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Value for Money: Local Authority Action on Clean Energy for Net Zero

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Abstract: Local authorities are well placed to realise co-benefits of integrated local energy systems; however, in the UK they have no statutory energy mandate. Planning and developing clean energy are discretionary, and persistent budget reductions, combined with the lack of strategic direction from the UK government for more localised energy provision, limit local capacity, expertise and resources. Nevertheless, some local authorities have led energy initiatives but have been unable to stimulate investment at the pace and scale required to align with net zero greenhouse gas targets. Using evidence from such initiatives, this paper discusses the institutional changes needed to enable local authorities to act. It examines existing climate and local energy plans, and their integral socio-economic value. Using this evidence, investment opportunities from locally led net zero programmes are identified. EU technical assistance funds provided a particularly successful route to local energy developments: based on value of investment secured against initial funding, it is estimated that GBP 1 million technical assistance funding to every local authority would lead to GBP 15 billion investment in local energy. Other potential funding innovations are assessed and the paper concludes with recommendations for policy and resource measures needed to convert local ambition into clean energy and energy saving investment at scale.

Keywords: social value; local authority; integrated local energy systems; net zero energy; innovative governance

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1. Introduction

In accordance with the international Paris Agreement, the UK has made a legal commitment to net zero greenhouse gas emissions by 2050. Whilst net zero is all encompassing across sectors and scales to include forests, soils, peatlands, food production, waste and water, clean energy is integral to net zero targets. This requires ending societal dependence on fossil fuels, which are a major contributor to emissions. To date, most progress has been made in decarbonising electricity; urgent action is needed to decarbonise transport and heat and to develop new forms of energy storage. In addition, there is potential for integrating these at local scale to maximise flexibility and use of locally available energy sources. Local authorities are likely to be crucial civic actors in such integration. They have relevant powers and responsibilities for local transport, spatial planning, building controls, social housing and energy efficiency. There is also political appetite for change, with over 75 percent of UK local authorities declaring a climate emergency since 2018 [1,2]. A key field of local authority action is therefore the planning and development of integrated local energy systems, which is the central focus of this paper.

Action to mitigate climate change through transition to clean energy yields multiple benefits—or 'co-benefits'—including the potential for enhanced economic and political empowerment, improved health and wellbeing, access to skills and development opportunities and increased social inclusion. These benefits are central not only to climate protection, but also social justice and, in the UK context, the central government 'levelling-up' agenda [3]. Current neoliberal political–economic commitment to market solutions however usually restricts investment models to lowest short-term price, marginalizing wider social value [4].

In principle, local authorities are suitably placed to realise the co-benefits of low carbon infrastructure [5]. However, in practice, UK local authorities have no direct powers over energy, and, despite their roles in service provision, procurement and community leadership, they have limited capacity, expertise and resources to govern clean energy development. These constraints have been exacerbated by continuing cuts in public financing and lack of clear strategic direction from the UK government [6]. Some local authorities have nevertheless developed clean energy and energy conservation initiatives, but they have been unable to stimulate investment at the pace and scale required to achieve net zero greenhouse gas targets [7,8]. Hence, change in governance powers and resources is needed to advance planning and investment.

However, to date, there is limited academic literature evaluating place-based local energy systems and their social value, or the governance reforms needed to enable rapid, systematic change. This paper makes three distinct contributions to debates about the potential for local authority, place-specific action for net zero energy. First, it contributes to understanding the intermediary roles of UK local authorities in planning and developing integrated local energy systems, in the context of net zero greenhouse gas targets and public value for money. Second, it presents empirical evidence to demonstrate the opportunities for local authorities to create increased value from energy systems, using a place-based approach. Third, it makes a novel contribution to conceptualisation by integrating the concepts of social value and local governance in a net-zero context, providing a stimulus to debate on place-specific net zero energy investments. Using these three contributions, we aim to answer the research question: What needs to change to enable UK local authorities to meet net zero greenhouse gas ambitions?

This paper is structured as follows: in the next section, we develop a conceptual framework by reviewing the intermediary role of local governments in planning and developing local energy systems, paying particular attention to the potential added social value of local leadership and plans customised to place. The third section describes our methodology. The fourth section presents empirical findings on opportunities for local authorities to catalyse wider social and societal value from place-specific action. The fifth section discusses the synergies between local governance of clean energy and social value. It considers the societal value of local energy systems customised to place using the dimensions of capital, organisational and regulatory structures. It makes recommendations for policy to enable UK local authorities to act systematically and rapidly on clean energy to support climate emergency declarations and the transition to net zero.

2. Conceptual Framework: Creating Value from Locally Led Integrated Local Energy Systems

2.1. The Ambiguous Role of UK Local Authorities in Planning and Developing Local Energy Systems

Meeting commitments to net zero emissions is dependent on the coordination of multiple actors across scales and sectors [7–9]. Local authorities are the political scale closest to citizens and local businesses, as well as having place-based governance responsibilities. They are frequently the connective tissue between micro-scale small group action and macro-scale states and markets, exemplified by the EU Covenant of Mayors for Climate and Energy. They are hence expected to be a key intermediary, governing low carbon initiatives through enabling, advising on and investing in clean energy [8–12]. Many UK local authorities have declared climate emergencies and established energy plans, signifying political appetite for change. The National Audit Office found that almost two thirds of councils in England are aiming for 100 percent clean energy 20 years before the UK's national target; however, they have no direct energy or carbon budget mandate [8,13].

Recent fiscal austerity in public finances has also progressively reduced local government funding and resources. This has proved particularly damaging to public services in the highly centralised UK government structure, where local authorities have limited tax-raising powers [14]. Ultimately, the legitimacy of local public spending on climate protection is at risk and there is a lack of clarity over local authority responsibilities and ca-

pacity for effective long-term planning [8,13,15]. Moreover, the recent COVID-19 pandemic has further exacerbated the resource pressures and reduced the scope for discretionary action [16].

