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UK CITIES 
Climate Investment Commission

City Investment Analysis Report

CATAPULT
Connected Places

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Report for Connected Places Catapult

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The United Kingdom Cities Climate Investment Commission is a collaboration of the Catapult Connected Places, London Councils and Core Cities. Together, this is a coalition of 12 of the UK’s largest cities representing 60% of the UK’s population and over half its economy. The Commission aims to engage with all parts of local and regional government as well as the financial community in every nation of the UK to find investable solutions for our Net Zero challenges.

Core Cites: Belfast, Birmingham, Bristol, Cardiff, Glasgow, Leeds, Liverpool, Manchester, Newcastle, Nottingham and Sheffield

Executive Summary

The Challenge

The transition of our existing carbon intensive systems to Net Zero will require significant up front capital, and presents unique challenges for the UK's cities:

- **Scale:** This report estimates that £206 billion (in a range of £112-£334 billion) must be spent to achieve Net Zero pledges across the UK's Core Cities and London Councils, representing around one quarter of the UK population
- **Urgency:** Implementation must accelerate as soon as possible to meet Net Zero deadlines and mitigate temperature increases
- **Complexity:** The systemic transitions required within cities are complex and interlinking and are unlikely to be achieved successfully through individual decision making
- **Just Transition:** Already stretched social inequalities risk being exacerbated if the outcomes of policy changes are not appropriately considered

The quantity of capital that must be deployed is beyond the reach of public finances. If this funding gap is met only by citizens and businesses there will be damaging impacts on the poorest sections of society, counter to the levelling up agenda.

Furthermore, existing financing and delivery systems have not been designed to deal with the complexity of coordinating action locally in multiple sectors - the built environment, energy, transport, waste, and green infrastructure. Tweaking these existing financing structures is unlikely to deliver the scale and speed of transition required in these interlinked systems in a just and equitable way.

The Opportunity

In this context, the UK Climate Change Investment Commission (UKCCIC) sees private sector finance as a critical tool for achieving the Net Zero transition. Alongside supporting substantial GHG reductions, integrating private finance into the Net Zero transition will support the UK's levelling up agenda, create local jobs, deliver clean and inclusive places to live, and prompt greater collaboration between all stakeholders in local places.

The scale of private finance available is sufficient to support substantial progress towards Net Zero. However, there is a need to understand where private finance can play an effective role, and where hurdles must be overcome to unlock this resource.

New approaches are therefore required to deliver this multi-intervention and place-based transition. In this context, this report has:

- Assessed the magnitude of investment needed to take the UK's Core Cities and London to Net Zero;
- Investigated the opportunities and limitations for private finance to play a leading role in financing key Net Zero infrastructure for cities: commercial real-estate, domestic housing, transport, renewable electricity generation, waste management and green infrastructure; and
- Provided recommendations for how flows of private finance into city-based Net Zero infrastructure could be enhanced.

In doing so the intention of this report is to support the acceleration of Net Zero financing, particularly through the bringing together of private and public sector bodies to support decarbonisation of the UK's Core Cities and London. This has the potential to create a £300-£500 billion investment opportunity for long term capital such as pension funds and insurance companies.

Approach

This UKCCIC report has been supported by Connected Places Catapult, Core Cities UK, and London Councils. The focus is therefore the UK's Core Cities¹ and London, though the findings are widely applicable to the rest of the UK.

The evidence presented in this report draws on several data sources:

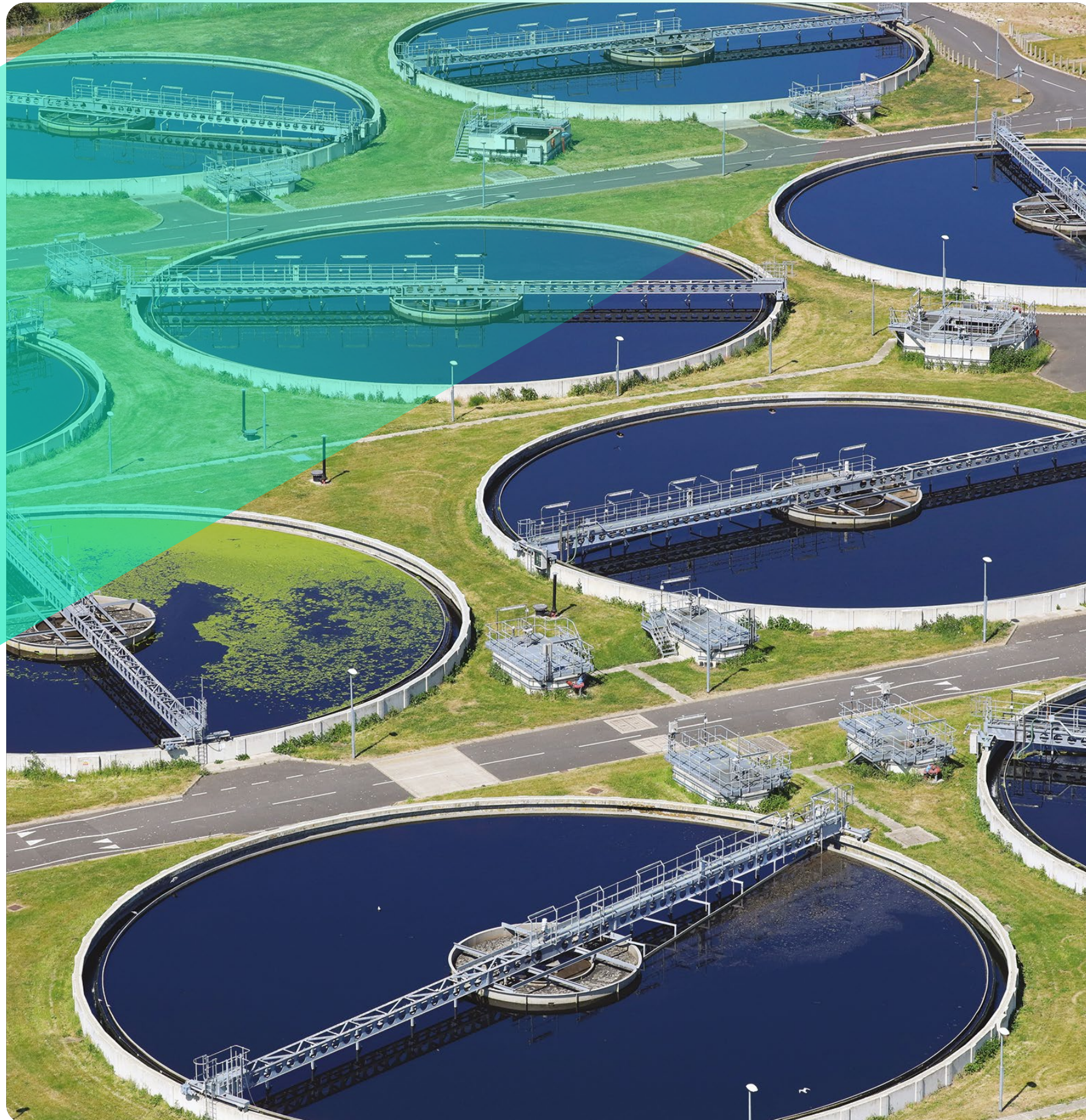
- The Net Zero plans of Core Cities, London Boroughs and London as a whole;
- Reviews of relevant literature;
- Discussions with Local Authority representatives in financing and Net Zero delivery roles;
- Discussions with Finance Industry representatives; and
- The expertise of subject matter experts in financing and decarbonisation.

The report is structured around a review of the key urban infrastructure sectors relevant to Net Zero: commercial building decarbonisation, domestic building decarbonisation, renewable electricity generation, transport decarbonisation, waste management decarbonisation, and green infrastructure. Each of these sectors has been evaluated to identify theoretical opportunities for private financing and hurdles to be overcome. Practical examples of projects requiring finance are also presented to illustrate the opportunities available for private sector investors.

Using the sector-specific evaluations, the report collects findings regarding the present opportunities and limitations for private finance to participate in city Net Zero transitions, and develops recommendations for actions to enhance the scale of private sector involvement in the coming years.



¹ Belfast, Birmingham, Bristol, Cardiff, Glasgow, Leeds, London, Liverpool, Manchester, Newcastle, Nottingham, and Sheffield



Key Findings

1) Economic incentives across most sectors are challenging stand alone

Conclusions regarding the present viability of private finance across each of the individual Net Zero infrastructure sectors are presented in Table 1. These can be grouped as follows:

- **Renewable electricity generation offers the greatest opportunity for private finance at present**
 - Large scale solar and battery storage schemes can provide good financial returns
 - Equally, onshore wind has the capacity to deliver good returns, but local planning hurdles are often insurmountable
 - Hydro power is also capable of delivering acceptable returns, but the availability of suitable sites is scarce, mostly in Scotland
 - Other novel technologies such as tidal power and geothermal are attracting investment but heavily dependent on Government support
- **Domestic building retrofit, commercial building retrofit, and transport decarbonisation all offer some direct return on investment, but to a limited extent.** There is therefore a need for enabling actions to deliver additional financial incentives and to structure Net Zero projects in a way to scale and blend financing sources
 - In the **built environment** emissions can be reduced through a range of demand reduction and heat source changes, but the financial returns are very poor. Subsidies of around 80% are needed solely to cover financing costs, let alone create a financial incentive
 - Incorporating solar PV and battery storage increases the overall capital cost but materially improves the combined return profile for the interventions
 - For **transportation**, EV cars increasingly demonstrate a beneficial financial return through Total Cost of Ownership. Range anxiety and installing sufficient EV charging infrastructure remain key challenges. Economic cases for public charging points are currently negative and will need sustained subsidy support
 - EV buses can demonstrate an economic return if the true cost of carbon reductions is incorporated, but from a purely financial return, have negative returns without subsidy
 - Active travel schemes such as dedicated pedestrian walkways and cycle lanes can demonstrate strong co-benefits through improved mental and physical health. However, with limited income streams they deliver a poor financial return
- **Green infrastructure and waste management decarbonisation** present the greatest challenges for private sector investment. Conventionally considered 'public service' infrastructure, using private finance to initiate these projects will require substantial policy development and restructuring of delivery models
 - **Green infrastructure** deployment can attract co-funding from organisations that see cost reduction as a result. This includes water companies who see reduced volume yet higher quality water flowing into their infrastructure, as well as developers seeking biodiversity offsets, or corporates looking to offset residual carbon footprints
 - **Waste infrastructure** is largely paid for through taxation, presenting more limited avenues for private sector investment in the current market. This may change with the establishment of Extended Producer Responsibility (EPR) schemes. Policy changes are central to creating financial incentives for private sector investment in this sector

2) Implementation requires delivering interventions across multiple sectors in single places

'Sector-by-sector' consideration of Net Zero interventions is inefficient, impractical, and lacking in vision. It overlooks the potential for aggregating revenue streams and therefore finance, delivering economies of scale, and maximising the climate benefits of implementation through a multi-intervention, place-based approach.

Collectively, transitioning a neighbourhood to Net Zero will deliver financial returns in the form of direct savings, additional revenue streams, and a wide range of other social and environmental co-benefits. Aggregated and monetised in the right way, these returns can attract a blend of large-scale capital sources.

The transition has the potential to create overall economic value while also delivering better, healthier places to live and work.

3) Capacity and capability building is required for delivery

There is a gap in available headcount within Local Authorities to deliver this work as well as some gaps in capability and skills across a number of specialist areas such as low carbon technology and financing. Nor are there centralised resources adequate for Local Authorities to draw upon.

4) Policy changes will be necessary to maximise the role of private finance

Even in scenarios where the economic incentives of projects are more attractive, stronger policy incentives for lower carbon infrastructure would further enhance the attractiveness for private sector investment.

Recommendations

To maximise the potential for private investment to support the transition to Net Zero, this report recommends:

- 1) Placed-based investment demonstrators:** This will involve piloting the implementation of multi-intervention, place-based Net Zero delivery models. In practice, this would be likely to include local electricity generation, local renewable heat provision, more efficient buildings, increased green infrastructure, electric charging infrastructure, provision of local service provision to reduce travel requirements, access to lower carbon travel options, and lower carbon waste management services.

Piloting these models will demonstrate whether it is possible to wrap interventions together, to obtain an overall package which can attract private investment by capturing cash returns and co-benefits into a blended finance structure.
- 2) Incentivise public-private partnerships, building on existing structures:** Develop the necessary structures and services to enable collaboration between local public bodies, private sector investors, local businesses, and local residents. Whole neighbourhood change of the type that would maximise the possibility of investment requires effective partnership working. At present there are few examples of structures and services that enable the type of collaboration necessary between all of the relevant stakeholders. This is critical for enabling any investment to be a success.
- 3) Support advanced planning and creation of investable propositions:** Allocate further resource to understanding Net Zero infrastructure needs and developing plans to advanced stages. Whilst Local Authorities have developed Net Zero action plans, these have so far had to be high-level in nature due to limited resources. They set out the direction of travel but will need to be augmented by more detailed planning to secure investment. This requires resourcing and support to Local Authorities, including detailed local Council capacity analysis.
- 4) Accelerate specific policies to support delivery.** In particular, attaching financial disincentives to activities associated with higher GHG emissions, whilst ensuring these are designed to not disproportionately impact vulnerable or low-income consumers. In addition, enabling other co-benefits (such as health improvements and biodiversity enhancements) to be effectively monetised and deliver real revenue streams. These will often drive the economic case for action.

Summary

This report concludes that there is a positive economic case for investing rapidly in the decarbonisation of neighbourhoods, which will contribute to levelling up through significant investment in place-making. The Net Zero transition offers UK cities the opportunity for green jobs, increased demand for UK businesses and suppliers, and further enhancement of the UK's thriving urban environments.

Unlocking this potential will require new models of co-ordinated delivery and combined financing from multiple sources. Financial benefits must be aggregated to support repayable finance and significant improvements in fuel poverty, health care and even carbon emission reductions must be evaluated and harnessed together in a precise financial framework. Standardisation of reporting, governance, billing and legal structures will be required to encourage private investor confidence and allow aggregation for scaled investment.

The Net Zero transition can deliver an economic outcome that will attract both financial, return driven, capital as well as capital with socio-economic outcomes as its core focus. A model for delivering a multi-intervention, place-based route to decarbonisation is mapped out in this report.



Table 1: Summary of Net Zero Infrastructure Findings

Net Zero Infrastructure Sector	Current suitability for private sector investment*	Suitable for:				Need for policy development to enhance private finance flows	Key Enabling Actions to Increase Private Flows
		Principle-Agent issue to address?**	Carbon co-benefit payments?	Health co-benefit payments?	Biodiversity co-benefit payments?		
Domestic Building Decarbonisation		✓	✓	✓	✗	High	<ul style="list-style-type: none">• Blending private finance, public funding, and co-benefit payments• Aggregating to street or neighbourhood level to achieve economic efficiencies
Commercial Building Decarbonisation		✓	✓	✗	✗	High	<ul style="list-style-type: none">• Blending private finance, public funding, and co-benefit payments• Developing financing arrangements between tenants and landlords, with commercial real-estate companies playing a key role
Renewable Electricity Generation		✗	✓	✗	✗	Low	<ul style="list-style-type: none">• Aggregating project types and processes across cities• Integrating with other infrastructure types to support projects with poorer returns
Transport Decarbonisation		✓	✓	✓	✗	High	<ul style="list-style-type: none">• Blending private finance, public funding, and co-benefit payments for active travel infrastructure• Using policy to incentivise the provision of charging infrastructure for electric buses
Waste Management Decarbonisation		✓	✓	✓	✗	High	<ul style="list-style-type: none">• Combining market mechanisms and policy to increase the cost of higher emitting management practices• Using policy to require green design criteria to minimise waste and maximise re-use and recycling
Green Infrastructure		✓	✓	✓	✓	High	<ul style="list-style-type: none">• Effectively pricing co-benefits to develop additional revenue streams• Implementing projects alongside those with direct revenue sources

*Green = Strong existing business case with tangible and predictable financial returns for investors. Amber = Some consistent predictable revenue to provide investors with a return, but lower than desired. Red = Limited to no financial returns.
** Refers to misalignments between those financing projects, and those receiving any associated savings or benefits.

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1 Introduction

1.1

Purpose of this Report

This report investigates the opportunities for private finance to support the transition to Net Zero across the 11 UK Core Cities, the 32 Borough councils, and the City of London that make up London Councils, which together represent approximately one quarter of the UK population. The report seeks to:

- Quantify the magnitude of investment needed to take the UK's Core Cities and London to Net Zero;

- Assess the opportunities and limitations for private finance to play a leading role in financing key city-based Net Zero infrastructure: commercial real-estate, domestic housing, transport, renewable electricity generation, transportation, waste management, and green infrastructure;
- Set out specific projects within cities which would benefit from private sector financial support; and
- Provide recommendations for how flows of private finance into city-based Net Zero infrastructure could be enhanced.



Whilst there is widespread acknowledgement of the scale of the challenge associated with achieving Net Zero across the UK's cities, far less consideration has been given to how the necessary infrastructure will be practically implemented. The provision of finance is a crucial component of this delivery and has been identified by the three commissioning partners (CPC, Core Cities, and London Councils) as warranting examination. In addition, the interaction within cities between public bodies, the private sector, and local communities, is a core focus of

this report. Collaboration between these stakeholders will be important for successful delivery of Net Zero infrastructure within UK cities.

The focus of this report is on Net Zero infrastructure which delivers GHG reductions and climate change mitigation. Whilst in some instances this overlaps with climate adaptation (particularly in the case of green infrastructure), the authors acknowledge further research specifically focussing on climate adaptation would be useful in the future.

1.2

Structure of the Report

The report is structured as follows:

- Section 2.0 includes contextual information regarding Net Zero financing applicable throughout the report;
- Section 3.0 presents the estimation of investment need calculated for the report, setting the scene for the scale of investment required to achieve Net Zero across the cities within scope;
- Sections 4.0 - 9.0 then address the following infrastructure sectors to explore the opportunities and limitations for attracting private finance:
 - Domestic property decarbonisation
 - Commercial property decarbonisation
 - Renewable Electricity Generation
 - Transport decarbonisation
 - Green infrastructure
 - Waste management decarbonisation

As well as setting out financing considerations in principle, each section includes a range of illustrative examples of city investment needs. These examples have been developed in collaboration with the Core Cities and London Boroughs to offer specific instances where the contribution of private finance, in combination with the recommendations for enabling actions made in this report, could move forward Net Zero implementation.

2

2.1

Financing Context

There is considerable context relating to financing Net Zero projects which re-occurs throughout the sector-specific sections later in the report. This section provides this background context to avoid repetition in subsequent chapters.

Investment principles



Upfront spend

Typically, significant upfront spend is required to change the way an existing system operates, whether that is transitioning a bus network from diesel buses to battery electric (more expensive vehicles and the charging infrastructure required), or making buildings more thermally efficient by investing in insulation, cladding, and better glazing.



Lower ongoing costs

Once that upfront spend has been made, the new system may be cheaper to operate, delivering cost savings. For example, electric buses are cheaper to fuel per mile travelled and maintenance costs are lower given fewer mechanical moving parts. Similarly, energy costs to achieve a comparable comfort level in a house are lower once that house is thermally insulated.



Additional revenue streams

In some instances, whilst investment in new infrastructure may not reduce operating costs, opportunities to generate additional revenue streams may be created. For example, payments to use bike-hire schemes, or sales of electricity generated through PV installations, provide an ongoing revenue stream to contribute to repayments on borrowing.

