



RetroMeter: Milestone 2 Report

Examining the key roles of an Aggregator and developing an MES-enabled retrofit business model canvas

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Glossary of Terms:

ABS:	Area-Based Scheme delivered by a Community Intermediary
Aggregator:	The term “aggregator” is used throughout this report as shorthand for a Retrofit Aggregator who aggregates multiple retrofit projects from multiple Retrofit Providers (where available). This definition may overlap with aggregators of flexibility and other energy services, but may also support non-MES-enabled energy efficiency projects alongside MES-enabled schemes.
BS40101:	A British Standard that provides a basis for the verification of specified performance in new and upgrades buildings. This covers the planning of Building Performance Evaluation studies, data to be gathered and data storage.
Contractor:	A retrofit contractor, often responsible for designing, coordinating, and installing the retrofit measures to buildings.
CalTrack:	CalTRACK is a set of methods for estimating avoided energy use, related to the implementation of one or more energy efficiency measures, such as an energy efficiency retrofit or a consumer behavior modification. CalTRACK methods yield whole building, site-level savings outputs. CalTRACK methods are built off of the OpenEEMeter solution, described and defined below.
CBA:	Cost Benefit Analysis
CDM:	Construction Design and Management Regulations
CMZ:	Constraint Managed Zone - This is a geographic region served by an existing network where network requirements related to network security of supply are met through the use of flexible services, such as Demand Side Response, Energy Storage and stand-by generation.
Comfort Take Back:	Increased energy demand through changing occupant behaviour, namely increased use of their heating systems (or other core building systems such as lighting) following the retrofit. This increased consumption relates to restoration of a desired comfort level rather than through inefficient system operation.
DNOs:	Distribution Network Operators - licensed companies that own and operate the electricity network from the National Grid intake (132kV) to the end users. Please note that whilst DNOs traditionally operate reactive or passive grids, in this case various forms of active management are discussed, usually segregated under the role of the Distribution System Operation (DSO). For simplicity, the term “DNO” will be used throughout this report as a catch-all for both DNO and DSO functions.
DW:	Data Warehouse (a detailed description can be found in the Data Warehouse Proposal report).
EE:	Energy Efficiency - the process of reducing the amount of energy required to provide products or services.

ENWL:	Electricity North West
EPC:	Energy Performance Certificates (in context of houses)
Explicit Flexibility:	Flexibility services that can be arranged and delivered in real time or on short notice, and where the volume is controllable, usually based on ongoing flexibility contracts
FI:	Financial Institutions: Large investors with primarily financial objectives
GFI:	Green Finance Institute
Implicit Flexibility:	Flexibility services arising from customer responses to price signals.
IPMVP:	International Performance Measurement and Verification Protocol
KPI:	Key Performance Indicator
MES:	Metered Energy Savings (described in Milestone 1 Report)
M&V:	Measurement and verification
NHS:	The National Health Service
O&M:	Operation and Maintenance
OpenEEMeter:	An open-source methodology of calculating avoided energy use, underpinning the CalTRACK methods.
OBI:	Outcomes-based investor: A provider of funds to deliver retrofits that is focused on outcomes rather than seeking a financial return. This could be an NHS Trust or a pure impact investor who may accept sub-market returns in projects with defined and measured social impact.
PAS2035:	This Publicly Available Specification is a British energy efficiency retrofit standard that creates a recognisable quality standard for the retrofit and energy efficiency sector for housing.
PB:	Public Bodies are local authorities that have sizeable assets that can be used to support their local community's health and wellbeing and tackle health inequalities, for example, through procurement, training, employment, professional development, and buildings and land use.
PPA:	Power Purchase Agreement (PPA) (long-term electricity supply contract agreement between two parties).
Recurve:	A commercial company in the US that helps utilities leverage their smart meter data and the OpenEEMeter methods to quickly and accurately measure energy usage and the impact of efficiency and demand flexibility on the grid.
RIO-ED2:	Ofgem's framework for setting price controls that set the outputs that the electricity Distribution Network Operators (DNOs) need to deliver for their consumers and the associated revenues they are allowed to collect. ED2 is the five-year period from 1 April 2023 to 31 March 2028
RP:	Retrofit Providers. These could often also be called retrofit one-stop-shops or community intermediaries, but retrofits are also provided by bodies such as Registered Housing Providers.

- SIF: Strategic Innovation Fund
- SSB: Standard Setting Body (as described in the Introduction of this report).
- WHR: Whole House Retrofit – in this case, this refers to the practice of taking a holistic retrofit approach which includes house-wide building fabric, key inefficiencies in core building services such as lighting and heating and a whole-house financing solution aligned with occupant needs. It should be noted that there are different definitions of this term for different organisations.

Executive Summary

The Strategic Innovation Fund (SIF) supported RetroMeter project aims to advance the state-of-the-art of the UK's retrofit ecosystem by developing an open-source, replicable metered energy savings (MES) methodology. This report is focused on business models and roles for an MES enabled aggregator.

This report provides additional detail to the definition of key retrofit stakeholders presented in the Milestone 1 report, and demonstrates how an aggregator¹ would map its engagement with these various stakeholders onto an idealised project development process (below) - unlocking, contracting and capturing revenue streams that can be help fund the retrofits.

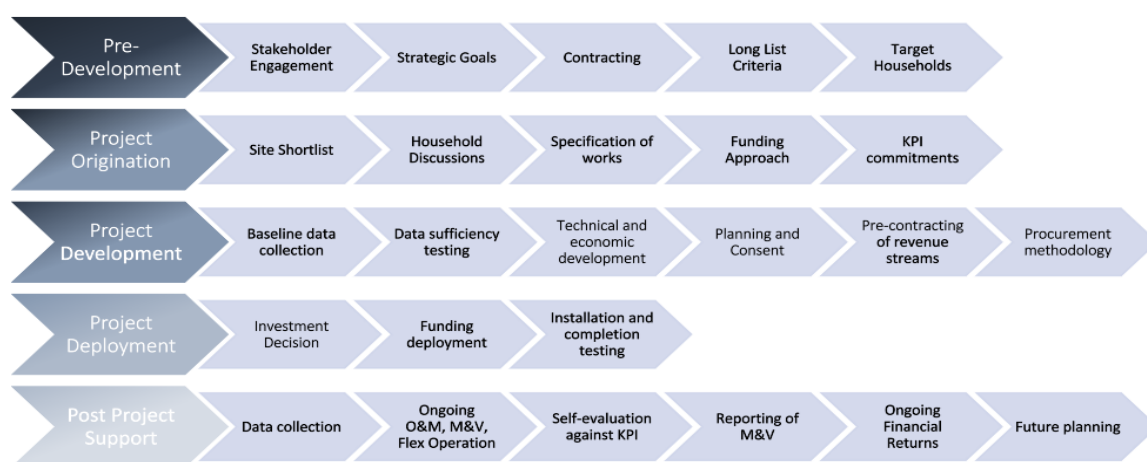


Figure 1: An idealised project development process onto which further concepts can be mapped.

Each stage of the above lifecycle is discussed in turn (see Appendix 1 and section titled “Identifying Key Roles, Financial De-risking and Barriers and Enablers across the development cycle”). For each stage, the key stakeholders, activities and project development barriers are identified and summarised. This will assist with answers to the following questions throughout our future work, which will support the upscaling and adoption of MES-enabled retrofit by additional actors across the UK:

- Who is playing this role currently, and have they implemented all de-risking measures?
- What responsibilities are covered, and what skills are needed to support these?
- How must the aggregator organisation be designed to cover these responsibilities?
- Who could fill this role moving forwards? What changes would need to be made?

This report then focuses on how these key roles and actors deploy the revenue streams that link projects to aggregated funding, demonstrating a range of key revenue decisions mapped onto a decision tree (overleaf) which spans the project development process.

¹ The term “aggregator” is used throughout this report as shorthand for a Retrofit Aggregator who aggregates multiple retrofit projects from multiple Retrofit Providers (where available). This definition may overlap with aggregators of flexibility and other energy services, but may also support non-MES-enabled energy efficiency projects alongside MES-enabled schemes.