Governance and institutional changes, including greater powers over resources, are hence needed to enable UK local authorities to act systematically on clean energy development with the urgency required [8,17]. Local responsibilities for waste, health and social care, transport, building control and housing services, and the influential position of local authorities as major employers, community leaders, planners and developers and social landlords, could then work to secure the social value, or co-benefits, of clean energy and climate protection [5,18]. Such local empowerment is likely to be an essential component of 'best value' sustainable transitions, as discussed next.

2.2. Realising Social Value in Local Decision Making of Clean Energy Plans and Investment

The potential to maximise social value from clean energy investment is central to justifications for local government action. The concept of 'social value' offers a means to delineate expected co-benefits, but it remains subject to different interpretations, depending on interests and contexts, resulting in a degree of fluidity and ambiguity [19–21]. There is also long-standing debate about how to assign value to societal benefits, and whether these need to be quantifiable in order to govern decision making [22]. Here, we define social value broadly, encompassing environmental, economic and social welfare, health and quality of life. Used in this sense, it is aligned with arguments about the value of a just transition, where benefits and opportunities are shared across society and work to reduce inequalities [22,23]. Common examples of tangible social benefits from low carbon infrastructure include increased jobs and skills, physical and mental health gains from clean air and unpolluted environments [23] and potential for increased community participation and inclusion [6]. Factors less amenable to quantification include aspects of wellbeing such as a sense of shared purpose, community cohesion and resilience and protection of 'ontological security', which can be disrupted by climate change anxieties [24,25]. These less-tangible benefits are important because they acknowledge wider societal and environmental dynamics associated with community regeneration and sustainable economies.

Each of the UK's devolved jurisdictions have embedded social value criteria in legislative frameworks, with similar ends relating to 'value for money' from public spending. In England, social value is recognised through the Public Services (Social Value) Act 2012. The act requires public sector commissioners to have regard for economic, social and environmental wellbeing in connection with public service contracts. It binds public authorities to consider the social value in the services commissioned and procured, by applying the Social Value Model. Broadly, the model aims for local authorities to consider five key themes in their decision making, which are evaluated against the following criteria: COVID-19 recovery; tackling economic inequality; fighting climate change; equal opportunity; and wellbeing [26] (p. 7). Similarly in Scotland, social value is recognised in the Procurement Reform (Scotland) Act 2014 through a requirement to include sustainability criteria in decision making. In Wales, social value is conceived broadly as "*the social, environmental and economic impacts of actions taken by communities, organisations, governments and individuals*" [27] (p. 6). It is embedded in the Public Services (Social Value) Act 2012, and the Well-being of Future Generations Act (2015), which embrace social, economic, environmental and cultural wellbeing [27]. The suspension of government in Northern Ireland delayed legislation, although social value was integrated into public procurement policy in 2021. Social value principles are therefore a formal requirement of UK local authority spending, but their prioritisation over and above short-term cost is precarious. In addition, the conjecture that local leadership can generate additional social value from local energy remains largely untested. Overall, the integration of social value criteria in *place-specific* local energy systems is in its infancy, as described next.

2.3. The Value of Place-Specific Local Energy Systems

Place-specific analyses indicate how distinctive social value from local energy systems might be configured and realised. Recent research has introduced a spatial lens into analysis of energy transitions [28,29] and considered the geography of local and place-specific energy planning and development [2,8–12]. This aids the understanding of options for allocating responsibilities for governing change at differing scales and potential to customise transitions to locations. A place-specific perspective also considers the uneven processes and path dependencies which have particular local impacts related to differences in location and landscapes [28]; a distinctive example is the emergence of low carbon clean-tech clusters in the Ruhr Valley, Germany (see: [19,30]). "Place-specific" and "locally led" planning and action are customised to local interests, priorities and circumstances, rather than the implementation of centralised decisions. Planning and investment for net zero infrastructure tailored to place-specific needs and resources requires inclusion of local actors, including businesses and citizens. A place-specific (rather than 'place-agnostic') approach to net zero initiatives utilises more local knowledge, investment, skills and delivery, allowing regions to maximise social value from cleaner air, improved health and increased local employment and skills [9,12]. In addition, locally led or place-specific initiatives arguably reinforce social bonds and direct democracy and work to stimulate economic regeneration [18,20,31].

The UK government has recently acknowledged the merits of a place-specific approach, notably in the Net Zero Strategy [32] (p. 29) as part of the levelling up agenda: "*We will [. . .] take a place-based approach to net zero, working with local government to ensure that all local areas that have the capability and capacity for net zero delivery as we level up the country*". The wording in the document is however ambiguous, potentially implying that it is *only* places that have existing capability and capacity for net zero delivery that will be involved. Specific policies are also lacking. In the context of limited powers, mandate and funding, the first question is therefore: can UK local governments adopt a place-based approach to net zero investment in practice, and secondly, can a place-specific approach generate social value for localities as a component of the transition to net zero energy systems? We seek to address these questions through examples of innovative UK local authorities in the next section.

2.4. Innovative Governance to Capture Social Value of Place-Specific Energy Systems

Financialised governance of infrastructure in the UK's neoliberal political economy has made the implementation of clean energy plans largely dependent on private investment prioritising short-term payback at commercial rates of return over wider social and environmental value [4]. Projects have frequently stalled or been scaled down, with investment only in the most lucrative [14]. Consequently, analytic frameworks directly applicable to assessing social value of net zero infrastructure are lacking. Debates about the financialisation of urban infrastructure, however, provide a perspective on local governance struggles to configure income streams for local benefit and social value [33]; this has proved to be a precarious enterprise, subject to reversals and uncertain returns [34,35].