Sufficient savings to ongoing costs and/or additional revenue streams combine to produce a business case for the upfront spend. In the sector-specific sections within this report, a primary consideration is whether the Net Zero infrastructure being considered presents sufficient cost saving or revenue generation opportunities to warrant borrowing for investment. If this is not the case, additional sources of finance - such as grants or payments for co-benefits - are required to repay upfront capital borrowing.



Financing vs funding

Financing and funding are applied with distinct definitions within this report:

- **Funding:** Typically finite, often annual budget-based, grant capital which does not need to be repaid, but can't necessarily scale
- **Financing:** capital that must be repaid. It could be development finance from a public sector source where the initial capital must be repaid but with no additional return requirement, or it could be purely commercial requiring market interest rates (or a coupon) to be repaid on top of the capital over time. Increasingly, there is a spectrum of options

between these two ends of finance looking to deliver impact in addition to generate returns. By its nature, if projects that create returns (ongoing income) can be scaled then so can the finance that provides the upfront capital

Bringing private finance into city Net Zero implementation will require a change of mindset away from grant funding towards returns-based investment and innovation in financial structures. An investment mindset means looking at the positive cash-based returns from Net Zero projects, then capturing, de-risking, and using these revenue streams to raise and then repay finance as part of the upfront capital requirement.

However, having reviewed the Net Zero action plans for Core Cities and London Boroughs, most funding sources referenced are restricted to forms of public sector grant finance, the potential to encourage residents to contribute through various means, and the potential to encourage local businesses to contribute. All of these are effectively forms of non-repayable capital. As stated, based on the context above these sources are unlikely to be sufficient to deliver the scale of infrastructure investment required.

Some Local Authorities reference the role of private finance in the context of green bonds². If these are used as a form of direct Local Government borrowing for general purposes - as is the case in the municipal bond market in the US - a couple of important issues arise. In terms of cost, these green bonds will be competing against the keenly priced Public Works Loan Board³, and will still be limited by overall public sector fiscal borrowing caps, therefore are unlikely to be of sufficient scale.

Clearly, additional sources of finance are required to meet the scale of the funding challenge.

The quantity of expenditure required to deliver Net Zero is therefore very significant compared to public resources, particularly when it is considered that much of the implementation of the Net Zero transition will occur at the local level. The private sector presents a logical route to expand the pool of available finance for the Net Zero transition.

2.2

Scale of the challenge

Analysis undertaken for this report demonstrates a total investment requirement of approximately £200 billion (within a range of £125-£416 billion) to support the transition to Net Zero for the UK's Core Cities and London. The CCC has estimated overall UK Net Zero investment needs to scale to £50 billion per year by 2030, and remain at or above that level until at least 2050 - demonstrating a similarly large order of magnitude of overall cost.

To put the scale of these numbers into some context, UK GDP is around £2 trillion per annum, UK domestic household net savings are around £50 billion (having increased from almost zero pre-pandemic), central Government annual spending in 2020 was around £700 billion, and Local Authority combined annual spending was £180 billion. While the latter numbers feel large, many core services are still recovering from the period of austerity post financial crisis.

2.3



Private financial sector

Potential fit with Net Zero transition

There has been considerable change in the private sector financial services industry over the last few years, led by firms in the UK and Europe, to fully embrace the Environmental, Social and Governance (ESG) impact of their business models. This change is occurring at varying paces in different parts of the industry, but is arguably being led by the pension funds and insurance funds, with, outside of some notable exceptions, others such as bank lending, private equity, and sovereign wealth funds.

This change is being driven by the ultimate asset owners (i.e., individual pension holders, policy premium payers, and savers) putting direct pressure on the organisations that manage their funds, as well as increasing pressure from regulators. That 'push' is now being augmented by a 'pull' as many asset managers realise that sustainable investments may actually perform better in the longer term as a result of negative impacts of unsustainable assets starting to be reflected in valuations and access to capital.

This means there is an increasing quantity of capital which, while still seeking a return

commensurate with the risk being taken, is also seeking demonstrable positive social and/or environmental impact. To put some context on the scale of this, the UK asset management industry managed £9.1 trillion at the end of 2018 (approximately 45 times the £200 billion estimated spend for city Net Zero in this report), and there were £2.8 trillion of funds in the UK pension fund industry.

A key enabler to capital flow into Net Zero infrastructure projects will be the ability to demonstrate impact as well as de-risked returns. Co-ordination and collaboration on data will be key. In the first instance, there is the importance of baseline measurement from which any impact can then be measured. The metrics will of course depend on the individual funders, but are likely to include the likes of air quality, local healthcare outcomes, water quality, biodiversity, community engagement and wellbeing - in addition to the obvious ones of energy consumption and carbon footprint reduction. It will be important to design and adopt consistent frameworks across projects and geographies for data collection and reporting, to enable investors to aggregate and report across their portfolios of funded projects in an efficient way, serving to reduce the barrier to invest.



Investment Horizon

In addition to overall scale of capital, another key consideration is investment horizon. The financial services industry seeks to match the tenure of assets to liabilities. Short term lending by banks is funded by short-term borrowing by the banks, and longer-term assets such as infrastructure are matched with long term liabilities such as pensions. The changes required to drive the Net Zero transition are long term in nature. For example, a deep building retrofit creates small energy savings that repay over a long time period. This alignment of timescales between certain long-term finance sources and Net Zero infrastructure pay-back periods enhances their compatibility.

² A green bond is a type of financial instrument used to fund low-carbon projects

³ Belfast, Birmingham, Bristol, Cardiff, Glasgow, Leeds, London, Liverpool, Manchester, Newcastle, Nottingham, and Sheffield



Project scale

The capital within these funds is also aggregated with individual funds running into tens of billions. Large scale investment opportunities are preferred, often with a minimum ticket size of £30-£50m per investment. Investing smaller amounts requires a similar level of due diligence per investment from the fund manager for a much smaller relative impact on the overall fund.

The nature of many Net Zero transition projects at the city level is a tendency to be fragmented. A domestic retrofit spend per property of somewhere in the region of £10,000-£50,000 is clearly unviable for individual consideration by large private sector funding sources. Solar farms on public land might scale to tens of

millions, but still below a typical minimum pension fund investment.

Therefore, the ability to aggregate Net Zero transition projects to match minimum investment sizes will also be important to unlocking private finance. Aggregation does not necessarily mean Local Authorities collaborating to run large scale projects over wide geographic areas with a combined source of funding. It can also mean co-ordinating on structures and reporting, so that the investor can easily aggregate multiple smaller individual projects into one investment process through common frameworks. It may also mean exploring fund structures to aggregate funding and then invest at a local level in a variety of projects meeting overall return requirements.



2.4

Financial structure of Net Zero transitions

Engaging private finance will require borrowing some of the upfront capital to deliver Net Zero infrastructure. Whilst there are patient sources of capital that can be repaid over the long term, they will still need to be repaid eventually. In making the transition from a 'funding' to an 'investment' mindset, the interventions required to deliver Net Zero create outcomes that typically manifest as long-term annual benefits. These benefits can be separated into:

- Cash returns; and
- Co-benefits



Cash Returns

Some of these benefits have the potential to occur as cashflows. As an illustration, they might be energy savings, energy sales, or transport revenues. If a house is retrofitted with an upfront capital cost, the energy requirements are lower, resulting in an annual energy saving. This looks very similar in cashflow terms to many financial products.



Co-Benefits

In addition to cash returns, many of the outcomes associated with Net Zero infrastructure accrue as more distributed societal benefits, also known as 'co-benefits'. Nonetheless, these co-benefits have very real financial value - local economic stimulus, improved healthcare outcomes reducing the ongoing cost of healthcare services, improved biodiversity outcomes, alleviation of fuel poverty, job creation and the opportunity to upskill redundant roles, mitigation of water run-off, avoidance of flood damage etc. However, challenges can arise when the financial value is difficult to quantify, are not realised immediately, or fail to accrue to the financing organisation (another principal-agent example).

It is reasonable and demonstrable to assume that the transition to Net Zero for the whole economic system will be a positive investment. The aggregate economic value of the cash and co-benefit outcomes could be considerably larger than the upfront investment required to achieve them (particularly when the economic costs of climate change are accounted for). Successfully pricing these co-benefits into our economic system will enable them to be more readily recognised in investment cases, and ultimately help drive private finance towards lower carbon infrastructure.





The Principal-Agent Problem

Successfully harnessing cash returns and co benefits requires any **principal-agent issues** to be addressed.

To illustrate a principal-agent issue, consider public investment in low carbon mass transport options. If delivered to a sufficient standard, the new public transport system may provide an incentive for a car owner to give up their car. The car owner would make costs savings including the annual MOT, insurance, services, maintenance, and fuel. However, the amount recouped by the transport system through incremental ticket sales will typically be significantly less than the savings that accrue to the individual who gave up their car. These savings therefore don't become a revenue source for repaying the upfront capital requirement.

It should also be stated that there can be a clear tension between using the savings that

accrue from a Net Zero intervention to support repayment of finance, or delivering a socially-just transition. For example, a Local Authority funding retrofit of social housing may deliver significant energy savings for residents. That energy saving reduces resident fuel expenditure, which is clearly a positive social outcome. However, if this saving is passed onto the tenant, it isn't then usable to help raise the finance.

Connecting cash returns to the entity that will spend the upfront capital presents the potential to harness these returns to raise funding for that capital - either as simple debt or asset equity. Innovation in contracting and legal entity/finance structures may be required to capture those benefits in a way that allows this. This in turn will create governance requirements to ensure alignment of commercial, civic, and public sector interests, but these are solvable issues.

2.5



Placed Based Investment

Systemic Interventions in One Place

There is a strong tendency to think about the Net Zero transition in isolated technological chunks. How to encourage domestic heat pump installation? How to bring investment into hydrogen as a fuel?

The reality when implementing solutions in practice, is that these occur in local places, and multiple infrastructure needs are required simultaneously. As demonstrated through **Figure 1**, the transition of a residential neighbourhood to a low carbon community will require several interventions. The building fabric will need to be made more thermally efficient, new heating sources will need to be provided, localised renewable energy generation could be rolled out, charging/refuelling infrastructure will need to be provided for new mobility options, green infrastructure will need to be planted and

maintained, and potentially new community assets will need to be funded to allow residents to obtain goods and services closer to their homes. In other words, a wholesale investment into communities is required.

Similarly, to the frustration people feel when a particular road is dug up and re-surfaced in succession by the gas company, the broadband provider, and then the water company, implementing these changes in an uncoordinated way is liable to create a backlash from the people living in the community, and will also overlook potential economic efficiencies. It is cheaper to dig up the road once, rather than three times in succession.

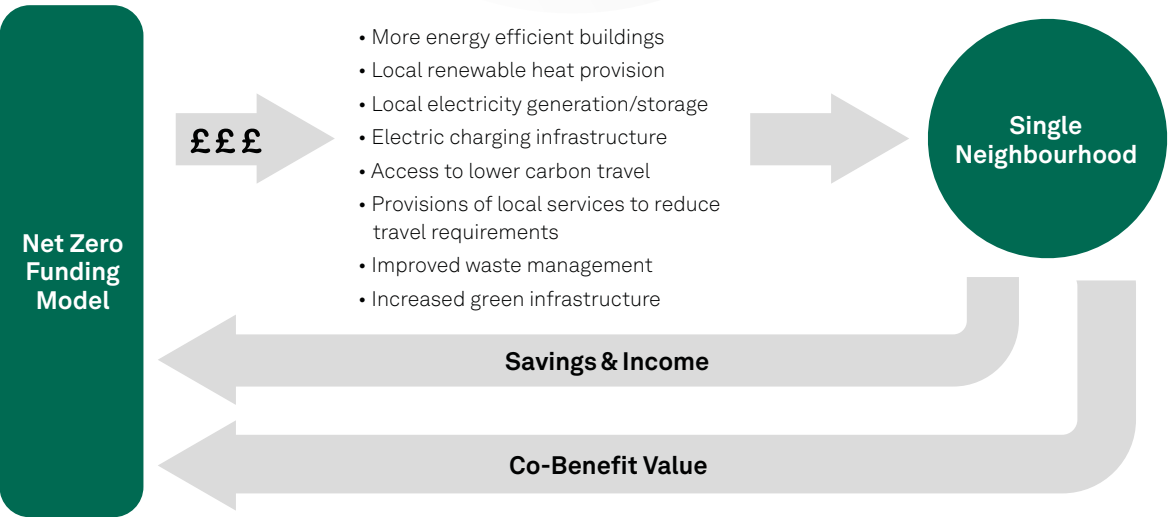
In addition, different interventions can have multiplying effects when combined. A commonly cited example is that it is more cost effective to combine heat pump installation with solar PV and building fabric thermal efficiency improvements, as the latter helps offset the relatively higher cost of electricity (rather than gas) used by the heat pump.

Combining a range of complementary interventions enables consideration of aggregated financing requirements and the multiple benefits that will accrue. It allows funding models to be considered that can aggregate, and therefore scale the spending that is required, allowing engagement with sources of finance beyond individual loans, simultaneously removing the need for individual resident indebtedness - a key barrier to action.

This instead supports blending different sources of grant finance, while also using the cash returns to support a layer of private finance. This is explored in greater detail in the next section.

As mentioned, this will require contracting mechanisms to capture the energy savings and other cash benefits from residents who benefit from the investment at no upfront cost.

Figure 1:
Centrally funded
place-based
decarbonisation



In addition, orchestrating these systemic neighbourhood changes facilitates procurement at scale, improving economic efficiencies and providing more certainty to a supply chain which will itself be required to invest and upscale. These structures can also ensure that the borrowing stays away from Local Government balance sheets - segregated against the future income streams rather than against the general revenue budget.



Engagement – “With” not “To”

An important practical consideration of the place-based approach is that it can't simply be done “to” communities and residents. At least, not without significant and controversial policy to force action, and potentially regressive economic impacts.

The place-based approach would operate much more effectively “with” communities, where the necessary steps are taken to enable communities to embrace the positive changes to the places that they live and increasingly work in. The behaviour change required by individuals to facilitate Net Zero infrastructure investment will not be insignificant, and will be an important area for further consideration around these financing models.

Box 1: Bristol City Leap - a new approach to £1 billion city scale decarbonisation

Bristol is leading by example in taking action on climate change. They were the first UK city to declare a climate emergency and have committed to being a carbon neutral city by 2030. To meet the 2030 target, Bristol needs to up the pace of delivery and created the City Leap initiative. This is an ambitious new approach partnering the public and private sector, designed to attract £1 billion of new investment into Bristol’s energy projects and support the creation of a zero-carbon, smart energy city by 2030. The initiative will focus on a range of project types, including low-carbon heat networks, renewable energy from wind and solar, as well as energy efficiency, electric vehicles and smart energy systems using emerging technology.

The Council is creating a joint venture company which will be co-owned with a private Strategic Partner to deliver and fund low carbon energy projects across the city. The Council will be forming a partnership with a company who has the scale, resources, and capacity to deliver in a way the Council would not be able to on its own. City Leap will seek to leverage its work on the Council’s estate to deliver projects in the domestic and commercial sectors, as well as working with other Local Authorities.

As well as tackling the city’s environmental challenges, City Leap will deliver significant social and economic benefits for the people of Bristol and its businesses, including investment in local facilities and jobs, clean air, and warmer healthier homes. City Leap is a world first, a game changer. Building on the £60 million of investment that the Council has already made into renewable and low carbon technologies, it has the potential to completely transform Bristol’s energy system, creating a replicable model for others to follow.



2.6 Blended Finance - Solving for Poor Cash Returns

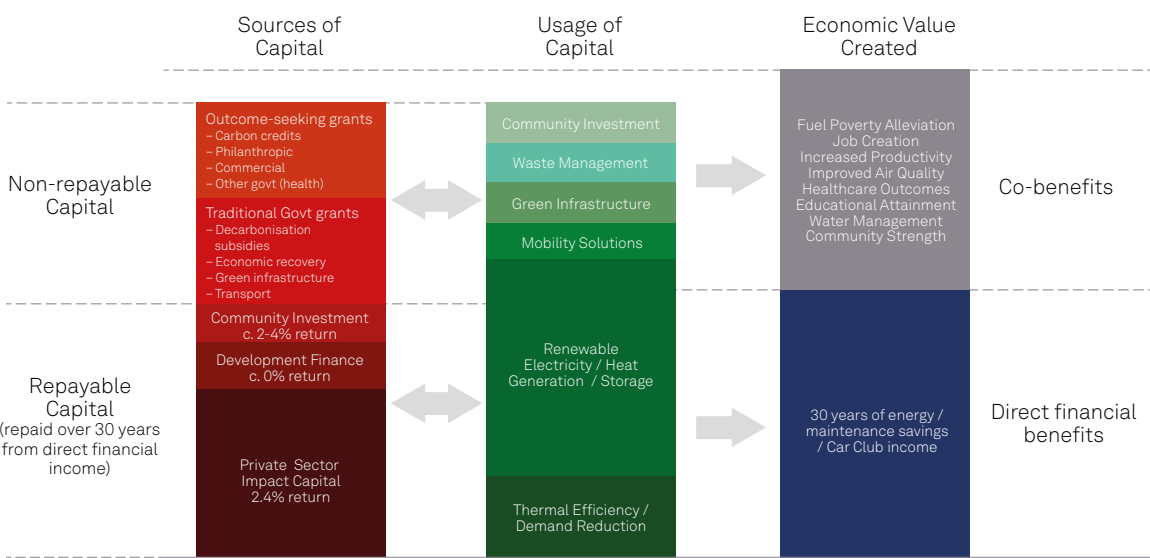
There is, as stated, a strong case that the transition to Net Zero will be in aggregate, economically beneficial to society. However, given the current lack of scaled implementation, and in some cases immature technologies, the cash benefits from decarbonising our cities are often not sufficiently compelling for private sector investors alone.

The solution is to blend finance. By covering part of the up-front capital through grant-type, non-repayable funding, the remaining financing component of the capital can then be supported by the available income streams. The lower the cash returns, the more grant funding is required to subsidise the initial investment.

As demonstrated through **Figure 2**, the cash returns (at the bottom of the most right column) are used to repay long term private finance (the bottom of the most left column), while the co-benefit returns (top half of the most right column) support the blending of non-repayable grant-based finance (top half of the most left column).

Figure 2: Blended finance illustration showing sources and usage of capital with associated returns

Source: BwB



Risk plays a role as well. The lower the return that the lender requires (driven by a perception of a lower risk to the income stream), the more capital they can lend for a given absolute income stream. Therefore, a greater portion of up-front capital can be delivered by private finance. Given this dynamic, there is a potentially crucial role from HM Treasury and the insurance industry to provide guarantees or insurance on future income streams, particularly for innovative or pilot-stage Net Zero projects.

The lower and/or riskier the cash returns are, the higher the amount of subsidy is required in the model. This means that a risk of this simple approach is one of cherry-picking. The best returning technologies can occur with reasonable levels of grant financing, leaving the most challenging interventions unfunded. It follows that there is an opportunity to combine projects with different return profiles to achieve an overall reasonable return profile - as discussed in the previous section on 'place-based investment'.

3

Quantifying Net Zero Investment Need

Method

This section provides a summary of the Stage 1 findings of this work. The Stage 1 findings are intended to present the scale of investment required to achieve Net Zero across the following UK cities:

- Belfast
- Birmingham
- Bristol
- Cardiff
- Glasgow
- Leeds
- London
- Liverpool
- Manchester
- Newcastle
- Nottingham
- Sheffield

Delivering the estimate of total investment need for Net Zero involved:

- 1) Gathering city climate plans and developing a data collection system;
- 2) Extracting data from city climate plans, including required infrastructure and associated costs;
- 3) A review of the collected data by city representatives, including recommended amendments;
- 4) Addressing data gaps through extrapolation approaches; and
- 5) Data analysis to calculate estimated investment needs.

