents collective (self)-consumption using a microgrid/'private wire'.

A microgrid can be used for e.g. a multiple occupancy buildings or housing estates. It is consistent in the literature that this usually occurs 'behind an electricity meter' (by shifting the Meter Point Administration Number to the perimeter of the site), so the actual low voltage physical infrastructure is owned privately by a local private network operator (could be community owned), therefore no distribution network operator's responsibility; may also form a virtual energy company, responsible for billing customers for the energy they consume within the private network (Hall et al. 2019). The microgrid model is 'less regulatory oversight'; with a private network there is 'more licence to do more things', have more freedom and flexibility, and there can be different metering and transaction arrangements (LEE_UK3). Although many early microgrids were 'islanded' (e.g. as a solution for remote areas), now these models usually have a grid connection (Brown et al. 2020), e.g. residents get their energy from on-site generation, topping up from the grid when needed, and exporting any excess energy back to the grid. Microgrids are still seen as a viable model to enable generation and self-consumption of community owned

[59] Feed-in-Tariff (FiT) was introduced in 2010 for England, Wales and Scotland; it has seen significant reductions since its launch; the scheme was closed to new applicants since April 2019. https://www.gov.uk/feed-in-tariffs

[60] Community Energy England is 'a not-for-profit organisation dedicated to helping community energy organisations create and implement new projects by advocating for a policy landscape that will support community energy and providing opportunities for community energy practitioners to connect, learn, share business models and help each other overcome obstacles.' https://communityenergyengland.org/

[61] 'Community Energy Wales is a not for profit membership organisation that has been set up to provide assistance and a voice to community groups working on energy projects in Wales.' http://www.communityenergywales.org.uk/en/about-us

[62] https://communityenergyengland.org/files/document/387/1592389779_CommunityEnergy-StateoftheSector2020ExecutiveSummary.pdf

renewable energy, particularly in combination with other elements of energy system, e.g. energy efficiency measures, heat pumps, and energy storage, e.g. for new housing developments where the provisions for a private network can be incorporated into the project.

The majority of schemes exist on the public network and have to use an intermediary – a licensed electricity supplier to make payments on both generation and export from eligible installations. As explained earlier, in GB electricity supply is a licenced activity, in very specific circumstances it is possible to supply electricity without the need for a licence (precisely defined and limited in terms of scale – only up to five megawatts of activity over the public network). Thus, one of the options for a community renewable organisation is to become an energy supplier (a local area can create its own supply company and they can either be licensed or exempt i.e. does not have to abide by the balancing and settlement codes). The established models of community renewable energy generation, distribution and (shared) consumption, particularly microgrids, can be seen as a form of local electricity exchange rooted in prosumer business models. However, they are very limited in terms of electricity exchange and actual transactions between residents (and use of market mechanisms) and do not allow e.g. P2P electricity trading.

The community energy groups and projects that are often discussed in relation to P2P electricity trading and LEE are very diverse. The most noticeable are mentioned in this report or discussed in more detail as examples of SIE-initiatives (e.g. Energy Local, WREN, Repowering London).

Besides community energy actors there are other (non-profit) organisations that are active in the field of sustainable energy. The obvious example is *Power for People* which is a not-for-profit organisation, campaigning for the UK to rapidly transition to 100% clean energy and for this to benefit local economies.[63] Their campaign for the Local Electricity Bill (The Community Energy Revolution) is one of the most noticeable initiatives that could potentially enable the development of the SIE-field.

(Energy) Tech companies play an increasingly important role in the development of LEE and LEMs by providing digital tools for decentralised energy systems e.g. platforms for P2P trading.[64] Several of those companies are involved in P2P trials and are mentioned in the report (Piclo, Verv and Dipole).

- Piclo (previously known as Open Utility) claims to be Britain's first online P2P marketplace for renewable electricity[65] (P2P trading for commercial customers); founded in 2013. The service (P2P trading) was trialled by Open Utility and Good Energy

[63] https://powerforpeople.org.uk/about/

[64] There are examples of companies that offer these services to domestic customers but usually in experimental format (trials) or as part of a nation-wide market rather than local energy exchange. For instance, Social Energy has debuted in the GB electricity market offering to connect prosumers' solar to energy storage and trade this energy through AI software and utility/virtual power plant, i.e. creating an energy network made up of customers, their solar and energy storage. https://www.social.energy/

[65] https://www.piclo.energy/

and was funded by DECC. Following the successful trial, in 2016 Good Energy launched online business platform Selectricity which offers UK businesses choice over their electricity supply (a diverse range of sources, including wind, solar, hydro and biogen generators, many owned by community groups). In other words, Selectricity[66] allows business customers to choose how renewable energy is generated, and where it is generated; this can be seen as a way to demonstrate CSR credentials but also providing support for the local economy and community (by selecting from nearest sustainable electricity generator). Piclo also provides the independent marketplace for trading energy flexibility online.[67] In 2019 Piclo secured its first commercial contract with a DNO, Scottish and Southern Electricity Networks (SSEN) for its flexibility platform. This will allow SSEN to use Piclo's flexibility marketplace to procure flex and other 'smart' energy services from providers using the online auction process.[68]

- Verv is a company that specialises in high-speed data acquisition and AI in the electrical domain. Verv has developed a peer-to-peer renewable energy trading platform based on high-speed data acquisition and AI technology for understanding the consumption and production of energy, teamed with blockchain for trading. The platform would enable households with solar panels to sell the excess energy that they generate directly to their neighbours, improving their ROI and incentivising uptake. It also claims to improve access to cheaper, green energy for those that can't afford renewables.[69]

- Dipole aims to build a reliable and efficient platform to trade distributed energy. Dipole allows users to trade distributed electricity using blockchain technology and Internet-of-things. For energy providers, Dipole aims to be the energy platform of smart cities in the future.[70]

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66 https://www-test.goodenergy.co.uk/selectricity/

67 https://picloflex.com/

68 Piclo pens 'milestone' Flex agreement with SSEN https://www.current-news.co.uk/news/piclo-pens-milestone-flex-agreement-with-ssen

69 https://verv.energy/research

70 https://www.dipole.tech/

SIE changing social relations
In the SONNET project, social innovation in energy (SIE) is defined as 'a combination of ideas, objects and/or actions that change social relations and involve new ways of doing, thinking and/ or organising energy' (Wittmayer et al. 2020b, p. 4). In order to observe the diversity of SIE, a typology of SIE was developed (Wittmayer et al. 2020a). We identified seven different types of SIE (for more information see https://sonnet-energy.eu/typology/), including one called 'Local peer-to-peer electricity exchange' (later renamed to Local electricity exchange (LEE)). Here, social interactions (and changes to social relations) that aim to bring about changes in the energy system are often based on exchange/doing and to some extent on cooperation, rather than conflict or competition. LEE (and P2P electricity trading) is at the early stage of development. It has been evolving in the UK in recent years, with a number of examples of successful projects and trials across the country that represent different models and innovative approaches to LEE. The SIE-field is characterised by technological change (e.g. blockchain technology) and a reconfiguration of social relations. This suggests a growing role for local authorities, community groups and citizens/prosumers, but is also affected by changing roles of some traditional actors in the electricity market (e.g. DNOs turning into DSOs). The emergence of new (multi-actor) alliances as a result of increased collaboration involving the public, private and community angles is one of the main characteristics of the SIE-field. The boundaries of the SIE-field are being actively negotiated and re-drawn as new actors entering the scene and forming partnerships with more traditional players (e.g. DNOs, utilitxies or local authorities) and newcomers (technology companies such as digital platform providers). As a result, new propositions for local/regional production, distribution and trading of electricity are being discussed, tested and in some cases implemented. However, different categories of actors may attribute different meanings and values to emerging practices around LEE.

'Outside' institutional environment shaping the development of the SIE-field
The SIE-field (local electricity exchange, and P2P electricity trading as its component) is part of the energy system and is nested within an 'outside' institutional environment constituted by formal and informal institutions that shape the activities of actors within the SIE-field. Energy/electricity systems consist of a wide range of institutionalised rules, norms and beliefs, which have undergone some significant changes over the past decade. These changes are due to various developments rooted in events, contestations, inter-field interactions, external shocks and societal trends. In the SONNET project we are interested in the 'outside' institutional environment that 'surrounds' and 'penetrates' (i.e. shape/influence/interact with) the SIE-field. We want to understand how dominant institutions of the 'outside' institutional environment influence the emergence and development of local electricity exchange and P2P electricity trading.

Britain's energy mix is changing, and the energy system is evolving to include more distributed sources of electricity generation. In the energy system the fundamental changes include:

- the liberalisation of the electricity system and the reduced level of vertical integration;
- the need to decarbonise the electricity system as a result of climate change;
- the growing deployment of renewable energy technologies as costs have fallen;
- some enabling technologies (e.g. smart meters) have opened up the possibility for the creation of new business models (van Soest 2018).

These changes lead to 'a renewed interest in the local context' and an understanding that there is a need for local solutions for the electricity system which is becoming increasingly distributed and decentralised (ibid.).

LEE and particularly P2P electricity trading are instigated by many parallel technological developments. The technological advances make it possible for electricity trading to take place between otherwise unconnected actors, through e.g. virtual private wires or blockchain technology (ibid.).

The energy policy, e.g. the electricity market reform in GB, and transition to smarter electricity system, have a direct impact on development of LEE and P2P electricity trading. The reforms result in changing the governance arrangements for the electricity system (e.g. the shift from Distribution Network Operators to Distribution System Operators, a transition to a more complex, systemic model that accounts for and manages multiple points of variable supply and consumption).

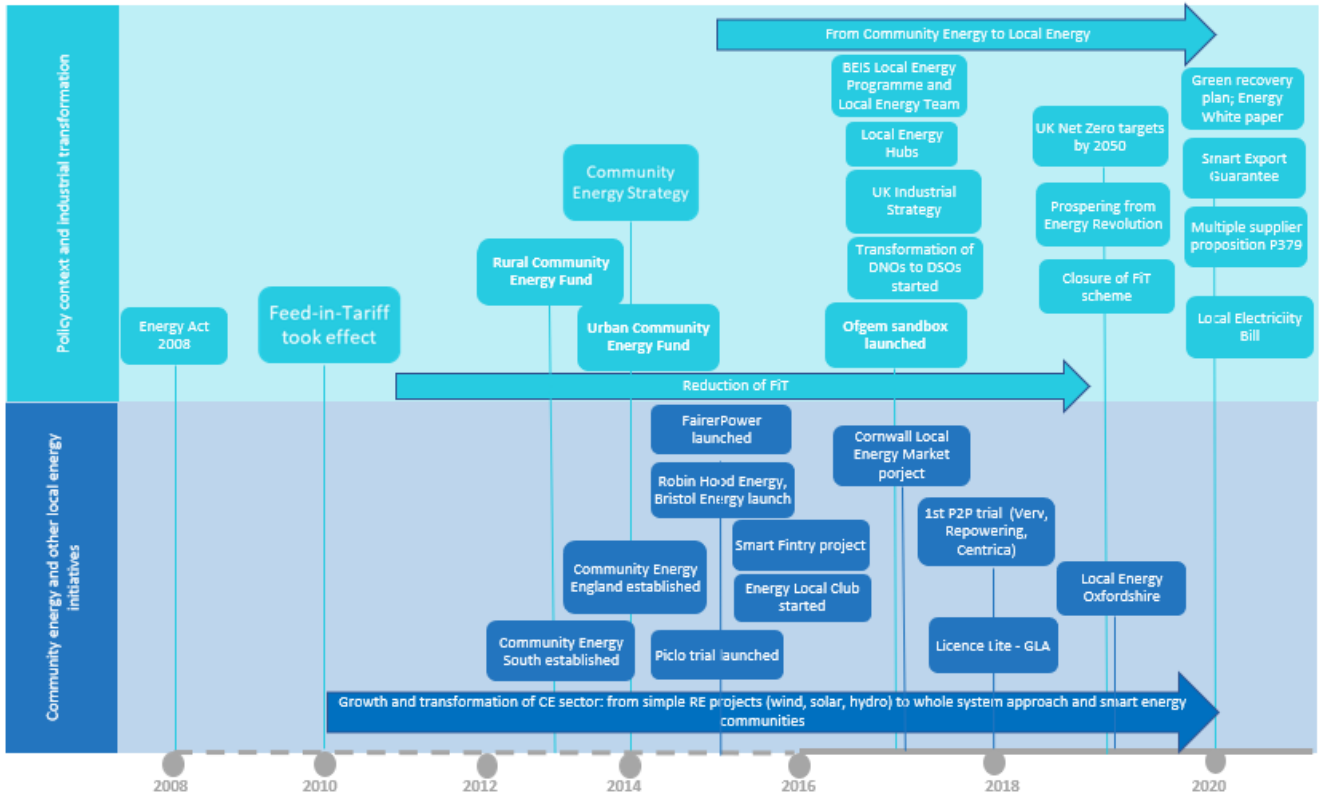
Other policies e.g. the closure of FiT, the subsidy scheme in which households with renewables and other small generators are remunerated for generating green energy, also influenced developments in the SIE-field. As a result, prosumers and community energy groups are more actively searching for new business models, also exploring opportunities around LEE and P2P electricity trading.

The emergence of local energy markets (including flexibility markets) and smart local energy communities (a more coherent and inclusive approach to energy at local level), emerging in response to the increasing decentralisation, digitalisation and decarbonisation of energy, can have a significant impact on the wider adoption and implementation of LEE and P2P electricity trading.

In section 5 'Emergence and development of local electricity exchange' the roles of different SIE-field actors and the relations between them are discussed further with a focus on particular periods of the SIE-filed development and under relevant

themes. In Phase 1 (pre-2015) the trends that started creating ground for local supply of electricity are briefly described (local supply examples, the rise of community energy generation). Phase 2 (2015/2016-2020) discusses in detail a number of new entrants including the community energy sector and municipal energy companies, the evolution of the policy landscape during this period and the emergence of novel models for local electricity exchange (including three examples of SIE-initiatives). Here the P2P electricity trading and regulatory 'sandbox' trials that happened (or at least were initiated) during this period are also discussed followed by some analysis/reflections. Phase 3 (2020 and beyond - the uncertain future for LEE) focuses on future potential of LEE in the light of multi-vector local energy developments and relevant policy context, as well as some legislative changes that would have an impact on the SIE-filed.

4 Timeline of Local Electricity Exchange development[71]



[71] Although the visual timeline does not show all of the events and sites of activities connected to local electricity exchange and peer-to-peer electricity trading in the UK over the last ten years, it is supposed to give a 'flavour' of different events, activities and sites. The detailed description of the SIE-field timeline can be found in Annex 2.

5 Emergence and development of local electricity exchange

Phase 1: Pre-2015

Before 2015 there was already interest in some forms of local energy and local supply with few examples, such as local electricity tariffs offered by some energy companies. For instance, Good Energy, the UK's first 100% renewable electricity supplier, offered UK's first Local electricity tariff in 2013 to reward households near its wind farms with lower electricity bills (a 20% discount on its standard electricity prices).[72] OVO Energy launched OVO Communities in 2014,[73] a new energy platform aiming to enable local community groups to become energy suppliers. It gave community groups, local authorities and housing associations the tools they would need to run a utility business including customer service, billing, trading, and power generation. Plymouth Energy Community, established in 2013 with significant support from Plymouth City Council, became the first community energy supplier.