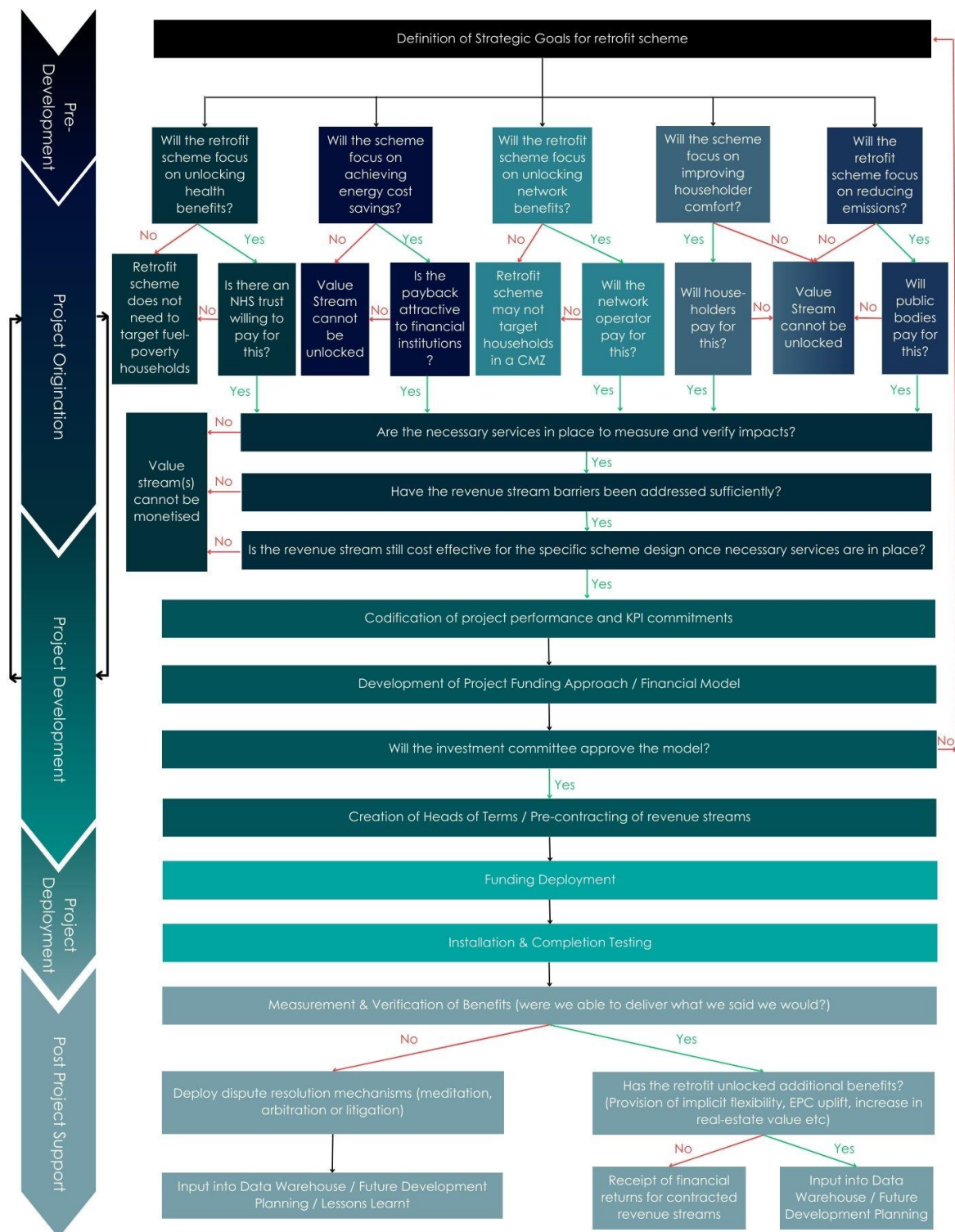


Figure 2: A decision tree to demonstrate how retrofit providers could evaluate the feasibility of various revenue streams throughout the project development process, aligning with aggregators as needed.

This report then discusses the need for a Retrofit Aggregator to assist with formalising and de-risking these revenue streams, defining the four key roles of an aggregator as follows:

- 1) To act on behalf of investors to identify high-quality projects that can be financed, blending together a range of risk-reward profiles as well as financially-driven capital and outcomes-driven capital, to ensure that financial returns are matched appropriately with positive environmental and social impacts.
- 2) Develop specialist expertise, resources and contracting to enable outcomes-based finance to be blended into the funding solution, increasing the total available capital and assuring positive impact where possible.
- 3) Work with project developers to de-risk and align their project development processes to provide greater, more timely access to finance at a lower transaction cost. This could be done by pre-qualifying projects for funding using standardised data exchange and parameterisation, but the fund could also pre-finance the development of projects to secure them in their fund's investment portfolio.
- 4) Monitor project performance and create actuarial data sets to improve the iterative targeting and development of high-quality projects.

These key roles are then converted into a roster of resources that will support the establishment of Retrofit Aggregators, as shown below in Table 1.

Table 1: A roster of resources to support the establishment and alignment of Retrofit Aggregators.

Aggregator Component	Benefits for Funding MES-enabled Retrofit
Actuarial Data Sets (Data Warehouse)	Reduction in uncertainty, risk and cost of capital
Project / Portfolio contextual information	Improved household targeting & iterative scheme design
Financial case data requirements	Rapid and low-cost funding qualification
Standardised project evaluation methods	Rapid evaluation improves risk and lowers transaction costs
Specified due diligence elements	Transparency between applicant and funder, due diligence helps de-risking projects
Relationships with outcomes-based funders and financiers	Public or outcomes-based funding can be blended into private finance funds, attracting additional investment
Expected impacts or risk-return profiles from upstream funders	Transparency between applicant and funder, ability to blend finance and outcomes-based funding
Investment Committee	Investment committee can build specialist skills in evaluating retrofit cases, speeding & de-risking decisions
Accredited Fund Manager	Fund manager can build specialist skills in aligning development best practice with the evaluation of retrofit projects, speeding & de-risking decisions
Finance pre-qualification processes	Rapid and low-cost funding qualification
Contracting packages	Distributed risk across all actors, with actors incentivised by the risks they have greatest control over (i.e. contractor bears installation risk)
Deployable de-risking measures	Best practice applied to the project development process reduces default rate.

In order to support the alignment of Retrofit Provider with the above resources, they were categorised under 5 categories (*Evidence Base, Evaluation and Due Diligence Procedures, Access to Capital, Governance, Operational and Risk Mitigation Resources*), with an alignment approach specified for each category (see section titled “*Establishing and Aligning Retrofit Aggregators*”).

A remaining list of key decisions for establishing Retrofit Aggregators is then proposed considering the targeting and collaboration options for aggregators, along with three

potential project procurement approaches – Project Purchasing, Project Transactional Fees and Project Concessions.

Finally, this report concludes with a summary of the proposed aggregator business model defining the services presented to Funders (Figure 3) and Retrofit Providers (Figure 4) in turn:

This report concludes with a summary of the proposed aggregator business model canvas, which draws out the key channels, customer relationships and value propositions to support our work moving into the third milestone period, where the focus shall shift to propose a route for the scaling-up and adoption of the business model by area-based retrofit facilitators or one-stop-shops around the UK.

Whilst out of the scope for the SIF Alpha Phase project, future work should involve exploring the roles and responsibilities of an Aggregator in deploying finance for commercial retrofits, thus unlocking a series of completely different value streams and business cases for energy efficient retrofits.

Introduction

The Strategic Innovation Fund (SIF) RetroMeter project, through which this report was funded and produced, aims to advance the state-of-the-art of the UK's retrofit ecosystem by creating an open-source, replicable MES methodology, based on learnings from international experience, specifically CalTRACK and its use by Recurve in the USA. The methodology will then be used to validate the energy savings from retrofits, potentially unlocking investment in the UK retrofit market through the establishment of metered efficiency or 'pay for performance' transactional structures.

EP's Milestone 1 report focused on reviewing the prospective value streams in this project and assessing their feasibility for incorporation into a delivery model. The MS1 report also focused on identifying the key stakeholders involved in the delivery of an MES-enabled retrofit scheme. Following several discussions with project partners and representatives from the Green Finance Institute (GFI), EP has since revised the stakeholder roles to reflect the latest changes to the business models and accompanying narrative for the delivery model in Milestone 2. These changes have been summarised in Table 2.

Table 2: Key Stakeholders for a retrofit scheme design, abbreviated and colour coded for association with specific roles and activities.