Results

Delivering Net Zero will require substantial quantities of finance. The outcome of the calculations undertaken show Net Zero investment need to be £206 billion (this sits within a range of £112-334 billion). Table 2 shows the investment need split by five key sectors: Commercial Decarbonisation, Domestic Decarbonisation, Renewable Electricity Generation, Transport and Waste.^{4, 5, 6}

Version	Commercial Building Decarbonisation	Domestic Building Decarbonisation	Renewable Electricity Generation	Transport	Waste
Upper bound	97	136	26	70	4
Average	43	95	17	48	3
Lower bound	19	53	9	29	2

Examples of the type of interventions requiring investment in each sector are as follows:

- **Commercial Decarbonisation:** Building energy efficiency, low carbon heat sources, decarbonising industrial processes
- **Domestic Decarbonisation:** Building energy efficiency, low carbon heat sources
- **Renewable electricity generation:** rooftop solar PV, some wind generation
- **Transport:** A variety of measures, such as EV bus roll outs and creation of cycling infrastructure
- **Waste:** A variety of measures, e.g., improving recycling rates and removing plastic from residual waste

This level of investment will not be payable by the public sector alone. It requires the co-ordination of public and private sector actors,

as well as private financing. This goes well beyond “business-as-usual” public funding capacity.

Whilst it has been possible to develop these overall estimates of investment need from city climate plans, data availability was sparse and substantial use of extrapolation was required to deliver the results. To improve these estimates, give cities greater certainty regarding the scale of action required, and appropriately direct implementation efforts, cities would benefit from further support to address gaps in decarbonisation plans. This includes details of the type and scale of interventions required to meet Net Zero, as well as the specific costs that will be relevant in their areas. In addition, more systematic development of plans and presentation of data would benefit the investment community by more clearly indicating areas of greatest need and opportunity.

Next report sections

The following sections now turn to detailed assessment of the financing opportunities associated with each Net Zero sector, and in particular, how private finance can play a role in delivering the estimated £200 billion of investment need.

⁴ Rounding may mean that the figures do not exactly add up.

⁵ The costs presented are capital costs. This includes the upfront costs of paying for new infrastructure. Other considerations such as potential savings, or the cost of borrowing, are not included.

⁶ There are some evidence gaps; green infrastructure plans were less extensive across cities so have not been included in the total cost figures. Also, adaptation measures were not the core focus of this research and are not explicitly presented within the costs.

4

Domestic Decarbonisation

Summary

Tackling GHG emissions from the UK's domestic housing stock is one of the major challenges to achieving Net Zero. Knowledge of the interventions required to achieve decarbonisation is now well developed, and there is increasing acknowledgement from citizens and public bodies that rapid progress is required.

However, the direct financial returns on domestic retrofit in the current market are currently insufficient to warrant cumulative action by individual homeowners, or to attract large scale private finance. In addition, a range of principal-agent misalignments, as well as hesitancy around the complexity of retrofit amongst homeowners, are limiting the pace of implementation.

Opportunities to enhance the scale of finance in this sector include:

- Using energy spend savings associated with rooftop solar PV and battery storage to subsidise retrofit interventions with poorer returns, such as heat pumps
- Initiating community focused, multi-intervention Net-Zero-as-a-service implementation models to aggregate project sizes and coordinate blended streams of financing



4.1 Domestic Decarbonisation at a Glance

Current suitability for private sector investment	Principle-Agent issue to address?	Suitable for carbon co-benefit payments?	Suitable for health co-benefit payments?	Suitable for biodiversity co-benefit payments?	Need for policy development to enhance private finance flows
	✓	✓	✓	✗	High

4.2

Net Zero Interventions

4.2.1 Scope of Interventions

Energy consumption in buildings accounts for c.17% of the UK's Green House Gas emissions, or 87mtCO₂e. Residential properties (29 million in the UK) account for just under 70% of these emissions. Interventions for decarbonising residential property can include:

- 1) Reducing the energy required to heat and cool the home through thermal efficiency improvements to the building fabric, such as insulation, double glazing, cladding and mechanical ventilation
- 2) Changing heat sources to lower carbon options, for example switching gas boilers for heat pumps or renewable powered district heating
- 3) Replacing older, less efficient appliances including lighting for lower energy consumption models
- 4) Resident behaviour changes to reduce unnecessary energy consumption, which can also be enhanced by smart technology deployment

5) Adding rooftop solar/battery systems to reduce reliance on power from the grid

On point 2 there has been recent debate about whether hydrogen can be distributed using the existing gas network to replace gas as the fuel for heating our homes. There have been several trials, but the case remains unproven. In the recently published UK Hydrogen Strategy a potential role is acknowledged, but demand is expected to be low⁷. Hydrogen will clearly have a role in the overall Net Zero transition but there are some arguments to suggest distributed heating is not the best use case.⁸

One feature of the global Net Zero debate has been a temptation to rely on future innovation to solve current problems. Whilst important, this can prove a distraction to current action. Therefore, in this document we are only considering currently viable technology for degasification - principally the installation of heat pumps or roll out of district heating solutions. The focus on innovation is instead focussed in the financing considerations.

⁷ https://assets.publishing.service.gov.uk/Government/uploads/system/uploads/attachment_data/file/1011283/UK-Hydrogen-Strategy_web.pdf

⁸ <https://energymonitor.ai/sector/heating-cooling/heating-homes-with-hydrogen-are-we-being-sold-a-pup>

On point 5, whether installation of solar/battery should be included within retrofit is a subject for discussion. This is returned to in the economic case section below, as well as the Renewable Energy Generation report chapter.

4.2.2 Cross over to other domains

There can also be potential interactions with other Net Zero domains which have an additive impact, and hence further support the argument for coordination of various Net Zero sectors in single locations. For example;

- **Green infrastructure:** While focus on building energy consumption is often on heating - as that is currently the most significant energy usage for homes - the average temperature rises likely in the UK also suggest growing uptake of residential air conditioning. National Grid have predicted 60% of homes could adopt air conditioning by 2050. A report by the UK Energy Research

Centre suggested a lower adoption of less than a third of properties, but either way this will likely be a significant new energy demand for household comfort.⁹ In warmer areas, deploying green infrastructure in the immediate vicinity of the property has a temperature regulating impact, serving to reduce the heat island effect (potentially by 10 degrees Celsius) and therefore mitigate increased energy demand for cooling measures during heatwaves

- **Transportation:** Growing uptake of battery electric vehicles (EVs) for personal transportation is already driving installation of household chargers in approximately 60% of UK homes that have off street parking. This is creating additional energy demand through household meters, and therefore further enhances the business case for on-site solar/battery for the homeowner

4.3 Economic Case

In the first stage of this report, the total cost of domestic decarbonisation for Core Cities and London Councils was estimated to be £57-£158 billion with a central case of £108 billion.

The CCC has estimated a total cost for the UK of £250 billion, made up of £55 billion on energy efficiency measures, £180 billion for low carbon heating (principally heat pumps), and the remaining balance on behavioural change measures. These figures do not include solar PV. Energy efficiency measures and heat in residential housing are considered the two most expensive abatement measures across all domains on a £/tCO₂e abated basis.

Domestic decarbonisation as defined by the CCC's 6th carbon budget has very poor returns. Analysis conducted by BwB suggests that 80% subsidies will be required to make the investment return from energy savings enough to offset borrowing costs for work required. Including solar connected batteries within the project scope increases the capital required, but materially improves the returns and may be key to changing localised incentives.



⁹ https://d2e14xsswepgz.cloudfront.net/uploads/2020/10/WSNF_IVUGER-Report_Oct-2020.pdf

4.3.1 Basics of Economic Drivers

The economic case for domestic retrofit is a simple returns model.

An upfront capital budget pays for the required blend of energy efficiency measures, in turn creating a home with a lower energy cost to deliver the same level of comfort that existed pre-retrofit. This delivers an annual cost saving as well as savings to the NHS through better insulated homes with healthier occupiers. In theory, the annual saving in energy costs can be used to repay the upfront capital and provide a return over a period of years, hence creating an incentive for action.

However, current deep retrofit rates are less than half a percent of properties per annum, despite various subsidies being made available. This is a global issue. Four inter-related barriers considered to cause this low implementation rate include:

- 1) Motivation
- 2) Implementation Complexity
- 3) Principal-Agent Issues
- 4) Poor Economics

Motivation

In part due to the other three barriers, citizen interest and motivation to carry out retrofit work is low. For those whose income or wealth means that the financial investment isn't immediately prohibitive (on a relative basis at least), the potential savings are limited, and the perceived disruption of a home renovation is significant.

For those where discomfort is an active problem and therefore a potential motivator (overly cold, overly warm, damp and/or draughty homes), the financial barriers are typically greater.

While environmental motivation is growing, it isn't currently widespread enough to spur mass action.

Implementation Complexity

As recently highlighted by a coalition led by Citizens Advice, even for the motivated citizen with an appropriate budget, working out the best and most economic decarbonisation is complex.¹⁰ Navigating various technology focused subsidies, dealing with Local Authority planning submissions for solar installation, and picking from a range of potential interventions (typically supplied by different specialist firms), is not easy.

Principal-Agent Issues

A recent report commissioned by Connected Place Catapult and authored by Vivid Economics called "The potential for innovative financing to drive sustainability in the UK built environment sector", explores this issue in detail and focuses particularly on the private rental market.¹¹ If an investment yields a return, but the return accrues to a different entity than the investor, the return won't incentivise the investment.

Principal-Agent Issues in the Private Rental Market

As an illustration, a private landlord's profit motive is to maximise their rental yield while minimising ongoing spending on the property. If they "invest" in retrofit of their property, the benefit of lower energy costs accrues to their tenant, and not to them. Their yield therefore falls. One solution is to increase the rent by the same amount that the energy costs have fallen. The tenant is now in the same financial position as previously and the return now accrues to the investor. However, this makes the headline rent on the property higher and therefore the property less marketable. The Vivid Economics report suggests this is the key barrier to retrofit in the private rental market.

The Principal-Agent issue isn't only present in the 19% of households that are privately rented. Counterintuitively, it is arguably a greater issue in the 18% of households that are socially rented.

Principal-Agent Issues in the Social Housing Market

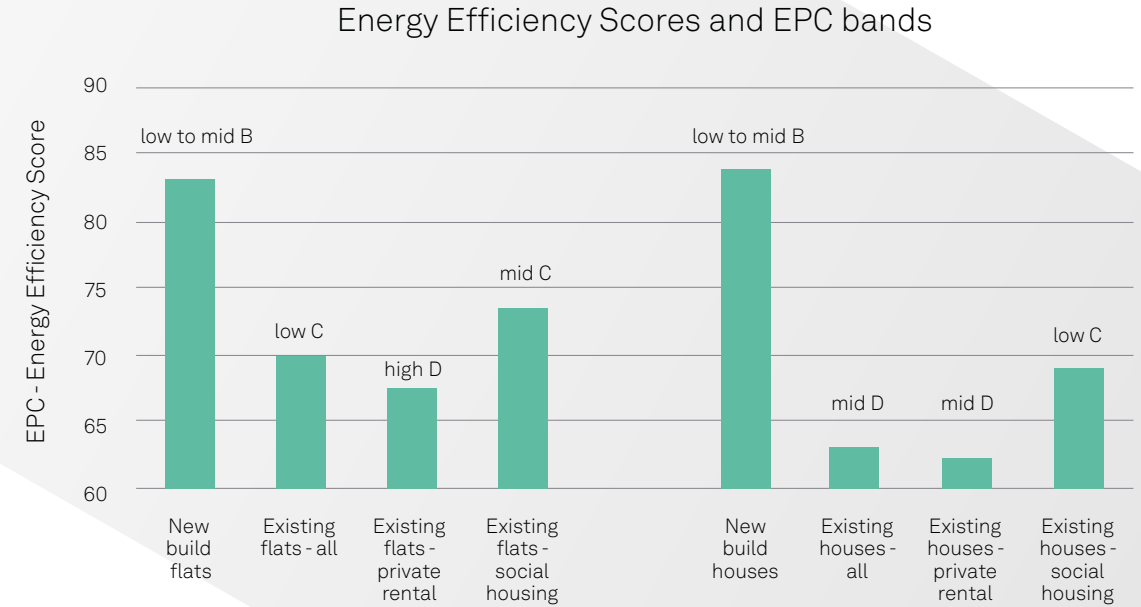
In theory, the incentives of a social housing landlord should be more aligned with the social

outcomes for their tenants who are more likely to be living in fuel poverty. The motivation to invest in the property for the good of the residents, should be higher.

The data (in this case for England and Wales) bears this out.¹² **Figure 3** shows that social Housing properties (both flats and houses) are more energy efficient than the broader stock, while private rental properties are less energy efficient.

Figure 3: Energy Efficiency Scores and EPC Bands

Source: BwB & Office of National Statistics



In part, this is because social housing landlords have been significant new property builders, so their existing stock is more skewed to more efficient newer properties. It also reflects ongoing efforts to improve existing buildings.



So why do we argue that the Principal-Agent issue is potentially greater in social housing than private rental?

The reason is the underlying business models. Private rental landlords are profit seeking organisations. They can afford to invest in the properties, they simply choose not to because it reduces their profit. This can be addressed through policy.

¹⁰ <https://www.citizensadvice.org.uk/about-us/about-us1/media/press-releases/decarbonisation-of-29-million-homes-at-risk-due-to-significant-gaps-in-net-zero-plans/>

¹¹ <https://cp.catapult.org.uk/news/the-potential-for-innovative-financing-to-drive-sustainability-in-the-uk-built-environment-sector/>

¹² <https://www.ons.gov.uk/peoplepopulationandcommunity/housing/articles/energyefficiencyofhousinginenglandandwales/2020-09-23#coverage-of-energy-performance-certificate-data>

Social housing organisations do not have the same profit motive. When established, a social housing organisation is capitalised based on assumptions of below market rental income, and an expected annual operating and maintenance cost to be a sustainable but not highly profitable enterprise. Adding in extra, unexpected and unfunded capital expenditure to rapidly improve the housing stock, breaks the business model unless rents are increased.

Social housing organisations want to invest in decarbonising their properties, but they can't afford to, and/or other pressures such as building safety come first. Applying policy to force them to invest will ultimately impact their ability to operate or push economic burden onto those who can least afford it.

Principal-Agent Issues in the Owner-Occupier market

Finally on the Principal-Agent issue, and perhaps even more counterintuitively, it is also a significant issue in the remaining 63% of UK homes that are owned by the occupier. In theory this shouldn't be the case. The owner of the house also lives in it, so they benefit from the lower energy costs for the time period they inhabit the property. However, as we will see in the next section, the annual energy saving is small compared to the upfront investment. So, to make any economic argument attractive requires

receiving that energy saving for a long time, and this is only viable if the home owner remains in the property over this period.

Over half of owner-occupiers are over 65. While this demographic may have access to savings and may have repaid most or all of their mortgages, these assets are typically earmarked for future cost of living post retirement, and most mortgage providers are unlikely to lend for retrofit investments.

For younger demographics, the intent to stay in their current property is unlikely to be long enough, given future changes in employment and/or family situations. Therefore, unless there is strong belief that energy efficiency investments will be fully reflected in the house price, a different version of the Principal-Agent issue has been created. The investor is the current resident. The main beneficiary of lower energy prices is a future unknown resident.

Poor Economics

The poor returns associated with investment in domestic retrofit are a core reason for low implementation rates.

Using CCC data, analysis undertaken for this report demonstrates achieving a 0% return (i.e. repaying the initial investment) would take 29 years. To achieve the 2% return a mortgage lender lending for 10 years requires, would take 38 years.

Required return	0%	1%	2%	3%	4%	5%	6%
Years of investment	29	33	38	46	60	100	Never

Government subsidy is a potential solution to these poor returns. Using Government subsidy means an investor is able to use any energy savings to pay back other finance sources utilised. Calculations undertaken for this report show that subsidising the cost of retrofit works by approximately 80% would enable a commercial loan to be used to fund the remaining 20%, assuming savings on energy costs could be used to repay the loan.

Range of Costs

In the worked example above, the CCC estimates for average cost of retrofit and associated returns have been applied. These are limited to energy efficiency measures and heat pump installation, and exclude spend on rooftop solar and battery storage.

For individual houses, the scale and technical potential of possible interventions will vary, as will the associated economic case. The exclusion of domestic solar and battery storage from the CCC's calculations warrants consideration.

The argument against distributed rooftop solar deployment as a component of housing retrofit, is that from a national perspective, it would be more cost efficient to deploy PV capability (and wind) centrally to continue the decarbonisation of the National Grid. This is due to the economies of scale of larger centralised facilities. This may also reduce the need for upgrading grid infrastructure required by power flowing back and forth in a grid designed primarily for one way delivery. This argument is strong from an economic perspective, however the

economic upside of this approach likely flows predominantly to the listed utility companies or to all end consumers, and therefore isn't harnessed as an incentive for individual action.

The argument for including solar/battery in domestic decarbonisation is that solar/battery is one of the potential interventions with the best overall economic investment case (even at a single house scale). Therefore, from the perspective of the individual or entity funding decarbonisation of the house, while its inclusion increases the upfront capex budget (typically by around £5,000-£10,000 depending on size), it enhances the overall economic case. This creates a greater impetus for action on the whole package of decarbonisation interventions. The solar PV and battery combination effectively cross-subsidises other components and the overall "profit" of deploying solar PV is deployed directly in further decarbonisation.

Looking at an illustrative investment case of the solar/battery standalone, the investment period is much closer to the benchmark ten-year mortgage rate of 2%.

Required return	0%	1%	2%	3%	4%	5%	6%
Years of investment	10	11	11	12	12	13	14

From the perspective of spurring action on local decarbonisation, solar/battery could play a pivotal role in a blended economic structure.

In addition to the cash return benefits discussed above, there are considerable co-benefits associated with domestic decarbonisation. Poor quality housing creates issues such as damp, and temperatures that are too high or low can have a negative impact on health. This delivers a cost to the National Health System. The CCC estimate a £1.4-£2.0 billion per annum healthcare provision cost related to poor housing.¹³

There is also a more indirect cost on productivity from residents suffering from ill health, which is not severe enough to require direct engagement with the healthcare system, but enough to stop them from working as productively.

Finally, by reducing the costs to heat homes, fuel poverty can be reduced. This opens up broader spending capacity into the local and national economy, and reduces costs specifically amongst disadvantaged groups.

13 <https://www.theccc.org.uk/publication/uk-housing-fit-for-the-future/>

4.4 Enabling Factors

Most existing financing approaches are aimed at encouraging the individual property owner to undertake and pay for the interventions themselves. These approaches include, but are not limited to the following:

- Green mortgages;
- The recently closed Green Homes Grants Voucher Local Authority Delivery programme;
- Local council support for property insulation;
- Grant support for cavity wall insulation; and
- Energy Company Obligation.

There have been many different support schemes and products, but few have had real traction. Continuing to increase individual homeowner subsidies and incrementally apply policy to force spend, risks costing the Treasury significantly and create regressive outcomes.

The technical complexity and poor economics associated with domestic retrofit suggest a different, more centralised and co-ordinated approach might be better suited. A key recommendation of this report is to trial a new approach: creating Local Authority aligned agencies to provide retrofit-as-a-service which will:

- Centralise and leverage technical expertise;
- Create economies of scale in procurement;
- Aggregate projects at a scale that matches finance sources;
- Act as a funding organisation to blend grant-based funding with returns-based finance at scale;
- Apply technical solutions to whole streets at a time at no cost to the asset owner;
- Legally contract with properties to capture net resident energy savings in return for paying for the retrofit works; and
- Upskill workers currently employed in diminishing sectors to reduce unemployment.