The period 2010-2015 was characterised by the rise of the community energy in the UK which was largely associated with government support for renewable energy installations, mainly through Feed-in-Tariff (FiT), a subsidy-based mechanism, introduced in 2010 (for England, Wales and Scotland). The FiT scheme intended to encourage the installation of small-scale renewable and low carbon technologies up to 5MW capacity. The scheme required licensed electricity suppliers to make tariff payments for the generation and export of renewable and low carbon electricity. This scheme is the principal mechanism of support for PV, wind, AD and hydro installations. After the introduction of FiT and especially the Community Energy Strategy 2014[74] by the Coalition government (which presented a decentralised vision of energy transitions in which communities would play a leading role), there was a noticeable growth in community renewable energy projects across the country (generation of renewable energy but also generation coupled with community self-consumption).

Up to 2015/2016 much of the focus for community energy groups was on setting up their own generation projects (Stephens Scown & Regen SW 2016). Although there were no noticeable activities that would constitute LEE or P2P trading, this created grounds for local supply of electricity through a rise of decentralised renewable energy generation, including community energy projects.

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[72] Good Energy: UK's first local electricity tariff. 'Customers who live within two kilometres of the company's flagship 9.2MW Delabole wind farm in north Cornwall, will qualify for its new Local Tariff, offering a 20% discount on its standard electricity prices.' https://www.greenhousepr.co.uk/good-energy-announces-uks-first-local-electricity-tariff/

[73] https://www.ovoenergy.com/ovo-newsroom/press-releases/2014/april/ovo-communities.html OVO Communities: Empowering Everyone https://www.ovoenergy.com/binaries/content/assets/documents/pdfs/ovo-communities-brochure.pdf

[74] https://www.gov.uk/government/publications/community-energy-strategy

Phase 2: 2015-2020

The rise of local energy supply and 'municipalisation' of energy

Over the past ten years, the design principle of GB energy system has been challenged with the rapid roll-out of decentralised generation. At the beginning of the period covered in this study (2015/2016), the supply market saw a number of new entrants including the community energy sector and municipal energy companies. The new entrants to the electricity supply market were seeking to challenge the way electricity is bought, sold and distributed (Stephens Scown & Regen SW 2016).[75] Many of them were interested in local supply and distribution of electricity or had it as part of their proposition.

At the same time the idea of P2P electricity trading started getting its practical implementation (e.g. Department of Energy and Climate Change (DECC) funded Open Utility/Piclo and Good Energy P2P trading trial in 2014; the trial white paper was published in 2016). As a result, Open Utility developed a proposal for Ofgem that would allow charging consumers and generators 'more fairly for using the local distribution grid' (Open Utility, 2016). The belief was that 'peer-to-peer local energy matching could unlock billions of pounds of additional revenue for renewable generation in Great Britain and overseas, which would herald an age of decentralised and clean electricity' (ibid.). This period is also characterised by the emergence of the local energy market concept as linked with the decentralisation of energy generation. It was noted that with increasing numbers of landowners, community groups and individuals financing and maintaining distributed energy generation assets, the next step would be for the electricity to be purchased by local communities (ibid.).

In 2015 the start of municipal energy companies was a big step forward as part of 'municipalisation of energy'. At that time, for many LAs, dealing with the energy agenda was 'new territory', but that was changing with a number of examples of LAs projects. The Association for Public Service Excellence (APSE)[76] provided an overview of key barriers that LAs faced: Engagement ('energy' was not seen as a political, corporate and community priority); Policy (the need for more consistency at Government level for LAs to properly plan and implement their programmes); Procurement (e.g. EU rules; procurement can be quite prohibitive); Regulation (difficulties in terms of accessing the market to supply energy and over grid connection and capacity); Resources (a lack of both internal and external resource to support the development of local programmes and to implement projects, e.g. funding to undertake initial feasibility and business cases).[77]

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[75] Local supply: options for selling your energy locally https://www.stephens-scown.co.uk/wp-content/uploads/2015/07/Local-Energy-White-Parper-with-Regen-Updated-version-March-2016.pdf

[76] APSE Energy was formed to reflect the changing dynamics of the energy market in the UK. LAs are increasingly looking at the developing prospects of municipal energy. APSE energy is designed to bring councils together to share information, ideas, resources, best practice, and to support local energy projects. https://www.apse.org.uk/apse/index.cfm/local-authority-energy-collaboration/about/

[77] Bramah, M. APSE Energy (2015) State of play for local authorities https://erpuk.org/wp-content/uploads/2015/04/2.1-APSE-Energy-ERP-Workshop-24.3.15.pdf (The aims of APSE energy are to support councils to deliver the local municipalisation of energy services)

Despite of those difficulties, LAs were realising the value of their local knowledge in relation to energy and their understanding of community needs. It was believed that LAs could be 'uniquely placed to create a successful supply business that can directly link local green energy to nearby communities', giving generators certainty of revenue and providing households and businesses with access to cheaper and more sustainable energy (Local Partnerships and Cornwall Energy, 2016).[78] LAs were also encouraged by the government to be more entrepreneurial with their resources.[79]

In 2015 few municipally-owned energy companies were established. The first local authority-led energy supplier in the UK since nationalisation in 1948 was Fairerpower that was set up in March 2015 by Cheshire East Council as a 'White Label' supplier (a contractual agreement with Ovo Energy was signed in December 2014), which aimed to offer substantial savings against the national average tariff rates charged by the Big Six suppliers.[80] They also partnered with Preston City Council and collectively delivered energy to Cheshire and Lancashire residents.[81] In order to supply energy LAs had to partner with a licenced energy supplier, OVO Energy.[82] Fairerpower's partnership with OVO ended in June 2019.

Two other municipally-owned energy companies, Robin Hood Energy and Bristol Energy, were fully-licensed energy suppliers and were also set up in 2015 but were sold off in 2020.

Robin Hood Energy was a not-for-profit energy company launched in September 2015 by Nottingham City Council as an initiative to reduce fuel poverty both locally and nationally, and as a competitor to the 'Big Six' energy suppliers in the UK. The company supplied gas and electricity nationally to homes and businesses until September 2020, when its customer

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[78] Local Partnerships and Cornwall Energy (2016) Local Energy Options – A Guidance Document for Local Government https://localpartnerships.org.uk/wp-content/uploads/2016/12/Local-Energy-options-guide-web-version-1.pdf#:~:text=With%20local%20generation%20on%20the%20rise%2C%20the%20way,system%20to%20local%20distributors%20and%20finally%20to%20consumers.

[79] BBC 16 September 2020. Robin Hood Energy: The failed council firm that cost city millions https://www.bbc.co.uk/news/uk-england-nottinghamshire-54056695

[80] https://www.cheshireeast.gov.uk/council_and_democracy/council_information/media_hub/media_releases/previous_media_releases/media_releases_december_2014/fairerpower_to_residents.aspx#:~:text=Cheshire%20East%20is%20the%20first%20local%20authority%20in,energy%20in%20the%20UK%20since%20nationalisation%20in%201948.

[81] https://powercompare.co.uk/fairerpower/

[82] 'White Label supply involves an authority partnering with an established supplier. This partner will therefore already possess a licence and the relevant statutory and compliance infrastructure required. The local authority then offers energy to consumers through this third party, using its own brand. The exact nature of the relationship between the two parties varies for each arrangement.' https://localpartnerships.org.uk/wp-content/uploads/2016/12/Local-Energy-options-guide-web-version-1.pdf#:~:text=With%20local%20generation%20on%20the%20rise%2C%20the%20way,system%20to%20local%20distributors%20and%20finally%20to%20consumers

accounts were sold to Centrica, the parent company of British Gas. The company operated on a not-for-profit basis and had no private shareholders or bonus schemes. This model allowed using profits to create more affordable tariffs.[83] As it was a council-run energy company, any disorderly collapse would be 'embarrassing' and even more financially damaging to Nottingham City Council. A recent report from auditors showed the council had invested £43m in the company as well as providing £16.5m of guarantees to support them. The council would lose millions from the collapse of their supplier.[84] As in 2020, Robin Hood Energy 'failed to turn a profit, ended up losing millions and is being closed down, leaving 230 workers redundant'.[85] British Gas has purchased the business, Robin Hood Energy has ceased trading and entered administration on 5th January 2021.[86] Robin Hood Energy was also the white label provider behind other energy suppliers. A 'white label' is an organisation that does not hold a supply license but works in partnership with a licensed 'partner supplier' to offer energy tariffs under a white label brand. Through collaborating with 'like-minded businesses' and in particular councils (e.g. Leeds City Council, Liverpool City Council and Derby City Council) Robin Hood launched 10 'white label' energy companies.[87]

Bristol Energy was a national gas and electricity company[88] that was set up by Bristol City Council as a separate company and had the commercial independence from the council. The overall aim of Bristol Energy was to support the city in its social objectives and sustainability goals, with a mission to help and support energy-vulnerable households within the city. Bristol Energy's approach focused on 'the value of localism'; it was based on the assumption that people care about their community and about keeping things local, and energy suppliers can play a part in that. The company sourced energy within the UK, around 40 percent of generators were in the South West; less than 20 percent of customers were in Bristol (LEE_UK16). Bristol Energy started to explore innovation models based on matching local generation with local consumption to offer it to Bristol customers but have 'never got to that point' (LEE_UK16). In 2019 Bristol Energy's residential business has grown to over 165,000 customer supply points, their B2B business has grown to over 4,500 business supply points, and they contracted with 54 independent, renewable generators (many of which were community owned). Bristol Energy was part of different projects entered into a number of partnerships. For instance, they were collaborating with community owned renewable generators Gower Power and the technology company Origami to develop a local energy system, installing a new solar and storage facility at their existing 1MW solar farm. This would enable smart grid management and demand matching

[83] Award Winning Energy! https://robinhoodenergy.co.uk/news/award-winning-energy/

[84] Robin Hood Energy customers transferring to British Gas https://www.choose.co.uk/news/2020/robin-hood-energy-customers-transferring-british-gas/

[85] BBC 16 September 2020. Robin Hood Energy: The failed council firm that cost city millions https://www.bbc.co.uk/news/uk-england-nottinghamshire-54056695

[86] https://robinhoodenergy.co.uk/

[87] White label partners https://robinhoodenergy.co.uk/white-label-partners

[88] https://www.bristol-energy.co.uk/about-us

for local electricity supply, using smart meters.[89] In September 2020 it was announced that an energy firm, Together Energy[90] acquired Bristol Energy's residential customer base, ensuring a continued service for customers and securing the jobs of 110 frontline workers.[91]

It is important to note that in contrast with some other European countries, municipally owned energy companies with a full supply licence have to operate nation-wide, i.e. be open to customers across the UK, and have to compete in markets with other players. The general rule is that all domestic license electricity supplies are subject to the same rules and the same obligations that they will have to have to operate and behave in the same way. As a way to avoid the complexities associated with a full supply licence, a new form of licence was introduced in 2009, Licence Lite. It offers a route to market for small suppliers allowing a Licence Lite supplier to contract with a third party licence supplier to avoid adhering to complex and costly market codes. It is worth mentioning the Greater London Authorities (GLA) Licence Lite Scheme[92] as an example, which aimed to develop a new commercial model that would enable small scale low carbon generators to receive a higher price for their energy sold on to local organisations. Although in its current state it does not fit our definition of LEE SIE-field (as serving a non-domestic customer, Transport for London (TfL)), it represents another attempt of LAs to match locally produced electricity with local consumption. Licence Lite lets smaller, local electricity suppliers sell power to the market without the significant licensing requirements and costs that larger suppliers need to meet. This means that the GLA can buy excess electricity generated by London boroughs, public bodies and others and sell it to consumers, offering better prices to the generators. The GLA became the first authority in the country to go operational with a new type of electricity licence. Ofgem granted the Electricity Supply Licence Lite in December 2017, and the project started operation on 1 January 2018. The Licence Lite scheme revealed that involvement in novel energy market regulation is complex, time consuming, and involves a high degree of uncertainty; it may have only niche applications. The commercial arrangements were rather complex; a final commercial arrangement was not viable for all parties.[93] It had been intended to be a P2P model, however this was not able to be delivered in practice – instead all the electricity was bought and sold off the wholesale market resulting in higher shared system costs, exposure for the GLA to wholesale risk when generation was less than the demand, and exposure to imbalance risk for the third party licenced supplier.[94]

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[89] APSE Energy. 2019 Energy across the authority https://www.apse.org.uk/apse/assets/File/Online%20v7%20Energy%20across%20the%20authority%202019.pdf

[90] Warrington Borough Council is a 50 per cent shareholder of Together Energy.

[91] Together Energy acquires Bristol Energy's residential customers and brand 9 September 2020 https://www.bristol-energy.co.uk/together-energy-acquires-bristol-energy-residential-customers

[92] https://www.london.gov.uk/what-we-do/environment/energy/energy-supply

[93] Licence Lite Evaluation: A Report for Greater London Authority (15 October 2019) https://www.london.gov.uk/about-us/londonassembly/meetings/documents/s82520/Appendix%201a%20-%20Licence%20Lite%20Evaluation_Final_Redacted%20for%20publication.pdf

[94] Licence Lite Evaluation: A Report for Greater London Authority (15 October 2019) https://www.london.gov.uk/about-us/londonassembly/meetings/documents/s82520/Appendix%201a%20-%20Licence%20Lite%20Evaluation_Final_Redacted%20for%20publication.pdf

Evolving policy landscape

During the period 2015-2020 one could observe a shift in the policy discourse from community energy to local energy,[95] with the focus turned towards local authorities and local enterprise partnerships (LEPs) (Devine-Wright 2019). It is argued that these changes represent 'an ideological shift in how decentralized energy transitions should take place': moving from a 'communitarian ideology' (strong and cohesive communities characterised by empowerment, autonomy and self-sufficiency are beneficial outcomes for society) to a 'neoliberal ideology' (economic growth and prosperity facilitated through energy actions; market actors, working with and coordinated by public authorities, are to deliver energy services) (ibid.). This means 'reduced support for grassroots, citizen-led action in favour of institutional partnerships and company-led investments', and can lessen collective participation in energy transitions (ibid.).

In 2017 the Department for Business, Energy and Industrial Strategy (BEIS) Local Energy programme was set-up to support the development of local energy projects. As part of the Local Energy Programme £1.6 million allocated in 2017 to support LEPs[96] across England to develop energy strategies for the local areas. This followed the creation of Local Energy team[97] as part of BEIS Local Energy programme aiming to increase investment in local energy. In September 2017 BEIS sent out 'local energy hubs proposal' to all LEPs;[98] £4.8m total funding was provided for five local energy hubs (up and running in 2018).[99] The Local Energy Hubs have been created to increase public sector capacity to bring forward energy schemes, with flexibility to agree objectives that align with local needs.[100] The key tasks include supporting LEPs to deliver the ambitions within their new energy strategies, and promoting 'local energy' schemes (often capital projects that rely on partnerships and collaboration).