MS1 Report Titles	MS2 Revised Titles	Description
Delivery Agent	Retrofit Providers (RP)	<p>This group of stakeholders represents the organisations responsible for engaging with householders and delivering retrofits, in liaison with the contractors.</p> <p>It should be noted that individual retrofit providers will require their own set of value propositions and business models for MES enabled retrofits. EP will explore the adoption of these business models around the UK in the Milestone 3 report.</p>
Institutional Anchor Organisation	Public Bodies (PB)	This group of stakeholders represents the local authorities, or public bodies, that provide political remit, manage reputational risk and, oftentimes, invest into retrofits in order to achieve their net zero targets and improve public wellbeing.
Network Partner	Network Operators (DNOs)	This group of stakeholders represents the network operators responsible for uptake of network forecasting outputs, and where applicable, providing payments for verified network benefits from MES-enabled retrofits.
N/A	NHS Trust (NHS)	<p>This group of stakeholders represents public sector bodies established by the parliamentary order by the secretary of state for health to provide healthcare services to the NHS.</p> <p>In this case, the NHS trust could be considered an impact investor in retrofit projects, funding retrofits with the aim to reduce the number of GP visits due to cold home related illnesses.</p>
Investor	Financial Institutions (FI)	This group of stakeholders represents the institution organisations that can contribute towards the funding stack for MES-enabled retrofits. In this report, this group specifically represents private financiers, such as commercial banks or mortgage lenders, that look to invest in quality-assured projects, offering attractive

		<p>payback and the opportunity to reduce carbon from their loan books.</p> <p>This group differs from the impact investors, which are represented distinctly as public bodies, network operators or NHS trusts above.</p> <p>It should be noted that each funder will have their own value propositions and key performance indicators (KPIs) for the retrofit scheme, which will help to define the thresholds to unlocking the revenue streams.</p>
Householder	Occupants (Oc)	<p>This group of stakeholders covers the occupants within the buildings that will receive the retrofits. In some cases, occupants may also contribute towards the funding stack to deliver the MES-enabled retrofits.</p> <p>For the scope of this project, this group is primarily composed of householders due to the fact that the retrofits are targeted at residential buildings. However, it should be noted that Milestone 3 may look at occupants with a wider view to include the commercial and industrial buildings that future schemes may target.</p>
Contractor	Contractor (Con)	<p>In this case, the contractors encompass the retrofit installers, coordinators, architects, designers, and in some cases, the individual retrofit project managers. These organisations will work with the retrofit facilitators to deliver the retrofits, and where quality-assured contracting is in place, may bear the risk of underperformance alongside the retrofit facilitators.</p>
Data Warehouse	Data Warehouse (DW)	<p>Based on information available currently, EP has defined the data warehouse to be a data repository that could collect, store and analyse smart meter data from the retrofit participants. The data warehouse will support the measurement and verification of the impacts of the retrofits, ensuring the value of retrofit is captured and monetised where possible.</p> <p>The full proposal for the data warehouse has been developed separately and will be submitted alongside this report for Milestone 2.</p>
Methodology Working Group	Standard Setting Body (SSB)	<p>This body is an independent standards committee that sits above the organisations working together to deliver MES-enabled retrofits. The committee will engage with standard setting institutions to ensure a singular MES methodology.</p>

Milestone 2 now focuses on bringing together these stakeholders together in a business model canvas for the body delivering the MES-enabled retrofit, with a focus on how the stakeholder's key activities will contribute towards unlocking funding at each level of the value stack.

It should be noted that EP will focus on developing the narrative for an 'Aggregator' body that will enable the delivery of MES-enabled retrofits, rather than the business models for individual retrofit providers. This is because many of the value streams identified in Milestone 1 are externalities, and so will benefit from a clearly defined, overarching entity to help capture externalised value, distribute relevant risks, standardise procurement framework and aggregate projects to reduce the cost of capital.

The aggregator will need to engage with various stakeholders, unlocking, contracting, and capturing revenue streams that can be channelled back into the retrofits, whilst ensuring the

retrofit specifications contribute towards addressing the wider strategic objectives for each group of stakeholders.

In order to monetise the impact from the retrofits, aggregators will need to ensure the retrofit schemes are sufficiently de-risked and quality-assured by aligning the scheme design or contracted revenues with a standardised project lifecycle.

5 distinct project stages will take the project stakeholders through a series of key activities, responsibilities and 'decision points' to determine which value streams will be feasible and can be codified in the particular retrofit scheme's KPIs and contracting, and thus, which value streams will be unlocked through the retrofit. We have developed a model decision tree that an aggregator would use. At each of the project stages, key barriers to realising and monetising the value source will also be identified, and the roles and responsibilities of the aggregator in tackling barriers will be analysed, thus leading to the development of the value propositions for each customer segment. This report will also explore the ways in which an aggregator can be set-up, and the components of a successful aggregator, leading to the creation of a business model canvas for the aggregator,

Identifying Key Roles, Financial De-risking and Barriers and Enablers across the development cycle

The following sub-sections will run through the development cycle proposed for an MES-enabled retrofit scheme, identifying key barriers present at each development step, along with the responsibilities and activities that support the de-risking of retrofit projects and enable access to additional finance and funding.

These barriers and enabling activities will then be fed into future deliverables throughout Milestone 3 to provide a route map for how the business model could be adopted and upscaled by area-based retrofit facilitators or one-stop-shops around the UK.

Please note that whilst the development cycle below has been used to map key roles, and integrates de-risking best practice from institutions such as the International Performance Measurement and Verification Protocol (IPMVP) and the Investor Confidence Project, this approach will not be prescribed as part of the exploration of routes to adopt and upscale MES-enabled retrofit solutions.

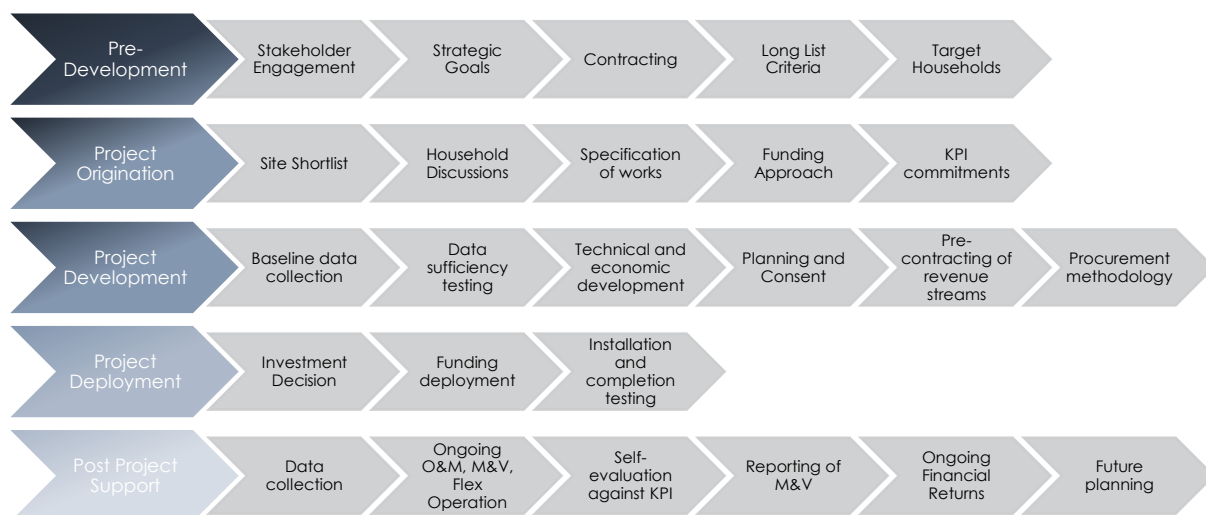


Figure 3: An idealised project development process onto which further concepts, such as stakeholder roles, development barriers and aggregator interactions can be mapped. ****N.B. this approach will not be prescribed as part of the exploration of routes to adopt and upscale MES-enabled retrofit solutions**

This non-prescriptive approach aligns with the goal to enable further upscaling and adoption of MES solutions, as various actors could develop compliant retrofit schemes. In order to enable this flexibility, activities are connected to generic roles, as shown and exemplified for the area-based scheme (ABS) in Table 2. These colour coded roles are utilised throughout activity descriptions in the following subsections:

Using the categorisation of actors above and the key development stages defined in upcoming sub-sections, this section aims to provide the input data required to answer the

following questions, which will enable replicable approaches and upscaling to take place across diverse organisations in the future.

<i>Who is playing this role currently, and have they implemented all de-risking measures?</i>
<i>What responsibilities are covered, and what skills are needed to support these?</i>
<i>How must the aggregator organisation be designed to cover these responsibilities?</i>
<i>Who could fill this role moving forwards? What changes would need to be made?</i>

Stage 1: Pre-Development

Figure 4, below, shows the pre-development lifecycle stage (highlighted in light blue/teal), with the latter figure exploring the underlying activities within each development step.