Debate about realising social value from investment in clean infrastructure has mainly focused on central state interventions, with limited attention to local scale strategies. In particular, there is limited analysis of consistent routines for replicating and institutionalising place-sensitive best practice for social value. With this in mind, this paper adapts O'Neill's [36] conceptual framework, which is designed to analyse the interactions between private finance investment and public infrastructures at urban scale. The same categories are used here to assess public sector financing for place-specific-integrated local energy systems.

The framework distinguishes between three interdependent dimensions governing urban infrastructure investment decisions. The first dimension is organisational type, which is used to analyse shifts in political attitudes towards private finance in the public infrastructure sector. The second dimension, capital structure, analyses innovation in

capital flows for financing infrastructure. The third dimension, regulatory conditions, considers the contested interpretation and negotiation of rules among governmental and non-governmental actors. O'Neill argues that urban infrastructure decisions result from a "*package of organisational types, capital structures and regulations that create the circumstances and conditions for the entry of finance into the world of infrastructure*" [36] (p. 1320). We adapt O'Neill's dimensions to analyse the potential social value from locally led planning of clean energy infrastructure customised to place. This advances the conceptual framework by integrating concepts of social value and financialisation of infrastructure, in the context of climate protection and clean energy goals. The intention is to stimulate further research and debate on the potential value of place-specific local energy systems' investment.

Various emergent local strategies have sought to avoid the prioritisation of short-term payback and commercial rates of return. Such strategies contrast with hierarchical financialised governance, structured by austerity budgets and key performance indicators obliging local authorities to pursue short-term growth priorities. They have been characterized as a form of 'new municipalism', which serves as an entry point for local government to develop (and build upon existing) place-based social justice and regeneration strategies [37]. A prominent example of a local authority strategy applying these principles is the Community Wealth Building project led by Preston City Council (together with the Centre for Local Energy Strategies) since 2012. Additionally, known as 'The Preston Model', it is an example of a UK local authority recognising the need for, and potential to act directly on, increasing the social value from public contracts and services to the locality. The model has reconfigured institutions to secure and retain wealth locally [37–39], including net zero investment projects such as a windfarm for local energy generation [40]. It aims to benefit the local economy by increasing the contract opportunities for small and medium-sized enterprises, which are often outcompeted by larger suppliers [40]. In addition to their own procurement practices, Preston City Council has sought to *redirect* the procurement practices of other local non-profit anchor organisations (such as hospitals and universities) to local suppliers through what is referred to as 'progressive procurement'.

Through innovation within current public sector regulation, Preston City Council deliberately challenged routinised assessment and evaluation procedures across their operations to increase societal and environmental returns. Although piecemeal, place-based investment strategies such as the Preston Community Wealth Building project serve as pre-figurative forms for potential social value from local energy systems. Locally led, place-specific planning may in addition be a more effective route to social value creation than a place-agnostic model, with "*significantly better outcomes when places tailor their net zero delivery to the needs and opportunities of the [local] area*" [9] (p. 5). This conjecture is examined in the empirical research outlined below.

3. Methods

3.1. Data Collection

Data collection methods include: desk-based analysis to assess the value of UK local authority investment in net zero energy initiatives; qualitative interviews with expert stakeholders; and expert practitioner feedback on indicative findings. A working paper/report [7] for policy practitioners provides the basis for this paper, which situates the findings in academic debate and analysis. The paper also updates the findings through further desk-based analysis (2020–2022) of secondary sources and policy documents. These mainly local and central government reports were available online. Data were also extracted and compiled from programme factsheets. For example, the ELENA programme report was published by the European Investment Bank (Appendix A). Where applicable, figures were calculated using the exchange rates at the time and social rates of return in line with Treasury Green Book guidance.

Interviews with expert practitioners from 11 organisations provided perspectives on specific data, as shown in Table 1 below. These semi-structured interviews were conducted during 2019, in-person and by phone, and lasted between 1–1.5 h. The interviews were

recorded, transcribed and coded using qualitative software NVivo to identify key themes common throughout discussions. Interviewees were anonymised and were made aware that they could withdraw at any point. Data analysis was triangulated with academic literature and findings from a desk-based review of policy documents and related sources. Additionally, a report of indicative findings was independently reviewed by approximately 20 practitioner experts. Resulting feedback informed the final analysis.

Table 1. Interviews with experts.

Type of Organisation	Key Contributions to Report
Sustainable Investment Organisations (n = 2)	New platforms for financing (e.g., crowdfunding municipal bonds and investment products) Bringing institutional investors into regional funds, e.g., Mayor of London's Energy Efficiency Fund
Local Authority (n = 4)	Leveraging investment through technical assistance and development funding; net platforms for financing; working with sustainability investors
English Regional Energy Hubs (n = 2)	National and regional coordination of opportunities, e.g., Hubs
UK Government Departments (n = 2) UK Government Agency (n = 1)	Prospering from the Energy Revolution (PFER) Industrial Strategy Challenge Programme. Local and national energy policy

3.2. Data Analysis

We adapt O'Neill's [36] urban infrastructure investment framework to investigate social value from local government planning and investment in clean energy infrastructure and ultimately to answer our research question: What needs to change to enable UK local authorities to meet net zero ambitions? To date, there is limited academic literature analysing the social value of place-specific energy planning and development; thus, we seek to add to this field. As highlighted in Section 2, locally led planning and investment is predicted to be a more effective route to realising social value than a place-agnostic model. We contribute to testing that claim and hence to conceptual development.

4. Results: Added Value of Place-Specific Local Energy Systems

4.1. Scaling up and Accelerating Social Value across Localities

Local political commitments to net zero greenhouse gas emissions signal the ambition, willingness to innovate and, importantly, momentum for integration and scaling up of place-specific clean energy investments.