This approach will make the sign-up process and implementation as simple as possible for residents improving engagement.

This model effectively creates a financing solution that leaves the cost with the building rather than the occupier. This overcomes the present challenge of occupiers often vacating a property before a return on their investment in low carbon infrastructure would be realised. The new occupiers will pick up the responsibility for the remaining payments which would in effect be a maintenance and comfort contract, or energy as a service model, rather than being characterised as debt - potentially over a significant period of time. This is a variation on the financing model in the US which is known as a PACE model and in Europe the Euro-Pace model. Tenancy agreements must be created that allow the provider of capital for the interventions to capture the benefits. This could be achieved with an “on bill” solution as we have seen in the USA with a role for Ofgem in implementation.

Regional schemes need to be developed for communities to turn to for trusted, independent advice about what can be done to their homes. This will include approved tradespeople, manufacturers, and financing schemes. These regional schemes should share information nationally to capture learnings, drive best practice, understand bottlenecks in the process, and make sure buying scale is maximised. Central Government should provide local councils with the financing to build these advisory services.

To progress this enabling solution, councils should conduct neighbourhood pilot schemes where local capacities can be tested, trialling different financing schemes and in particular, attempting to understand how citizens can be motivated to embark on this necessary programme. These schemes need to be funded centrally to create the necessary capacities within councils, but also with external providers such as surveyors, engineers, lawyers, and financiers so that pilot schemes have the capability of being scaled up in the future.

There remains an issue of engagement from residents. A broader vision for providing retrofit-as-a-service at a neighbourhood level would be to embrace a multitude of other interventions, across domains that look to maximise the decarbonisation of a neighbourhood. A combination of transport, green infrastructure, community investment, and building retrofit would enable a truly low carbon environment to be created. This reinvention of a neighbourhood into a cheaper, cleaner, and better place to live could prove far more engaging than building fabric driven disruption. As proposed by Bankers without Boundaries, a blended finance scheme that captures different Government subsidies, financial recognition of health and carbon benefits, along with energy bill savings, should be explored to deliver this. It is noted that in the detailed CPC report by Vivid Economics, there was recognition that a place-based holistic approach to decarbonising neighbourhoods can create stronger momentum towards Net Zero targets.



4.5 Illustrative Examples

These illustrative examples were collated from UK Core Cities and London Boroughs to demonstrate the type of projects which may be suitable for private sector investment.

Glasgow: £10 billion requirement for 428,000 home retrofit

Across the Glasgow City Region it is projected that there are nearly 428,000 properties that are currently in the Energy Performance Certificate D-G categories. These homes need to be retrofitted to meet local and national climate change targets. Approximately £10 billion will be required to delivery this ambition.

A programme of investment on this scale will be the most comprehensive and ambitious home energy retrofit programme ever to have been undertaken, and requires sustained long-term investment. Over a 10 year programme of investment and delivery, it is estimated that the programme would support over 75,000 jobs and generate £4.4 billion in Gross Value Added (GVA) across the Glasgow City Region. In addition to the employment and economic benefits, widespread insulation across the region would remove 10.7 million tonnes of carbon emissions per annum.¹

¹ <https://invest-glasgow.foleon.com/igpubs/glasgow-green-investment-prospectus/glasgow-city-region-home-energy-retrofit-programme/>

Bristol and Liverpool: £3.7 billion combined requirement for low carbon heating systems

Bristol and Liverpool have identified the following heat pump and district heating connection requirements for their cities:

- **Bristol:** 93,465 homes need to be fitted with an air source heat pump and 61,873 homes need to be connected to district heating to reach Net Zero by 2030. This is estimated to need an investment of approximately £2.4 billion*
- **Liverpool:** The city's *developing* Net Zero Carbon plan has identified that 193,000 homes need to be fitted with a heat pump and 65,000 homes to be connected to district heating to meet its Net Zero ambitions by 2030. This will require an estimated capital investment of £1.3 billion*

Combining these requirements presents an investment of transaction costs and increase efficiencies through economies of scale and shared learnings.

*Cost estimates vary due to differencea an underlying assumptions

Manchester: £250 million Social Housing Partnership Retrofit Project

The retrofit project requires investment for an initial four-year programme to enable Manchester social housing providers to establish a collaborative approach to procurement and delivery, with a programme of around 3,500 properties per year and funding of £260 million.

The Manchester Housing Provider Partnership (MHPP) is made up of 17 social housing providers who manage 68,000 homes across the city. The project would develop bespoke solutions to property archetypes across the member's portfolios, and using procurement packages, would allow the team to secure capacity and expertise from the construction sector. The investment will bring properties up to a zero-carbon standard, each with their own energy generation and storage. The Partnership's housing retrofit programme is the initial phase of a 15-year programme for affordable homes. As the first stage of understanding what zero-carbon looks like, organisations have begun stock-profiling exercises to establish the level of investment over the next 18 years. Indications are for an investment figure of £21,500 per property, contributing to a total investment of £1.7 billion across MHPP over the next 18 years.

Leeds, Sheffield and Belfast: £9 billion combined requirement for domestic retrofit

Leeds, Sheffield and Belfast have identified the following domestic retrofit requirements for their cities:

- **Leeds:** Investment required to retrofit domestic homes (including installation of solar PV) is £2.6-£5.5 billion
- **Sheffield:** Investment required to retrofit domestic homes to meet its climate targets by 2030 is £2-£5 billion. The costs include improvements to building fabric, LED lighting, smart heating controls, decarbonising cooking equipment and installing heat pumps. It excludes district heating connections, solar thermal collectors and building-mounted PV - which have been accounted for separately under energy generation investment
- **Belfast:** Investment required to reach Net Zero through retrofitting approximately 100,000 homes with a range of low carbon measures such as lighting upgrades, double glazing, insulation, and solar PV installations, is £1.5 billion

Combining these requirements presents an investment need of approximately £9.1 billion. Collaboration between these cities could help minimise transaction costs and increase efficiencies through economies of scale and shared learnings.

Annual energy expenditure savings are expected to be up to £395 million from these lists of measures, and the investment for Leeds and Belfast alone is anticipated to result in approximately 7,000-15,000 employment years.



London: £98 billion requirement for retrofit (including solar PV)

The majority of homes across London require retrofit works to reach Net Zero, including improvements to building fabric, installation of low carbon heat sources, installations of low carbon lighting, and installations of photovoltaics (3,834MWh, roughly 11,502 panels). The anticipated investment required to deliver this transformation is £98 billion, £13 billion of which is associated with the installation of photovoltaics.¹

On a sub-regional basis this need can be split into the following sub-regional needs:

- **783,000** properties in North London, with a total investment requirement of £20 billion. This need includes Barnet, Camden, City of Westminster, Enfield, Haringey, and Islington
- **787,000** properties in East London, with a total investment requirement of £19.5 billion. This need includes Barking and Dagenham, City of London, Hackney, Havering, Newham, Redbridge, Tower Hamlets, and Waltham Forest
- **792,000** properties in South East London, with a total investment requirement of £20 billion. This need includes Bexley, Bromley, Greenwich, Lambeth, Lewisham and Southwark
- **644,000** properties in South West London, with a total investment requirement of £17 billion. This need includes Croydon, Kingston upon Thames, Merton, Richmond upon Thames, Sutton, and Wandsworth
- **773,000** properties in West London, with a total investment requirement of £20 billion. This need includes Brent, Ealing, Hammersmith and Fulham, Harrow, Hillingdon, Hounslow, and Kensington and Chelsea

An investment of £85 billion in building retrofit is estimated to result in roughly 1.3 million FTE jobs.² Moreover, an investment of £13 billion in photovoltaics is estimated to result in approximately 130,000 net jobs.³ This demonstrates how investment in building retrofit, including solar PV installation, can strongly support the building of a low-carbon economy in the UK.

¹ Parity Projects (2021) London Councils: Pathways Report

² Calculated using C40 Cities toolkit (C40 Cities, BuroHappold, Rokwool (March 2020) 'The Multiple Benefits of Deep Retrofits: A Toolkit for Cities') lower bound estimate of 12.8 FTE jobs per €1million invested. Using a conversion rate of 1 EUR = 0.85 GBP (as of 30 July 2021).

³ UK ERC (2014) Low carbon jobs: the evidence for net job creation from policy support for energy efficiency and renewable energy (available <https://ukerc.ac.uk/publications/low-carbon-jobs-the-evidence-for-net-job-creation-from-policy-support-for-energy-efficiency-and-renewable-energy/>)

Commercial Decarbonisation

Summary

There are a growing number of examples where district heating schemes connecting public and/or private commercial buildings are providing viable investment opportunities.

In addition, increased demand from tenants for ‘green’ tenancies, and carbon reporting and reduction targets being established by large landlords, have the potential to stimulate investment in this sector.

However, the scale of the challenge ahead of decarbonising commercial building stock remains significant. The considerable quantity of property occupied by SMEs with restricted capacity to pay for retrofit works, is a particular issue in this sector. Challenging return profiles when considering the retrofit of individual buildings also present limitations for private financial investment.

Structures for aggregating retrofit works across multiple commercial premises, or alongside place-based holistic Net Zero projects, presents an opportunity for enhancing the return profiles of these projects. These structures would be further stimulated by policy requiring enhanced levels of building energy efficiency.

5.1 Domestic Decarbonisation at a Glance

Current suitability for private sector investment	Principle-Agent issue to address?	Suitable for carbon co-benefit payments?	Suitable for health co-benefit payments?	Suitable for biodiversity co-benefit payments?	Need for policy development to enhance private finance flows
	✓	✓	✗	✗	High

5.2

Net Zero Interventions

This section considers opportunities for financing the decarbonisation of commercial and public buildings.

Commercial and public buildings account for c7% of the UK’s CO2 emissions, or 35mtCO2e. Similarly to residential buildings, there are several measures that existing landlords and occupiers can embrace to lower their carbon emissions:

- Energy efficiency measures such as insulation, efficient lighting and efficient appliances;
- Incorporating energy management systems that allow for more efficient zoning and timing of energy use services;

- Encouraging behavioural changes such as switching lights off and accepting lower ambient temperatures;
 - Low carbon heating interventions such as air or ground source heat pumps;
 - Solar PV installation and associated battery storage solutions.
- Commercial and public buildings can be important enablers for broader neighbourhood decarbonisation through connection to district heating schemes that can benefit both public and residential communities.



5.3

Economic Case

At a high level the CCC in their 6th Carbon Budget calculate that Commercial and Public buildings can effectively reach zero emissions by 2050. The total investment would be £110 billion, for annual operating savings of £3 billion.

Large landlords and occupiers increasingly recognise the sizeable cost and growing risk in failing to address the carbon footprint of their buildings. Tenants are increasingly demanding ‘green’ office spaces, and the commitment to Net Zero by large commercial landlords is turning the spotlight towards the emissions arising from these assets. In addition, the potential to generate revenue streams from some interventions is leading to the implementation of large-scale projects. See **Box 1** for an example project in Birmingham, and **Box 2** for an example in Cardiff.

However, in many instances only modest returns are delivered through retrofit works on commercial buildings, particularly when considered on a building-by-building basis. One opportunity to improve the rate of return is to go beyond the CCC’s core proposals for commercial building retrofit and invest in solar PV and battery storage systems. Analysis from Verco suggested Internal Rates of Return¹⁸ of 13% could be achieved through installing solar PV on commercial buildings.¹⁹ The BRE National Solar centre argues that self-financed solar PV schemes can see a payback period of 6-12 years depending on energy usage.²⁰ These return rates could be used to support an overall package of retrofit measures.

Box 2: Birmingham: >£5 million District Energy Scheme

The Birmingham District Energy Scheme is playing a pivotal role in Birmingham City Council’s climate change strategy.

Birmingham District Energy Scheme, with a cost of >£5 million, is a working partnership between EQUANS and Birmingham City Council (BCC). It incorporates three district energy networks, all built and operated by EQUANS through the Birmingham District Energy Company (BDEC).

BDEC’s three core schemes initially involved supplying energy to ten users from both the public and private sectors (including Utilita Arena Birmingham, residential buildings on Aston Campus, and council housing). However, due to the significant financial and carbon savings achieved, it has rapidly expanded to include several third-party private developments.

Overall, the scheme produces over 60,000MWh of heat annually, is synchronised with the national grid, and saves >15,000 tonnes of CO2 per year.

The capital expenditure to build the Scheme, which included the design and installation of several energy centres, plantrooms, and buried heating and cooling networks across the city, was £24 million. The capital invested was a private sector investment, provided by EQUANS. The capital is recovered over the length of the subsequent contract period between Engie EQUANS and BCC, Aston University, and Birmingham Children’s Hospital through the sale of heating and cooling to the buildings/consumers connected to the network. This means the capital is recovered as an element of the energy tariffs.

18 A commonly used metric for establishing the profitability of an investment opportunity
19 <https://www.vercoglobal.com/latest/the-business-case-for-commercial-pv-projects-stacks-up-despite-Government-policy-barriers>
20 <https://www.bre.co.uk/filelibrary/nsc/Documents%20Library/NSC%20Publications/123160-NSC-Solar-Roofs-Good-Practice-Guide-WEB.pdf>

Box 3: Cardiff £15 million Heat Network

Led by the city council, in its initial phase, a Cardiff heat network project will take excess heat produced at industrial sites to public buildings in the area.

The Department for Business, Energy and Industrial Strategy has contributed c.£6.6 million in grants towards the project. The remainder of the funds needed to develop the first phase of the project are being met by a £8.6 million interest-free 30 year loan from the Welsh Government. The first phase of the heat network is expected to be operational by 2022.

The Welsh Government were keen for the project to be funded this way to champion Net Zero products and capture all benefits locally.

A further challenge regards the nearly 6 million SME businesses across the UK. In particular, the 5.7m “micro” companies that have fewer than nine employees.²¹

With average revenues of £150,000, costly interventions will be difficult business decisions for many of these micro businesses to make. Principal-agent issues between landlords and occupiers regarding who pays for the investment and who accrues the benefits are prevalent. When returns from investment offer such poor payback periods, other incentives are required.

One of the observations about why the pace of retrofit work is so poor, is simply the inconvenience and motivation. This also applies to small business owners. The various interventions can be complicated, and they are likely to interfere with or at least inconvenience the day to day running of the business.

Therefore, looking at ways of tackling these challenges not at an individual building owner and occupier level, but at a district, high street, or local business park level, may be warranted. If the interventions were to incorporate other important elements that impact the effective running of commercial businesses, this could

influence and motivate the businesses and encourage them to embrace the retrofitting of their buildings.

For instance, staff wellbeing, hiring and retention are critical to business. Therefore, a scheme that provides and improves transport links, EV charging capacity, cycling schemes and storage facilities, good broadband connectivity, and access to local green space would potentially have a much greater appeal to the landlord and occupier.

The benefit of the wider system intervention is that other funding sources such as local carbon offset schemes, monies dedicated to air pollution, and external EC charging operators, could be brought into a blended financing model.

In the case of new developments there is now an increasing commercial logic. Energy efficient buildings are seen as a means of securing higher rental rates and thus increased valuations. An article by the Royal Institute of Chartered Surveyors (RICS) claims that there is already a significant green rental premium and equally a brown discount for poor performing buildings. This is a sign that in some instances, low carbon interventions are beginning to become self-financing.²²

21 <https://researchbriefings.files.parliament.uk/documents/SN06152/SN06152.pdf>
22 <https://www.rics.org/uk/news-insight/future-of-surveying/sustainability/build-back-better-is-commercial-property-going-green/>

5.4

Enabling Factors



Policy

Policy surrounding building quality standards will be necessary to encourage commercial landlords to implement quality enhancements to their building stock.

- Government policy is already in place that demands existing rented properties achieve an EPC E rating, and is currently in consultation about new future building standards.^{23,24} Enhancing EPC minimum requirements for rental presents an opportunity to mandate reduced GHG emissions from properties

- Policy also needs to reflect the fact that EPC ratings measure energy running costs, and as such, are not an accurate proxy for carbon reduction
- Policy changes that will stop fossil fuel heating systems being sold over the course of the next decade are also essential

These policies and standards can, and need, to be tightened but act as very important motivators for landlords and tenants to undertake necessary interventions.



Financing

Corporates are motivated by the cost and access to finance sources for their business activities. The emergence of green and sustainable linked loans and bonds are having an important impact on their financing choices.

Sustainable linked bonds and loans can deliver reduced finance rates if outcomes are achieved such as energy efficiency standards within buildings. Businesses can struggle to access finance, but if they can demonstrate that the

money is being spent on green initiatives, such as renovating heating systems or installing solar PV, then green loans can be accessed.

Co-benefit payments also have the potential to contribute to commercial decarbonisation (whilst being broadly applicable to all infrastructure types). For example, **Box 2** includes a carbon offsetting system within the London Borough of Bromley which monetises excess carbon emitted by developers.



Contracting and Delivery

Given the multi-stakeholder relationships associated with commercial property, the development of suitable governance arrangements and systems for sharing of procurement and delivery expertise will be

useful in this sector. The RE:FIT system, which supports public bodies to procure energy efficiency services, exemplifies the kind of initiative that may enhance the efficiency of decarbonising commercial real estate.

Box 4: London Borough of Bromley: £800,000 Carbon Offsetting Fund

A Carbon Offsetting Fund (COF) has been established through developer (s106) contributions to be used on a variety of carbon reduction projects across the Bromley Borough.¹ Projects can include energy efficiency measures on council property and street lighting. The current available balance is £250,000 with further funding of £800,000 (from 'approved' planning applications) projected. The COF is based on the cost of reducing a ton of carbon.

¹ Developer contributions (Section 106, Community Infrastructure Levy and Infrastructure Funding Statements) are financial contributions provided by developers to the Local Authority for them to pay for infrastructure to meet the needs of their development.

²³ rigorous-new-targets-for-green-building-revolution

²⁴ <https://www.gov.uk/guidance/domestic-private-rented-property-minimum-energy-efficiency-standard-landlord-guidance>

5.5

Illustrative Examples

These illustrative examples were collated from UK Core Cities and London Boroughs to demonstrate the type of projects which may be suitable for private sector investment.

Leeds and Belfast: £3.5 billion combined requirement for commercial retrofit

Leeds and Belfast have identified the following commercial retrofit requirements for their cities:

- **Leeds:** The investment required to retrofit commercial and public properties to meet its climate targets through to 2050 is £1.3-£2.6 billion
- **Belfast:** Approximately 2,500 commercial establishments need to be retrofitted with a range of low carbon measures such as retail heating upgrades and office heat pumps to reach Net Zero. This is estimated to cost £451-£935 million

Combining these requirements presents an investment need of approximately £3.5 billion. Collaboration between these cities could help minimise transaction costs and increase efficiencies through economies of scale and shared learnings.

Annual energy expenditure savings are expected to be up to £324 million from this list of measures, and the investment is anticipated to result in approximately 8,266-16,739 employment years.

Glasgow: £40 million requirement for strategic district heating network

Glasgow is focused on transforming its energy production and consumption through a series of projects to build into a wider strategic district heating network across the city. Following the delivery of the £154 million Glasgow Recycling and Renewable Energy Centre (GRREC), a partnership between Viridor and Glasgow City Council (GCC), GCC is now looking to kick-start a wider district heating network through two key projects in Polmadie and Gorbals Districts, as well as a unique and innovative proposal to harness the power of the River Clyde for the city's heat demands. Glasgow city centre offers potential investors surety of demand with a solid customer base of over 17,000 permanent residents and 1,300 commercial and residential buildings.