In 2017 the UK Industrial Strategy[101] was published. Since then, local energy evolved into support for 'smart local energy systems' (SLES) characterised by a 'holistic approach' to energy (heat, power generation, distribution, storage and

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[95] Community energy and local energy represent two modes of implementing decentralised energy with a focus on place-based system of provisions and arguably different pathways for energy transitions (Devine-Wright 2019).

[96] LEPs are voluntary partnerships between local authorities and businesses; were set up in 2011.

[97] https://www.apse.org.uk/apse/index.cfm/local-authority-energy-collaboration/beis-local-energy-team/ The BEIS Local Energy Team was established to support Local enterprise partnerships (LEPs) and LAs in England to play a leading role in delivering low-carbon economic growth.

[98] https://westyorkshire.moderngov.co.uk/documents/s4418/Item%2010a%20-%20Appendix%201%20-%20Local%20Energy%20Capacity%20Support%20letter%20to%20LEPs%20190917.pdf

[99] Five Local Energy Hubs across England include North West (hosted by Liverpool), North East, Yorkshire and Humber (Tees Valley lead), Midlands (Nottingham lead), Greater South East (Greater Cambridge and Peterborough lead), South West (West of England lead). The work of Hubs is coordinated and overseen by BEIS Local Energy Team.

[100] Johnson, J. Local Energy Hubs – An update (15th March 2019) https://www.apse.org.uk/apse/assets/File/Local%20Energy%20Hubs%20-%20APSE%20v2_0%20140319.pdf

[101] https://www.gov.uk/government/publications/industrial-strategy-building-a-britain-fit-for-the-future

consumption, and transport/electric vehicles) (Devine-Wright 2019). SLES is an emerging concept, both technically and commercially, and is defined as 'a particular form of local energy project involving multi-vector, multi technology solutions to system integration, management and flexibility challenges' (Wilson et al. 2020). It is suggested that a SLES approach can allow for capitalising on local knowledge; leveraging engagement and trust; enabling coordinated planning; building on local economic strategy; unlocking co-benefits; and providing a route to scale-up (Fell et al. 2020).

The £102.5 million Prospering From the Energy Revolution (PFER) programme, funded through the UK Industrial Strategy as part of Industrial Strategy Challenge Fund,[102] seeks to develop, test and scale up SLES that deliver cleaner, cheaper and more resilient energy.[103] PFER is supporting this development through SLES demonstrators[104] and design consortia (2019–2022). The 'whole system' demonstrators in Orkney, Oxford, Oxfordshire and West Sussex 'exemplify cross sector collaboration, with matched public and private funds, for innovation' (Tingey & Webb 2020). PFER defines SLES by outcomes rather than by constituent elements, leaving some interpretive flexibility as to what is SLES (Wilson et al. 2020).

A related (and sometimes overlapping) concept of Local Energy Markets (LEM) was also emerging in the UK during this period as a potential solution to coordinate an increasingly complex decentralised energy system. The term LEM is used 'to describe initiatives that aim to establish a marketplace to coordinate the generation, supply, storage, transport, and consumption of energy from decentralised energy resources (e.g. renewable energy generators, storage and demand-side response providers) within a confined geographical area'[105] (Energy Systems Catapult 2019). The concept is still in early stages of development, and the value, costs and benefits of LEM are yet to be tested and evaluated (ibid.).

Energy Systems Catapult[106] analysed the policy and regulatory context for new LEM and published findings in 2019. It was noted that significant regulatory changes are underway across the electricity sector. Despite of uncertainty regarding future governmental support for energy investments in e.g. small-scale renewable generation and other demand-side response (DSR) and generation/storage technologies, the key areas of the reform can be beneficial for LEM development, including:

- transformation of DNOs into DSCOs that would change DNOs roles and responsibilities;
- half-hourly market settlement reform for development of more accurate pricing signals (has potential to maximise the use of local energy resources e.g. local renewable energy generation);

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102 https://www.ukri.org/our-work/our-main-funds/industrial-strategy-challenge-fund/

103 https://es.catapult.org.uk/wp-content/uploads/2019/06/ISCF_PFER-brochure_A4_full-proof.pdf

104 Project Leo (Local Energy Oxfordshire), the Energy Superhub Oxford, ReFLEX Orkney, Smart Hub SLES

105 The policy and regulatory context for new Local Energy Markets https://es.catapult.org.uk/news/the-policy-and-regulatory-context-for-new-local-energy-markets/

106 'Energy Systems Catapult was set up to accelerate the transformation of the UK's energy system and ensure UK businesses and consumers capture the opportunities of clean growth. The Catapult is an independent, not-for-profit centre of excellence that bridges the gap between industry, government, academia and research.' https://es.catapult.org.uk/about-us/

- review of retail supply and the supplier hub model which would open up market arrangements for new business models and to more actors, including those at local level;
- changes in the calculation and allocation of network charges (Energy Systems Catapult 2019).

Despite of the changing policy discourse and some support for the development of SLES and LEMs, the regulatory environment (particularly, the electricity market rules) has been seen as an impeding factor for LEE and P2P electricity trading. However, a number of initiatives based on different models/approaches happened or were conceived during this period. The data collected for this study suggests that in the last five years there were two trends in the (local) electricity exchange field: (1) to come up with propositions that would work within the existing policy/regulatory framework (using e.g. 'sleeved' PPAs); (2) to experiment with new models, e.g. P2P electricity trading, using sandbox mechanism supported by Ofgem granting 'exemption' from current electricity market rules (led by industrial partners and tech companies in collaboration with community energy groups). In the following sections – Novel community energy models for local electricity exchange; P2P electricity trading and regulatory 'sandbox' trials – the development of these two categories of projects are discussed in detail with few examples of SIE-initiatives to illustrate the ideas behind them, vital collaborations and challenges faced by SIE-filed actors.

Novel community energy models for local electricity exchange

During the period 2015-2020 a growing interest in developing local electricity exchange suggested a more active role for communities and citizens/prosumers, that would also involve a move away from a 'supplier hub' model changing the relations between consumers/prosumers, supplier and network operators.

As mentioned earlier, up to 2015 much of the focus for community energy groups was on setting up their own generation projects (Stephens Scown & Regen SW 2016). Selling that energy within the local community was viewed as a natural progression from community owned generation. This could potentially make the development of new generation much more acceptable and help manage energy more effectively (ibid.).

In order to adapt to changing regulatory and institutional environments (in particular the reduction and eventually removal of subsidies, as well as changes in the electricity system), community energy groups started developing new business models. As noted by Community Energy England, with FiT subsidies it was 'easy' to do standard projects (e.g. community owned solar generation), now community energy groups have to be more innovative and explore new ways of being able to operate (LEE_UK14). Community Energy England argues that community energy organisations 'take the lead as entering a new era of subsidy-free projects'. As the energy system is becoming more complex (moving towards decentralised usage, distributed, smart energy systems), this is seen as an opportunity for community energy groups to experiment and develop new models for local energy and new partnerships. Another catalyst for searching new solutions is the motivation that drives those groups ('95% of our members motivated by climate change'); they want to do 'bigger, more impactful'

projects, that would also allow engaging a broader community (climate active groups, food projects) looking at more of a 'whole place solution.' (LEE_UK14) The models advocated and implemented by community energy groups usually deliver benefits for consumers in terms of electricity price (like local tariffs).[107] This leads to the situation when 'old types of projects' started to decline, although 'the simple more generation ones were always a 'backbone' and seen as an easy way to bring surplus to enable other types of projects.' (LEE_UK14)

Microgrids have been seen as a viable model to enable generation and self-consumption of community owned renewable energy, particularly in combination with other elements of energy system, such as energy efficiency measures, heat pumps, and energy storage, e.g. for new housing developments where the provisions for a private network can be incorporated into the project. Although many early microgrids were 'islanded' (e.g. as a solution for remote areas), in recent years these models usually have a grid connection (Brown et al. 2020), e.g. residents could get their energy from on-site generation, topping up from the grid when needed, and exporting any excess energy back to the grid. For the majority of schemes that exist on the public network, the new models for LEE still involved a licensed electricity supplier as an intermediary (based on a Power Purchase Agreement,[108] and as a variation – a 'sleeved' PPA[109]).

Among novel models for LEE the most commonly mentioned is Energy Local which is often spoken about as a successful example of implementing a version of P2P model in the current regulatory framework (using a 'loophole' in regulation and 'complex site arrangements'). The scheme started in 2016 in Wales. It represents a version of local energy tariff model (allows selling locally generated electricity to both prosumers and non-prosumers through special tariffs in specific geographies) which is optimised with smart meters being paired with time of use tariffs (Brown et al. 2020).

[107] This is not new, as energy companies were first to start offering local tariffs, e.g. Good Energy, the UK's first 100% renewable electricity supplier, offered the UK's first local electricity tariff in 2013 to reward households near its wind farms with lower electricity bills.

[108] There are three main types of PPA used in the UK: wholesale PPAs, 'sleeved' PPAs; private wire PPAs (electricity is sold to the consumer via a direct wire rather than the grid).

[109] In a sleeved PPA, an intermediary utility company handles the transfer of money and energy to and from a renewable energy (RE) project on behalf of the buyer. The utility takes the energy directly from the RE project and 'sleeves' it to the buyer at its point of intake, for a fee. If the purchased renewable energy isn't enough to meet the buyer's energy needs, the utility is also responsible for supplying the additional power required. The utility bears the market risk. https://www.urbangridsolar.com/what-is-a-sleeved-ppa/

Introduction to SIE-initiative

Energy Local[110]

Energy Local has designed a local market in power via Energy Local Clubs. This enables households to club together to show when they are using local clean power when it is generated. The scheme gives generators a price for the power they produce, that reflects its true value, keeps more money local and reduces household electricity bills.

The basic principle of Energy Local scheme is that households and small scale renewable generators as members form an Energy Local Club (ELC) - legally a Coop. Households have smart energy meters installed to show when and how much power they are using.

Members (households and generators) agree a price ('match tariff') that will be paid to the generator when they match their electricity use to when electricity is generated locally, for example, turning their washing machine on when they know the local Hydro scheme is working at full pelt.

The club chooses a partner energy supplier (such as Octopus Energy) that sells the extra power they need when there is not enough local electricity generated. The supplier sends each household the bill for their total power use.[111]

The first Energy Local Club started in a small town called Bethesda, in North Wales back in 2016. Clubs have also been set up in Dorset and other parts of Wales where it seems to be popular; now trying to develop more schemes across the UK working with some key partners and funders (e.g. Coop community Energy and Octopus Energy). There are concerns, however, that the changes in the legislation might not allow the replication of the model: '…the legislators in the UK are kind of changing the legislation, which means it may not be practical going forwards because they see it as them exploiting a loophole' (LEE_UK12). The Energy Local model was not compliant with the Balancing and Settlement Code, 'a complex site arrangement'[112] was granted by Elexon. (LEE_UK12))

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

111 https://energylocal.org.uk/guide1

112 The mechanism is explained e.g. in (Boait and Morris 2018): 'The UK Balancing and Settlement Code (BSC) includes a concept known as the "Complex Site". This was conceived to apply to situations such as an industrial site with distributed generation present and multiple industrial consumers. It allows the local generation to be allocated to local consumption, with the aggregation of the generation and consumption being treated as export or import for the site as a whole. It requires half hourly metering of all connections and the processing through settlement of these half-hourly meter readings, which is currently not possible with UK domestic "smart" meters. […] Energy Local has worked with metering and retail electricity supply partners to devise an interpretation of this process which allows a group of domestic consumers to take power from one or more small scale generators that share the same LV network. The consumers pay a preferential tariff for the locally generated electricity that they use. The balance of their consumption is purchased from a retail supplier at a time-of-day dependent tariff. This supplier manages payments to the generator for matched power and presents a consolidated bill to each consumer in the group. This supplier also purchases any generation that is not taken by the consumers in the group under a conventional power purchase agreement (PPA).'

Another issue is whether the model can work in other locals, particularly in big cities: '…if you live in a nice village where a local farmer is able to put in a hydro generator, then it works very well and the whole village gets on very well with each other. And everyone wants the renewable electricity. It is very nice. And people meet every month in the village hall to discuss how well it's going. But this isn't the way that the whole of the UK is. It's a part of the UK. So if the model is going to work for everybody, it needs to work in London, in towns, in cities so that they're looking at working with a project in London to see how the energy local model works there basically.' (LEE_UK12)

The idea of Energy Local came from a local activist who set up and run the project. Energy Local tried to connect a group of consumers and a generator on the same low voltage 11 kV network, all at the same substation, and then putting meters into people's homes and putting meters on the generation site (the scheme used hydro) and incentivising people to use electricity when the hydro plant is generating energy. This way it can be proved that people are using electricity from the hydro power plant because it is on the same low voltage network. The scheme demonstrates that there is a cost reduction benefit as well, because of using the same network ('marginally cheaper electricity and less distribution costs').

The main challenges were technology-related (smart metering) and the engagement of the community: ' So you really have to bring the whole community on the journey with you and say you need to change the way you use electricity if you're going to benefit from this.' (LEE_UK12)

The system employed for managing the actual consumption involved notifications (e-mail alerts) about e.g. the cheapest time to use electricity or suggesting the peaks when lots of electricity would be generated encouraging people to use electricity at that time. 'I think that worked quite well in the beginning. But maintaining that level of motivation is difficult because people may be engaged to start with, but then later on they may be getting into your old habits or, you know, they kind of can't put the washing machine on because I am at work, you know. You constantly need to keep reminding people and finding ways to keep people engaged with the concept, otherwise it does not work.' (LEE_UK12).

Another noticeable project is SMART Fintry,[113] a two-year smart grid project in the Scottish village of Fintry that aimed to match local electricity supply and demand.[114] In 2016 the project gained funding from Local Energy Scotland within the 2015/16 Scottish Government Local Energy Challenge Fund programme. This Stirlingshire village has a very active local

See also: Elexon (2018) Shared SVA Meter Arrangement of Half Hourly Import and Export Active Energy https://www.elexon.co.uk/csd/bscp550-shared-svameter-arrangement-of-half-hourly-import-andexport-active-energy/

[113] http://smartfintry.org.uk/

[114] https://www.goodenergy.co.uk/fintry-local-tariff/

community with a great interest in making Fintry a carbon-neutral and sustainable community.[115] Almost one third of households in Fintry have also signed up to participate, as well as four local renewable generators.[116] The Project was delivered by a consortium of partners: Fintry Development Trust (project lead), Veitch Cooper, Energy Assets Good Energy, and Heriot Watt University. The £1.25m project, which was delivered over two financial years (2016/17 and 2017/18), received £841,000 of funding from the Scottish Government Local Energy Challenge Fund (LECF). The partners contributed the remaining £409,000.[117] This community project pioneered a new way of trading and charging for electricity so that householders and businesses could buy their electricity directly from nearby renewable energy generators, using the existing electricity grid infrastructure. The aim was to reduce both electricity costs and carbon impacts. The project also aimed to demonstrate a simple, low risk and replicable local energy economy that links local, sustainable generation with consumption, and which could be adopted by other communities across the UK.

One of the most common models that allows linking renewable energy generation with consumption is a 'sleeved' PPA. The well-known example is a joint venture formed by Co-op Energy[118] and Octopus which offers a green tariff that comes from renewable energy (proved via 'renewable energy guarantees of origin'). In 2018 Ripple Energy started a wind farm project in partnership with Co-op Energy and Octopus Energy which claims to be the first co-operative to enable its members to own a wind farm and be supplied by the electricity it produces.