Since Bristol City Council declared a climate emergency in November 2018, almost three quarters of the 408 UK local authorities have followed. By February 2020, 281 of the UK's 408 local authorities, as well as eight combined authorities/city regions, had declared climate emergencies and set net zero targets for their own operations, with the aim of establishing net zero carbon localities across the whole area. In these plans, local authorities aim to contribute to the development, or act as enablers, of a clean energy system, integrating heat, power, transport and storage at local scale, whilst reducing energy demand.

Data from the Place-based Climate Action Network [41,42] demonstrate the potential for *place-specific* local energy investment to access untapped local and regional value, as well as significant emissions reductions. For example, in the city of Edinburgh, the 2019 total annual energy bill was around GBP 823 million. This of course pre-dated recent sharp and continuing increases in energy prices. Costs of investment in cost-effective measures (e.g., in housing, public, commercial buildings, transport and waste sectors) up to 2030

were assessed as almost GBP 4 billion, representing less than five years of the city's annual energy bill [41,43]. The estimated annual financial savings from such investments were GBP 553 million, with a 55 percent reduction in 2019 emission levels, and a payback of around seven years. Investing on a cost-neutral or technical-potential basis would increase carbon reductions and financial savings further. For example, investment in cost-neutral measures up to 2030 was assessed as costing almost GBP 7.5 billion, which represented just over 12 years of the city's 2019 annual energy bill. Financial savings were expected to be GBP 535 million, with a 61 percent reduction from 2019 emission levels. Investments in technical potential up to 2030 were assessed as costing just over GBP 8.1 billion, representing almost 16 years of the city's annual energy bill, with financial savings of GBP 597 million and a 68 percent reduction from 2019 emission levels (Figure 1). Given subsequent energy price rises, cost savings would now be considerably greater, with corresponding potential to reduce carbon emissions faster.

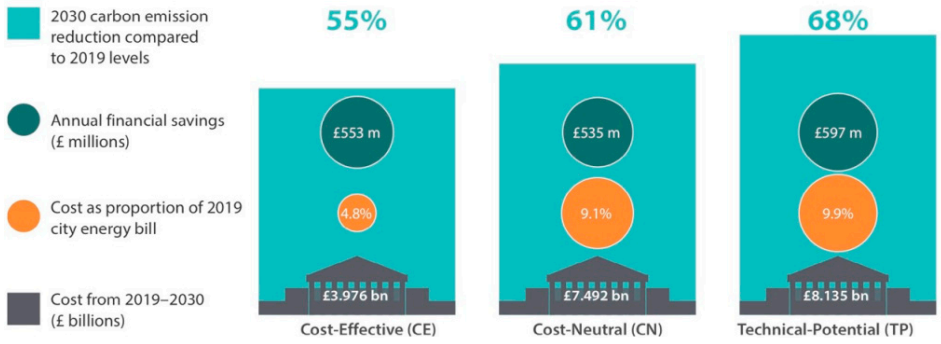

Figure 1. Edinburgh's emission reduction potential from investing in local energy. Emissions include Scope 1 and Scope 2. Adapted from: [41,42] in [43] (p. 9).

Heat network developments are necessarily customised to place and exemplify the potential for scaling-up local energy systems. Using available data from the Department for Business, Energy and Industrial Strategy [42], we established a very simple proxy measure of the average size of a heat network: of the 54 projects where costs are available, combined capex is GBP 745 million with a GBP 13.8 million average cost. Based on these figures, if every local authority developed one average-sized heat network (approximately 12 km network with 2 MW combined heat and power capacity, at GBP 13.8 million), this would represent an investment of over GBP 5.6 billion in low carbon heat supply (Figure 2). This far exceeds the "*£1 billion of private sector and other investment in heat networks in England and Wales*", which is stated by the Heat Networks Delivery Unit and Heat Networks Investment Programme [42] (p. 4), and as a result, could make a significant contribution to heat decarbonisation. (It is in practice unlikely that such development would happen everywhere; this calculation is intended to give an indication of scale of opportunity given that much larger scale heat networks would be suitable in a proportion of places. In both Scotland and England, there are now plans to establish heat network zones, which will provide a more accurate picture of potential [44,45]).

4.2. Generation of Virtuous Cycles of Investment and Technical Capacity across Localities

Stimulus funding for place-based local energy systems has the potential to result in virtuous investment cycles, combining improved local technical capacity with health and economic benefits and carbon savings. Investment transcends multiple governance scales and actors, such as unitary, metropolitan, county, districts and boroughs and combined authorities across the UK and can help realise the social value of place-specific investment of local energy system.

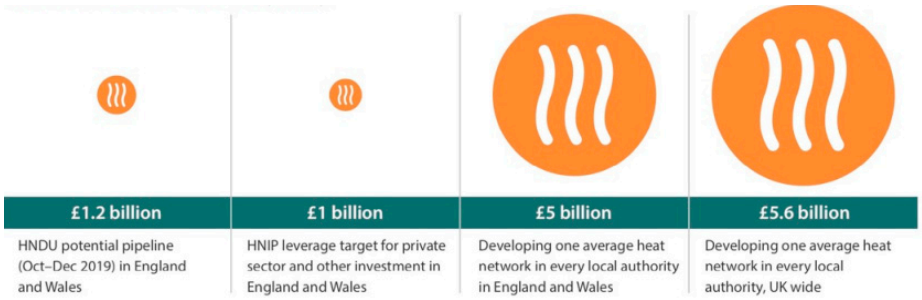

Figure 2. Decarbonising heat through rolling out heat network development. Adapted from [42] in [43] (p. 10).

Local level investment in energy systems has been enabled by regional funding from two European Union programmes: European Local Energy Assistance 'ELENA' and Mobilising Local Energy Investment 'MLEI'. These European funding schemes, established in 2009 and 2011, respectively, provided 'technical assistance' grants to employ staff to develop investment pipelines over 3–4 years. Local authority recipients had to leverage investment into energy initiatives in accordance with an agreed target. At the time of data analysis, the larger of the two schemes, 'ELENA', led by the European Investment Bank, had 103 programmes to date across Europe, of which 37 are completed and 66 ongoing. For the 85 programmes with available data, EUR 150 million invested in grants led to the investment of EUR 5.6 billion into low carbon and energy efficiency projects [46] (p. 5). In tandem, 28 projects across Europe from the MLEI programme have led to the investment of EUR 615 million in local energy.