Phase One of the project has an investment need of £40 million and provides opportunities for:

- The deployment of energy centres and heat networks at scale, including heat interface technology for delivery into buildings;
- District energy and associated utilities works, surveys, utilities diversions, contracts development, procurement, tendering and installation;
- The ownership, operation, management, and maintenance of district heating networks for extended periods; and
- Skills deployment for delivery of this infrastructure.¹

¹ <https://invest-glasgow.foleon.com/igpubs/glasgow-green-investment-prospectus/glasgows-district-heating-network/>

4.5

Illustrative Examples

These illustrative examples were collated from UK Core Cities and London Boroughs to demonstrate the type of projects which may be suitable for private sector investment.

Bristol, Sheffield, and Liverpool: £371 million combined requirement for non-domestic retrofit

Bristol, Sheffield, and Liverpool have identified the following heat pump and district heating connection requirements for their cities:

- **Bristol:** 963 non-domestic buildings need to be fitted with an air source heat pump and 5,816 non-domestic buildings need to be connected to district heating to reach Net Zero by 2030. This is estimated to need an investment of approximately £174 million
- **Sheffield:** 15,000 non-domestic buildings need to be fitted with a heat pump and 2,000 industrial properties and 6,000 commercial properties need to be connected to expanded district heating networks. This is estimated to need an investment of at least £99 million (if all properties assumed to need only small heat systems)
- **Liverpool:** In the city's *developing* Net Zero Carbon plan they identified that 10,000 non-domestic buildings need to be fitted with a heat pump and 5,000 non-domestic buildings to be connected to district heating to meet its Net Zero ambitions by 2030. This will require an estimated capital investment of £98 million

Combining these requirements presents an investment need of approximately £371 million. Collaboration between these cities could help minimise transaction costs and increase efficiencies through economies of scale and shared learnings.

Newcastle: Net Zero Schools

Newcastle City Council is working with 15 schools as part of its Net Zero Schools programme to develop and implement retrofit programmes for GHG reductions. These include solar PV installations, energy efficiency measures, lighting and Low or Zero Carbon Heating systems to a range of schools from some of the city's largest academies to the smallest primary schools and include PFI schools. Newcastle City Council is deploying around £9m to deliver these projects to take them to a near Net Zero position using a whole-building approach to deliver a cost saving to the school by using 30 year cash flows capturing DEVEX, CAPEX and REPEX. A key element of the project is demonstrating the feasibility for private sector investors such as PFI operators and lenders to play a key role in investing in their own estate. Successful implementation is expected to catalyse the availability of large scale financing for school retrofit interventions across Newcastle. Works have now started on site across 11 of the 15 schools and are expected to be completed by March 2022, with the next batch of 10 schools entering the programme shortly.

London: £3 billion requirement for district heating networks

The anticipated investment required to deliver adequate district heating networks across London, compatible with a Net Zero scenario, is approximately £2.7 billion.

Individual projects of note requiring investment include:

- North London Boroughs of Barnet, Camden, Enfield, Hackney, Haringey, Islington and Waltham Forest, alongside the North London Waste Authority and Energetik (LB Enfield's district heating company) are investigating how to join Borough heat networks. This has the potential to support ambitious decarbonisation across North London and build on existing innovative projects. The project could supply and connect more than 200,000 homes, leisure and community facilities, education facilities, and commercial office buildings to support the capital's zero carbon ambitions with a remaining investment requirement of around £1 billion. Some existing investment is already in place, but the additional investment required is broken down as follows:
 - £750 million to provide heat and to retrofit 35,000 homes in Enfield;
 - £120 million for the Haringey Network;
 - £117m for 10 new clusters in Hackney including the cost of retrofitting existing buildings.
 - £80.5 million for the Islington Network, including the advanced GreenSCIES Islington New River network project to connect 900 homes, a university, office developments, and a theatre with an investment requirement of £16 million.
 - £10 million for expanding the Gospel Oak network in Camden.
 - Waltham Forest have identified six further potential networks or extensions of existing networks within the borough.
- Kingston District Heating Network will extract heat from the Thames Water Waste Water Treatment plant, and discharge water into the Hogsmill River. The first customer will be a new GLA-supported social housing and mixed-use estate of over 2000 homes (Cambridge Road Estate). The total project budget is £16 million, with a current funding gap of £7.25 million to complete groundwork for the energy centre on the Thames Water site, a pipe bridge over the river, and pipeline route to Cambridge Road Estate via RB Kingston-owned land, and a £1.12 million gap to complete necessary retrofit works in the Estate. Future customers will be Kingston Hospital, Kingston University, RB Kingston, and a new development in the town centre - there is enough carbon zero heat available from the Thames Water site to provide for 40% of Kingston Town Centre's building requirements by 2030

6

Renewable Electricity Generation

Summary

Mainstream renewable generation technologies – solar and wind – provide the most favourable return profiles considered in this report. Private finance is already making substantial contributions to this sector. Enabling actions are therefore less critical in this sector, but those that are implemented should be focussed on supporting more novel technologies such as tidal and geothermal.

6.1

Renewable Generation at a Glance

Current suitability for private sector investment	Principle-Agent issue to address?	Suitable for carbon co-benefit payments?	Suitable for health co-benefit payments?	Suitable for biodiversity co-benefit payments?	Need for policy development to enhance private finance flows
	X	✓	X	X	High

6.2

Net Zero Interventions

To deliver Net Zero, renewable electricity generation is arguably the component with the best economic profile and most proven investment case. However, this varies across renewable generation technologies.

While limitations to Government subsidy for **large scale (>5MW) onshore wind farms** was removed in 2020, the planning process - in England in particular - remains difficult. This is especially the case for smaller local projects. If planning permission can be attained for a wind farm the financial logic is reasonably easy to make.

Hydro power only constitutes 2.2% of the UK power market. The potential for future development remains (particularly in Scotland) but the nature of the rugged landscapes they would sit in - such as areas of outstanding natural beauty or National Parks - is likely to prevent significant new project developments. They can be potentially interesting for small communities of 100-250 houses.

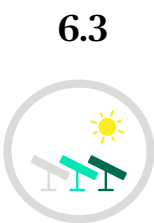
Tidal, geothermal, and other technologies remain in development but relevant for specific geographies. These new and emerging technologies rely heavily on Government bodies to encourage investment through various grant and concessional finance schemes. For instance, the Orbital Marine Power tidal turbine (which generates renewable electricity through tidal changes) in the Orkneys received funding from the EU's Horizon 2020 Research and Innovation programme, European Regional Development Fund, the Scottish Governments Saltire Tidal Challenge Fund, and a Corporate Debenture from the Abundance Investment Platform.²⁵

On a larger scale, **solar energy projects** can be more easily scaled from highly distributed individual household systems to small community schemes, and through to larger solar farms. Ongoing reductions in initial capital costs mean the return profiles are frequently attractive to private investors.

There are also positive benefits regarding smaller scale solar projects. Most poignantly, they provide local energy generation and visible signs of the transition. Furthermore, roofs are a significant resource that do not compete with wildlife or food production on land, hence can be accommodated with little or any grid changes. They are particularly useful when linked to EV and storage.

Storage solutions should also be considered, given the risk of mismatch between the timing of renewable generation and peak demand for power. While battery storage is clearly required, other technologies including gravity storage are also being developed which can improve the economic value of the power generated.

25 <https://www.insider.co.uk/news/orbital-marine-power-launches-worlds-23962213>



Economic Case

Solar and storage

There is an economic argument that from a national perspective, it is more cost effective to build very large solar parks with energy storage capabilities at a utility scale. This is due to greater economies of scale in both construction and then operation, which in turn lead to a greater proportion of renewable energy in the grid for all consumers.

The inclusion of storage solutions drives additional revenues through flows to and from the grid, helping improve the overall returns of the combined intervention. Also, local storage reduces the need to upgrade the national grid, which can provide significant savings for cities.

However, the counter-argument for more distributed roll out of solar energy assets at a local level, is that the excess returns of these projects over the cost of capital, can be used to

offset negative rates of return on some of the other components of the Net Zero transition. Therefore, the benefits are directed to the local region rather than accruing centrally to privately held utilities or other investors. For example, Local Government owned solar and storage parks built on public land which is not suitable for housing development could utilise excess profits to fund other local interventions to reduce GHG emissions.

As these returns are commercially competitive, it would be sensible to engage with private sector finance to fund these in structures that do not use up finite Local Authority borrowing capability or finite Public Works Loan Board finance. These public finance sources may be better reserved for enabling finance in other areas with less substantial return profiles.

Box 4 and **Box 5** provide two examples of blended public and private finance for the installation of solar PV.

Box 5: Leeds: £1.2 million private funding to develop domestic solar PV business case

The Fitting the Future (FTF) project will develop and demonstrate a business case for domestic solar photovoltaic (PV) energy generation utilising energy storage. This enables a greater proportion of the renewable energy generated to be used directly by domestic properties. This will include insulating and fitting energy systems to 250 homes, and solar PV and vehicle chargers to a commercial depot. £1.2 million is provided through private funding and £4.2 million through grant funding.

Box 6: Warrington: £62.3m solar investment

The example of Warrington Council's investment of £62.3 million in two solar farms and a battery storage unit is very interesting. With partner Gridserve, they are building two solar arrays and a battery storage unit. The construction and operating risks are held by Gridserve, while Warrington will own the assets once completed and capture a conservatively calculated £130 million surplus profit over the life of the project. A combination of IRRs of 11% and 16% are estimated on the two projects.



Wind

If planning permission can be attained, on-shore wind farms can achieve good returns on investment. There are numerous variables such as the proportion of power consumed on site, the average wind speeds, and the overall power output of the turbine. Taking data from Renewables First, a 1MW turbine, with average wind speeds of 6.5m/s and utilising 50% of the power produced on-site (with the remaining power exported), achieves an IRR of 18%.²⁶



Hydro

The likelihood of developing a meaningful scaled hydro development is unlikely, though smaller, often community based schemes can drive quite interesting returns. For example, a 100 KW scheme, powering approximately 100 homes, capturing 50% of the energy and exporting the rest, could generate IRRs of 9%.²⁷

6.4

Enabling Factors

Given the reasonable return profiles of mainstream renewable generation assets, the ambition of enabling factors in this sector are not as extensive as in other chapters of this report.

Generally thought of as the cheapest form of renewable energy generation, a shift in support for localised onshore wind generation would be a significant policy shift, and could open up opportunities for investable renewable generation.

More generally, streamlining the planning process to enable renewable generation projects to be approved, is a key enabler.

In addition, considering policy that encourages design and delivery of packages of measures (including but not limited to renewable energy), with a combined economic outcome, rather than single technical measures on a piecemeal basis, will help utilise the positive economics of renewable generation and storage.

6.5

Illustrative Examples

These illustrative examples were collated from UK Core Cities and London Boroughs to demonstrate the type of projects which may be suitable for private sector investment.

²⁶ what-would-the-return-on-investment-be-from-a-wind-turbine
²⁷ <https://www.renewablesfirst.co.uk/hydropower/hydropower-learning-centre/what-would-the-return-on-investment-be/>

Manchester: £5 million for renewable energy projects

Annual carbon savings for Manchester City Council will be generated as part of a £5 million European Regional Development Fund (ERDF) project, Unlocking Clean Energy. This is funding solar PV on roofs, solar car ports and battery storage at the National Cycling Centre (in 2021-22) and Hammerstone Road depot (in 2022-23) to save an estimated 400tCO₂e. The works are part of a wider Greater Manchester project, which includes the Energy Systems Catapult developing innovative business models to support the rollout of renewable energy in the future. This will include:

- Identifying business models that allow Local Authorities to secure greater value from the electricity they generate. An example of this is the P379 proposed change to the Balancing and Settlement Code, which would allow multiple meter points to supply a single site, opening up competition and potentially enabling Local Authorities to secure a better deal
- Finding opportunities for Local Authorities to share renewable energy across their sites through the establishment of peer-to-peer trading under a Local Energy Market model
- Providing a blueprint for how policies, regulations, and investments can be aligned to grow markets for low carbon investment

Bristol, Sheffield, Newcastle, and Liverpool: £3.6 billion combined requirement for solar PV

Bristol, Sheffield, and Liverpool have identified the following solar PV requirements for their cities:

- Bristol: 500 MW of new solar PV (requiring a £600 million capital investment) across the city which generates a return of more than 5% (>300MW at >6% IRR) at 2019 electricity prices (for export and avoided import) and latest ‘post-subsidy’ installation costs
- Sheffield: Potential to generate up to 518 GWh of solar energy by installing solar PV on 53,000 buildings within Sheffield. This will be a 90% increase on the solar PV installations currently in Sheffield. The investment need required to achieve this is estimated to be in the region of £695 million
- Newcastle: 644,000 350W solar PV modules with a rated capacity of 225MWp. The investment need required to install solar PV on all suitable roof space in Newcastle is approximately £1.5 billion
- Liverpool: Solar PV capacity approaching 760MW from 77,714 individual installations, requiring a capital investment of around £775 million

Combining these requirements presents an investment need of approximately £3.6 billion. Collaboration between these cities could help minimise transaction costs and increase efficiencies through economies of scale and shared learnings.

Nottingham: £570 million requirement for solar PV and wind

Modelling undertaken by Nottingham City Council suggests that 365 GWh of electricity annually could be generated by the installation of 4kWp solar PV systems on Nottingham’s favourable domestic properties (approximately 75%). It is also estimated that 38.6 kWh of electricity annually could come from the installation of approximately 5 large turbines and 50 small turbines in the city. If this was all realised, domestic solar PV and wind generation in the city would be meeting about 29% of the projected total electricity demand for Nottingham. The combined investment need to achieve this would be approximately £570 million.



Sheffield: £3 million requirement for ground mounted solar and wind

Sheffield’s ‘City-level Zero Carbon Mitigation pathway for Sheffield’ report indicates that approximately 31 million m² of land may be suitable for ground mounted solar PV, which could yield roughly 750GWh of electricity annually. The investment required to achieve this would be approximately £550 million. The report also identified the potential for the generation of 16GWh of electricity annually from new wind turbine installations in Sheffield, requiring an investment of £2.4 million.

Despite many investors typically requiring a minimum rate of return of 5% for large-scale solar PV installations, and 5.2% for onshore wind, the report identifies that the opportunity exists for the Council to invest in these installations, which would yield a return that can supplement revenue budgets with the potential for rates of return similar to third party investors.

Transport Decarbonisation

Summary

The areas where there is the greatest opportunity for Local Government and private finance to lead change in transport are:

- Construction of dedicated active travel infrastructure;
- Provision of electric vehicle charging infrastructure;
- Purchase of electric buses; and
- Provision of Car Sharing Schemes.

Of these, provision of electric vehicle charging infrastructure has the strongest economic case and largest variety of financing models available, with active travel and to a lesser extent, electric buses requiring looking to other benefits to make the financial case stack up.

Transport at a Glance

Current suitability for private sector investment	Principle-Agent issue to address?	Suitable for carbon co-benefit payments?	Suitable for health co-benefit payments?	Suitable for biodiversity co-benefit payments?	Need for policy development to enhance private finance flows
	✓	✓	✓	✗	High

Net Zero Interventions

Transport is a major source of GHG emissions in the UK, contributing to 22% of the UK's domestic emissions. There are of course multiple forms of transport, and each creates emissions in different ways and to different extents. Local Authorities have limited impact on most of these modes, and eliminated impact on a few of them. This analysis will focus on those that Authorities can seek to impact through policy and investment. This demands focus on:

- Cars and taxis which contribute to 55% of transport emissions;
- Distribution vehicles (heavy and light) which contribute to 32% of transport emissions; and
- Buses and coaches which contribute to 2.5% of transport emissions.²⁸

Decarbonisation of these modes can be achieved through a widely used 'travel hierarchy' of four changes. These are presented below along with a commentary on the way they are dealt with in the following analysis.



- 1) Reducing travel need. Measures to reduce overall travel need are varied and fragmented and are usually part of broader "business as usual" operation of a city or Borough. Typically, they are related to directly providing or supporting provision of services embedded into local communities, which reduce the need to travel beyond the community to access them - enabling the 15-minute city concept. They don't lend themselves to specific overall funding models and are only addressed in passing.
- 2) Increasing active travel. This is a major area of focus as there is a requirement for infrastructure to deliver this and there are a number of co-benefits that are important to account for.
- 3) Increasing use of public transport. Measures to increase overall usage of public transport are core to existing provision and funding of those services. These are therefore not addressed in this analysis. There is attention, however, to car club schemes. These not only improve the utilisation of vehicles (which has an economic benefit), but also weaken the case for individual car ownership which may have a knock-on effect of increasing public transport usage and active travel - as well as freeing up kerbside real estate to support charging infrastructure roll out and/or green infrastructure.
- 4) Conversion from fossil to electrified forms of travel. Significant support for the pace and scale of transformation to Battery Electrified Vehicles (BEV) both in private passenger cars and in buses is required. There is a particular need for development of local charging infrastructure.

28 <https://www.theccc.org.uk/publication/sixth-carbon-budget/>

7.2.1 Active Travel (Hierarchy change 2)

Reducing vehicle journeys by replacing them with walking or cycling is an important factor in achieving Net Zero emissions ambitions and is an important component in councils local transport plans. Over 60% of all journeys between 1 and 2 miles are made by motor vehicle, of which a large proportion could be made by walking or cycling.²⁹

Constructing dedicated cycle highways and pedestrian walking routes, while enabling the provision of new modes such as cycle and e-scooter sharing schemes are critical elements in supporting active travel to be the easy choice for shorter journeys.