Introduction to SIE-initiative
Ripple Energy (Ripple Energy Limited) is a crowdfunding and management company with expertise in green energy.[119] Ripple partners with Co-op Energy and Octopus Energy (the supplier) for a wind farm project.[120] The Graig Fatha wind farm will be located in the heart of south Wales, near Coedely, and was consented by Rhondda Cynon Taff County Borough Council in early 2018. Building on the area's rich industrial heritage, it would 'help create a new clean energy future for Wales'.

115 SMART FINTRY – Year 1 Operation Report http://smartfintry.org.uk/wp-content/uploads/2018/04/Appendix-1-SMART-Fintry-Year-1-Operation-report.pdf

116 https://www.goodenergy.co.uk/fintry-local-tariff/

117 SMART FINTRY – Year 2: Innovation Workstream Findings http://smartfintry.org.uk/wp-content/uploads/2018/04/Smart-Fintry-Innovation-Report-final.pdf

118 'Co-op Energy is a British energy supply company based in Warwick that began trading in 2010. It is an alternative to the Big Six energy suppliers and, given that its parent is Midcounties Co-operative, it is the only co-operative supplier in the market. Since August 2019, energy supply, billing and customer service have been operated by Octopus Energy.' https://en.wikipedia.org/wiki/Co-op_Energy

119 https://rippleenergy.com/

120 https://rippleenergy.com/graig-fatha

The Graig Fatha is claimed to be the first co-operative to enable its members to own a wind farm and be supplied by the electricity it produces. The co-op can also deliver wider benefits, such as helping to reduce fuel poverty in the local community around the wind farm and local environmental projects.

Currently Ripple Energy is raising funding through a share offer that would allow people to own a percentage of the wind farm. Customers decide how much of the wind farm they want to own, and pay for that share of the wind farm's construction cost (one-off payment). The scheme also offers flexibility for the wind farm's lifetime ('Take your clean electricity with you even if you move home!').

Once all the shares in the co-op have been bought, the wind farm will be built (it is planned to be operational and start generating energy in late spring 2021). It will be owned entirely by co-op members. Ripple performs as the co-op's managing agent in relationships with companies needed to build and operate the wind farm on the co-op's behalf.

Once operational, the cost of running the wind farm becomes the electricity bit of customers' electricity bills (they still pay grid charges and taxes like any other customer). Electricity will be supplied by Co-op Energy, powered by Octopus Energy, and customers are offered to choose one of Co-op's tariffs. 'Octopus Energy is the supplier. They will be buying the electricity from the wind farm. And if I wanted to take part in the scheme, I would need to be Octopus energy customer. And so the electricity from the wind farm gets discounted from my bill.' (LEE_UK12)

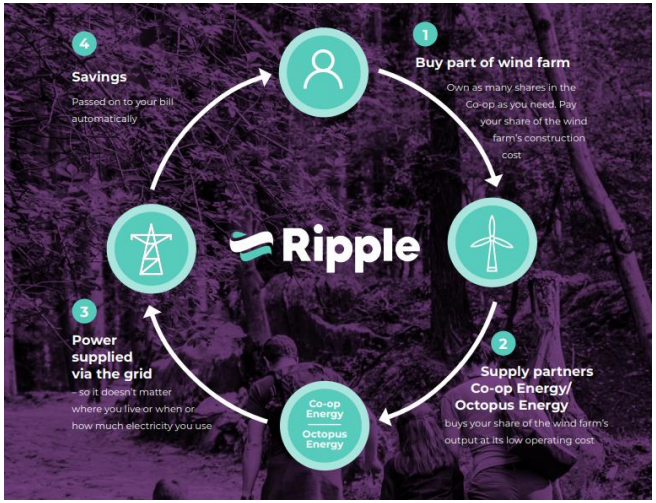
Although at the moment there is only one energy supplier involved, it is suggested that in the future more suppliers can sign up making the scheme more flexible in a way that customers could switch in between suppliers but still maintaining the benefits.

The scheme has been 'very successful' in raising funding, and not all of its customers live in Wales. As the scheme allowed anyone to buy shares, it is seen more as an example of citizen involvement ('citizen energy') rather than 'community energy', as people engage as individuals, not as a community. The obvious advantage of this model, compared with local community schemes, is that anyone can benefit from owning part of wind farm, whether living in a village in Wales or in London: ' So I'd say the way it works is almost if you imagine like a virtual private wire to everyone's home basically.' (LEE_UK12)

The cost of running the wind farm is claimed to be lower than the market price for electricity, so owning a share of the wind farm would create a saving. So the justifications for the proposed model include both the economic and environmental benefits (lowers and stabilises electricity bill for the long term as generates electricity at a low and stable cost for its 25 year lifetime; onshore wind is the lowest CO2 source of power; enables new wind farms to be built).

It is advertised as a cheaper option compared with solar: '65% cheaper than rooftop solar! With energy bigger is better, and substantially cheaper. Shared ownership alongside thousands of others is way cheaper than going it alone.' 'The greenest and now the most affordable source of electricity in the UK. Your own source of new, genuinely green

electricity from as little as £250.' The offer is also open to businesses to invest in a share of a new wind farm and power businesses with 100% renewable electricity.[121]



Source: Co-Pilot Wind Project Ltd Co-operative Society. Share Offer for the Graig Fatha Wind Turbine https://static.rippleenergy.com/assets/GraigFatha/Ripple-Co-PilotWindProject-20200929.pdf

In January 2020 Co-op Energy launched new tariff sourcing clean energy from community projects across the UK – the community power tariff, which aims to 'pave the way for a decentralised energy future'[122] and support local community initiatives. All electricity sold through the deal is produced by local wind and solar projects, with all gas usage being offset. This community energy tariff sourced from community renewable energy projects is characterised as 'ground-breaking' and 'unique': 'it's quite unique where we're the only company that offers this. But we are seeing quite a big demand for it' (LEE_UK12). This model can be seen as a way for consumers to support community energy by signing up to this tariff, although it does not necessarily mean that consumers buy power from their local community energy projects: the basic principle is that for every unit that is consumed (taken out of the grid), the energy company (e.g. Octopus Energy) replaces it with a unit generated from the community energy projects.

121 https://rippleenergy.com/business

122 https://www.energylivenews.com/2020/01/14/co-op-energy-launches-new-tariff-sourcing-clean-energy-from-community-projects/

The question can be asked about how 'local' manifests in these models which seem not having clear locality boundaries. For community power tariff electricity comes from community-run renewable energy projects around the UK, not necessarily from the projects in consumer's local area. The model that is being implemented by Ripple Energy also does not have all characteristics of local electricity exchange (users of the scheme does not necessarily live locally/near the wind farm), however, the scheme provides a clear link between energy produced at the wind farm owned by citizens and their consumed electricity (through reduction on energy bills); it also allows local residents to buy a share of a wind farm. The model is innovative in a sense that it uses a new form of funding mechanism – crowdfunding for a citizen owned wind farm, but also the mechanism that allows to discount electricity produced by the wind farm from customers' electricity bills (rather than e.g. paying dividends).

A similar mechanism to be used in a project that is being developed by Wadebridge Renewable Energy Network (WREN), who are also looking to collaborate with Coop Energy and Octopus Energy (started in 2020). WREN is planning to use the so-called 'solar allotment model' for investors as part of their Energy Equality project.

There were a couple of noticeable Initiatives developed by WREN, which was set up in 2011, before they started looking into this model. One is a solar farm that supplies electricity to a water company, South West Water sewage treatment plant (through a 'private wire'). A proportion of profit made over a year goes to a community energy fund. It is funded by Low carbon society,[123] the funding to which is coming from Cornwall council; it is a revolving fund and needs to be repaid. WREN intends to do that by raising community energy shares (re-financing through community energy scheme) and hopes to combine it with Energy Equality project as one whole portfolio. The other initiative was a trial on domestic demand side response – Sunshine tariff trial (with WPD, Regen[124] and Tempus Energy) which was a predecessor of the Energy Equality project. WREN historically 'did a lot of lobbying work around parliament' e.g. for a community energy bill, a strategy for community energy. Its membership is about 1,200 people, not all of them live in Wadebridge – it is wider than the local community, arguably because Sunshine tariff attracted a lot of attention and was taken by the press (e.g. BBC coverage). (LEE_UK11)

[123] 'The Low Carbon Society (TLC Society) is a Community Development Finance Institution (CDFI) and Industrial and Provident Society (IPS), which was established in 2009 through a partnership between CEP, Kabin and Cornwall Council. Its purpose is to provide loan financing specifically tailored to the needs of community renewables schemes in Cornwall.' https://www.cornwall.gov.uk/media/3627769/The-Low-Carbon-Society.pdf

[124] 'Regen is a not-for-profit centre of energy expertise and market insight whose mission is to transform the world's energy systems for a zero carbon future. Regen offers independent expert advice and market insight on all aspects of sustainable energy delivery.' https://www.regen.co.uk/

Introduction to SIE-initiative

Wadebridge Renewable Energy Network (WREN)[125]

One of the catalysts for the new project was 'a big shake up' when the Government started reducing FiT, which meant that lots of projects that WREN was working on would no longer be viable.

WREN was keen to look at ways to alleviate fuel poverty in their community and make renewable energy more 'inclusive' ('we wanted basically make renewable energy as inclusive as possible'). There are a lot of very engaged members who have taken steps towards solar or wind or biomass, green sustainable living that are embedded in their personal ethos, but usually those are not in fuel poverty ('it is very much preaching to the converted') (LEE_UK11). WREN struggled to engage with less environmentally minded members of the community or those who renewable energy is not typically a key priority, i.e. people who can't afford solar PV, don't have a suitable roof or don't have a roof at all because they live in a flat or an apartment.

The FiT scheme is recognised as 'unfair' with an 'unfortunate' side effect: the people who could afford it right at the beginning are now financially benefiting from FiT, in some cases the system paid off itself years ago, and the cost of that is being split across everybody's electricity bills. So as a result, those who could least afford to pay (e.g. those in fuel poverty), end up with exactly the same proportion as anybody else, to pay for this wider FiT bill to cover the cost of running the scheme.

'We want to be able to find enough headroom within the energy trading business model to be able to subsidise people in fuel poverty, by reducing their energy bill and giving them a cheaper tariff if we can. That's what we are looking to do.' (LEE_UK11)

These ideas inspired the Energy Equality project, and WREN started the feasibility study in February 2020 (the funding is until February 2021). At the current stage WREN is looking to collaborate with Co-op Energy (and Octopus Energy behind them) to see how the project would work from the energy trading point of view. Octopus would be doing trading and covering all Ofgem regulations, WREN will be working with Co-op energy to set up a structure of the tariffs. The Local Authorities play a supportive role, e.g. by providing a lease agreement for rooftop spaces owned by Cornwall council or Wadebridge Town council; they are also asked to sign up and buy energy that is being generated by the local community.

The proposition for investors is referred to as a 'solar allotment model': rather than paying them a dividend, WREN want their dividend to be paid as a credit to their electricity bill as if the solar panels they have invested in are directly connected to their electricity meter

[125] https://www.wren.uk.com/

The Energy Equality project would allow a trial of a peer-to-peer platform and create a marketplace in which people could sell their surplus electricity (e.g. solar) along with community project (community energy owned assets) to sell its electricity to it, which can then be bought by consumers within the local area. WREN is looking not only at domestic but also at commercial customers and people who already have their own PV systems. They are also trying to decide about the shape and the size of the project for it to be viable. There are certain costs related to running this platform (around metering, the cost of set up). A potential platform solution provider, such as Dipole, would serve as an interface between consumers and the backend side of energy trading.

At the moment there are a couple of 'critical bits in regulation' seen as barriers for implementing the scheme as 'a cohesive marketplace for people to trade energy'. (LEE_UK11)

WREN wants to go beyond Wadebridge and share their experience with other community groups: 'That the whole cooperative vibe we have, we see our community not necessarily on our doorstep but the wider UK and other community groups as well' (LEE_UK11). They started discussing with Community Energy England the idea of using the scheme as a 'blueprint' for other communities. If successfully implemented in Wadebridge, the model can be picked up and reproduced across other towns across the UK; this would potentially allow bringing them all on one platform and set up an energy supplier. 'And that's where it gets really interesting because then you're talking big movements of energy at any moment in time and that's when the likes of National Grid start to get interested in the sort of scale of what we are trying to do.' (LEE_UK11)

Power and power relations (power to + power over + power with)

In SONNET we are interested in power dynamics in the SIE-field under study: how SIE-field is enabled and/or impeded by power relations and vice versa; how and to what extent existing power relations are transformed and/or reproduced by the developments in this SIE-field.

The concept of 'power to' relates to actors having different kinds/levels of power/capacity to mobilise SIE-related resources and/or to achieve goals. 'Power to' can therefore be summed up as people's capacity and resources to take action to be able to change the existing energy system (and social relation within it). The concept of power 'over' relates to actors having power over others in social innovation in energy (SIE) related processes. The concept of 'power with' relates to actors holding and exercising power together with other actors to achieve collective goals, through e.g. strategic collaboration, pooling resources, joining forces, etc.

The electricity system/market in GB is a highly regulated field, so the ability to act is limited by existing regulatory framework (although there are examples of implementing LEE/P2P bypassing some rules e.g. exemptions granted for sandbox trials or Energy Local using a 'loophole' in regulation). The electricity system is 'socio-technical' by nature, and the material infrastructure, i.e. the physical configuration of the grid, is another factor that sets the framings for possible action in LEE. There are significant asymmetries regarding the resources possessed by different types of actors in the SIE-field. Community energy groups' resources for implementing new innovative projects in LEE are scarce in comparison with the traditional industry actors such as energy companies. Local groups and NGOs that support LEE at the grassroot level often rely on volunteers and/or external support for their activities. However, LEE is an emerging field, and the power relations are evolving. It is expected that a push to transform the electricity market from centralised, supplier-centric structure towards more decentralised, consumer-centric structure can empower consumers/prosumers and other actors with limited power, making them active market participants with capability of trading energy and/or flexibility from their resources (Ibn Saif A. & Khadem, S. 2020).

Power 'over' is well-illustrated by the position of a regulator and the decisions about changing 'the rules of the game', as well as in relation to individual actors (e.g. licencing or granting exemptions). For example, Ofgem exercises its power through regulatory instruments, by awarding sandbox trials, setting up the guidelines for electricity market players.

The development of SIE-field over time demonstrates how actors collaborate and work together towards common goals. The arrangements around the electricity system and market are complex, and can perform as impeding factors for LEE (e.g. the electricity supply licence rules can be an obstacle for small generators/suppliers). It is common for SIE-initiatives to be based on multi-actor collaborations. The successfully implemented projects are good examples of (public-private) partnerships between actors that have different 'weight', e.g. between community groups, energy suppliers, LAs, DNOs, commercial developers, tech companies. The latest developments around local energy markets and smart local energy communities, within which LEE/P2P can be developed, lead to new alliances being formed, although it seems that the role for less powerful actors like communities could be limited in large-scale projects.