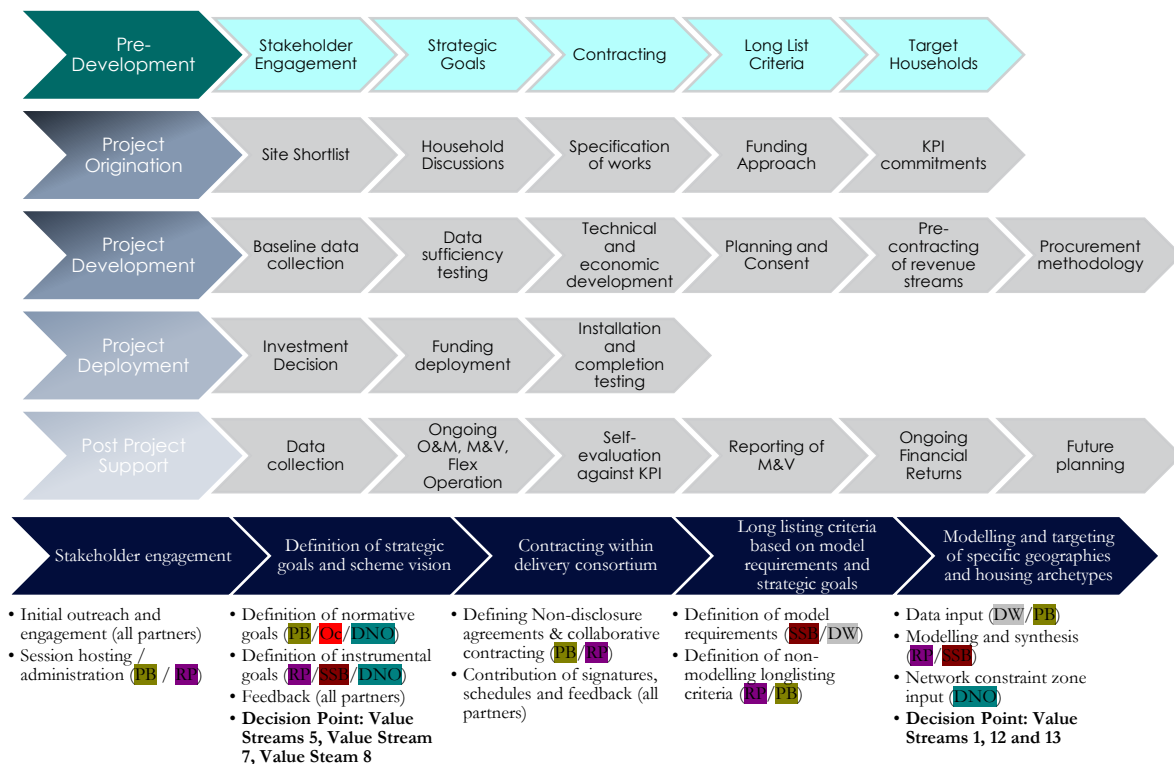


Figure 4 (combined): The above figure section shows the pre-development lifecycle stage, whilst the lower figure section explores the underlying activities within each development step. Please note that within this figure and other lifecycle figures within this section, "Oc" is used as an abbreviation for occupants of buildings in which retrofits may be deployed. In this report, occupants refer specifically to householders.

The underlying activities, de-risking steps and barriers to development are discussed in detail in Appendix 1 (Table 5). The bulleted list below provides a summary of barriers within this development stage. This bullet list will provide a specification for barrier mitigation approaches to be considered as part of the route for external actors to upscale and adopt the RetroMeter solution.

- Stakeholders are not responsive, or the wrong contact is engaged
- The stakeholder session, developed at risk, does not yield any further collaboration
- The partners fail to capture a key strategic goal present within the target area, or the goals set do not lead to equitable outcomes
- The partners select an instrumental approach which is not appropriate or cost-effective.
- Some partners fail to feedback in a timely manner
- Contracting adds additional legal development costs before the scheme launches, which must be funded at risk
- The contracting delays the scheme launch.
- The review and signing of contracts delays the scheme launch
- Schedules do not fully distribute risk and liability
- SSB (Standard Setting Body): Confidence intervals are too onerous or reduce the ability of the consortium to access specific value stacks

- *DW (Data Warehouse): The data sources selected are not sufficient, or large data gaps persist into the data collection phase.*
- *Delivery Organisation: The minimum data requirements are overly onerous or do not fully satisfy the model requirements*
- *Public Bodies: Defined criteria or exceptions are appropriate and do not lead to monetised revenue streams.*
- *Data connections are not appropriate or timely access to data and metering cannot be arranged*
- *Retrofit Provider: Modelling approach leads to inaccurate or biased results*
- *SSB: Model output specifications or acceptance of non-routine energy profiles are not appropriate or aligned with the scheme design*
- *Local network constraints are insufficient or not aligned with the contracting of localised flexibility or demand reduction services.*

Stage 2: Origination of projects

Figure 5, below, shows the project origination lifecycle stage (highlighted in light blue/teal), with the latter figure exploring the underlying activities within each development step.

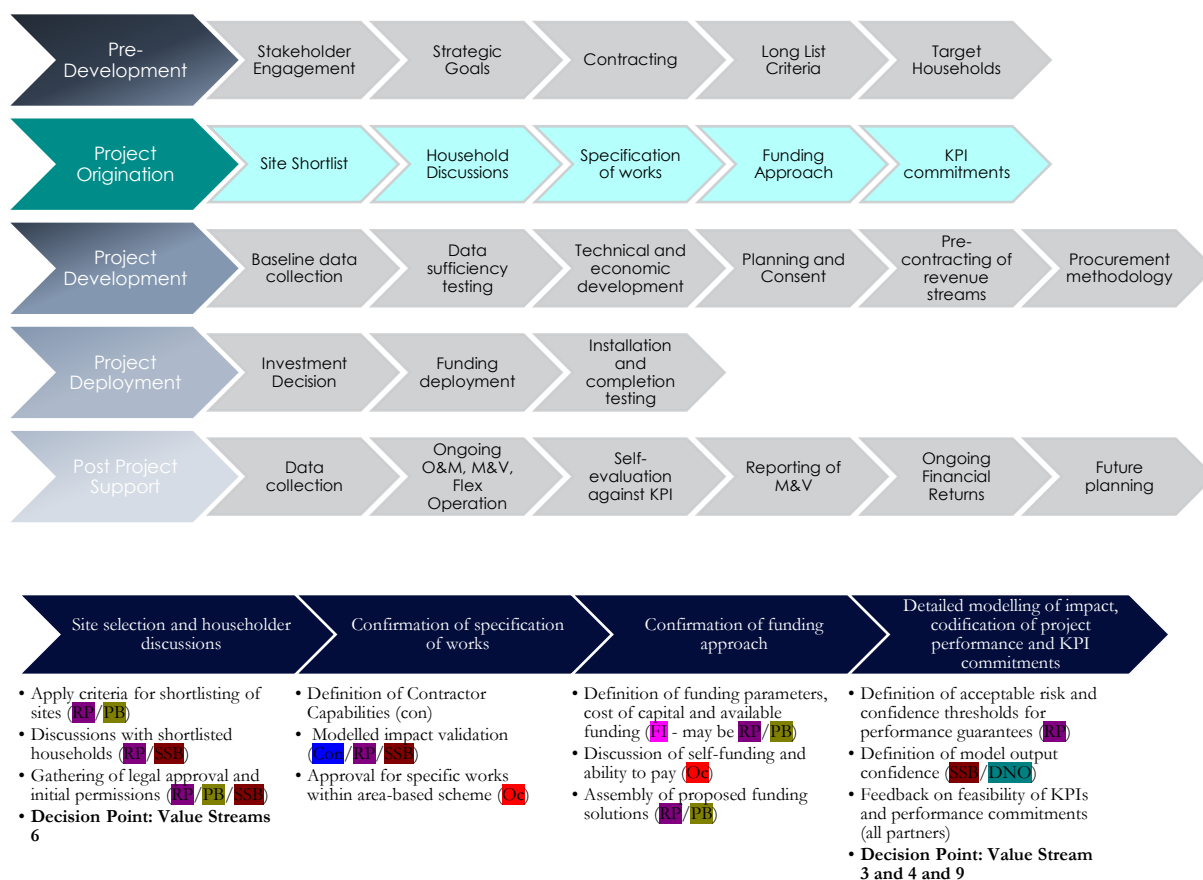


Figure 5: The above figure section highlights the project origination lifecycle stage, whilst the lower figure section explores the underlying activities within each development step.