7.2.2 Cars and Charging Infrastructure (Hierarchy change 4)

The switch from Internal Combustion Engine (ICE) vehicles to EVs is predicted to accelerate dramatically in the next few years from c250,000 today to 5.5 million by 2025 and 15.5 million by 2030.³⁰

The most common concerns for people making the switch to EV have been threefold:

- **The lack of vehicle choice:** Vehicle manufacturers have more than doubled the range of both cars and vans available on the market in the last five years. Further increases of 20% have occurred in the last year alone, demonstrating the rapid change on this front. This concern can therefore be assessed as reducing rapidly. It is also beyond the realm of Local Government to influence
- **The high initial purchase price:** Effective marketing is helping erode the issues of initial purchase price premiums to a focus on the vehicle's Total Ownership Cost (TOC), where the economics of switching are more

compelling given lower fuel and maintenance costs. In the LV= latest Electric Car Index, a side-by-side comparison of nine popular vehicles shows in all cases that they were more price competitive from a TOC perspective than their fossil fuel equivalents.³¹ Again, this is an issue that lies outside of Local Government influence

- **Range anxiety:** Range anxiety is influenced by two factors: battery life and charging infrastructure. This is partially being addressed through investment by the car industry in higher capacity batteries. The CCC suggest that a medium sized car will do 300km on a full charge today, rising to 375km by 2030 and 450km by 2040.³² Again, this is beyond Local Government influence. Charging infrastructure therefore remains the only major barrier that Local Government can influence

The provision of widely available charging infrastructure is the one key element in offsetting range anxiety where Local Authorities can have a clear enabling impact - both through direct investment and policy. This is most potent where dwellings do not have off-street parking and the challenge remains to provide shared "near home" charging infrastructure. Where there is not an existing or adequate power supply to deliver on-street charging infrastructure, new power connections need to be delivered. For faster, rapid charge points, this can significantly increase the demands on the local energy supply and thus costs of delivery. On-street charging infrastructure is currently being delivered in a number of different ways, making use of the existing power supply through:

- Conversion of streetlighting to have charging capabilities; and
- Utilisation of existing power supply street infrastructure such as the broadband cabinets of BT and Virgin Media.³³

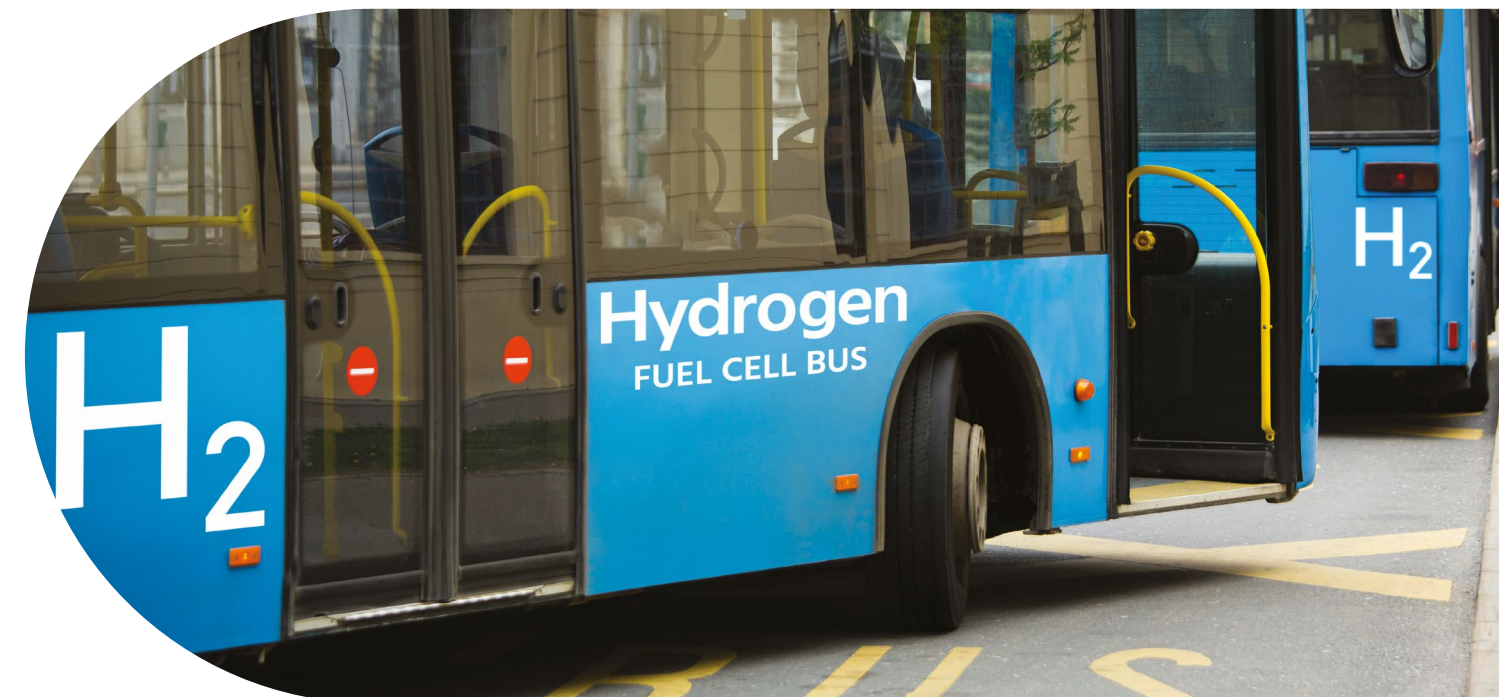
7.2.3 Car Clubs (Hierarchy changes 1, 2 and 3)

In addition to the switch of private car ICE vehicle ownership to EV, there are emerging models of shared car ownership. These have emerged partly from a convenience perspective for low volume drivers who don't want to, or cannot take on the cost of car ownership, but want occasional access to them.

While it is unknown how car clubs impact individual user travel behaviours - they may even encourage non car owners to make higher carbon journeys instead of using public transport - it is known that car clubs have a role to play in encouraging and enabling the move to Net Zero by familiarising and enabling user access to EVs. If rolled out widely in a neighbourhood, car clubs can reduce overall car travel (by concentrating travel on fewer vehicles), and result in lower local car ownership by providing convenient alternatives. CoMoUK estimates that each car in a car share scheme takes 18.5 cars off the road in the UK and therefore the freeing up of roadside parking space that could be repurposed for green infrastructure and/or EV charging infrastructure.³⁴

7.2.4 Buses (Hierarchy change 4)

Converting fossil fuelled bus fleets to EVs will help decarbonise this part of transport and will also have an important impact on air pollution, particularly in urban environments, by reducing nitrogen oxides and particulates. The necessary depot charging infrastructure needs to be carefully planned given it is a substantial cost but can also have a significant impact on local energy systems. Hydrogen fuelled buses may also be considered, but are not focussed on in this analysis.



29 <https://publications.parliament.uk/pa/cm201719/cmselect/cmtrans/1487/148705.html>

30 <https://www.theccc.org.uk/publication/sixth-carbon-budget/>

31 how-much-electric-cars

32 sixth-carbon-budget

33 <https://gtr.ukri.org/projects?ref=105426>

34 <https://como.org.uk>

7.3 Economic Case

The fragmented nature of transport interventions means there is not a single coherent economic case across all these measures. There are several areas where the economic case already exists and does not require additional sources of finance. For example:

- There is now a good cash based economic case for EV purchase when looked at through a Total Cost of Ownership (TCO) lens. This is relevant to Local Authorities directly through their own fleet management, and in expected growth in demand for charging infrastructure
- National charging infrastructure has been rolled out around the motorway network and busy trunk roads

This section examines the economic case for the interventions that Local Government can influence or stimulate.

7.3.1 Active Travel

Any analysis of the infrastructure investment needed for pedestrian walkways and cycle lanes is incredibly difficult to make a standalone positive finance case for, as there are few opportunities to generate any meaningful cash income. It therefore needs a broad economic case beyond simple financial returns. The Co-Benefits from health, noise, and air pollution are the most logical to include in this case, though they are often difficult to calculate at a local level.

The economic case becomes more robust if you can conduct a cost benefit analysis versus car travel, however this introduces a clear Principal-Agent issue in that the infrastructure cost is borne by the Local Government while the lower cost of transport accrues to users.

Example: Santander Cycles

According to a Verdict report in 2018, cycle-hire schemes with dedicated parking infrastructure, such as the Santander London scheme, fail to cover their annual cost base. That is despite sponsorship support, annual membership fees, and pay as you go revenues. Even in a dense city, the cost benefit analysis of such an active travel scheme needs to be made around reduced pollution levels and health benefits.³⁵

35 <https://www.verdict.co.uk/londons-boris-bikes-scheme-has-cost-taxpayers-nearly-200m-foi-disclosure-reveals/>

Financing

Given the overall poor economics of measures to encourage active travel, they could be considered alongside other neighbourhood-based measures that have better economic cases in blended models.

7.3.2 Charging Infrastructure

In terms of charging infrastructure, from a financial perspective there is a large upfront capital payment to deploy the infrastructure and the lost parking space revenue. There is an opportunity to recover both ongoing operational costs through electricity sales to charging customers, and create an incremental profit to generate a return on the upfront capital spend, highly sensitive to charging demand and therefore utilisation of the infrastructure.

Initial charging structure approaches were effectively loss leaders, aimed at capturing customer attention, such as supermarkets providing free charging for shoppers. This has evolved to a reasonably simple model of charging a premium for the energy versus the cost of wholesale electricity prices.

There are a few derivations of this core model:

- Charging for ancillary services such as convenience shopping, temporary workspace etc.³⁶,
- Reducing the input cost of the energy by utilising off-grid solutions such as solar and battery storage rather than buying wholesale from the electricity grid; and
- Charging a subscription fee to access a dedicated network.

36 <https://www.gridserve.com/braintree-overview/>

37 https://www.ey.com/en_gl/power-utilities/how-to-make-ev-charging-pay

The economics of these models can be variable given a leveraged operating model. That is to say that the cost of operating charging infrastructure is broadly fixed in terms of ongoing operations, maintenance, and provision of customer interface for booking and billing. **The volume of charging therefore has a significant impact on the profitability.**

Typically, this will mean these operating models may be loss making in the early days while volume (and the BEV fleet on the road) is growing, until volume moves the economic model through break even. In a study conducted by EY in 2020, data showed that charging infrastructure as a core service will turn cash flow positive, but the payback is greater than 10 years and has a negative IRR of 5%.³⁷

Local Authorities can play a role as a direct investor in infrastructure, through enabling actions around policy, and making real estate available to private operators. This will be discussed in the next section.

An approach the Local Authorities could consider is refinancing their existing, owned charging infrastructure. If they have a dataset that can show existing utilisation rates over a period, they could look to refinance or sell these assets to an operator or infrastructure investor. This could then free up invested capital for further investment. In essence, they have acted as the provider of development or project finance, at least partly de-risked the infrastructure, and then developed an income stream that will have value for others. Such a process could be adopted for future packages of EV Charging points as the councils invest over time. The Go Ultra Low City Scheme Programme has been set up with this in mind. It provides public funding to cover the initial capital costs, installation and maintenance over the first five years, with the aim of using that operational track record to then enable refinancing.

Financing

Council car fleet purchases

For own fleet vehicle purchases, the higher upfront capital cost per vehicle may be prohibitive from a regular annual budget perspective. This will be exacerbated if planning to switch a fleet in one go or at least at a faster pace than the natural vehicle replacement cycle.

Financing can be used to push some of the upfront capital into ongoing annual operating cost, matching and therefore being funded by the expected reduction in fuel and maintenance costs.

This could be achieved through a leasing model rather than a capital purchase, or the capital cost could be part covered by annual budget and partly by separate borrowing repaid over the expected vehicle life. This would enable incremental annual financing costs to balance out the fuel and maintenance savings. With TCO being lower for EV, this should cover any interest charges on the loan.

Charging Infrastructure

Councils need to increase the charging infrastructure footprint. There are a few options open to them:

- **Invest directly in a similar commercial charging model to the private charging networks:** This would involve recycling any excess profit into further network expansion, although returns are sufficiently poor that this is unlikely to be a core strategy. This could however be combined with direct investment into renewable energy generation and storage capacity, whereby energy is sold directly to end users (see renewable energy generation section). It could also be combined in local neighbourhoods with the provision of car clubs, whereby the electricity price is combined into the vehicle rental fee
- **Concession model:** Rent the necessary public real estate access to the commercial networks, and recycle the rent into further network build out
- **Bundle access to prime sites:** This would include those with strong economic cases with weaker economic sites (i.e. with lower expected volume) as a prerequisite for guaranteed network rollout across whole regions

Clearly, the returns on charging infrastructure investments will depend on what premium drivers are willing to bear compared to underlying energy prices. One critical issue however, is asset utilisation.

In the early days of roll out of infrastructure, while volume is still building, the revenue levels may be insufficient to create an attractive proposition. Each kWh of energy sold at a premium to the wholesale electricity price will create a gross profit for the infrastructure operator. However, while early volume is low this profit may not in aggregate be enough to cover the relatively fixed costs of maintaining and operating the infrastructure, leading to a net loss overall.

Long term capital may be able to look through these early losses, banking on higher volumes at maturity, but it increases the risk profile of investment.

Other payment models could be considered for users of the infrastructure, potentially adopting the bundled payment structure used by the mobile phone industry, with a certain number of kWh pre-purchased per month providing more certainty on payments for operators. Examples of how Leeds and Cardiff are encouraging EV uptake are provided in **Box 6** and **Box 7**.

Box 7: Leeds: EV trial scheme

The EV trial scheme will launch in 2020, offering free trials of electric vans and e-bikes to organisations in West Yorkshire and free trials of EVs to private hire drivers. This scheme has been funded through £1.9 million from the Clean Air Grant from Highways England and £900,000 through charge to users via a Clean Air Zone.



Box 8: Cardiff: Combining renewable energy generation with EV charging

Cardiff City Council is developing business cases and funding options for a pipeline of renewable energy generation projects to add to its current portfolio of schemes. The project overall business case is being driven by a combination of renewable energy generation, with EV charging at neighbouring council vehicle depots and some battery storage. The Welsh Government has made it a stated ambition for the Welsh public sector to be carbon neutral by 2030. However, the installation of renewable energy generation cannot be counted in its carbon monitoring framework as the renewable electricity is typically going into the grid and there are direct supply issues. Combining the renewable energy installations with the Council's low carbon transport strategy could transform the business case allowing the Council to benefit in both carbon and financial terms.

7.3.3 Car Share Schemes

Overall car utilisation rates are very poor at approximately 4%.³⁸ They mostly sit on the drive at home or at work. Therefore, their return on capital is very low, though individual citizen awareness of the true total cost of car ownership is generally also quite low.

The economic model of car share schemes is based around increased utilisation rates and charging a membership and usage fee to users, driving up the overall return on the capital costs of the vehicles. A reasonable return can be generated while still creating an economic saving for the users relative to the cost of single car ownership. Again, establishment of such a scheme requires upfront capital with ongoing profit repaying that capital and generating a return.

These can be implemented within neighbourhoods, also providing residents with more flexible access to vehicle types. For example, most cars in a scheme could be smaller, more efficient, vehicles appropriate for most uses, but with some larger cars and even vans or people carriers available for occasional use. This convenience factor can help offset a sometimes deeply ingrained car ownership culture.

In addition, councils can consider hiring out their own fleet when it's being unused. Scottish Borders Council, in conjunction with E-Car Club, wanted to get better efficiency and utilization rates out of its fleet of cars. They swapped them over to low emission vehicles and made them available to the public when not in use by employees. In the first 6 months of operation, they had taken 6,500 private bookings for the 55 vehicles.³⁹

In another trial, Leeds City council recognised that the charging infrastructure at a site could be a significant capital outlay, and may well be a problem for the local energy network. They agreed to allow employees to take vehicles home and charge them overnight, repaying the more modest home charging infrastructure and the cost of energy, but also improving the personal economics for the employees as they don't incur the commuting costs.⁴⁰

Financing

There are several models for car sharing that have proven economically viable once the initial investment is made in the vehicles.

7.3.4 Buses

Switching to an EV bus involves a higher vehicle cost but lower annual fuel and maintenance costs. However, unlike cars, when combining these two together, the total cost of ownership is still higher for EV vs ICE - although this is expected to improve over time. In the Scottish Government bus review, despite the annual fuel and maintenance cost advantages, the cash based economic case (expressed as a Net Present Value) was a negative £30,000 per bus.⁴¹

There are however additional economic benefits not included in this cash-based analysis:

- Diesel buses are important contributors to air pollution and switching to EVs will lead to improved healthcare outcomes and hence reduced demand on the NHS
- The carbon emissions reduction alone is worth, at today's carbon price of £53/t, nearly £5,000/bus each year, which alone could move the current TCO into positive territory

In addition, relying solely on depot-based charging infrastructure can have a negative impact on the overall economic case depending on route length and extent and speed of charging infrastructure. A bus that has a depleted battery when arriving at the depot is then out of commission until charged. Across an entire bus fleet this can mean a larger number of EV buses are required than the prior number of diesel buses with a negative impact on the economic case. This can be mitigated with overhead charging at bus stops.⁴²

Financing

A financing model that can be considered is to adopt a part ownership/lease model. The operator purchases the chassis and then leases the battery - approximately 35% of the total cost - and leases the charging infrastructure. In doing so, upfront capital costs are swapped for ongoing annual lease costs, funded by the operating cost savings.

In addition, the depot charging infrastructure that will be required to charge the buses can be used to create incremental income through the provision of "grid services". For example:

- Zenobe, working with Abello in South London, have utilised this model. Zenobe operate a mixture of stationary and mobile battery chargers in the depot, earning a revenue stream from the stationary batteries feeding the National Grid during peak hours⁴³
- In another example, Zenobe, working with National Express in Birmingham, took previously used bus battery cells to create a stationary battery capable of charging buses. This extends the life of the battery by 30%. Extending the life of the batteries and reducing their cost will drive significant savings over the next few years and accelerate the transition⁴⁴

38 <https://www.racfoundation.org/data>

39 Scottish borders car sharing scheme

40 <https://www.local.gov.uk/case-studies/leeds-fleet-transition-zero-emission-home-charging>

41 EY_Report_Low_Carbon_Investment_-_Scottish_Bus_Electrification_commercial_and_economic_content_report.pdf

42 https://www.researchgate.net/figure/Bus-stop-with-charging-station_fig3_328829198

43 abellio-and-zenobe-energy-to-bring-34-electric-buses-to-london

44 first-double-decker-electric-bus-fleet-launched-by-national-express-and-zenobe-energy-in-birmingham

7.4

Enabling Factors

Government policy and subsidy support has been crucial in driving ongoing change within the transport sector. Effective support has acted as an important enabler for a positive economic case for EV cars. In most cases though, this support will need to be maintained for many years ahead.

Given the generally poor financial economics within transport, it is very important that the co-benefits, particularly health and carbon reduction, are recognised and accounted for in decision making.

7.4.1 Active Travel

Councils need to consider the whole local transport plan, in particular, how e-scooters, pay-as-you-go cycle schemes, and cyclists interact with the urban transport system. Even for rental schemes, the economics are difficult as already explored. It is vital that funding approval mechanisms properly price in the carbon cost and the co-benefits of health and pollution when debating proposals and funding for transport projects - and doing so relative to the tax benefits of transport proposals that encourage car usage.

Clarity around e-scooters legal status, the ability to effectively control their speed, and access to pavements, will be important aspects of the public and councils licencing of the schemes in their area.

Also, policy needs to include an active shift towards more compact, mixed land uses where most of the facilities residents require, are within a short walk or bicycle ride from their homes to reduce the need for a car. This would be similar to the 15 minute City concept.⁴⁵

7.4.2 Cars and Charging Infrastructure

The most important policy is the Government's 10-point plan for a green industrial revolution where they announced the ban on sales of new petrol and diesel-powered cars and vans in 2030.

There are a number of fiscal and direct subsidies related to BEVs. These include the on-street, home and workplace charging schemes, the zero-road tax, as well as the support for new vehicle purchase known as the OLEV or Plug-in-car grant.

The TCO is a powerful economic driver behind people's decision to switch to BEVs. The OLEV grant has already been reduced as the demand for BEVs increased. With the successful growth in BEVs, there will be a risk that subsidy support will be further curtailed. A similar model was followed in the support for solar. Government needs to be confident that initial purchase costs are falling in line with the CCC's predictions of equating in 2025.

These national policies can be augmented with local policy action as well.

For example, Local Authorities can:

- Set a local precedent by switching their own car fleet to BEVs. Procurement rules may need to be reviewed to ensure that the higher up-front vehicle cost doesn't block purchase despite lower TCO
- Use own fleet vehicles to encourage adoption from the public. In Aberdeen, the local council has switched to hydrogen vehicles and is making some of the council cars hireable by the public so that people can experience driving non-ICE cars before taking the plunge into ownership
- Consider mandating the provision of electric charge points when approving relevant local planning proposals, for example any developments with significant parking space
- Consider implementation of Ultra Low Emission Zones and or the provision of discounts for BEVs for services such as parking in city/town centres
- Take ownership of planning for the overall charging network, identifying areas with more limited access to charging points to develop a plan for full access

- Consider mandating that dedicated car sharing space with charging points are incorporated into all parking schemes

7.4.3 Buses

Due to the negative TCO, subsidy for switching to an EV is required, in particular for more rural areas where infrastructure will be insufficient to provide for EV buses.