P2P electricity trading and regulatory 'sandbox' trials

One of the most controversial local electricity exchange models is P2P electricity trading that involves e.g. the use of digital platforms and blockchain technology. It became a 'serious consideration' in the electricity market in the last four years (LEE_UK05). In theory, P2P models seek to remove the licensed supplier as an intermediary when trading prosumer generation over the public grid. Using third-party digital platforms, prosumers can securely trade energy with minimal involvement from suppliers and select the provenance of their electricity; prices can be negotiated directly with other prosumers (Brown et al. 2020 D4.2).

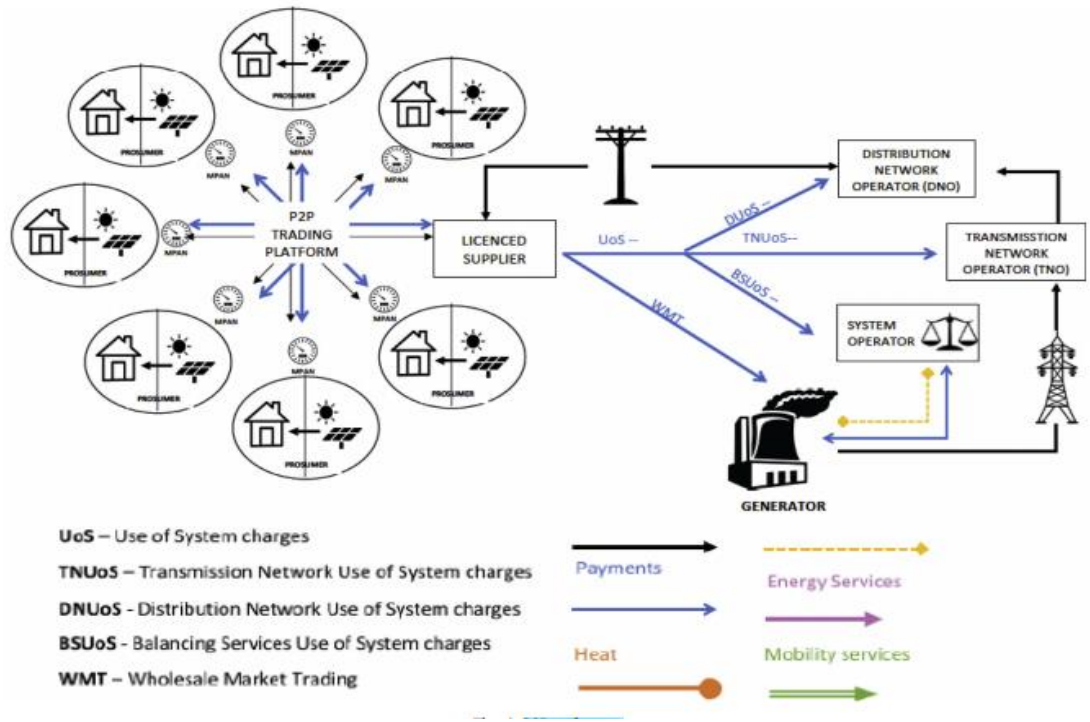
In the current regulatory environment households are not allowed to buy and sell energy to and from one another, so the projects that provide an explicit opportunity for trading electricity between consumers/prosumers can only exist in a form of so-called regulatory sandbox trials.[126] In parallel with the initiatives that are operating or being developed with the current regulatory framework, there have been several P2P trials taking place in recent years.

In 2017 the Regulator, Ofgem launched the regulatory sandbox as 'a means of experimenting with ways of mitigating barriers where an innovator's plans didn't readily fit with the rulebook'.[127] The sandbox plays a key role in enabling trials and supporting innovators in launching new low carbon products and services. It is administered by Ofgem's Innovation Link (launched in December 2016[128]) who work with other teams in Ofgem, helps policy/regulator to get the insights about what is happening on the ground and using some of the insights to influence the shape of future policy (Ofgem 2020).

[126] It is worth noting that the regulatory sandbox is only capable of providing a tweaked version of today's regulatory environment, not an alternative regime. The effect of this being that even through sandbox trials, P2P trades across the public network have to be intermediated by a licensed supplier. (LEE_UK05)

[127] https://www.ofgem.gov.uk/publications-and-updates/innovation-sandbox-service-overview

[128] Innovation Sandbox Service Overview https://www.ofgem.gov.uk/publications-and-updates/ofgem-launches-innovation-link-0#:~:text=Ofgem%E2%80%99s%20Innovation%20Link%20will%20provide%20fast%2C%20frank%20feedback,consumers.%20The%20Innovation%20Link%20will%20also%20bring%20



P2P archetype (Source: Brown et al. 2019)

Over the last four years Ofgem's Innovation Link have worked with about 400 innovators, and 20-25 percent of those are interested in local energy, largely around electricity and its various archetypes (tend to be domestic); 10 percent of those explicitly talked about peer to peer, and want to understand how they can get involved or at least provide some form of local electricity scheme (LEE_UK05). The role of Innovation Link is to help them to understand what that means in practical terms and how they can do peer-to-peer trading, but within the confines of the current regulatory regime ('helping them translate their aspirations into today's reality') (LEE_UK05).

The value propositions and the models of P2P are slightly different: for some peers there is explicit network and system value involved and benefit; for others the peers are seeking to match generation and supply and realise the incentives associated with avoiding imbalance in the GB balancing and settlement system (LEE_UK05). The models tested in the trials are seen as 'experiments' and represent a very small scale peer-to-peer trading, but the scale of energy involved would never satisfy all of the customers' needs – a licensed supplier is to provide the top up a backup power to meet those needs.

Innovation Link ran two 'competitions' in 2017; the first awards were granted in late 2017, the second awards in 2018. The expectations were to see early results within two-year time (from late 2019) but realistically this won't probably now happen until summer / autumn 2021. 'Some schemes faced set-up delays, and for another Covid-19 has affected consumer recruitment and their ability to operate the trial across different seasons.' (LEE_UK05) At the time of the study there were three running live sandbox trials, and the fourth was on its way (it struggled to secure funding as the original funder fell through so it has been negotiated with another one). (LEE_UK05) Ofgem expected to have a bigger cohort, but some of the projects that expressed interest didn't secure the funding they needed.

Two trials are based in London in tower blocks, both involve fuel poor vulnerable consumers. Each of them has solar PV on the roof. The idea was to try a mechanism whereby the residents of those buildings would benefit from the solar PV which is typically just used for communal lighting and communal heating with the rest of that power being sold onto the public network. Both are testing very similar arrangements but use slightly different technology; learning objectives are the same for both those trials.

The first P2P electricity trading trial is delivered by Verv,[129] Repowering[130] and British Gas/Centrica. For this trial Verv received funding from Innovate UK (proof-of-concept) and was selected to be part of UK regulator Ofgem's sandbox for new and disruptive technologies which provides regulatory flexibility to test the platform. Verv has developed a cutting-edge peer-to-peer renewable energy trading platform which is based on high-speed data acquisition and AI technology for understanding the consumption and production of energy, teamed with blockchain for trading.[131]
The trial was set out to power a social housing community with solar PV using the energy trading platform, to help residents access the environmental and financial benefits of renewable energy. The target community was an estate in Hackney, London that had solar panels installed on 14 of the blocks of flats. The solar panels were installed in 2015 by Repowering, a social enterprise set up to facilitate community owned energy, who worked with local residents and Hackney Council to create Banister House Solar. The green energy generated by the solar panels was being used to power the community areas but the residents could not benefit directly from it due to regulation in the UK market.

The trial aimed to allow residents to benefit more directly from the solar by reducing the cost of their electricity. Verv and British Gas will trial a new arrangement that maximises the benefits from local generation and tests peer-to-peer electricity trading across a distributed ledger platform. The aim is to trade energy supplied by Banister House Solar on a software

[129] Verv is a company established in 2017 that specialises in high-speed data acquisition and AI in the electrical domain. Verv has developed a cutting-edge peer-to-peer renewable energy trading platform.
[130] Repowering was founded in 2011 with the aim of building sustainable, community-led energy systems. They established Brixton Energy Solar in 2012 which was the first community energy scheme on social housing in the world and spearheaded inner-city projects; ever since have developed another five projects on social housing. https://www.repowering.org.uk/
[131] https://verv.energy/research

platform developed by Verv. Verv Home Hubs in the flats of participating residents will monitor electricity consumption. The trial allows Verv to test practical applications of their technology, including how consumers respond to it (Ofgem 2018).

In April 2018, Verv conducted the UK's first peer-to-peer trade of energy on blockchain technology. As reported by the company, the first trade saw 1kWh of energy being sent from an array of solar panels with excess energy on one of the block's roofs, to a resident residing in another block within the estate. Results have shown a potential to reduce energy bills and carbon emissions by 20%.[132]

This trial was followed by a similar project CommUNITY – it aims to enable residents of a selected building in Brixton, London, to trade solar energy generated on the roof with each other, and to certify the transactions using blockchain technology (Bellini 2019). It was conducted by EDF Energy also working with Repowering and the UCL Energy Institute.

The third trial which was directly related to P2P trading is about creating a marketplace (across GB, not local), and was developed in collaboration with BP and Tonik Energy.[133] BP developed a platform that would allow consumers who generate their own electricity (prosumers) to sell excess electricity in a marketplace ('excess power trading platform'). This could create market-based revenues for prosumers, often not available to small-scale domestic generators. Tonik Energy wanted to explore the value proposition of accessing more domestic distributed generation from their customers. This could allow Tonik to enhance their ability to match supply and demand, as well as offer lower cost power to their customers. The aim of the project was to understand the opportunities for using a platform to match supply and demand, as well as how customers might interact with and benefit from it. Domestic customers across Great Britain were participating in the trial (around 100 – LEE_UK05), using a digital platform created by BP that simulates energy trading from prosumers. While simulated trades will be based on real-time user data, no physical electricity will be bought or sold during the trial.' (Ofgem 2018) 'The trial partners were looking to test people's appetite for trading, to see what kind of behavioural changes it would create, and also whether or not there was financial benefit in it for the prosumers and the consumers themselves' (LEE_UK05).

Projects operating within the regulatory sandbox have two years to do so, after which the regulator is to publish a series of findings and possible interventions. Ofgem has published some early findings, in particular, noticing an emerging lack of clarity within energy and tech firms surrounding electricity exemptions for small-scale generation and distribution (such as local smart grids), which is making its interaction with existing licensing regimes difficult.[134]

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132 https://verv.energy/research

133 Since the data collection was completed, Tonik Energy has exited the supply market and its consumers switched to another supplier. As such, the trial is no longer active.

134 https://www.current-news.co.uk/news/bp-and-british-gas-named-among-new-regulatory-sandbox-participants-as-energy-marketplaces-take-off For more detail see Ofgem's 'Insights from running the regulatory sandbox' https://www.ofgem.gov.uk/system/files/docs/2018/10/insights_from_running_the_regulatory_sandbox.pdf

Key changes in the SIE-field over time
One of the central research questions and empirical foci within the SONNET case studies is to understand the development of the SIE and its SIE-field over time (Hielscher et al. 2020). We therefore take a 'process perspective' and investigate change through focusing on the emergence of the field and the activities of SIE-actors shaping them (Wittmayer et al. 2020b, p. 33). We look at internal field events, key changes in the development of the SIE-field and its relationship with the 'outside' institutional environment, changing narratives and societal trends that enable or impede the development of the SIE and its SIE-field. During the period covered in this study a number of new actors entered the electricity market experimenting with various approaches/models trying to match local supply with local demand (including LAs, community groups, tech companies). The traditional actors (e.g. energy suppliers) have been actively involved in the development of the SIE-field and started developing new propositions for LEE. As such, one of the most noticeable changes is the emergence of different models for enabling LEE and P2P electricity trading that are developed and implemented by different actors. This is represented by Ofgem's sandbox trials and other projects led by community groups and industry actors. The innovation such as distributed ledger technologies (blockchain) were regarded as a key element and an enabler for P2P electricity trading mechanism and LEE several years ago: 'Say around three or four years ago everyone would just say blockchain all the time because they felt it was something that they needed to do to factor into an energy project without really understanding what it was or why they needed it. More recently not many people talk about blockchain anymore, and probably the reason for that is that they realise that they don't need a blockchain to make the project work. […] they're [Repowering London Brixton Energy] the only people that I know of using blockchain successfully in their project. […] For example, Ripple doesn't use blockchain technology. I think it would add a layer of complexity that isn't needed to do what they need to do. Energy local doesn't use blockchain because it doesn't need to.' (LEE_UK12) Smart metering is seen as a step-change for the energy industry overall and is of utmost importance for the development of LEE and P2P electricity trading. The rollout of smart meters (started in Autumn 2015) enables the use of real-time energy consumption data, which helps link consumption directly with generation and can change the way energy tariffs are structured.

P2P electricity trading: reflections and critique

Although P2P electricity trading may look as an advancement for local electricity exchange and an attractive option for some (e.g. the case for energy generated locally to be cheaper), there are a lot of uncertainty, unresolved issues and concerns related to electricity market regulation, technology solutions, scale, potential beneficiaries and overall complexity of the

model. It is also questioned whether P2P trials can be turned into a commercially viable business model and what the benefits of the models are.

There is a strong belief that P2P electricity trading is driven by tech companies promoting the technology, who potentially want to have a share of the emerging (platform) markets. (LEE_UK01) One of the issues is that the underlying technology is being developed by tech companies that are for profits, whereas the community organisations that would like to actually apply it tend to be non-profit. (LEE_UK10) This means power to be concentrated in the hands of tech companies, which goes against the common ethos of community energy organisations. Although there is some interest in P2P models, there is also scepticism in terms of what it can deliver and how much power different organisations might have in potential P2P models (LEE_UK01). At the moment the technology developers are seen as 'gatekeepers' and as being 'quite cagey' about what they can and cannot do making it unclear what actually works: '…if you speak to some of them and sometimes they like if you were to interview somebody from of the tech companies, it might just seem like a sales pitch. Because they talk about all this wonderful stuff. But then you realise that they've been talking about the same wonderful stuff for four years and they still don't have anything they've done that has delivered a working business model. And, you know, it is unclear really what works and what doesn't work that's out there.' (LEE_UK10)

Another important question to ask about P2P trading is who would benefit from this type of service . Although the general response could be 'consumers', but in reality only those who participate and those who are capable of participating (e.g. the 'early adopters'/'early movers'), can meet the cost of participation, and somebody has to pay for the technology that enables these P2P transactions. The challenge here, as seen by the regulator, that the use of these schemes shouldn't create costs that 'other consumers end up having to pick up', as some P2P schemes have argued that they should not be subject to standard network charging arrangements which is contrary to Ofgem policy: 'Some advocates of local trading and P2P schemes make the case that they only use a very small / localised proportion of the public network and shouldn't be required to contribute to other network costs. While we can understand anyone's desire to minimise their costs, this shouldn't be at the detriment of other people; as such, local trading and P2P schemes are treated like other arrangements using the public network and should pay their fair share of network costs.' (LEE_UK05)

This view is supported by Community Energy England who sees pure P2P platforms as currently more suitable for 'the more experienced participants who understand about energy system, have solar panels, more middle-class type residents or it's more businesses.' (LEE_UK14) If the process is automated, it would not engage in net zero behaviour change and may not bring local benefits for the community, it could be simply a technological transaction that is more about saving a bit of money for those participating in the scheme. (LEE_UK14) Some communities of interest or communities of place, where people want to make lifestyle choices, have been looking at the opportunities to roll these technologies out.