In the UK context, technical assistance funding was effective in leveraging investment into local energy systems. From ELENA grants alone, EUR 23 million in aid to fund people, skills and expertise delivered approximately EUR 859 million in UK low carbon investment at local scale. This is benefitting approximately 180 local authorities and additional public sector organisations. The ELENA fund set the most ambitious leverage target for sustainable energy with the requirement for every EUR 1 grant funding to result in EUR 20 investment. The target has however been far exceeded: every EUR 1 ELENA funding led to EUR 37 in investment. This demonstrates the significant impact of technical assistance funds for unlocking locally led clean energy investments.

The programmes also have benefits after their formal end date. For example, across Europe almost two-thirds of beneficiaries retained a technical assistance delivery unit after their ELENA grant ended, accruing at least EUR 780 million in additional investments [46].

Using the example of ELENA funding, an injection of funding to UK local authorities would result in major progress in net zero plans and investment: using a 1:37 investment leverage factor, an illustrative figure of GBP 1 million in technical assistance funding to every local authority would represent over GBP 15 billion in local energy investment (Figure 3).

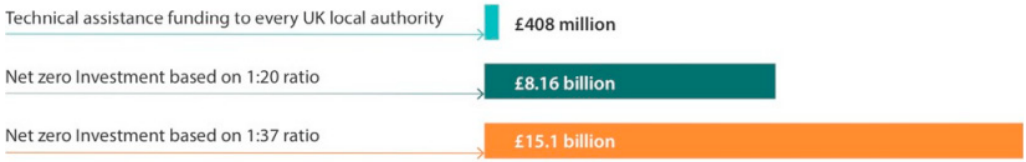

Figure 3. Scaling up local energy through investing in technical capacity within local authorities. The ratios used here replicate the targets set by EIB for the sustainable energy category (1:20) and actual delivered investment ratio of the local ELENA programmes (1:37) Adapted from: [46] in [43] (p. 13).

Multiple benefits from the project development assistance programmes included improving low carbon and energy efficiency supply chains, and helping get projects off the ground, as highlighted in Table 2.

Table 2. Benefits from project development assistance.

Benefit	Explanation
Helping get projects off the group	Targeted technical assistance at local level provides competencies across technical and energy audits, business plans, financial and legal advice, procurement, project bundling and project management, addressing the resource gap of development capital and technical expertise to develop projects.
Leads to aggregating projects	Individual projects are often small scale, yet scheme design assists with packaging them (minimum investment level for ELENA is EUR 30 million; MLEI was EUR 10 million.
Replicating and scaling up after grant funding ends	Beneficiaries retaining a delivery unit after the grant ends secure long-term retention of skills and expertise. To illustrate the long-term improvement of local capacity: RE:FIT energy performance contracting, first developed under a GLA ELENA grant, has been rolled out to public sector bodies across the UK.
Improving low carbon and energy efficiency supply chains	Major investment in local projects builds local supply chains. However, evaluations also found limited responses to tenders indicating immature markets requiring upskilling and development.
Ability to encompass a wide range of local energy technologies and projects	Primarily targeted decarbonisation and energy saving across public estate, but could target area-based cross-sector net zero investment.
Success based on demonstrable achievements	Leverage factor, the ratio between the committed investment pipeline and the value of technical assistant grant is used to measure success and are useful control and monitoring tools; a results-oriented approach stimulates investment and locks in local political commitment. However, more ambitious and innovative projects sometimes tend to be set aside in favour of straightforward projects guaranteed to meet the target within the 3–4-year timeline.
Articulates local political commitment	Requires senior champions and commitment from senior leadership across organisations, giving a high priority to local energy and its co-benefits.
Recipients contribute	ELENA funding covers 90% of technical assistance costs, with recipient contribution 10%; MLEI covered 75% of technical assistance costs.
Central ELENA team assists local delivery	ELENA team based at EIB provide expert support to bring forward an investment pipeline and support recipients; a similar function is provided for MLEI and its successor.
No application deadline	Applicants approach EIB when they are ready to take forward a local investment programme.

Source: Adapted from [7] (p. 14).

This virtuous circle of funding is also exemplified by community municipal bonds, which are a recent improvisation to avoid, or work around, financialisation [47]. These are a means for local authorities to invest in low energy, green and social infrastructure. They are issued under the local authority covenant and are considered to make investment more straightforward, accessible and affordable [47–49]. This results in lower due diligence costs than project finance and can provide finance at lower than equivalent Public Works Loan Board (PWLB) rates. It is estimated that if community savers in the northwest of the UK invested just 0.1 percent of their total savings in community municipal bonds, this would amount to approximately GBP 219 million for local investment [48].

Using the same cautious baseline assumption of 0.1 percent demand for community savers can be used to provide a UK-wide estimate of the potential funding from community municipal bonds for local energy programmes. The latest data on UK Adult Individual Savings Accounts (ISAs) revealed subscriptions of approximately GBP 69 billion in 2017–2018, which brings the market value of Adult ISA funds to GBP 608 billion [49] (p. 10–13). Assuming the same 0.1 percent level of demand, this indicates that around GBP 69 million could be raised through annual subscription (using 2017–18 levels) if community municipal bonds were eligible, and around GBP 608 million from total Adult ISA funds. However, total savings are estimated at around four times the Adult ISAs [49], indicating that over GBP 2.4 billion could be raised from community municipal bonds for local net zero investment programmes (Figure 4). Again, this is a significant investment figure given fiscal pressures and would have wider societal benefits through emission reductions, local jobs, economic regeneration and social welfare. The same assumed demand as Abundance Investment (0.1% of total savings) is used; this does not of course show whether savers are prepared to invest.