The underlying activities, de-risking steps and barriers to development and de-risking are discussed in detail in Appendix 1 (Table 6). The bulleted list below provides a summary of barriers within this development stage. As with the pre-development activity barriers, this bullet list will provide a specification for barrier mitigation approaches to be considered as part of the route for external actors to upscale and adopt the RetroMeter solution.

- Inclusion of unsuitable homes in the shortlist will raise development costs (Note that all homes will need to undergo retrofit or energy improvement projects to reach net zero, however due to the phased scheme approach not all may be suitable for current scheme concepts. I.e. heat pumps installations may only be effective in homes with a certain level of airtightness, or fabric first measures may be targeted at homes with poor airtightness, excluding well-insulated homes).
- Standard Setting Body: The assets or revenue streams are over specified, or underly conservative, damaging the project financials.
- Retrofit Provider: The discussions result in householder expectations that are not appropriate/aligned with the proposed scheme design. The information asymmetry leads to the householder feeling like they did not receive the retrofit they were promised.
- Legal permissions are not suitable, miss key schedules/clauses, or have gaps and missing permissions.

- Contractor capabilities are not described accurately or are not sufficient for de-risked project delivery.
- Contractor models or savings estimates are not accurate.
- Modelled impact (relating to outcome-based KPIs and project performance aspects such as the level of financial, energy and carbon savings) is not validated correctly
- The modelled impact cannot be verified by the RetroMeter solution
- Household does not accept specified works and requests to leave the scheme or be provided with a custom specification.
- The specification of funding is not suitable or sufficient for the given project or portfolio
- There is a miscommunication regarding the funding package
- The household's ability to borrow changes between this stage and confirmation of finance
- The funding parameters or household contributions change, impacting the number of retrofits that can be funded
- Performance guarantees expose Retrofit Provider to undue risk.
- The Retrofit Provider has not sufficiently de-risked the development approach to offer performance guarantees.
- Performance guarantees can only be offered to a subset of retrofit sites, which may impact equitable outcomes
- The minimum level of model confidence is not achievable or discounts a significant number of homes from accessing retrofit or key retrofit value streams.
- Feedback is not timely or fails to capture key concerns

Stage 3: Development of projects

Figure 6, below, shows the project development lifecycle stage (highlighted in light blue/teal), with the latter figure exploring the underlying activities within each development step.

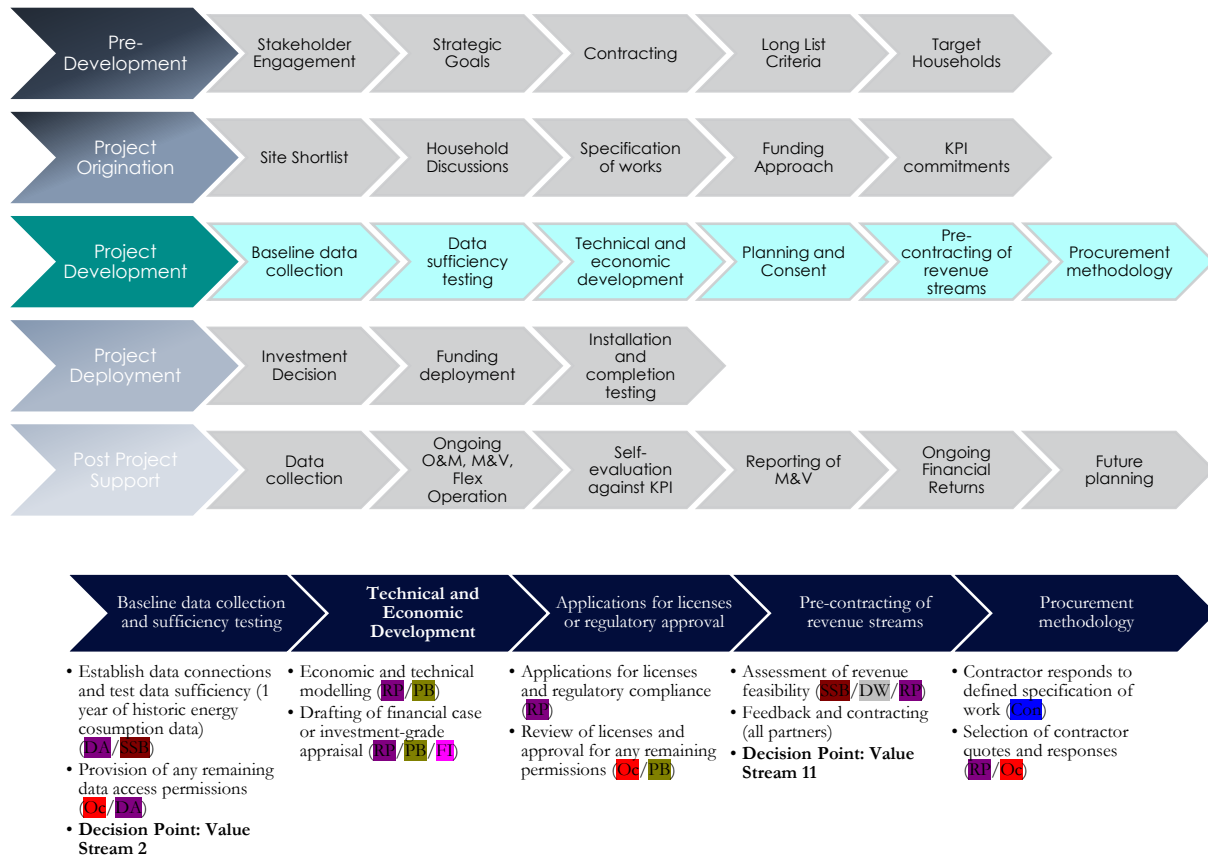


Figure 6: The above figure section highlights the project development lifecycle stage, whilst the lower figure section explores the underlying activities within each development step.

The underlying activities, de-risking steps and barriers to development and de-risking are discussed in detail in Appendix 1 (Table 7). The bulleted list below provides a summary of barriers within this development stage. As with the prior activity barriers, this bullet list will provide a specification for barrier mitigation approaches to be considered as part of the route for external actors to upscale and adopt the RetroMeter solution.

- APIs are complex to develop.
- Input data sources are not interoperable.
- The data sufficiency requirements are too onerous.
- Household refuses to grant data access permissions and cannot proceed
- Data access permissions do not reflect necessary data rights, impacting household trust or requiring re-engagement.
- Modelling to date is inaccurate, or relied on assumptions which do not hold true or cannot be evidenced to financiers / funding stakeholders
- The financial case is not strong enough for an investment to proceed
- Iterative feedback delays the retrofit project's development and deployment
- Licenses are not granted or incur delays or adaptations to the specified works

- *The underlying modelling or assumptions are incorrect and therefore revenues are not feasible in practice*
- *Feedback is not timely or fails to capture key concerns*
- *Iterative feedback and adaptation of contracts or schedules incurs expensive legal fees which increase development/transaction costs of retrofit*
- *Contractor does not complete their specified quote, or the costs, design specifications, guarantees or savings estimations are not accurate*
- *Information asymmetry persists between Retrofit Provider and Household*
- *Household or household group (in the case of an area-based scheme) does not select any quotes presented. In the case of social housing decarbonisation schemes, this may be selected in collaboration with the public body.*

Stage 4: Deployment of Project

Figure 7, below, shows the project deployment lifecycle stage (highlighted light blue/teal), with the latter figure exploring the underlying activities within each development step.