At the moment P2P electricity trading in its pure form is probably a 'niche solution' (LEE_UK12, LEE_UK05). It is not perceived as particularly important, and there are many others that are probably easier and deliver more benefit. (LEE_UK12) There

has also been a realisation among those that have been involved in the trials that the model is very complex: 'In terms of the amount of benefits that you can get at the moment or the amount of electricity that has traders, the complexity just appears to be excessive relative to the benefits.' (LEE_UK01) So it looks like 'an additional layer of complexity with very little benefits.' In examples of P2P trading discussed here, there is still a need to have a contract with a licenced supplier who provides balancing and settlement services. The complexity of the billing is 'so off putting' for energy companies that many are not willing to engage in P2P projects; the transaction costs are too high for the amount of electricity that's being traded. (LEE_UK01) Arguably, the adoption of P2P electricity trading would require a fundamental revisit of system management and understanding consumer protections and the different roles and responsibilities in this model. A number of questions are to be answered about the functions that are traditionally performed by energy suppliers. If, theoretically, the trading is done by peers, without an energy supplier involved, what responsibilities and obligations would they have to each other? And how does that manifest? What happens if something goes wrong for either those peer-net relationships, what would be the backup arrangement? And what happens when there is a failure and how to ensure security of supply for those customers that are affected by it? At the moment all of those functions are with a licensed supplier: they have to forecast what the physical consumption will be and to make sure that they are in balance so that the physical system can operate on a daily basis ('they actively manage that mismatch between what is largely intermittent generation that doesn't always align with when people want to consume power'). (LEE_UK05)

Phase 3: 2020 and beyond - the uncertain future for LEE

Future potential of LEE in the context of multi-vector local energy developments

Despite the complexity and other issues, P2P electricity trading is still seen as potentially having value for future energy systems. Reforms in market arrangements (the development of DSOs and new flexibility markets) may create an environment more conducive to P2P solutions (although P2P models will have to compete alongside other solutions to DSO system/network management). There could be potential in developing P2P business models that would work at a very distributed level, where commercial enterprises do not see any way of engaging or any profit margins that would be large enough for them to engage with. In this case social innovation lies in the emergence of 'local delivery ecosystems', which involves technological and business model aspects, but also fundamentally a community engagement aspect. The community engagement side would be key for P2P to work, i.e. engaging people to trade or to be part of one trading environment. (LEE_UK01) There are also housing developments that are choosing to build microgrids rather than put all of their activities on the public network, which typically means that they are investing in onsite generation and other capabilities. So P2P can happen within microgrids; that would be at very small scale and very particular to those areas. (LEE_UK05) One way to utilise them is for providing local balancing service as part of the DSO model in the future. Potentially P2P models could have quite a significant role to play for balancing local supplier demand considerations. How they would operate – whether it is domestic or business or a mixture of both, would probably depend on local circumstances and

whether or not it is about active balancing decisions demonstrably providing a service to the grid that stops the need for grid reinforcement, or looking just to match consumption generation.

One of the questions to answer when thinking about the role that LEE, including P2P trading, will play in future energy systems, is how important local electricity is for the majority of people in the UK: '…how important is it to a consumer that that electricity comes from that particular hydro plant that's located next to them? Because for most people, if it was that important, they would have solar PV on their roof. […] In terms of where buying electricity, I don't necessarily think people care too much.' (LEE_UK12) Local energy has some economic and environmental benefits that cannot be ignored, and one of the reasons for people to support local energy is arguably the benefits for the wider community as well as individuals. But the complexity of the solutions can be seen as a burden and 'off putting', e.g. with the use of local tariff ('If the answer is that to get the local energy from one of the models is you have to be at home at 3 o'clock to turn on your dishwasher or a washing machine or otherwise you need to get the cheap benefit, then I don't think it will work longer term' (LEE_UK12)). Even the models that are showing signs to be very successful e.g. Ripple Energy and Community tariff, have limits in terms of number of people participating in those schemes.

On the other hand, from a lifestyle choice perspective, there are always going to be people that through their supplier will want to choose where they get their power from, e.g. prefer hydro over wind. Although this is not necessarily true P2P trading and a licensed supplier is involved, people would be able to decide who to procure electricity from. (LEE_UK05)

The community energy organisations across the country are searching for new solutions in order to enable and increase local electricity production, consumption and trading (ranging from new propositions for more established approaches, e.g. microgrids, to very new experimental models like P2P trading). This also means new business models, new types of collaborations and partnerships. The diversity of approaches are probably explained by the early stage of developing community energy projects in new policy and institutional context but also by the fact that communities and community projects can be quite different ('That's the whole point about community energy, is that every community is so different and that's why every community energy project is so different.' (LEE_UK12)). This also can create an issue for replicability and wider disseminations of those models: 'Everyone wants their model to be replicable. […] So people just say we're going to do it in this very specific community. Now we're going to do it across the UK. But actually that community isn't representative of the rest of the UK.' (LEE_UK12)

There is still a lot of uncertainty about the models of the future; their viability is to be proven and investments are needed for realisation of the projects. Many of these projects are being developed by community organisations which rely on volunteers and have some social goals, e.g. elevating fuel poverty in their community (e.g. WREN); they are not purely commercial propositions, and the complexities of government policy can be a serious obstacle for them.

Contestations and relations between actors
SONNET is interested in understanding interactions between SIE-field actors and/ or other field-actors. These relations can be formal or informal, take different forms (e.g. formal alliances, networks, collaborations) and might differ in their quality (e.g. conflicting, competitive, collaborative or exchange-oriented relations; Wittmayer et al. 2020b, p. 14) as well as in their content (e.g. concentrating on learning, networking, lobbying etc.). Furthermore, field contestations between SIE-field-actors and/or other field-actors are of interest as they can 'unsettle' the existing 'outside' institutional environment (Hielscher et al. 2020, p. 19). Contestations are debates among relevant actors over SIE-field structures and processes such as disagreements about common aims or approaches to lobbying policymakers. Both, contestations and relations can provide an indication of how institutionalised (or not) the SIE-field is (e.g. are there formal networks). The main contestations in LEE are happening around policy and regulatory framework. The most controversial issue is the network charges which sparks debates between those actors arguing for regulatory change (e.g. supporters of the Local Electricity Bill suggesting proportionate charges) and those who do not see it as a working mechanism considering the complexity of energy system ('if you need a connection, you have to pay your contribution' (LEE_UK07)). These debates, as well as other contestations in the SIE-field, illustrate some differences between those who ought to consider the interests of all consumers and the 'bigger picture' (actors with responsibilities beyond localities/regions e.g. operating nationally or overseeing the GB regulatory framework), and those pursuing a more 'local' agenda, e.g. in the interests of communities that have interest, capacities and resources for participating in LEE. As the SIE-field actors are very diverse, with different amounts of power and resources, it is not surprising that their views on the aims and role of LEE/P2P can differ. Some have a more market-oriented view (especially commercial actors), others see LEE as an opportunity for citizens and local communities to benefit from those initiatives (including non-financial benefits like community cohesion or elevation of fuel poverty).

'Multi-vector' developments such as smart local energy systems (SLES), emerging in response to the increasing decentralisation, digitalisation and decarbonisation of energy, are likely to have a significant impact on the wider adoption and implementation of LEE and P2P electricity trading (which can be one of the components of SLES). As described earlier in this report, the UK government provides investment for economic and industrial innovation, including funding for delivery of decarbonisation programmes and for innovative projects on smart local energy systems, mainly through Prospering From the Energy Revolution (PFER) programme (as part of Industrial Strategy Challenge Fund). There are 25 projects being explored as part of the PFER programme, including 11 concepts designs, 10 detailed designs and 4 demonstrators.[135] The Energy Revolution challenge has funded several 'game-changing' local energy demonstrators that are to illustrate how

[135] https://data.es.catapult.org.uk/dataset/2gxq1/smart-local-energy-system-composition

integrated intelligent local systems can deliver power, heat and mobility to users in new and better ways. Three large-scale demonstrator projects are now underway, and will be completed by 2023.[136] Two of them are of particular interest for implementing LEE and P2P electricity trading: (1) ReFLEX Orkney, a first-of-its-kind integrated virtual energy system linking local electricity, transport and heat networks into one system; (2) Local Energy Oxfordshire (LEO), a local energy marketplace that actively balances generation with demand for power, heat and transport, enabled by an intelligent local grid. EnergyRev,[137] a key component of PFER, argues for a smart, local, energy system approach to post-pandemic recovery, as many of the critical measures for delivering a green economic recovery require implementation at household, community, or regional scales, rather than at national scale (Fell et al. 2020).

Policies and policy making

One important cross-cutting theme addressed in SONNET are the socio-political aspects and conditions of social innovation in energy. In SONNET we are interested in identifying enabling or impeding factors and how they influence social innovation processes. This case study therefore aims for identifying important policy events and policy making processes (Wittmayer et al. 2020b, p. 43). This includes asking about broader political debates, the role of different government levels involved in policy making, particular policy strategies and instruments used and how they enable or impede the development of SIEs.

At the EU level, the desire is to have an open regulatory field that does not hinder the development of new technologies (Soest 2018). The analysis of the legal position of P2P electricity trading within EU energy law suggests that, since there are no specific regulations regarding P2P electricity trading, 'European energy law is likely to allow P2P electricity trading', but pilot projects may be 'stymied by unclarified regulatory issues', e.g. the allocation of balancing responsibilities (ibid.). Over time a more direct regulation of P2P electricity trading is needed, taking into account the wider context (P2P electricity trading as part of the broader collaborative economy movement; it interacts with some parallel technological developments, e.g. blockchain or energy storage) (ibid.).

[136] https://www.ukri.org/our-work/our-main-fu nds/industrial-strategy-challenge-fund/clean-growth/prospering-from-the-energy-revolution-challenge/

[137] The Energy Revolution Research Consortium (EnergyREV) is made up of more than 60 researchers from 22 UK universities, working together to tackle challenges around smart local energy systems from an interdisciplinary and whole-systems viewpoint. It is one of the three key components of the UK Industrial Strategy Challenge Fund's Prospering from the Energy Revolution (PFER) programme. Its multidisciplinary approach and strong links with industry, policy and the wider local energy community make EnergyREV one of the most significant international academic programmes delivering research to accelerate the uptake, value and impact of SLES.

In relation to national contexts for P2P electricity trading and market potential, the attention is also driven to policy and regulation seeing it as an impeding factor for the development of the field – it is argued that 'the main threat concerns the legal framework in most countries' although this issue will be eventually resolved (Sousa et al. 2019).

In the UK the views on policy and regulatory context for local electricity exchange are polarised. Some emphasise the complexity and uncertainty, others see it as 'advanced' and open to innovation compared with other European countries. The regulatory framework is built around the 'supplier hub model'. The implementation of new models like P2P trading at a bigger scale would have significant implications for the way in which the electricity system is organised; it challenges the whole idea of what the role of a supplier is in a new arrangement (LEE_UK05).

The proposed changes for the regulatory framework (P379 – multiple supplier proposition) will allow customers to buy energy from more than one supplier, creating opportunities for more local electricity exchange schemes to come to market. Another proposal, although more controversial and contested by some, is the Local Electricity Bill which aims to empower communities to sell their energy directly to local people. The anticipated changes in policy and regulatory framework have a potential to empower SIE-field actors, alter the power balance in the SIE-field, and change how the electricity system operates in GB.

The development of LEE and P2P trading is also affected by a broader policy e.g. changes in subsidy schemes for small-scale renewables or changing policy discourse that shifted from community energy to local energy.

Policy framework and proposed legislative changes

In this case study the views on policy and regulatory context for LEE in the UK are quite polarised. Some characterise it as complex and uncertain which is the biggest barrier for the field development. (LEE_UK14) Others think that the UK has a 'facilitatory environment' and quite advanced policy, with Ofgem recognising that changes are coming and being 'very open thinking' about innovation in the sector (e.g. the sandbox trials) (LEE_UK08), and the government providing funding for new innovative projects (e.g. Industrial Strategy Challenge Fund).

At the moment the whole regulatory framework is built around the idea of big generators, networks that deliver energy, suppliers that sell it and consumers that consume it. So the only functions that are recognised in law are generation, supply, transmission and distribution. If models like P2P trading happen at scale, then that would have significant implications for the way in which the electricity system is organised, and it challenges the whole idea of what the role of a supplier is in a new arrangement. (LEE_UK05)

When discussing proposed changes, it is important to bear in mind the question about what benefits the changes can bring, what problems they can solve that the current arrangements do not. Within the context of the existing regulatory regime, more local electricity exchange activities could bring significant benefits for the transition to distributed system operation (DNOs to DSOs) and their expectation of whole system thinking at a local level: 'I could see that there's a market framework that emerges that peer to peer would naturally move into.' (LEE_UK05) However, if the government decides to bring e.g. P2P electricity trading as a fundamental design feature, it would require legislative change.

One of the most important initiatives introduced recently is probably the *Local Electricity Bill* which is supposed to enable electricity generators to become local electricity suppliers. A non-for-profit organisation, Power for People[138] drafted the Local Electricity Bill with the aims to empower communities to sell their energy directly to local people. This is a Private Members' Bill and was introduced to Parliament on Wednesday 10 June 2020 (1st reading, House of Commons).[139] The next stage for this Bill, second reading, is scheduled to take place on Friday 29 January 2021. It is estimated that it would probably take 18-24 months from now for the Bill to become law, and at least 12 months for its implementation. So far, the Bill has gained the support of a cross-party group of 208 MPs[140] (210 at the time of data collection). The problem that the Bill is trying to address is 'unfair' regulations and 'hugely disproportionate costs' that are arguably blocking the potential for community renewable energy to benefit local economies.

The main proposition is that 'the costs and complexity of being able to sell locally generated energy to local people need to be made proportionate to the size of the local energy co-operative's or business's operation.' If made law, it would give electricity generators the right to become local suppliers – i.e. sell their energy directly to local people – and make it financially viable to do so. The Bill gives the task of setting this new mechanism up to Ofgem.[141] It is argued that because of climate emergency there is a need for both types of actors, big developers and local community initiatives/projects. There is a huge potential for renewable energy at a smaller scale owned by local communities, there are around 500 community groups in the UK. The Bill could make more projects viable bringing more money for local economy and benefit communities directly. It is also suggested that local generation can make the whole energy system more efficient. As one of the arguments the historical example of energy system is used: in late 19th – early 20th century in GB the electricity system was built around municipal energy companies. (LEE_UK13)

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138 Power for People is a not-for-profit organisation, campaigning for the UK to rapidly transition to 100% clean energy and for this to benefit local economies https://powerforpeople.org.uk/about/

139 https://services.parliament.uk/Bills/2019-21/localelectricity.html

140 https://powerforpeople.org.uk/the-local-electricity-bill/

141 https://powerforpeople.org.uk/the-local-electricity-bill/

The supporters of the Bill include 60 county authorities and local authorities, Green Peace, trade associations such as British Hydropower association, Renewable Energy association, Solar trade association, Good Energy, Church of England, and many community groups (300 signed up), individuals lobbying their local MPs, 300 parish town councils, Chamber of Commerce. The Bill is welcomed by Community Energy England who are supporting the initiative and provided early insight into the Bill, which started off as a Community Energy Bill, but they would like to see 'more community embedded within there as the Bill progresses'; in terms of delivering real change its effectiveness is questioned ('we are supporting with certain caveats … more details are needed' (LEE_UK14)). The Bill could potentially enable much more local supply. Co-op Energy, who are tasked with growing renewable community energy projects, have not actively supported the Bill, because it does not mention renewable energy and it does not mention community energy explicitly. For them the concern is also that it may open the way for lots of diesel generators. In response to such concerns, Power for People ensures that 'any loophole is closed', and that it is 'categorically clear that we want to promote renewable energy, and renewable energy only.' (LEE_UK13) In its current state the Bill is only the first version and there will be amendments.