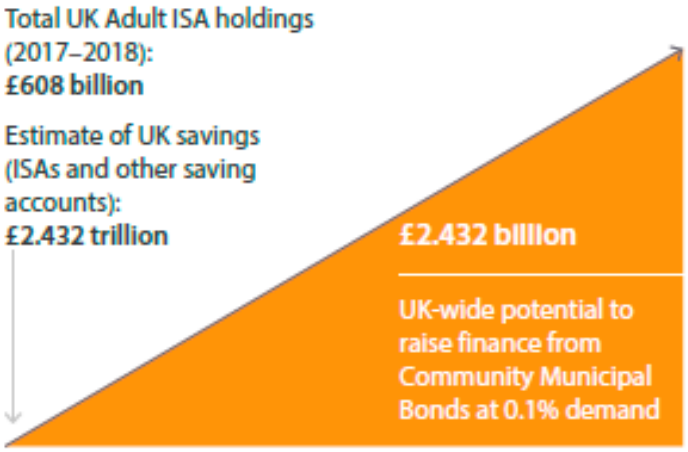

Figure 4. The potential to raise finance from community municipal bonds for net zero localities. Source: [7] (p. 16).

4.3. Integrated Local Energy Systems

Place-based-integrated energy systems' investment may have added value where such integration would defer or reduce high-cost investments in power grid reinforcement. Such integrated systems hence support public interest in securing clean energy at the most affordable price.

We illustrate this potential using examples from the UK Industrial Strategy Challenge: Prospering from the Energy Revolution (PFER), which is investing circa GBP 102.5 million in integrated local energy systems testing and development, with requirements for matched private investment. Investments include the ReFLEX Orkney project, which has GBP 6.7 million PFER funding. ReFLEX is led by the European Marine Energy Centre (EMEC), with cross-sector partners including Aquatera, Community Energy Scotland, Heriot-Watt University and Orkney Islands Council and Solo Energy [43]. Renewable electricity generation in Orkney, an archipelago in the northern isles of Scotland, has exceeded local demand

since 2013, and the grid connection to the UK mainland also constrains export. This limits Orkney's potential to support progress toward net zero greenhouse gas emissions. To solve this, ReFLEX (Responsive Flexibility) aims to optimise use of renewables through a 'smart energy island' concept. Distributed storage is intended to enable demand side response, providing local flexibility across heat, power and transport: batteries can be charged when surplus renewable electricity is generated; when needed, stored energy can be discharged back to the grid. An integrated energy system platform aims to trade flexibility across energy balancing technologies including domestic and commercial batteries, electric vehicles and charging points and heating appliances. The model also envisages a local renewable electricity tariff alongside purchase and leasing options to make these technologies available to householders and businesses. Current electricity network regulations are however posing considerable challenges to such localized service integration.

A further example is the GBP 41 million Energy Superhub Oxford (ESO) demonstrator (GBP 10 million PFER funding and GBP 31 million private investment). ESO is led by Pivot Power LLP (recently acquired by EDF Renewables), with cross-sector partners Habitat Energy Limited, Infinity Energy Systems, Kensa Contracting, Oxford City Council and Oxford University. It is connecting a large battery (50 MW lithium-ion and 2 MW vanadium flow) to the transmission network and supplying electricity for nearby local transport hubs and heat. It provides up to 25 MW of EV charging for council vehicle depots and around 100 charge points over a range of charging speeds for council vehicle and public use, whilst also supporting taxi electrification. This reduces stress on distribution networks whilst enabling system services through participation in the day ahead, and intraday, markets and balancing mechanism. Ground source heat pumps (GSHPs) are intended to provide heating and hot water for up to 300 social rented and private homes; smart controls, time-of-use tariffs and feedback on energy use should enable demand side management to lower heating bills by an estimated 25 percent. Development of integrated local energy systems can hence be aided by place-specific planning and investments with benefits for the local community, such as a reduced cost of energy, increased demand side management and control and increased energy security.

4.4. Shared Learning across Localities and Aggregation of Projects

Place-specific energy investment can also act as a catalyst for shared learning, with wider social value for local authorities including potential to establish a pipeline of projects for development. The English Local Energy Hubs pilot is an apt example.

In 2018, the UK government's BEIS Local Energy Team established five English pan-regional Local Energy Hub pilots. Up to March 2020, GBP 6.3 million in core funding supported a three-year programme with 38 staff. Each Hub is tasked with advancing a pipeline of local energy projects through supporting local authorities, other public sector organisations and industrial businesses within the geographical area. Although at an early stage, the Hubs are experimenting with different approaches reflecting the needs of their areas and are becoming commonly referred to as Net Zero Hubs [50,51].

Support and technical assistance span a range of areas: planning, including feasibility; business case development, accessing funding and managing procurement; identifying opportunities for scaling up through shared project delivery; and aggregating projects to attract private sector investment. The Hubs also now administer the GBP 10 million English Rural Community Energy Fund as a regional grant programme. The Local Energy Hubs have a pipeline of 180 projects valued at GBP 850 million for direct support and over half of this is identified as potential private sector investment. Of this pipeline, to date the Hubs have helped to finalise the investment case for projects totalling GBP 84 million. Across the Hubs, the project pipeline mainly includes renewable energy generation, district heating and building estate efficiency, but the Hubs have also assisted in investment cases for energy strategies for major developments such as ULEV fuelling, smart grids and grid reinforcement. A further 500 projects already identified by the Hubs have an estimated value of GBP 1.8 billion, which could be supported with additional resources (Figure 5).

In addition, the Hubs are being tested as a coordinating body for the English Energy Efficiency Green Homes Grant: Local Authority Delivery (GHG-LAD) scheme, funded by UK Government [50,51].