Cutting carbon emissions is an important outcome of the transition to EVs. If today's carbon price was imputed as a benefit, then

the economics would be positive for EV Buses. Therefore, recognising and valuing carbon reductions is important in the decision process.

Policy to stop the sale of fossil fuel-based buses, as we have seen with cars and vans, would drive significant change in this area, but is not yet on the horizon.

National Grid and local energy systems need to be encouraged, possibly through policy, to provide the necessary enablement and access to the local energy system for bus depot charging infrastructure.

7.5

Illustrative Examples

These illustrative examples were collated from UK Core Cities and London Boroughs to demonstrate the type of projects which may be suitable for private sector investment.

Leeds and Belfast: £2.5 billion combined requirement for transport measures

Leeds and Belfast have identified the following transport requirements for their cities:

Leeds:

- 28km high-quality, protected cycling highways;
- Increase in 13 million trips per year by public transport;
- 203 additional electric buses per year; and
- 15,241 electric vehicles (EVs) replacing conventional private cars per year.

This is estimated to cost up to £1.2-£2.0 billion.

Belfast:

- 6km high-quality, protected cycling highways;
- Increase in 2 million trips per year by public transport;
- 40 additional electric buses per year (400 in total); and
- 3,000 electric vehicles (EVs) replacing conventional private cars per year.

This is estimated to cost up to £240-£524 million.

The combined investment need for these measures in Belfast and Leeds is £1.4-£2.5 billion. Collaboration between these cities could help minimise transaction costs and increase efficiencies through economies of scale and shared learnings. Both reports identified that shifting diesel car journeys to diesel bus journeys was the most cost-effective measure in £/tCO2e.

These measures are expected to lead to approximately 1,982-3,433 years of employment.

45 <https://www.15minutecity.com/>

Bristol and Birmingham: £192 million combined requirement for EV charge points

Bristol and Birmingham have identified the following EV charge point requirements for their cities:

- **Bristol:** 95,127 private and public electric vehicle (EV) charge points need to be installed to reach Net Zero by 2030. The investment required for this scenario is £175 million
- **Birmingham:** 3,600 EV charge points by 2030, 600 of which will be rapid charge points. If all charge points installed are to be public then the investment required is estimated to be at least £16.5 million

The combined investment need for these measures is £192 million.

London: £520 million requirement for EV charge points

One third of all charge points in the UK are currently located in London, where there are currently more than 7,500 public charge points.¹ However, it is estimated that London will need more than 44,000 public charge points by 2030 and 54,300 by 2035. It is estimated that this will require £520m of investment by 2030.²

The charging network has seen rapid growth in London over the past three years, but further investment is required to fully meet the needs of the capital. The Green Finance Institute estimate that across the UK, a network of more than 6.7 million chargers will be required by 2030 - at a cost of £21 billion - of which a significant amount will be required in London. Both public and private finance have a critical role to play in the provision of EV charging infrastructure, and the majority of public charging points over the past three years has been funded through public funding available through the Office for Zero Emissions Vehicles (OZEV).

¹ ZapMap, June 2021
² Based on average costs of £10,000 per slow/fast charge point and £50,000 per rapid charge point it is estimated that £340m will be needed to support the roll out of slow - fast charge point infrastructure and £180m will be needed to support the roll out of rapid charge point infrastructure.

Cardiff: hydrogen project requiring investment

Due to operational demands on Cardiff’s heavy fleet vehicles and local grid constraints the council recognises that it will be challenging to convert the fleet to be fully electric in the future. In this instance, the depo can only accommodate the charging of 16 vehicles. To tackle this, Cardiff City Council has begun investigations into the possibility of hydrogen fuel fleet vehicles. This could include the involvement of a local water company which is investigating the commercial case of extracting hydrogen from the water works to fuel vehicles. The Cardiff City Region are also being approached to investigate the opportunity for potential funding due to the local economic development potential associated by such a project, including job potential and the possible development of a hydrogen hub in the region.



London: £900 million requirement for transport solutions

Achieving a Net Zero transport system in London will require investment in several areas to enable 80% of all trips to be made by foot, cycle, or using public transport by 2041.

Individual projects of note requiring investment include:

- **The West London Orbital** is an 18.5km proposed extension to the London Overground network, and will run from Hendon and West Hampstead to Hounslow, via Brent Cross West, Neasden, Harlesden, Old Oak Common Lane, Acton and Brentford. It will fill a gap in West and Northwest London’s public transport network, providing an attractive alternative to car use in a part of London dominated by road-based transport modes using heavily congested roads, including the North Circular. The project is expected to carry up to 11.9 million passengers a year and will cost c.£526 million (2017 prices)
- **Light Freight on the Thames:** This project is exploring opportunities to move freight off London’s roads, easing congestion and pollution by making effective use of river-freight on the Thames as an alternative conduit into London
- **The LB Haringey** has carried out a technical and financial feasibility assessment for a potential surface or underground cycle storage within Turnpike Lane Underground station. The anticipated investment required for such a project is £400,000 - £1.2 million. If a basic bike storage system was to be delivered at all of London’s Tube (270), Overground (84) and National Rail Stations (330), this has an anticipated investment need of c.£273 million
- **The Brentford to Southall rail scheme** is a public transport investment project that will support significant employment and housing growth in West London along the Golden Mile. It is estimated that the area contains around 450 businesses and 24,000 jobs, representing around 17% of all employment in LB Hounslow. It has been identified as an Opportunity Area that would particularly benefit from investment in its transport infrastructure, to support local economic growth and underpin commercial and residential development. This is integral to meeting the target of The London Plan for 7,500 new homes and 14,000 new jobs in the Great West Corridor. As a battery rail service, it meets the Net Zero aims of decarbonisation and improving air quality, and will assist in the reduction of congestion and car dependency on this route. In addition, it will halve the journey time to Heathrow and central London, providing wider employment opportunities to Borough residents. The current estimated cost of the scheme is £100 million, with design options that could reduce this figure by 10-20%

8 Waste Management Decarbonisation

Summary

This section focuses on the management of household waste. Provision of household waste management is the responsibility of Local Authorities, and residents receive this as a public service.

Opportunities to directly engage private sector finance are currently limited. The infrastructure required to reduce GHG emissions from waste management largely comes with little to no operational savings (the greatest savings are associated with reducing quantities of waste produced). At present, waste policy does not sufficiently disincentivise higher GHG emitting waste management methods.

Enabling actions are therefore key to stimulating private sector involvement. This could include a range of market measures and/or regulatory measures. In addition, incentives to improve product and packaging design to minimise waste, and maximise re-use and recycling, could present opportunities for private sector investment.

8.1

Waste Management at a Glance

Current suitability for private sector investment	Principle-Agent issue to address?	Suitable for carbon co-benefit payments?	Suitable for health co-benefit payments?	Suitable for biodiversity co-benefit payments?	Need for policy development to enhance private finance flows
	✓	✓	✓	✗	High

7.2

Net Zero Interventions

The actions required to tackle GHG emissions arising from waste management are one of the least researched components of the Net Zero transition. The UK's waste management policy, market, and infrastructure systems are varied and complex. Assessing opportunities to attract private finance therefore requires a clear scope for analysis. In this chapter, we focus on the management of household waste. Household waste is the major focus of city waste management activities and is therefore most relevant to this report.

GHG emissions associated with management of the UK's waste are generated by several sources. The biggest contributors are the degradation of biological materials (such as food waste and textiles) in landfills, and the combustion of waste in energy from waste (EfW) facilities (also known as incinerators).

However, whilst these GHG sources are those directly associated with waste management, it is important to note that the quantity and types of materials created and inputted into the economic system are the ultimate drivers of GHG emissions. Some of the financing opportunities identified relate to these 'indirect' GHG sources.

Tackling GHG sources arising from waste management firstly requires actions to reduce the quantity of waste produced in the UK. For the most part, achieving reductions in waste quantities is not associated with large investment needs for fixed infrastructure. Rather, behaviour change campaigns, combined with effective policy development (see 'Enabling Actions'), are the primary mechanisms required to incentivise homes and businesses to reduce waste quantities (particularly waste sent for incineration or landfill) and increase the rate of reuse and recycling.

However, infrastructure investment will be required to manage the waste that continues to be produced in a manner that reduces GHG emissions to the greatest extent possible.

These infrastructure requirements include:

- **Waste collection and sorting infrastructure.** This includes bins and other containers for collection, collection vehicles (the great majority of which are currently diesel powered), and facilities for sorting waste. Actions such as enhancing coverage of separate food waste collections will be required for facilitating reductions in GHGs from subsequent management stages, while there is also a need to decarbonise collection vehicles as far as possible
- **Facilities for the pre-treatment of waste prior to management.** With landfill continuing to decline as new EfW facilities come on stream, a priority here is to remove plastics from residual waste streams before incineration. The incineration of plastics contributes to a large proportion of GHG emissions from EfW facilities
- **Facilities for processing of food waste and textiles.** Anaerobic digestion facilities may be required to take food-waste that should be diverted away from landfill and incineration (without CCS). New forms of AD may need to be explored in order to avoid producing forms of digestate for which there is insufficient demand from farmers to apply it to their land
- **Carbon Capture and Storage (CCS) infrastructure for EfW facilities.** CCS may be necessary to address remaining GHGs from incineration and to achieve 'negative' emissions associated with the storage of biogenic CO2
- **Methane capture infrastructure for landfills.** The coverage of this technology is largely fulfilled across the UK, but some further installations may be necessary - whether to install at newly closed landfills or to improve captures at sites that are already closed

The remainder of this chapter focuses on financing principles that could apply in general to these interventions, with the exception of CCS infrastructure for EfW facilities. CCS technology is still in early stages of development and for this reason R&D for scaled application needs substantial direction from central Government.

8.3

Economic Case

Examining the economic case for attracting private finance into waste management infrastructure must start with a reflection on the current system for financing these activities.

Management of household waste in the UK is largely paid for by the taxpayer through council taxes and central Government budgets. Local Authorities hold responsibility for ensuring waste management services are provided to domestic premises. This means management of household waste is delivered as a universal public service in the UK (with somewhat different requirements set by each of the devolved administrations). GHG management is not a driving factor for waste management decision making. Rather, the waste management hierarchy (reduce, reuse, recycle, recover, treatment/disposal) is used to prioritise waste management practices, with investment constrained by the need for service improvements to be repaid through savings in waste disposal costs.

Whilst the public sector is responsible for funding the current system of waste management, it should be noted this is likely to change in the coming years. EPR fees - which place costs of waste management onto material producers - are expected to become more widespread following requirements in the Environment Bill. This will increasingly shift the costs of waste management onto producers.

Private sector involvement in the household waste management sector typically comprises of services being contracted to the private sector by Local Authorities. These services include: waste collection services, operation of HWRCs

(household waste recycling centres), operation of transfer stations, operation of material recovery facilities, and the operation of residual waste infrastructure (e.g. landfills or EfW facilities).

In theory, a Local Authority would be incentivised to invest in waste management infrastructure that reduces GHG emissions (with the associated opportunity for private sector involvement) if:

- The infrastructure reduced waste management costs (therefore saving the Local Authority money); and/or
- There was a regulatory requirement to achieve an enhanced standard of waste management which cut associated GHG emissions

However, these incentives are limited in the UK's present market for municipal waste management:

- Except for the increase in EfW installations over recent years (see **Box 8**), investment in infrastructure with the potential to cut GHGs arising from waste management is unlikely to deliver a saving relative to current waste management costs, without a significant change in the policy landscape. The CCC's 6th Carbon Budget identifies some opportunities for savings associated with reduced waste quantities, fewer residual waste collections, and improved quality of collected recycling, however these are outweighed by increased operating costs associated with CCS on EfW installations⁴⁶
- The present regulatory environment does not require standards of treatment which would lead to minimisation of GHGs arising from waste management

Box 9: Financing EfW Facilities

The Energy from Waste (EfW) market has grown significantly over the past ten years. Of the approximately 60 commercial incinerators that will treat municipal waste in the UK, 40 have become operational since 2010, and there are a further 20 due to commission before 2025. This growth provides an example of how market mechanisms can encourage investment in new infrastructure.

This growth has primarily occurred in response to heightened concerns regarding the environmental impacts of landfill waste, and the consequent introduction of the landfill tax in 1996 at £7/tonne. The significant annual rise in landfill tax to £94.15/tonne in FY20/21 has led to EfW being increasingly viewed as the optimal residual waste disposal option for Local Authorities. The gate fees per tonne paid at incinerators generally remain below the costs of landfill (including Landfill Tax), especially if authorities commit to long-term contracts of waste provision, and hence residual waste treatment via incineration is cost-competitive with landfill. In addition to gate fees, EfW operators also receive payment for their energy (typically electricity, but also heat if connected to a heat offtaker), providing another income source. In response to this, private financing of EfWs has become a more mainstream investment.

The environmental benefits of waste disposal by incineration are subject to discussion, as the resultant GHG emissions are not dissimilar to those produced by conventional fossil fuel energy. Actions to avoid the incineration of plastic waste will therefore be important to reducing the GHG impacts of EfW in the future. In general, EfW should not be the primary focus of efforts to reduce GHGs from waste management.

Unlocking the potential for cities to benefit from private sector investment in waste management infrastructure therefore requires policy measures which generate a cost saving incentive or a regulatory requirement. It is also possible that political ambition could warrant a change in practices, but this report assumes there must be a financial case to warrant private sector investment. With appropriate incentives/regulations, opportunities for private sector investment can be grouped into three categories:

- 1) **Investment in infrastructure to deliver waste management services on behalf of a Local Authority.** In this scenario a private sector provider of waste management services would invest in infrastructure to improve waste management (thereby minimising GHG emissions) on the basis of a long term contract with a Local Authority, or confidence in market demand.
- 2) **Financing of waste management infrastructure.** In this scenario, private sector investors would provide the required capital to finance the new infrastructure.
- 3) **Producer actions to enhance reusability/recyclability, or requiring producers to pay directly for waste management infrastructure.** In this scenario, the producers of materials which become waste would be incentivised to improve the reusability/recyclability of materials, and/or make financial contributions to the management of waste to a required standard. The cost of waste management is therefore shifted from the managers of waste (in the present system) to the producers of products. The improvements to material properties required to meet standards would likely require additional investment, which could be delivered by the private sector. This could be viewed as the most innovative means of leveraging private sector investment to address GHGs associated with waste.

The following section sets out the 'Enabling Factors' which could enhance these types of private sector investment in the UK's waste management infrastructure.

46 <https://www.theccc.org.uk/wp-content/uploads/2020/12/Sector-summary-Waste.pdf>

8.4

Enabling Factors

There are a wide variety of policy measures which could be utilised to incentivise shifting towards lower carbon waste management infrastructure, and encouraging intervention from the private financial community. These can be divided into:

- **Market mechanisms:** which increase the price of higher GHG emitting management options, making relatively lower GHG emitting managements price competitive; and
- **Regulations:** which require certain standards of management

It is recommended that any of the suggested actions are considered in the context of present Local Authority waste management contracts to avoid unintended consequences.

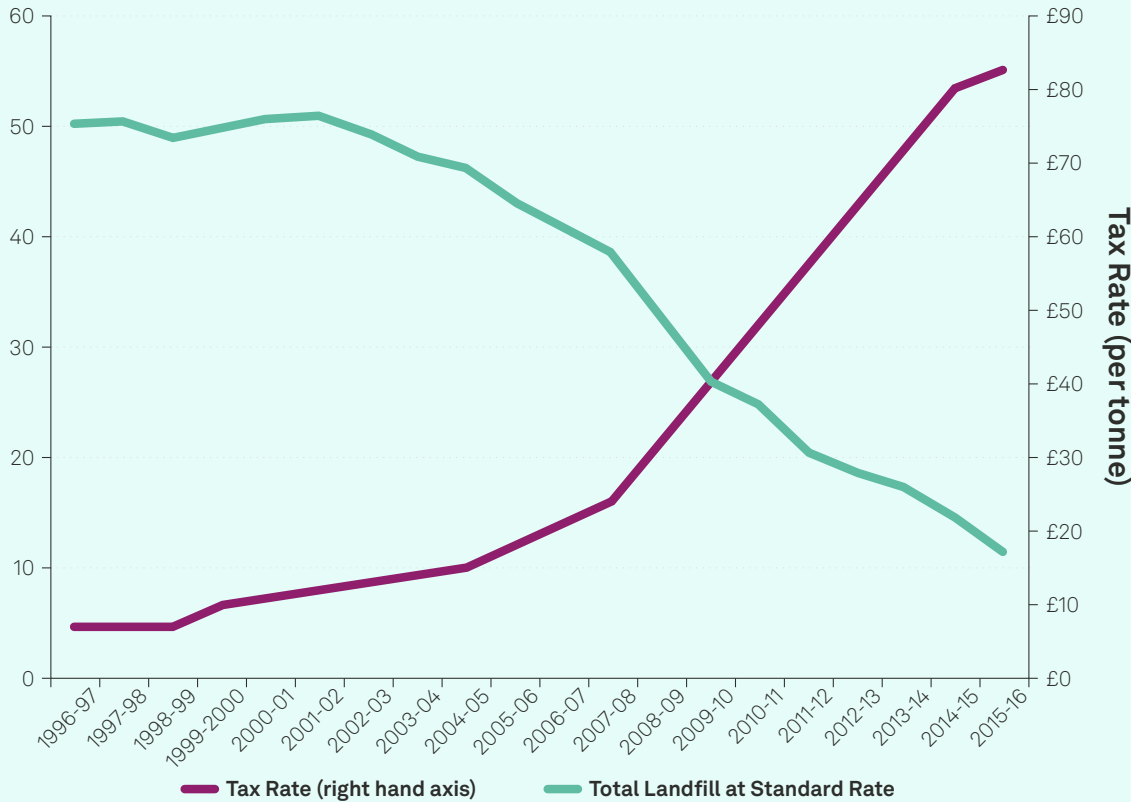
Market mechanisms

Tools for creating pricing structures with the potential to incentivise improvements in waste management (that will also reduce GHG emissions) include:

- **Extended Producer Responsibility (EPR) Fees:** EPR involves requiring the costs of waste management to be passed to those organisations involved in the creation of materials which ultimately end up as waste. These fees can be used to fund the implementation of appropriate waste management infrastructure. An EPR system that delivers sufficient revenue to pay for the required low carbon waste management system would incentivise private financial investment. Whilst the UK currently operates a quasi-EPR scheme in the form of the Packaging Recovery Note (PRN) system, this does not provide sufficient revenue to warrant investment into the necessary low carbon infrastructure. This system is changing under new requirements in the Environment Bill

- **Deposit Return Schemes (DRS):** These schemes involve the repayment of a deposit on the return of purchased packaging, usually beverage bottles. This provides an incentive for consumers to return packaging and ensures a consistent material source for re-use or recycling
- **Pay As You Throw schemes (PAYT):** PAYT involves linking the fee paid by a household for waste management services to a variable, such as the size of container, frequency of collection, the weight of waste produced, or a combination of these. By varying fees based upon waste types and quantities disposed, householders can be incentivised to alter their waste disposal behaviours. These schemes are currently illegal in the UK and would need to be carefully considered to avoid unintended consequences such as increases in fly tipping
- **Further Environmental Taxes:** the use of other environmental taxes to dissuade from the disposal of certain materials through particular processes could help attract investment into alternative management practices. Opportunities may include taxing EfW waste disposal, or a more general carbon tax. The impact of the UK's landfill tax is an example of how such taxes can rapidly alter waste management practices. Imposition of the landfill tax is widely perceived to have helped increase recycling rates, reduce landfill disposal, and increase EfW disposal rates. The trend of an increasing landfill tax rate, and decreasing landfill disposal rate, is shown in **Figure 4**

Figure 4: Landfill Tax and Landfill Disposal Interaction⁴⁷



Regulations

Possible regulatory interventions to reduce GHGs arising from waste management include:

- **Enforcing recycling targets:** Statutory recycling targets provide deadlines for achieving targeted levels of recycling. The UK currently has a target to achieve a 65% recycling rate by 2035; Wales and Scotland have both set their own more challenging targets. Enhancing penalties for missing these targets would stimulate a need for greater investment into waste prevention and waste management interventions, assuming the penalty was attributed to the organisation with responsibility for managing the implementation of waste management infrastructure

- **Green design requirements:** Enhancing specifications for product standards, such as levels of recycled content or design for reuse/recyclability, would have dual benefits. First, in providing lower GHG impacts from materials that do become waste. Second, in stimulating investment further up the supply chain to deliver enhancements to product standards (e.g. new manufacturing techniques)

Appropriate combinations of market mechanisms, targets, and penalties will be essential to enabling private finance to support the decarbonisation of city waste management infrastructure. The following illustrative examples demonstrate projects that would benefit from this finance.