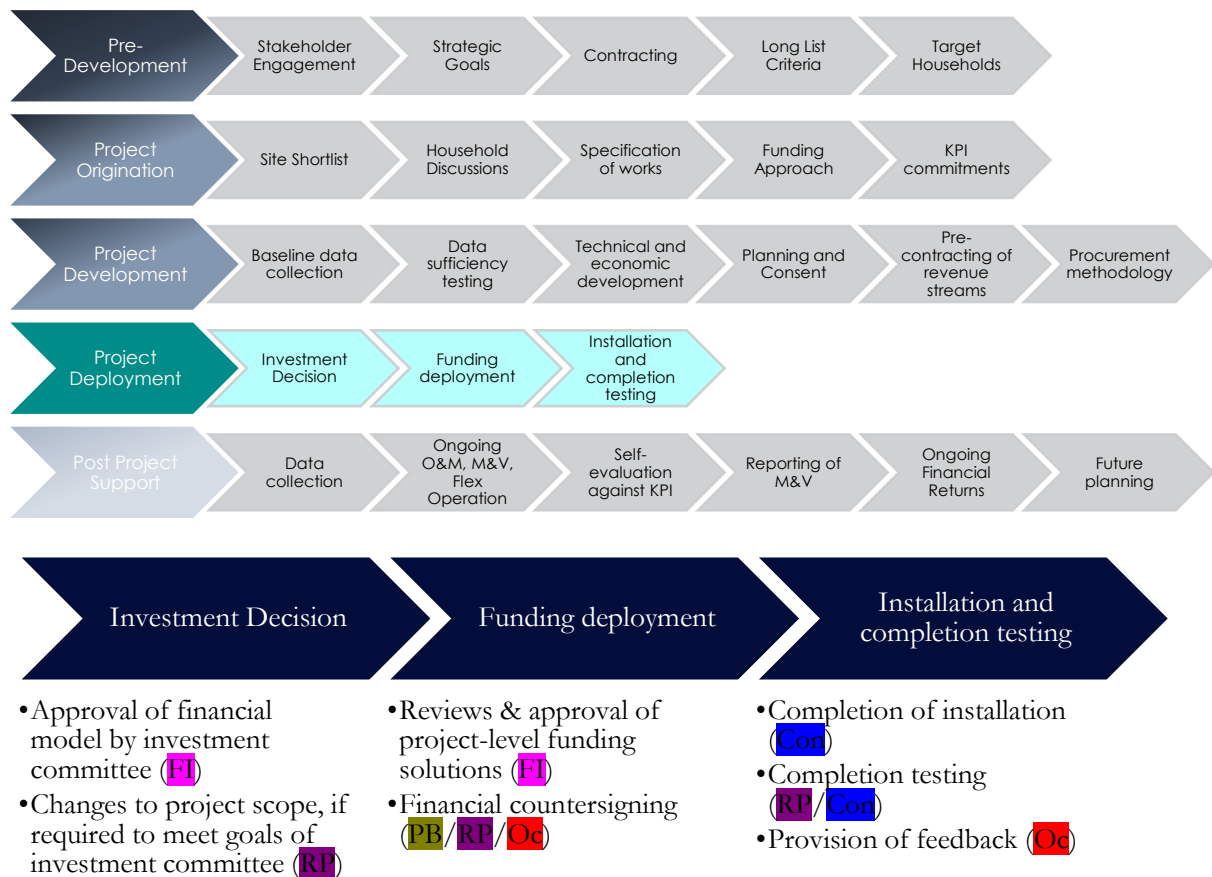


Figure 7: The above figure section highlights the project deployment lifecycle stage, whilst the lower figure section explores the underlying activities within each development step.

The underlying activities, de-risking steps and barriers to development and de-risking are discussed in detail in Appendix 1 (Table 8). The bulleted list below provides a summary of barriers within this development stage. As with the prior activity barriers, this bullet list will provide a specification for barrier mitigation approaches to be considered as part of the route for external actors to upscale and adopt the RetroMeter solution.

- Investor does not have sufficient information or confidence in the underlying financial case to fund the relevant projects
- One or more funders drops out and so the funding solution must be revisited or reconciled
- Signatures are not timely and delay project deployment
- Iterative feedback and adaptation of financing contracts or schedules incurs expensive legal fees which increase development/transaction costs of retrofit
- Contractor does not follow own quote/work specification; Installation is not of a sufficient quality
- Completion testing raises snags to be addressed
- Completion testing identifies a low-quality or non-compliant installation based on the agreed quote or works specification
- Snags, underperformances or technology issues are not identified at the earliest stage, creating a potential underperformance in the future
- Household is not suitably inducted into how to operate and maintain their new assets creating a potential underperformance in the future

Stage 5: Post-project Support

Figure 8, below, shows the post-project support lifecycle stage (highlighted in light blue/teal), with the latter figure exploring the underlying activities within each development step.

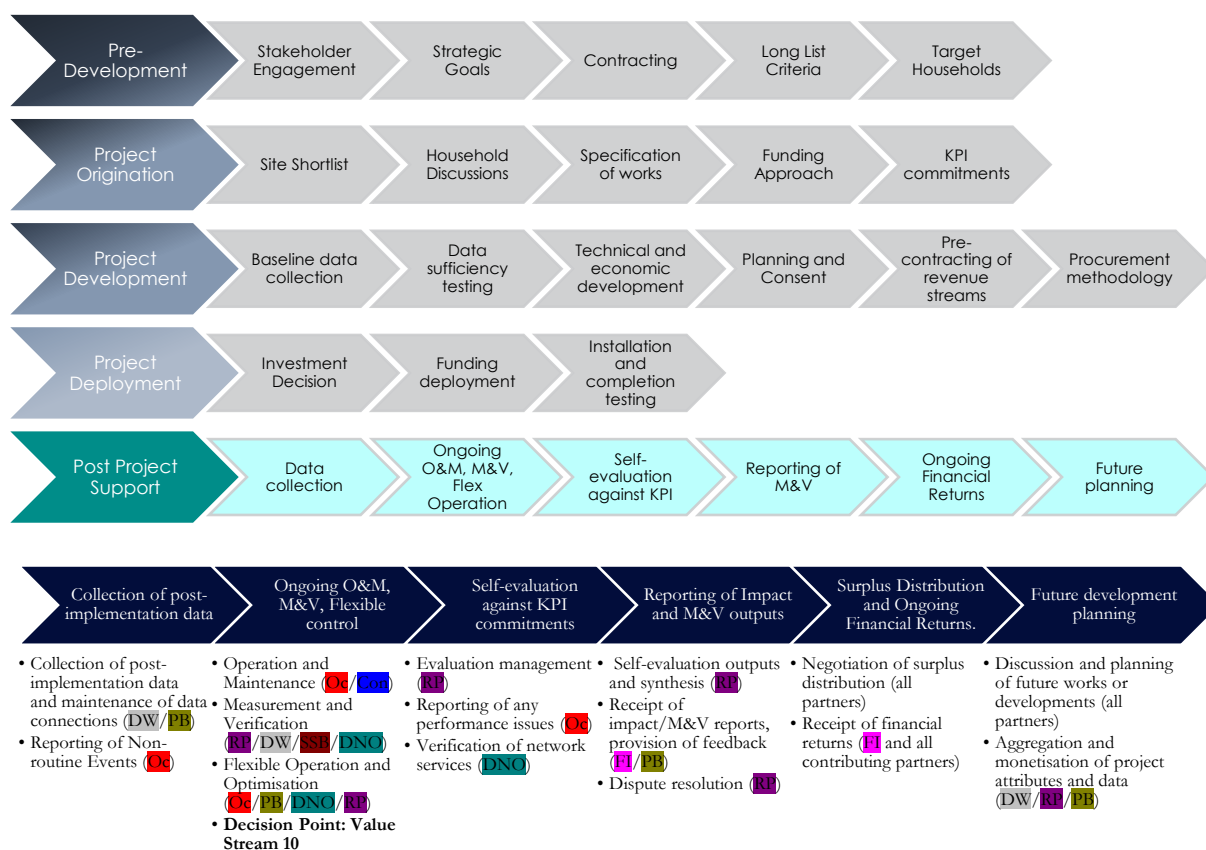


Figure 8: The above figure section highlights the post-project support lifecycle stage, whilst the lower figure section explores the underlying activities within each development step.

The underlying activities, de-risking steps and barriers to development and de-risking are discussed in detail in Appendix 1 (Table 9). The bulleted list below provides a summary of barriers within this development stage. As with the prior activity barriers, this bullet list will provide a specification for barrier mitigation approaches to be considered as part of the route for external actors to upscale and adopt the RetroMeter solution.