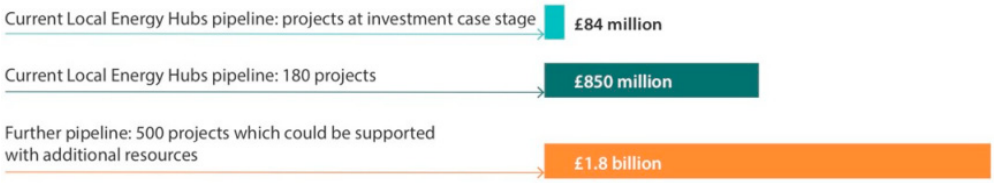

Figure 5. Realising the full potential of the Local Energy Hubs project pipeline. Data from the Local Energy Hubs [43] (p. 26).

5. Discussion

O'Neill's [40] conceptual framework is used to structure analysis of the empirical evidence and to answer the research question: what needs to change to enable local authorities to meet net zero ambitions? Each dimension of the framework is considered, first discussing capital structures, followed by organisational structures and finally regulatory structures. There is some overlap between these dimensions, but the category distinctions are useful for identifying the institutional changes that are needed for achieving net zero ambitions, demonstrating their success for meeting net zero targets.

The proposed institutional changes represent a significant alteration to current practices, but are a feasible route to achieving net zero targets in accord with other authoritative analyses (e.g., [51,52]) of necessary reconfigurations of the UK's energy systems and governance to achieve net zero. The benefits of a more decentralised system, such as accessing local demand flexibility to manage grid constraint issues, deferring costly network reinforcement and reducing transmission costs by locating generation closer to demand, are found to be a significant contributor to achieving net zero [52,53]. Recommendations are intended as a stimulus to further research and debate on place-specific local investment and potential added social value to localities.

5.1. Capital Structures

Evidence indicates significant potential for additional socio-economic, as well as environmental, value from local authority-enabled planning and investment in local energy systems. Benefits are evident at a regional level, resulting from technical assistance grants such as EU ELENA and MLEI, and at more local level, for example, associated with community municipal bonds or similar instruments. Changes in capital structures are however important to enable such programmes to be developed and routinised across localities.

As discussed in Section 2, UK local authority spending is largely governed by economic performance metrics and incentives which focus on short-term pay-back. Energy projects have frequently stalled or been scaled down, with investment only in the most lucrative [14]. A concerted focus on investment in low carbon industrial and business sectors for the long term would create and realise social value for place-based regeneration, health and community welfare. In return, central governments can expect benefits from inward investment, high-value jobs, skills, supply chains, improved housing and a just transition. Actions could include: customising the UK Guarantees Scheme, for 'nationally significant' schemes, for local scale net zero investment; co-investing in funds for local programmes; and using fossil fuel divestment strategies to draw in institutional investor and pension funds. Community municipal bonds are a good starting point for investigating interest in investing some personal savings in supporting local resilience and security. Aligning capital structures with carbon budgets would enable a whole-systems assessment of investment value, beyond the narrower, short-term calculation of financial value.

Additionally, UK and devolved central governments need to support investment in local authority net zero teams to create long-term capacity and expertise for local energy planning with cross-sector partners and technical assistance to advance project development.

5.2. Organisational Structures

Change in organisational structures at the local level are needed to secure the value of integrated energy systems. ReFLEX Orkney and Energy Superhub Oxford demonstrate the significant value potential from integrated local energy systems. These and other initiatives provide a route to aggregating local projects, to improve investment and to secure returns to whole-system efficiencies. There is also potential for pooling finance for de-risking and cross-subsidising projects with lower economic returns, in order to maximise benefits to locality. By making use of all locally generated renewable heat and power, integrated local energy could potentially support reduced energy prices, albeit regulatory changes would be needed to support local flexibility services and demand management [52,53]. This is particularly important in the context of recent energy price rises and renewed concerns about energy security. However, local action needs to move beyond a project-by-project focus to systematic area-based programmes for retrofit of buildings and local energy. The current powers of local authorities do not straightforwardly support such programmes.

Reform is hence needed and requires coordination and consensus building across scales of UK government. Devolved national and local governments need to collaborate to specify intended co-benefits from net zero carbon localities, built environment and transport systems, as foundations for costed and prioritised plans. Such planning requires explicit and consistent long-term policy, technical standards and guidelines to support low-regrets local investment. Ambitious central government policies would in turn establish long-term economic opportunities from net zero infrastructure across scales and support coordinated local and national government action.

Local governments need to be able to justify local energy investments in terms of their long-term benefits to the area and to meeting net zero targets, rather than, for example, as a way to reduce budget gaps for social care. In order to achieve this, local energy planning needs to be integrated into chief executive and senior management responsibilities, and ideally championed by political leadership with cross-party support.

5.3. Regulatory Structures

Finally, national governments have the necessary regulatory powers to set the trajectory and scope for clean energy investment across scales and sectors. A key government function is socialising the costs and benefits of transition to net zero, including principles for equitable shares of uneven costs in different places to improve distributive justice and amelioration of poverty.

As above, UK, devolved national and local governments can specify intended co-benefits from net zero carbon localities. Net zero carbon powers and responsibilities could then be integrated into the local governance framework and service delivery, setting the framework for local concerted action. The Climate Change Committee [12], House of Commons Science and Technology Committee [54] and Friends of the Earth [55] have recommended new statutory powers; Scottish government proposals already include a local statutory requirement for comprehensive Local Heat and Energy Efficiency Strategies.

Key considerations for net zero carbon planning and implementation include local systems integrating heat, power, transport and storage with spatial planning, building regulations and digital infrastructures. Local authority powers and remit should hence include: the ability to zone areas for specific heating systems where appropriate; the obligation, in designated heat network areas, to connect public buildings first, followed by larger commercial and domestic heat loads as buildings are refurbished; powers to support area-based high standards of energy efficiency retrofit in all buildings; and requirements for active engagement of gas, electricity and heat network operators with local/regional authorities to ensure coherent regional and national progress.