47 Source: Eunomia Analysis

8.5

Illustrative Examples

These illustrative examples were collated from UK Core Cities and London Boroughs to demonstrate the type of projects which may be suitable for private sector investment.

Bristol: £125 million requirement for pre-treatment of residual waste

Bristol have identified the following requirements to decarbonise waste in the city:

- Increased pre-treatment of residual waste to remove plastic film prior to incineration to significantly reduce the carbon emissions from the waste sector. The investment need associated with this is estimated to be £4.9-£6.7 million
- Treatment of residual waste using a mechanical-biological treatment (MBT) system. The associated investment need required is estimated to be £42-£125 million

London: £129 million requirement for improved recycling at kerbside and flats

The London Environment Strategy (2017/18) cites an investment requirement of £129 million for improve recycling at kerbside and flats, including adding all six dry materials to kerbside collections where not currently collected (glass, cans, paper, card, plastic bottles and household plastic packaging). Where the improvements for high-rise flats are not included, this intervention makes a £22 million saving by 2030 compared to business as usual. Including improved recycling in high-rises will increase recycling rates by 2%.

9 Green Infrastructure

Summary

Few Green Infrastructure projects provide direct revenue streams, limiting the ability of the private sector to finance implementation. However, Green Infrastructure projects are rich in co-benefits, such as carbon sequestration, biodiversity enhancement, flood prevention, and community wellbeing. Effectively monetising these co-benefits will be key to providing revenue sources for repaying private capital.

9.1

Green Infrastructure at a Glance

Current suitability for private sector investment	Principle-Agent issue to address?	Suitable for carbon co-benefit payments?	Suitable for health co-benefit payments?	Suitable for biodiversity co-benefit payments?	Need for policy development to enhance private finance flows
	✓	✓	✓	✓	High

9.2

Net Zero Interventions

Green Infrastructure covers a range of interventions and is often considered simultaneously alongside ‘blue’ infrastructure (relating to aquatic ecosystems). Natural England identifies Green Infrastructure as including parks and gardens, amenity greenspace such as village greens, urban commons, urban and semi natural urban greenspaces such as woodland and scrubland, green corridors such as river and canals, as well as other areas such as church yards and cemeteries.⁴⁸

The provision of green infrastructure in and around urban areas is now widely recognised as contributing not just to the Net Zero ambitions of the area, but also towards places where people want to live and work. The benefits provided by Green Infrastructure include carbon sequestration, creation of habitats, drainage and flood prevention, enhanced air quality, improved community wellbeing, and a reduction in the heat island effect - thereby enhancing climate resilience. These benefits formed part of the business case for a green wall investment in Liverpool, described in **Box 9**.

Box 10: Liverpool: £150,000 green wall project

Grosvenor Britain & Ireland is a privately-owned international property company which manages the 250,000m2 Liverpool ONE development in the heart of Liverpool. For several years, Grosvenor have been undertaking projects which have focused on reducing their emissions and their next planned project is an upcoming green wall at the entrance to Chevasse park at Liverpool ONE. Grosvenor are working with Liverpool City Council and Mersey Forest to deliver the 50m2 green wall. The wall is strategically placed to not only benefit biodiversity but also to help to improve local air quality, regulate building temperature and attract customers. The £80,000-£100,000 capital funding for the project is provided through externally sourced grant funding while Grosvenor are providing £50,000 maintenance and monitoring costs (over 10 years).

Whilst public projects such as this can attract capital funding, it is the commitment to ongoing revenue and maintenance that can be the stumbling block. Grosvenor Liverpool ONE is committed to managing and maintaining the installation for the future:

“we see this investment and partnership working as a valid commercial investment for the future to supporting the integration of nature-based solutions into the existing fabric of the city.”

9.3

Economic Case

The economic case for drawing private sector capital into green infrastructure is challenging in the current market given the limited number of direct revenue streams associated with these assets.

A small number of direct revenue streams can be identified, such as timber sales, visitor spending, and agricultural revenues (though these may not necessarily be associated with environmentally optimal practices). In a minority of instances these revenue streams can be sufficient to repay investment in Green Infrastructure, but the specific infrastructure types these lead to do not represent the full range of Green Infrastructure options. It follows that the range of outcomes delivered by these specific infrastructure types, falls short of the overall benefits which could be realised through investment in a more diverse range of green spaces.

Co-benefits therefore become an essential part of building the economic case for green infrastructure investment. These include:

- **Carbon benefits:** Growing interest in the potential for carbon markets to drive investment into Green Infrastructure is accelerating the potential for carbon finance to be a real contributor to green infrastructure projects
- **Biodiversity benefits:** Quantification of biodiversity outcomes is now emerging, led by tools such as Natural England’s ‘Biodiversity Metric’

- **Water quality and flood management benefits:** Water companies are increasingly prepared to fund interventions that help mitigate treatment costs and hard infrastructure spend. For instance, up-stream tree planting to help prevent storm water run-off, riverside planting can provide natural flood barriers and also help mitigate fertilizers run-off into the water system
- **Air quality and health benefits:** Urban green infrastructure can help tackle air quality issues and reduce healthcare costs. Mental wellbeing is also increasingly linked to the provision of high-quality green spaces

A recent research report published by UK100 illustrates these benefits. The report finds that planting trees across the UK’s towns and neighbourhoods could create £366 million of added value and 36,000 jobs. These benefits are in addition to those delivered as a result of reduced air pollution, mitigation of storm water run-off, reducing urban heat island effects, and carbon sequestration.⁴⁹

In the absence of direct cash returns from Green Infrastructure, enabling actions are essential to increasing the flows of private finance into this sector through blended financing structures.

9.4

Enabling Factors

The private sector is increasingly recognising the impact nature has on successful placemaking. This is being driven by a combination of voluntary action and policy development. Achieving scale Net Zero investment will require policy developments to be further enhanced - these can improve clarity around appropriate voluntary action, introduce market mechanisms to encourage particular behaviours, or regulate to ban certain activities.

Possible policy developments include:

- **Enhancing the coverage of carbon offsetting standards:** Woodland and peatland projects can currently receive payments for carbon reductions and removals through a carbon offsetting process. Expanding carbon offsetting certifications to other green infrastructure types would enable further private finance to support a broader range of Net Zero interventions
- **Developing authoritative systems for the claiming of co-benefits:** There is ambiguity about how ‘benefit claims’ associated with funding activities with co-benefits should be made. This limits the incentive for investors to support these outcomes, as they may not be able to legitimately claim ‘ownership’ of the benefits, or may be uncertain about the accuracy of the benefit calculation
- **Effectively connecting beneficiaries with project implementers:** Green Infrastructure Projects deliver benefits to a range of stakeholders. However, several

of those stakeholders may not be involved in the project financing. When considering project implementation, connecting with the potential beneficiaries may offer opportunities to harness new revenue sources. This model is growing particularly quickly in the area of flood prevention and water quality where water companies, insurers and land managers may benefit from direct financial savings through improved Green Infrastructure. This can provide incentives to contribute to upfront project financing

- **Developing systems for realising the monetary value of co-benefits:** Whilst the monetary value of co-benefits are often calculated in principle, it is rare for these impacts to be realised in actual cash transactions (carbon offsetting being the notable exception). Further policy initiatives are required to help incorporate monetary transactions for co-benefits within project financing structures. This will enable real revenue streams to be generated, enabling the repayment of upfront investment. The emerging Environmental Land Management Scheme (ELMs) is an example of how the Government is currently pursuing this aim
- **Creating multi-use Green Infrastructure:** In the absence of monetised co-benefits, combining Green Infrastructure with revenue generating activities provides a means of improving the economics of an investment. This is another instance of blended finance being an important means of realising Net Zero infrastructure

496 <https://pcancities.org.uk/news/planting-trees-could-benefit-economy-£366m-and-create-36000-jobs>

9.5

Illustrative Examples

These illustrative examples were collated from UK Core Cities and London Boroughs to demonstrate the type of projects which may be suitable for private sector investment.

Manchester: tree planting project requiring 3-year investment

Manchester City Council’s Green and Blue strategy and action plan identifies the need to plant 1000 trees, 1000 hedge trees and 4 community orchards each year for five years. Currently, only two years are funded and investment is needed for the remaining three years.

Glasgow: £10 million requirement for peatland restoration

Glasgow’s Climate Emergency Implementation Plan identifies the need to increase investment in peatland restoration in the city region to increase capacity for carbon sequestration. The investment need identified is £10 million.

Glasgow: £107 million requirement for 18 million tree planting programme

The Clyde Climate Forest (CCF) aims to plant 18 million trees in Glasgow City Region over the next decade (over 9,000 hectares of new woodlands). In doing so the CCF project will significantly increase the extent of atmospheric carbon sequestration through tree growth in the region, mitigate flooding and overheating from heatwaves, increase physical and mental health benefits from accessible woodlands, and increase inward investment. The investment need required is £107 million. This investment will cover:

- The need to secure land for tree planting and incentivise landowners to plant trees or by land acquisition;
- The supply, planting, protection, and aftercare of the trees; and
- Employment of people to work with land-owners to develop tree planting projects and a skilled workforce to deliver the woodland creation projects and necessary aftercare.

Belfast: £4.3 million One Million Trees Programme

Belfast City Council are working with city partners to plant one million trees across Belfast by 2035. Belfast One Million Trees was inspired by an original idea from the Belfast Metropolitan Residents Group, which is a collaboration between public, private, and voluntary sector partners.

Estimated cumulative cost for the necessary infrastructure, tree planting and management is £4.3 million. This does not include the potential cost for land acquisition. The total annual assumed benefits of 1 million trees are estimated to be £17.7 million. This includes £2.5 million for avoided runoff (355,900 m³/annum), £5 million for pollution removal inc. NO₂, SO₂ and PM2.5(190 tonnes/ annum) and £10.1 million for net carbon sequestration (5,300 tonnes/year).

There is three years of funding currently in place for the 15-year programme. This includes funding from the Emergency Tree Fund, Belfast City Council, and additional grant aid. There are 12 remaining years requiring funding (approx. £250,000-£330,000 per annum).

London: £1 billion requirement for Sustainable Urban Drainage across London

Belfast City Council are working with city partners to plant one million trees across Belfast by 2035. Several London Boroughs have identified opportunities to use Sustainable Urban Drainage (SuDS) infrastructure to contribute to surface water management and greening of local places. For example, the following Boroughs, in close proximity, have identified opportunities for SuDS schemes, of which combining these opportunities may deliver economies of scale:

- **LB Harrow** (where swale and tree pit opportunities have been identified), **LB Camden** (as part of streetscape and place upgrades) and **LB Ealing** (where 10,000m3 of flood mitigation projects have been identified); and
- **RB Richmond Upon Thames and LB Wandsworth** (where raingardens around schools and libraries are being investigated).

The minimum estimated cost of delivering all of the possible SuDS features available for each London Borough is £35 million (approximately £1 billion investment needed across London). Investment in SuDS would bring many benefits; it is estimated that a £35 million capital investment in SuDS would produce £190 million in flood damage reduction and £40 million in natural capital value. These figures are drawn from the award-winning London Strategic SuDS Pilot Study.¹

¹ <https://www.lotag.co.uk/london-strategic-suds-pilot-study>

The London Borough of Hounslow: £19 million for Green and Blue Infrastructure Strategy Projects

The development of a Green and Blue Infrastructure (GBI) strategy will support and help to deliver multiple, interconnected workstreams and projects associated with the Greener Borough Framework, Green Recovery, and climate emergency. The GBI strategy includes a fundraising strategy to ensure all projects can be supported by external funding.

The sites and improvements below have been identified as priorities in the GBI. The masterplans have been prioritised particularly in relation to areas of deprivation and community needs:

- £0.3 million tree plan community fund and £0.5 million for recycling bins in parks;
- £0.8 million for Farnell road pocket park development and Brentford old railway land repurposing;
- £10.1 million for Bedfont lakes, Hanworth Park, Hounslow Heath, Redlees, Dukes meadows, Beaversfield and Crane Valley Masterplans;
- £1.6 million for infrastructure improvement projects;
- £1.5 million for nature recovery projects such as control of invasive species, wildflower meadows, habitat interventions and deculverting of rivers and pond improvements; and
- £1.2 million for access improvements, urban greening and allotment capital improvement programme.

Not all projects have been fully scoped yet and will require further work to finalise the investment required. However, at this stage the combined investment need for these projects is approximately £19 million from 2022-25.

Box 10: £216 million Bristol Avon Flood Strategy

Bristol and its neighbouring communities have grown and thrived on the banks of the River Avon. However, people and property face an increasing risk of flooding. Large parts of Bristol's centre are vulnerable to flooding from the River Avon and the risk is increasing due to climate change, causing sea levels to rise and storms to increase in frequency and severity. A major flood event that has a small chance of occurring in the current climate, could become as frequent as once a year by the end of the century if no strategic management of the risk is implemented.

The Bristol Avon Flood Strategy – a £216 million programme – sets out the council's approach and vision for how flood risk will be managed over the next 100 years. The objectives of the strategy include: supporting safe living, working, and travelling in and around central Bristol; facilitating the sustainable growth of Bristol and the West of England; and maintaining natural, historic, visual and built environments within the waterfront corridor.

Bristol City Council declared a Climate Emergency in 2018, and in 2020 published the Bristol One City Climate Strategy setting out a strategy for a carbon neutral, climate resilient Bristol by 2030. Capital projects can form a major source of carbon emissions and early consideration of carbon is required to identify solutions that efficiently minimise whole life carbon impacts. The council, supported by partners, will work to develop solutions which efficiently minimise whole life carbon impacts.

Following the carbon management hierarchy, the Strategy can make a lasting contribution through options that avoid, reduce and replace carbon. Bristol's preferred approach will also significantly reduce the carbon impact of the emergency response and recovery prompted by widespread flood events that would occur in the absence of investment.



10 Conclusions

The scale of challenge requires new implementation and blended finance models

Meeting Net Zero targets requires the fundamental transition of multiple interlinked systems at pace. This requires the rapid spending of an unprecedented amount of capital on complex and fragmented changes across those systems, in parallel and often in combination, with local communities.

Public sector finances are not of sufficient scale to fund this work entirely, and household balance sheets are too small to fill the gap. Bringing in private sector finance is critical.

Existing public funding structures, policy/subsidy approaches, private investment into the public sector, and finance availability for individuals, was not designed to deliver at this scale. This means novel approaches are required to mobilise capital in a systemic way that avoids regressive outcomes.

In aggregate, the economic returns of the transition are poor - often because the true carbon cost (and other externalities) of existing systems are not fully priced in. This means a blended finance approach with both grant-based funding, and returns-based financing, is inevitable.

There are in some cases underlying direct cash returns from these transitions for the spender of capital, which must be used to repay a private finance component. There are also significant co-benefits with real economic value that accrue to local communities, Government, broader society, and other actors, which are rarely used to support funding, but must be harnessed beyond traditional Government spending.

These broader economic benefits include an increase and upskilling in jobs, and significant mental and physical health benefits, which even if not priced, eases the Government balance sheet whilst simultaneously boosting economic activity.



Co-ordination of larger scale projects (especially renewable energy) will accelerate build out

Some of the transition will take the form of large-scale (c. £5-£50 million) single asset projects with reasonably well-established business models, better returns, and pre-existing potential access to private finance, e.g., district heating systems and large-scale local solar/battery parks.

We recommend building on existing partnerships between local and national Government, to standardise and co-ordinate the development and financing of these projects on a national scale to help accelerate build out.

Fragmented multi-intervention local decarbonisation requires a new model

However, most Net Zero delivery depends on transitioning local communities to lower carbon footprints, involving a high volume of interlinked micro investments (c. £1,000-£30,000) which create significant local disruption, e.g., domestic and commercial retrofit, distributed renewable energy generation, on street EV charging, household heat source changes, and green infrastructure deployment.

There is no established business model for these changes. Existing models of change rely on policy and subsidy to force individual local asset owners to “invest” in these changes one by one. This approach will not work on the scale required, nor will they achieve co-ordinated and systemic change. Furthermore, the small scale of individual changes makes engagement with private finance impractical beyond individual loan products. Therefore, any progress is also likely to deliver significant negative economic and socially regressive outcomes.

Delivering local decarbonisation as a public service at scale

Where conventional financing models are not appropriate, this report recommends developing a new partnership approach to co-ordination, capital-raising, and implementation of local neighbourhood decarbonisation at scale.

This approach would:

- Design a systemic set of changes at a neighbourhood level;
- Combine public grant funding with other sources of grant-based, outcome-seeking funding and private patient capital to raise the investment into a local delivery vehicle; and
- Work with communities to implement the changes at no cost to residents, and secure the annual returns to repay the private layer of capital.

Returns would be secured through long-term, property-based (rather than individual-based) “comfort and maintenance” contracts allowing cash returns, such as energy savings, to be captured by the delivery vehicle leaving residents in an identical financial position after the work as before.

This approach would also yield other benefits such as:

- Allowing engagement at a community rather than individual scale and finding ways to deliver the change in an inclusive way;
- Creating a mechanism to tackle fuel poverty in specific areas by leaving some of the savings with residents;
- Aggregating projects to a scale that private finance can engage with;
- Improving economies of scale in procurement which will help improve returns and therefore the potential quantum of private finance in the funding mix; and
- Enabling more systemic design dovetailing with other projects such as district heating rollout etc.

Blended Finance structures will be critical to funding this approach

This approach will also provide an investment vehicle which can blend different forms of finance. This will be required to bring in private finance for part of the required capital, given the low cash returns prevent private finance from funding all the capital. It will also allow engagement with scaled sources of outcome-seeking capital to deliver the range of co-benefits that a full neighbourhood decarbonisation implementation would create.

While these implementation vehicles would necessarily have to operate locally in partnership with the communities involved, the establishment of a national agency (or focus within an existing agency) would help to achieve this, providing the following supporting role:

- Direct capital and revenue funding into Local Authorities to add capacity and capability to develop project pipeline;
- Funding central expertise (technical, legal, financial) through a mix of in-house and third-party services to act as a resource for those Local Authorities and to create reusable tools. For example, the contracting mechanism to capture energy savings;
- Ensuring learning and dissemination from projects across all Local Authorities and with international partners;
- Developing and implementing a series of trials for this model with scalable funding; and
- Aggregating and developing recommendations for policy and regulatory change to further enable delivery.

This report will now contribute to ongoing discussions amongst Connected Places Catapult, Core Cities, London Councils, and other stakeholder organisations in the run up to COP26. The recommendations will be reflected upon and used to inform further research and implementation activities, coordinated through the UK Cities Climate Investment Commission.

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