The Bill is also criticised for a lack of detail: it is not clear how it would operate, apart from saying that an obligation is put on Ofgem to develop a local supply framework; it would require the regulator arguably to introduce a new type of license for local generators. In response to that, the campaigners admit that the Bill is not rigid on the exact mechanism right now, as the aim is 'to unblock that massive potential for new renewable energy generation at community scale.' (LEE_UK13)

Another consideration is related to protection of customers. There are a lot of requirements in the license about the way that suppliers are expected to behave in their interactions with consumers, be there vulnerable consumers or other consumers. In case of changing the rules around licensing these might be reduced/affected. Besides, there is already a supply licence exemptions regime which might provide the basis of a route to market envisaged by the Bill's authors.[142] (LEE_UK05)

A potential novelty that would have a significant impact on local electricity exchange is Multiple supplier proposition (P379). The current market rules and structures were designed on the basis of consumers buying energy from (or selling energy to) a single retail supplier (Elexon 2018). Elexon's White Paper 2018 proposed that ELEXON's Supplier Volume Allocation (SVA) arrangements should be changed to recognise the right of customers to buy electricity from (or sell electricity to) other parties (not necessarily licensed suppliers). This is in addition to their 'main' or 'default' Supplier, who would continue to be responsible for metering and data collection/data aggregation activities under the BSC.

BSC Modification Proposal: P379 (Enabling consumers to buy and sell electricity from/to multiple providers through Meter Splitting) which is undergoing the assessment procedure, was raised by New Anglia Energy, a new BSC entrant, with support from a range of BSC Trading Parties including OVO Energy and Cooperative Energy, and non-BSC parties including Powervault

[142] It is worth noting that BEIS launched a call for evidence about the electricity exemptions regime which is likely to inform a future review. Deadline for submissions is 1 March 2021. https://www.gov.uk/guidance/electricity-licence-exemptions

and Verv.'[143] If this proposition comes through, it would mean that customers can buy energy from more than one supply business, and it might allow more local electricity exchange schemes to come to market (could have consumers getting main power from e.g. EDF but also getting extra power from a local scheme that involves platforms optimising trade between them; EDF would sit there in the background to deal with the big top ups).

The policy view on energy and net zero future in the latest Energy white paper includes the elements that can enable the development of local energy. In the Energy white paper: Powering our net zero future (2020)[144] the UK Government talks about smart technologies unlocking new opportunities to give consumers more control, choice and flexibility over their energy use and help engage in the market (Smarter, Cleaner Energy for all Consumers), as well as innovation and new business models (Green Finance and Innovation). The confirmed commitment to smart meters as part of an essential infrastructure upgrade would enable consumers to access innovative solutions such as smart tariffs, including 'time of use' tariffs, which also proved to be a requirement for local electricity exchange/P2P models. The policy document also highlights the Government's commitment to assessing market framework changes that may be required to facilitate the development and uptake of innovative tariffs and products that work for consumers and contribute to net zero. The leading role of LAs in delivering programmes that support decarbonisation, as well as smart local energy systems, are also mentioned as supported by Government who 'will continue to work with communities to enable projects to be tailored and delivered to meet local needs' (BEIS 2020).

Institutional work conducted by SIE-field actors and other field-actors
SONNET investigates how SIE-initiatives, SIE-field-actors and other field-actors 'perform institutional work – meaning they engage in creating, maintaining and transforming institutions to be able to work on, enable and/or impede SIE developments' (Hielscher et al. 2020, p. 20). This analytical focus emphasises that institutional changes are actively influenced by actors within the field (Wittmayer et al. 2020b, p. 31). The term 'institutional work' refers to these activities of creating, maintaining and transforming institutions, and can include diverse types of institutional work, such as material, relational and symbolic work. There is a belief that some degree of decentralisation is inevitable, and local energy supply and LEE mechanisms could play a key role in these processes. Such energy decentralisation is often strongly correlated with institutional change (Judson et al 2020). As LEE/P2P is still a nascent field, the SIE-field actors are actively involved in institutional work trying to shape the practices around LEE and to influence the design and operational principles of the future electricity system.

[143] https://www.elexon.co.uk/mod-proposal/p379/

[144] BEIS (14 December 2020) Energy white paper: Powering our net zero future (2020) sets out how the UK will clean up its energy system and reach net zero emissions by 2050; it builds on the Prime Minister's Ten Point Plan for a Green Industrial Revolution https://www.gov.uk/government/publications/energy-white-paper-powering-our-net-zero-future

One of the most important types of institutional work within the SIE-field under study are the various forms of advocacy, lobbying, and pressure deployed by SIE-field actors in attempts to shape the positions adopted by national government and regulatory bodies. This is related first of all to changing the existing policy and regulatory framework that would potentially enable LEE and P2P electricity trading. One of them is the Local Electricity Bill. Despite some criticism, it is supported by numerous stakeholders including local authorities, Greenpeace, Chamber of Commerce, trade associations, Good Energy, Church of England, community groups and individuals lobbying their local MPs; the Bill is welcomed by Community Energy England who is supporting the initiative and provided early insight. Another initiative that is lobbied by actors in the field is the Multiple supplier proposition which would change the current 'supplier hub' model and the way the electricity system operates.

One potential sign of institutionalisation of the SIE-field would be replicability and dissemination of models that at the moment are often represented by stand-alone projects developed in particular community/locality. 'Everyone wants their model to be replicable. I think maybe sometimes maybe that's an issue. So people just say we're going to do it in this very specific community. Now we're going to do it across the UK. But actually that community isn't representative of the rest of the UK.' (LEE_UK12) There are attempts to achieve wider adoption of particular approaches to organising LEE. For example, Energy Local initiatives are trying to set up clubs and use the model in different parts of the country. Trial projects is another way to test innovative approaches in order to find a working proposition.

The state can also be an 'institutional entrepreneur' suggesting/supporting the novel approaches to energy, e.g. local energy market concept and smart local energy communities. The state as the most powerful actor has resources to implement its agenda by mobilising other actors and through funding and other policy mechanisms.

6 Summary, synthesis and conclusions

6.1 How do SIEs and SIE-fields emerge, develop and institutionalise over time?

Over the past ten years, the design principle of GB energy system has been challenged with the rapid roll-out of decentralised generation. At the beginning of the period covered in this study (2015/2016), the supply market saw a number of new entrants including the community energy sector and municipal energy companies. Many of them were interested in local supply and distribution of electricity or had it as part of their proposition. At the same time the idea of P2P electricity trading started getting its practical implementation.

Although LEE (and P2P electricity trading) is at the early stage of development and has a relatively short history, there have been a number of examples of successful projects and trials across the country that represent different models and innovative approaches to LEE. In the recent years there have been two trends in the (local) electricity exchange field: (1) solutions/propositions that would work within the existing regulatory framework (e.g. Energy Local, Smart Fintry, WREN, Ripple Energy), where two approaches can be found – community energy e.g. WREN, and 'citizen energy' e.g. Ripple; (2) to experiment with new models using sandbox mechanism supported by Ofgem granting 'exemption' from current electricity market rules (Ofgem Sandbox P2P trials, e.g. Repowering London).

The SIE-field is characterised by technological change (e.g. blockchain technology) and a reconfiguration of social relations. This suggests a growing role for non-traditional actors in the electricity market such as local authorities, community groups and citizens/prosumers, but is also affected by changing roles of some traditional actors in the electricity market (e.g. DNOs turning into DSOs). The emergence of new (multi-actor) alliances as a result of increased collaboration involving the public, private and community angles is one of the main characteristics of the SIE-field. The boundaries of the field are being actively negotiated and re-drawn as new actors entering the scene and forming partnerships with more traditional players (e.g. DNOs, utilities or local authorities) and newcomers (technology companies such as digital platform providers). As a result, new propositions for local/regional production, distribution and trading of electricity are being discussed, tested and in some cases implemented. However, different categories of actors may attribute different meanings and values to emerging practices around LEE.

6.2 How do SIE-field-actors and other field-actors interact with the 'outside' institutional environment and thereby co-shape the SIE-field over time?

The 'outside' institutional environment is characterised by the changing energy mix in the UK and the evolving energy system that include a growing number of distributed sources of electricity generation. In the energy system the fundamental changes include: the liberalisation of the electricity system; the need to decarbonise the electricity system as a result of climate change; the growing deployment of renewable energy technologies as costs have fallen. Besides, LEE and particularly P2P electricity trading are instigated by technological developments – enabling technologies such as smart meters and blockchain technologies have opened up possibilities for new business models. These changes lead to 'a renewed interest in the local context' and local energy supply/consumption.

The energy policy, e.g. the electricity market reform in GB, and transition to smarter electricity system, have a direct impact on development of LEE and P2P electricity trading. The reforms result in changing the governance arrangements for the electricity system (e.g. the shift from Distribution Network Operators to Distribution System Operators, a transition to a more complex, systemic model that accounts for and manages multiple points of variable supply and consumption). Local energy markets and smart local energy communities emerging in response to the increasing decentralisation, digitalisation

and decarbonisation of energy, can also have a significant impact on the wider adoption and implementation of LEE and P2P electricity trading. Other policies e.g. the closure of the FiT scheme also influenced developments in the SIE-field – as a result, prosumers and community energy groups are more actively searching for new business models, also exploring opportunities around LEE and P2P electricity trading.

LEE as a SIE-field under study is closely linked with a community energy phenomenon. The community energy organisations across the country are searching for new solutions in order to enable and increase local electricity production, consumption and trading (ranging from new propositions for more established approaches e.g. microgrids to very new experimental models like P2P trading). This also means new types of collaborations and partnerships (e.g. with licenced suppliers) for delivering LEE schemes.

6.3 What are the enabling and impeding factors for SIE-field-actors and other field-actors to conduct institutional work and change the 'outside' institutional environment?

The UK is considered as an advanced market for energy prosumers (Brown et al. 2019), with the policy context which is conducive to innovation. At the same time, the current regulatory framework for the electricity market in GB that is built around the 'supplier hub model' is often characterised as an obstacle/impeding factor.

Lobbying activities for particular policy and regulatory changes are taking place and are supported by different types of actors and their alliances (e.g. the Local Electricity Bill, Ofgem regulations or codes for electricity market in the UK). The proposed changes for the regulatory framework (P379 – multiple supplier proposition) will allow customers buy energy from more than one supplier, creating opportunities for more local electricity exchange schemes to come to market. Another proposal, although more controversial and contested by some, is the Local Electricity Bill which aims to empower communities to sell their energy directly to local people. The anticipated changes in policy and regulatory framework have a potential to empower SIE-field actors, alter the power balance in the field, and change how the electricity system operates in GB.

The development of LEE and P2P trading is also affected by broader policy e.g. changes in subsidy schemes for small-scale renewables or changing policy discourse that shifted from community energy to local energy – both being enabling rather than impeding factors for the development of the SIE-field.

The innovation such as distributed ledger technologies (blockchain) is a key element and an enabler for P2P electricity trading mechanism and LEE. Smart metering is seen as a step-change for the energy industry overall and is a necessary element of LEE and P2P electricity trading. The rollout of smart meters that started in Autumn 2015 enables the use of real-time energy consumption data, which helps link consumption directly with generation and can change the way energy tariffs are

structured. At the same time, the complexity of some technologies that can enable P2P electricity trading (e.g. virtual platforms) could be an obstacle for wider adoption, particularly by domestic consumers.

'Multi-vector' developments such as smart local energy systems, emerging in response to the increasing decentralisation, digitalisation and decarbonisation of energy, are likely to have a significant impact on the wider adoption and implementation of LEE and P2P electricity trading (which can be one of the components of those systems). The UK government provides investment for economic and industrial innovation, including funding for delivery of decarbonisation programmes and for innovative projects on smart local energy systems. If a smart, local, energy system approach is adopted as part of the programme for post-pandemic recovery, it can stimulate the growth of LEE.

7 Recommendations for our city partners, national and EU policy makers and SIE practitioners

SONNET city partners /local authorities:

- Entering highly risky and competitive electricity markets means competing with established and resourceful players. Local authorities should carefully assess and appreciate those risks. The involvement in big commercial projects, which are beyond traditional area of expertise of local authorities, needs to be carefully assessed. This is particularly important in the current circumstances when council budgets are hit hard by the impact of the pandemic.
- Local authorities could be more active in developing and implementing/experimenting with different models of local energy exchange, including procurement of locally generated renewable energy. Local authorities could use assets, council–owned buildings and land to develop and implement local electricity exchange and peer-to-peer electricity trading (e.g. test innovation with social housing). However, a careful assessment of available resources and expertise is needed for developing local electricity exchange schemes and local energy markets.
- It is crucial to gain public support for new energy-related initiatives. This means that local authorities should carefully assess suitability of particular local electricity exchange models for particular communities as they might require a different degree of commitment and involvement of citizens (the level of community cohesion, members interest and motivation; the presence of support organisations); this would also depend on available partnerships, opportunities to attract investments and existing community energy initiatives that could provide grounds for local electricity exchange and peer-to-peer electricity trading in a particular locale.
- Local authorities should explore new forms of partnership and cooperate with different types of actors, e.g. look to community energy partnerships for innovation, expertise and greater social impact, work together to create long–term local energy strategies that would allow incorporate local electricity exchange and smart energy communities elements. Local authorities can potentially consolidate community energy projects in the area with interest in peer-to-peer or local electricity exchange (good arena for testing new local electricity exchange models) bringing

collaboration together, but letting community groups lead on it (local authorities need to 'drive' and help shape it rather than own it). Local authorities need also to work in partnerships with trade associations e.g. Community Energy South or Community Energy England, and local businesses.

National policy makers:

- For implementing local energy markets and smart energy communities as part of local energy agenda more widely, the government should develop guidance which would be flexible enough/adaptable to localities' needs, resources, and a range of potential stakeholders.
- If the government wants to encourage local electricity exchange as part of the local energy agenda, actors with less resources, e.g. local authorities, are more at risk and would need more certainty and government support. Local authorities are in a better position to understand the needs of their localities and communities. Some local authorities have started developing and implementing local electricity exchange in their cities/regions (usually those who set 2030 net zero carbon targets). More delegated power and resources to local authorities would help implement the existing strategies and encourage other local authorities to explore local energy market opportunities (including local electricity exchange/peer-to-peer models).
- There is a need for a coherent policy and regulatory framework for promoting activities in relation to local energy and local electricity exchange, as part of a reform of the electricity system and market. The changes should be introduced with caution with a careful consideration of the interests of all stakeholders; the UK experience with 'trials before change' is a welcome regulatory approach.
- The changes to the regulatory framework that would have a significant impact on enabling local energy markets and local electricity exchange beyond single experimental projects are those that would allow multiple energy suppliers to provide power to domestic and business customers, and the revision of electricity network charges towards more flexible models.