- Data Warehouse may have to provide advice and support on connecting devices, leading to additional cost or delays
- Incorrect or unmaintained data connections lead to data drop-outs and insufficiencies
- Non-routine events or technology issues are not identified at the earliest stage, creating a potential underperformance in the future
- Persistent issues or non-routine events could damage household trust
- Household is not suitably inducted into how to operate and maintain their new assets creating a potential underperformance in the future
- Insufficient operation and maintenance by contractors causes a technology underperformance.
- The wrong M&V approaches are applied, hampering the confidence and verification of metered savings
- The models are not appropriately adjusted or normalised, leading to under or over estimation of the resultant savings

- *Flexibility requests are not aligned with automated or manual flexibility responses*
- *The expected demand response cannot be verified by the DNO*
- *Household does not provide approval for automated asset operation and fails to conduct their own demand response.*
- *Evaluation shortfalls or miscommunications could damage household trust*
- *KPI shortfalls lead to adaptations to retrofit scheme or top-up measures.*
- *Failure to report performance issues could leave households with an asset which is not operating correctly, damaging long-term energy savings and financial returns*
- *The DNO challenges the M&V approach, delaying deferred network reinforcement / flexibility payments*
- *Disagreements as to how to distribute financial surplus or reinvest unspent funds hamper ongoing or future collaborations*
- *Financiers do not receive timely returns from their creditors, and are less likely to participate or fund projects moving forwards*
- *A single partner takes forward the potential future works outside of an MES scheme or collaborative structure*
- *Inappropriate monetisation or insufficient anonymisation/aggregation could breach in privacy or data rights agreements, leading to reputational and legislative risk.*

Unlocking Revenue Streams at Each Project Stage

Having identified the key roles of each stakeholder involved in delivering an MES-enabled retrofit scheme, this section will provide an exemplar decision tree that identifies key decision points to unlocking and monetising the revenue streams identified in MS1.

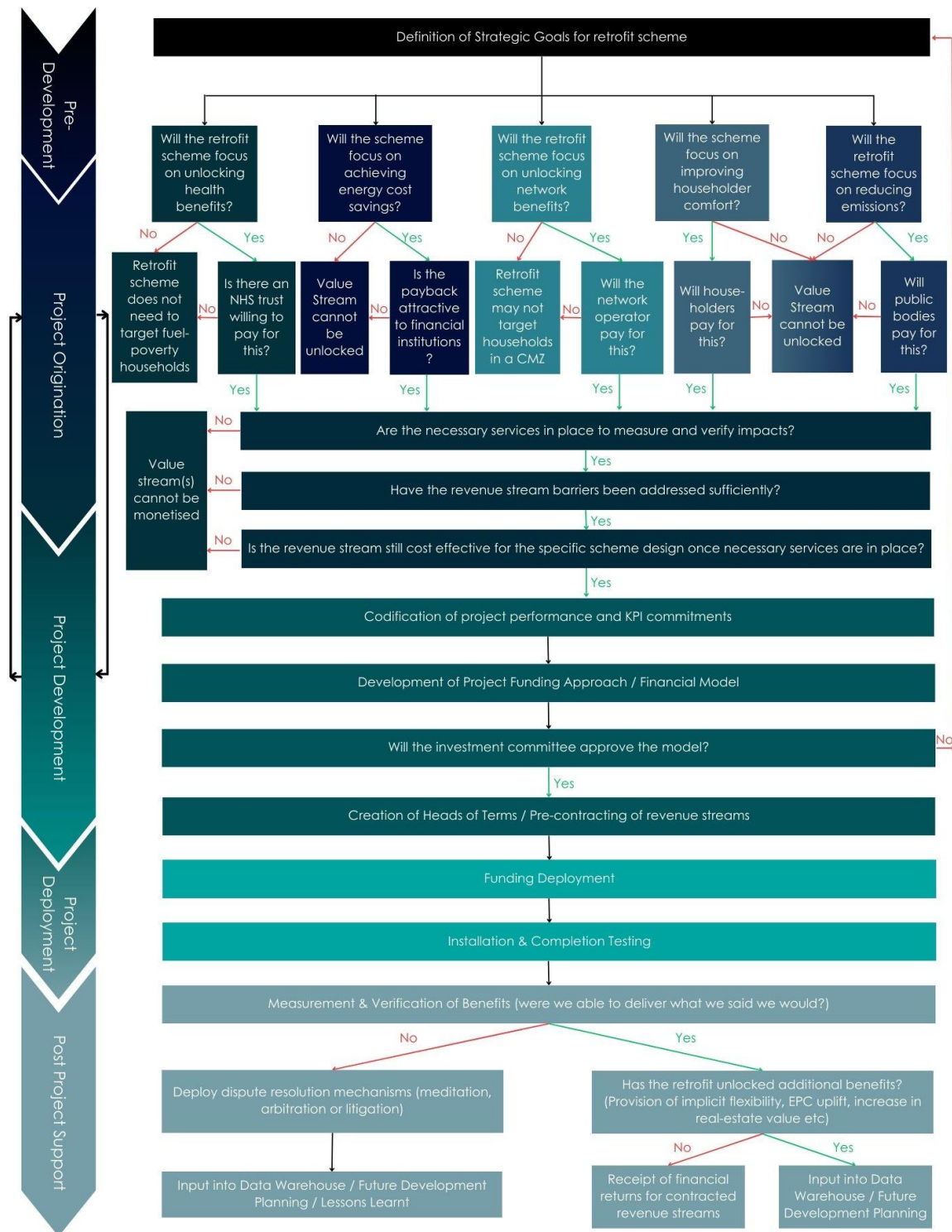


Figure 9: An exemplar decision tree that identifies key decision points to unlocking and monetising the revenue streams identified in EP's Alpha Phase Milestone 1 Report.

Through the pre-development and project origination stages, stakeholders will need to determine what revenue streams they wish to unlock through the retrofit scheme, with a focus on defining the goals of the scheme, and thus, the target householder geographies and archetypes. Conversations with institutional investors will determine whether these revenue streams can be monetised or not, after which a funding model for the scheme can be developed. A key stage in the project development process will be to take the model to the investment committee for approval; if approved, the retrofit scheme can be deployed, otherwise it will need to be re-evaluated to develop a more credible funding approach.

It should be noted that these decision points are not autonomous in unlocking the revenue streams, and an iterative approach to project development needs to be undertaken to ensure the strategic needs of the stakeholders align with the retrofit scheme design, and conversely, to ensure the promised benefits from the retrofit scheme can be realised, measured, and verified to unlock Pay for Performance financial models.

As such, there is a need for a body – the aggregator - that can engage with various institutions. Our next section will focus on this body, looking at its responsibilities and the business models behind it.

Need for Aggregation

Much of our work to date has been focused on roles and responsibilities at the level of individual retrofit schemes. As this report transitions to explore and outline draft business models to enable upscaling and adoption of MES-enabled approaches, our next steps are to develop value propositions and business model summaries from a high-level viewpoint.

In seeking to identify and specify this centralised perspective, EP has engaged with both Retrofit Providers (i.e. Carbon Coop) and investors (through the Green Finance Institute). This led to two key points:

1. Discussions with Retrofit Providers highlighted the variability across Public Bodies, retrofit schemes and even specific retrofit designs for individual homes or streets. Due to this, the Retrofit Provider's business model cannot / should not be specified or controlled by a singular MES body.
2. Discussions with financiers and their representatives revealed that most funders are indifferent to the project developer and their project development specification, provided projects are high quality and the projected financial outcomes are realised. Non-financial funders who are targeting outcomes, e.g. an NHS Trust targeting reduced hospital visits for example, are also likely to be indifferent to the project development specification but rather be focused on outcomes.

The Roles and Responsibilities of an Aggregator

The upcoming section (Aggregator Business Model) discusses the services that an aggregator provides to its financial and project development partners in detail. However, the role of an aggregators can be summarised as follows:

- 1) To act on behalf of investors to identify high-quality projects that can be financed, blending together a range of risk-reward profiles to ensure that financial returns are matched appropriately with positive environmental and social impacts,
- 2) Develop specialist expertise, resources and contracting to enable outcomes-based finance to be blended into the funding solution, increasing the total available capital and assuring positive impact where possible.
- 3) Work with project developers to de-risk and align their project development processes to provide greater, more timely access to finance at a lower transaction cost. This could be done by pre-qualifying projects for funding using standardised data exchange and parameterisation, but the fund could also pre-finance the development of projects to secure them in their fund's investment portfolio.
- 4) Monitor project performance and create actuarial data sets to improve the iterative targeting and development of high-quality projects.

By centralising this role within an aggregator, the necessary guidance, data connections and project evaluation infrastructure can be standardised and replicated across multiple retrofit providers, all of whom could apply for financing through the fund.

Establishing and Aligning Retrofit Aggregators

One of the primary benefits of retrofit aggregation is that the financial infrastructure, namely standardised guidance, data connections and project evaluation processes, can be developed centrally, with costs spread across multiple retrofit providers throughout the life of the fund, thereby lowering transaction costs and the cost of capital.