Progress also needs public procurement rules that prioritise carbon reduction through options evaluation on a whole life-cost basis. Public procurement currently continues, as a matter of necessity, to prioritise lowest up-front price; integrated assessment of costs and benefits, including social, technical-economic and environmental losses caused by the

climate crisis, tend to be set aside for the future. This is a false economy with disastrous impacts, as evident in the IPCC Sixth Assessment Report [56]. Public expenditure needs to lead by example, ensuring compatibility with a net zero greenhouse gas emissions trajectory. Central governments, local authorities and the public sector must establish new evaluation methods and a route map for net zero public investment. These need to be embedded in the updated UK Treasury Green Book guidance. Consideration also needs to be given to devolving carbon budgets to local or combined/regional authorities, alongside commensurate powers and resources. New guidance on tender specifications and evaluation metrics should be developed alongside professional training, simultaneously supporting supply chain innovation.

6. Conclusions

This paper has focused on the concept of social value and potential for integrated local energy systems to accrue additional value. Local authorities are expected to be key actors, yet are challenged by persistent funding reductions, lack of technical resources and powers and corresponding limited capacity. The intermediary role of local government in planning and developing local energy systems has been highlighted, with potential added social value from local leadership and plans customised to place. Empirical findings demonstrate novel and successful approaches to local clean energy and the added socio-economic value of place-specific investment. Benefits accrue primarily through: replicating and aggregating projects; accelerating action through sharing learning across localities; building technical capacity; and generating sustained investment in integrated heat, power and mobility services.

The main research question of this paper is: What needs to change to enable UK local authorities to meet net zero greenhouse gas ambitions? Securing the identified benefits requires changes in local authority capital, organisational and regulatory structures. Whilst these changes require significant alteration to current structures, the paper demonstrates that these are a feasible route to concerted local action on net zero greenhouse gas ambitions. Changes in capital structures include a focus on investment in low carbon business and industrial sectors, which would create and realise social value for place-based regeneration, community welfare and health. Investment needs a long-term horizon, using whole-systems assessment of societal value. Reform of local organisational structures is needed to secure the value of integrated energy systems. This requires renewed coordination and consensus building across scales of UK government, with local clean energy planning becoming a priority. Finally, new regulatory structures need to include greater local authority powers and remit, with revised procurement rules to prioritise carbon reduction on a whole life-cost basis.

These recommendations are intended to enable UK local authorities to act systematically and rapidly on their climate emergency declarations and net zero ambitions. Further research is now necessary to understand and map the synergies across net zero at the local scale, encompassing energy efficiency retrofit, green district heating networks, public transport and flexibility from local energy systems. In addition, further investigation and conceptual development is needed to understand the forms, and routes to realization, of social value in place-specific energy investment to aid the transition to net zero.

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Appendix A. Leveraging Investment through UK ELENA Programmes

UK ELENA Programme	Lead Organisation	Year Started	EIB Technical Assistance Grant	Total Investment in Technical Assistance [a]	Investment in Low Carbon Projects	Annual [b]			
						Local Energy Priorities	Energy Savings GWH/y	Heat &/or Electricity GWH/y	CO_2 Reduction Tonne CO_2e
Birmingham Energy Savers pathway	Birmingham City Council	2012	EUR 552,798	EUR 614,220	EUR 38,820,000	Domestic energy retrofit	30.88	6.04	18,434
Bristol Retrofitting—Innovative Technologies for Everyone	Bristol City Council	2012	EUR 2,332,229	EUR 2,591,366	EUR 64,000,000	Domestic energy; Heat networks; Public sector retrofit; Solar PV	19	26	9053
South West Energy Unit	Bristol City Council	2018	EUR 1,949,400	EUR 2,166,000	EUR 52,000,000	Domestic energy retrofit; EV charging and solar carports; Heat networks; Public sector retrofit; Solar PV; Street lighting	32	3.1	17,928
Cheshire East Energy Programme	Cheshire East Council	2017	EUR 1,069,101	EUR 1,187,890	EUR 27,860,000	Heat networks; Street lighting; Grid balancing; Grid during peak demands	11	-	2181
Decentralised Energy London	Greater London Authority	2011	EUR 2,904,744	EUR 3,227,493	EUR 142,600,000	Heat networks	-	-	43,904
RE:FIT	Greater London Authority	2011	EUR 2,884,640	EUR 3,205,199	EUR 107,349,656	Energy performance contracting	76.27	1.84	23,720
London RE:NEW	Greater London Authority	2014	EUR 3,016,440	EUR 3,358,308	EUR 102,000,000	Domestic energy retrofit	77.3	1.7	22,672
Greater Manchester Low Carbon Delivery Unit	Greater Manchester Combined Authority	2015	EUR 2,687,107	EUR 2,985,675	EUR 155,852,206	Heat networks; Street lighting	129	85	-
RE:FIT Wales	Local Partnerships Wales (Welsh government	2015	EUR 2,005,404	EUR 2,228,227	EUR 53,200,000	Energy performance contracting	20.33	-	9000
Energy Accelerator	West Yorkshire Combined Authority	2018	EUR 3,153,847	EUR 4,147,056	EUR 115,000,000	Public sector retrofit; Domestic energy retrofit; Solar PV; Street lighting; Heat networks	47	1.3	25,081
Totals			EUR 22,915,750	EUR 25,711,434	EUR 858,681,862		443 GWh	125 GWh	171,973

[a] ELENA funding recipients contribute 10% of costs to technical assistance. [b] For the ongoing programmes, these are estimated figures provided at the start of local programmes. Source: Data extracted and compiled from individual local ELENA programme factsheets published by EIB [40,57,58].

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