SIE-field-actors:

- Local electricity exchange, local energy markets and peer-to-peer trading rely on multi-actor collaborations. For most community actors and local authorities partnerships with energy supply companies and Distribution System Operators would be essential for implementing local electricity exchange models.
- The new arrangements for electricity exchange/trading have a potential for changing the power relations between actors in the electricity market. It is likely that power will be concentrated in the hands of technology companies (providers of trading platforms) and large players (e.g. Distribution System Operators). This also raises a question of governance and policy framework for an emerging phenomenon embedded in a highly regulated field (electricity system).
- There is a potential tension/contradiction between the idea of local electricity exchange and local energy markets on one hand, and a peer-to-peer electricity trading model on the other, in terms of geographical boundaries for

services, as in its pure form peer-to-peer electricity trading is based on the use of digital tools/platforms which normally do not restrict trading by locality.

- There is a need for flexibility in design and implementation of local electricity exchange for a particular community/locale. There is probably no 'one size fits all' model, considering the diversity of approaches and different models representing local electricity exchange and peer-to-peer electricity trading at the moment.
- For the projects that have been implemented or are undergoing trials there is still an issue of replicability and scale. It is uncertain which models/approaches will be most successful and more widely adopted.
- It is not very clear yet if there is enough interest among domestic consumers/prosumers and communities in local electricity exchange. Peer-to-peer electricity trading seems to be a 'niche' solution, at least in the nearest future.

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9 Annex 1

Methodology

In the UK the research started with exploring 'local P2P electricity exchange' for domestic energy consumption as the foci of the case study. As it became apparent that there is no working P2P electricity exchange/trading models and P2P markets in the UK (except for a few trials), the boundaries of the study were expanded by including SIE-initiatives connected to the national grid that claim to have some elements of local P2P electricity trading or to be representative of local electricity exchange. Local electricity exchange as a broader concept allows including some of the innovative approaches that aim to match local renewable energy generation with local consumption.

As the SIE-field, local electricity exchange, and its core component, peer-to-peer electricity trading, are very new phenomena, the historical account of the SIE-field's development focused more on the last five-six years, when the most noticeable and illustrative initiatives happened, as well as the policy changes relevant for this case study.

There are certain limitations to this case study due to a limited number of interviewees and types of actors they represent, documents and online resources that could be accessed and reviewed, and the timeframe for conducting the research. Another factor is a limited empirical base – there is still a lack of initiatives in the UK that would fit the adopted definition of SIE-field; it was not always possible to gain access to existing SIE-initiatives.

Overall, 15 in-depth interviews with 16 participants were conducted during the period September-November 2020. Pre-existing contacts were used to recruit the first few interviewees. A snowballing technique allowed to expand the contact base; online search also helped identify relevant organisations/people who presumably are/represent key SIE-field actors (e.g. through LinkedIn). A diverse range of interviewees include the following categories: representatives of the community energy sector (community groups and trade organisations), a regulator (Ofgem), researchers, industry experts, intermediaries, an energy company, a distribution network operator, a non-for-profit organisation. The first several interviews were rather exploratory and helped identify relevant actors and define the boundaries of the SIE-field.

The opportunities to conduct face-to-face observations were limited due to Covid-19 restrictions. Two online events/webinars organised by intermediary organisations were attended.

The review covered different types of documents: research papers, projects reports, policy documents, official regulator's documentation, companies' reports, press/media, news releases. For the document review, a search was conducted online. Some documents were shared or pointed to by the interviewees. Much of the historical narrative of the field has derived from studying and analysing the numerous websites (e.g. UK Government, Ofgem, Elexon, EnRev, energy projects websites).

The academic literature search was also conducted online using e.g. GoogleScholar, ScienceDirect with several search terms (e.g. peer-to-peer trading, local electricity exchange/trading, electricity market, local energy, smart energy communities). The review of the recent academic social science energy literature helped better understand the key terms, the underlying mechanisms of LEE and P2P trading and the features of particular models/initiatives. Some of the key documents are listed in the table below.

Documents reviewed

Author name	Document name	Document type	Year	Link to reference
BEIS	Energy white paper: Powering our net zero future.	Policy white paper	2020	https://www.gov.uk/government/publications/energy-white-paper-powering-our-net-zero-future
Brown D. et al.	Policies for Prosumer Business Models in the EU. Deliverable 4.2 of the Horizon 2020 PROSEU project (H2020-LCE-2017)	Project report	2020	https://proseu.eu/sites/default/files/Resources/PROSEU_Task%204.2_Policy%20for%20Prosumer%20Business%20models%20in%20the%20EU.pdf
Community Energy England	Community Energy. State of the Sector 2020	Report	2020	https://communityenergyengland.org/pages/state-of-the-sector
Energy Systems Catapult	The policy and regulatory context for new Local Energy Markets. ERIS Elective		2019	https://es.catapult.org.uk/news/the-policy-and-regulatory-context-for-new-local-energy-markets/
ELEXON	Enabling customers to buy power from multiple providers	White paper	2018	https://www.elexon.co.uk/wp-content/uploads/2018/04/ELEXON-White-Paper-Enabling-customers-to-buy-power-from-multiple-providers.pdf
Power for People	The Local Electricity Bill	Bill	2020	https://services.parliament.uk/Bills/2019-21/localelectricity.html
Ofgem	Enabling trials through the regulatory sandbox		2018	https://www.ofgem.gov.uk/system/files/docs/2019/02/enabling_trials_through_the_regulatory_sandbox.pdf
Ofgem	Innovation Sandbox Service – Overview	Guidance	2020	https://www.ofgem.gov.uk/publications-and-updates/innovation-sandbox-service-overview
Ofgem	Ofgem. Innovation Sandbox Service – Overview			https://www.ofgem.gov.uk/system/files/docs/2020/02/sandbox_service_overview.pdf
Ofgem	Guidance: Selling Electricity to Consumers: What Are Your Options?	Guidance	2020	https://www.ofgem.gov.uk/system/files/docs/2020/02/selling_energy_to_consumers_what_are_your_options_feb_2020_final_v0.23.pdf
Ofgem	Insights from running the regulatory sandbox		2018	https://www.ofgem.gov.uk/system/files/docs/2018/10/insights_from_running_the_regulatory_sandbox.pdf

ELEXON	P379 Enabling consumers to buy and sell electricity from/to multiple providers through Meter Splitting			https://www.elexon.co.uk/documents/change/modifications/p351-p400/p379-proposal-form/
UKPN	UK Power Networks response to A smart, flexible energy system		2017	https://www.ukpowernetworks.co.uk/internet/asset/ba4cec71-0970-4ac2-a8bf-99c2100473eb/UK%20Power%20Networks%20_A_Smart_Flexible_Energy_system_A_call_for_evidence_response_%20final.pdf

List of interviewees

Code interview	Empirical description of case	Type of actor according to SONNET	Date of interview	Duration of interview	Interviewer
LEE_UK01	Researcher and co-director of community energy organisation	SIE-field actor	11.09.20	00:53:14	Marfuga Iskandarova
LEE_UK02	DNO	SIE-field actor	17.09.20	00:51:46	Marfuga Iskandarova
LEE_UK03*	Researcher	Other field actor	23.09.20		Marfuga Iskandarova
LEE_UK04*	Researcher	Other field actor	23.09.20		Marfuga Iskandarova
LEE_UK05	Innovation Link Consumers & Markets, Ofgem	SIE-field actor	24.09.20	1:00:03	Marfuga Iskandarova
LEE_UK06	Energy company	SIE-field actor	29.09.20	1:08:55	Marfuga Iskandarova
LEE_UK07	Lead engineer and research manager (Centrica); Founder of non-profit organisation	SIE-field actor	30.09.20	1:06:00	Marfuga Iskandarova
LEE_UK08	Researcher	SIE-field actor	1.10.20		Marfuga Iskandarova
LEE_UK09	Community Energy South	SIE-field actor/ SIE-initiative	2.10.20	1:03:00	Marfuga Iskandarova
LEE_UK10	Researcher	Other field actor	6.10.20	56:37	Marfuga Iskandarova
LEE_UK11	Wadebridge Renewable Energy Network	SIE-initiative	7.10.20	1:00:42	Marfuga Iskandarova
LEE_UK12	Coop Community Energy	SIE-field actor/ SIE-initiative	15.10.20	1:06:03	Marfuga Iskandarova
LEE_UK13	Climate Change campaigning organisation	SIE-field actor	2.10.20	50:10	Marfuga Iskandarova

LEE_UK14	Community Energy England	SIE-field actor	20.10.20	34:00	Marfuga Iskandarova
LEE_UK15	Lockleaze Loves Solar, Team member	SIE-initiative	02.11.20	1:48:00 (WP2 & WP3)	Marfuga Iskandarova
LEE_UK16	Bristol Energy company	Other field actor	28.09.20	59:44 (WP2 & WP3)	Marfuga Iskandarova

*Note: joint interview (LEE_UK03, LEE_UK04)

List of meetings and events attended

Event name	Event organiser (name or description)	Type of event	Date of event	Who attended
Open Networks | Flexibility Consultation Webinar 1	Intermediary organisation /Energy Network Association	Online webinar	26.08.2020	Marfuga Iskandarova
Fighting for Local Power: how a UK Bill seeks to support local energy producers	Intermediary organisation/SONNET partners	Online webinar	15.09.2020	Marfuga Iskandarova

10 Annex 2

Detailed SIE-field timeline

DATE	TYPE OF EVENT	DESCRIPTION OF EVENT	SOURCE e.g. document, interviewee (D, I)
2008	Policy	Energy Act 2008 made provision in relation to electricity generated from renewable sources; provision relating to electricity transmission; provision about payments to small-scale generators of low-carbon electricity, among others	D
2010	Policy/subsidy	Feed in Tariff took effect in April 2010 The FIT scheme was available for installations up to a capacity of 5MW (or 2kW for CHP): Solar photovoltaic (solar PV), Wind, Micro combined heat and power (CHP), Hydro, Anaerobic digestion (AD).	I, D
2013	Community Energy	Community Energy South was established in 2013 as an umbrella organisation and regional hub enabling its members (local community energy groups and community organisations) to grow as sustainable low carbon businesses in the South East of England.	I, D
2013	Policy/funding	Rural Community Energy Fund was launched in June 2013 with funding through the Department for Environment, Food and Rural Affairs (Defra), and the Department of Energy and Climate Change	D
2014	Policy/funding	Urban Community Energy Fund was launched in November 2014 with government funding through DECC, and is administered by CSE and Pure Leapfrog; set up to complement RCEF ensuring that every community in England can access support for renewable energy projects.	D
2014	Policy	In 2014, the UK government published the first ever Community Energy Strategy, which presented a decentralised vision of energy transitions in	I, D

		which communities would play a leading role; DECC Community Energy Unit was set up.	
2014	Community Energy	Community Energy England was established in 2014 as a not for profit organisation, set up to provide a voice for the community energy sector and help create the conditions within which community energy can flourish.	D
2014	Industry	OVO Communities programme	D
2015	Industry	Piclo was launched on 1st October 2015. For the first time, business consumers like Eden Project could buy their electricity directly from the source. The trial was a collaboration between innovative technology company Open Utility and 100% renewable energy supplier Good Energy.	D
2015	Industry/LAs	First local authority-led energy supplier in the UK since nationalisation in 1948 was Fairerpower that was set up in March 2015 by Cheshire East Council as a 'White Label' supplier	D
2016	Industry/LAs	Launch of municipally-owned energy supply companies – Robin Hood Energy and Bristol Energy	I, D
2016	Community Energy	First Energy Local Club started in a small town called Bethesda, in North Wales back in 2016.	I, D
2016	Community Energy	SMART Fintry project was launched (2 years); aims to demonstrate a simple, low risk and replicable local energy economy that links local, sustainable generation with consumption	D
2016	Policy/Innovation	Innovation Link (Ofgem) was launched December 2016	I, D
2017	Policy/funding	The BEIS Local Energy programme has been set-up to support the development of local energy projects. The BEIS Local Energy Team was established to support LEPs and local authorities in England to play a leading role in delivering low-carbon economic growth. As part of the Local Energy Programme £1.6 million allocated in 2017 to support LEPs	D

		across England to develop an energy strategy for the local area; launched Local Energy Hubs.	
2017	Industry	UK Power Networks response to a smart, flexible energy system announced transition from DNO to DSO: DNOs must become DSOs and lead the transition to a smart, flexible energy system	I, D
2017	Policy & funding	UK Industrial Strategy set out Grand Challenges to put the UK at the forefront of the industries of the future (Clean Growth, through low carbon technologies and the efficient use of resources; smart energy). As an outcome Industrial Strategy Challenge Fund was set (Prospering from an energy revolution programme)	D
2017	Policy	Local Energy Hubs was set up to support LEPs and local authorities in delivering low-carbon economic growth. Since 2017, with the publication of a new UK Industrial Strategy, LE has evolved into support for 'smart local energy systems', characterised by digitalisation of information sharing and a holistic approach integrating heat and power generation, distribution, storage and consumption, as well as mobilities	D
2017	Industry	Cornwall Local Energy market project launched	I, D
2017	Policy/Innovation	First Ofgem sandbox award	I
2017	Policy	Energy Strategy Support for Local Enterprise Partnerships	I, D
2017-2018	Industry	Electricity Supply License Lite was granted to the Greater London Authorities by Ofgem in December 2017; the project started operation on 1 January 2018	D
2018	Community Energy/Policy enabled	In April 2018, Verv, Repowering and Centrica conducted the UK's first peer-to-peer trade of energy on blockchain technology (Sandbox trial – proof of concept)	I, D
2019	Policy/subsidy	FiT has seen significant reductions since launch. The scheme was closed to new applicants in April 2019	

2019	Industry	Global Observatory on P2P launched	I, D
2019	Policy/funding	Industrial Strategy Challenge Fund 'Prospering from the Energy Revolution' programme to unlock the potential of intelligent local energy systems (Innovate UK). Demonstrators/showcase projects: Project Leo (Local Energy Oxfordshire), The Energy Superhub Oxford, ReFLEX Orkney, Smart Hub SLES.	I, D
2019	Policy	UK becomes first major economy to pass net zero emissions law. New target will require the UK to bring all greenhouse gas emissions to net zero by 2050. Meeting this target will require significant decarbonisation and an increased demand upon the electricity network.	D
2019	Community Energy/Industry	Local Energy Oxfordshire project started. LEO is one of the most ambitious, wide-ranging, innovative, and holistic smart grid trials in the UK; it will improve an understanding of the transition to a smarter, flexible electricity system and how households, businesses and communities can realise its benefits.	D
2020	Policy	Smart Export Guarantee, a replacement of FiT, started in Jan 2020	D
2020	Regulation	P379 – multiple supplier proposition (under assessment)	I, D
2020	Policy/campaign	The Local Electricity Bill was introduced to the Parliament in June 2020	I, D
2020	Policy	Government's Build Back Greener Plan – November 2020	D