Whilst the section below (*"The Components of a Successful Aggregator"*) outlines detailed requirements for running an aggregator fund, the generic elements required to establish funds & align Retrofit Providers with an aggregated approach are shown in Figure 10 below:

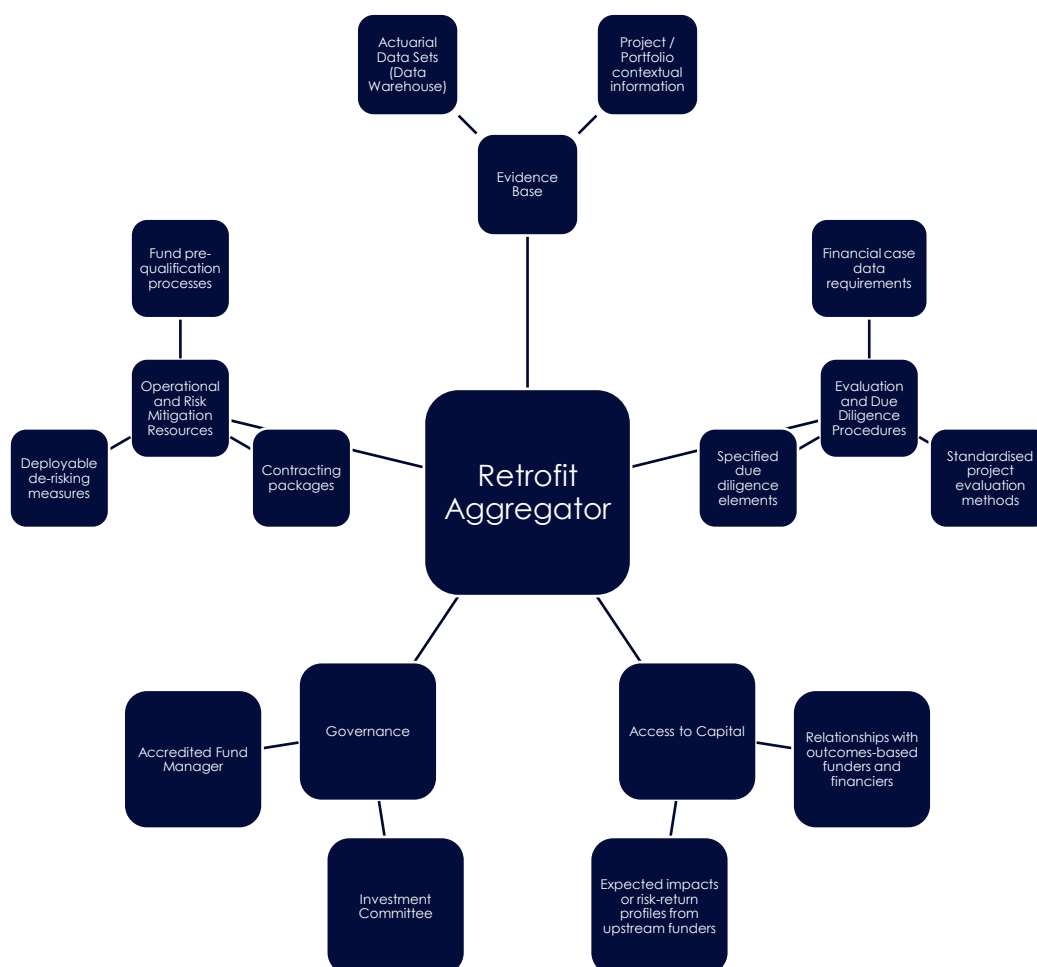


Figure 7: the generic elements required to establish aggregator funds & align Retrofit Providers with an aggregated approach

Taking the high-level component descriptions above, we can begin to determine how a Retrofit Provider would align with each element, a key consideration moving into the third milestone period of this project:

- Evidence Base:** Retrofit Providers can help to source an evidence base, and provide contextual and project performance data from their own projects and portfolios to support this evidence base. Providing such data will hopefully help these Retrofit Providers to evidence how their implementation of an MES-enabled scheme provides lower credit risks and default rates, and greater social, environmental and outcomes-based impacts, thereby attracting additional funding into their business model.

- **Evaluation and Due Diligence Procedures:** Retrofit Providers can take the evaluation and due diligence procedures specified by an aggregator and use them to specialise their project development processes to satisfy these requirements. This is particularly useful if the retrofits require pre-qualified funding to complete their project development stages.
- **Access to Capital:** The Retrofit Provider can discuss the blend of available outcomes-based funding and private finance that can be deployed with the fund and align the development of projects to ensure that the expected outcomes or risk-return profiles can be realised. This in turn provides confidence to the Retrofit Provider to take on development risk and support projects across the development gap.
- **Governance:** The Retrofit Provider can assist the fund manager, their staff and investment committee with understanding the advantages of their retrofit scheme and development approach. In return, the aggregator can provide the Retrofit Provider with a list of concerns against which projects will be evaluated, such as geographic overlap, financial case and environmental/social impact.
- **Operational and Risk Mitigation Resources:** The aggregator can share their operational resources with qualified/collaborating Retrofit Providers to enable the reduction in operational administration, transaction costs and project risk. These may take the form of pre-qualification processes to motivate Retrofit Providers to advance projects across development hurdles (knowing a financing solution is available). Equally, the contracting packages developed or procured by aggregators can be utilised by Retrofit Providers to de-risk their collaborations and revenue stream provision, by distributing risk and liabilities to appropriate partners to incentivise high-quality project development and installation. These are just two examples of de-risking measures that could be deployed, but a Retrofit Provider and aggregator could agree a range of industry-standard de-risking measures and development approaches to improve the risk-return profiles of their portfolio, such as use of IPMVP processes.

Now that we have defined the generic elements required to establish Retrofit Aggregator funds, and discussed how a Retrofit Provider can align to these elements, the next section will consider these components in more detail, drawing out existing examples in the marketplace and the benefit of each component in bringing funding to bear throughout the development lifecycle.

The Components of a Successful Aggregator

This section will discuss the components that need to be in place to support the successful aggregation of MES-enabled retrofit projects. These components will inform our ongoing work in the milestone 3 period to outline how MES-enabled approaches can be upscaled and adopted by varied Retrofit Providers.

Table 4 below walks through each of these components in turn, highlighting relevant sources or examples in the market, along with commentary on how each component assists with bringing funding into MES-enabled retrofit. Finally, each component is connected to points in the project development lifecycle, as discussed in detail in Appendix 1.

Table 3: A summary of components proposed for a successful aggregator, outlining exemplar cases, benefits for bringing funding to bear in MES-enabled retrofits & associated lifecycle development steps.

Aggregator Component	Existing Examples	Benefits for Funding MES-enabled Retrofit	Key Lifecycle Development Steps
Actuarial Data Sets (Data Warehouse)	De-risking Energy Efficiency Platform	Reduction in uncertainty, risk and cost of capital	Long list criteria / target households
Project / Portfolio contextual information	EN-TRACK, DeepKi	Improved household targeting & iterative scheme design	Long list criteria, Procurement methodology, Installation and Completion Testing
Financial case data requirements	eQuad	Rapid and low-cost funding qualification	Technical and Economic Decision
Standardised project evaluation methods	Investor Confidence Project	Rapid evaluation improves risk & lowers transaction costs	Investment Decision
Specified due diligence elements	Mayor's Energy Efficiency Fund; Investor Confidence Project	Transparency between applicant and funder, due diligence helps de-risking projects	Investment Decision
Relationships with outcomes-based funders and financiers	Government Outcomes Lab; Invesco	Public or outcomes-based funding can be blended into private finance funds, attracting additional investment	Stakeholder engagement
Expected impacts or risk-return profiles from upstream funders	N/A – commercially sensitive	Transparency between applicant and funder, ability to blend finance and outcomes-based funding	Funding Deployment / Investment Decision
Investment Committee	N/A – commonplace	Investment committee can build specialist skills in evaluating retrofit cases, speeding & de-risking decisions	Funding Deployment / Investment Decision
Accredited Fund Manager	N/A – commonplace	Fund manager can build specialist skills in aligning development best practice with the evaluation of retrofit projects, speeding & de-risking decisions	Funding Deployment / Investment Decision
Finance pre-qualification processes	eQuad / ESCO-in-a-box	Rapid and low-cost funding qualification	Funding Approach

Contracting packages	ESCO-in-a-box	Distributed risk across all actors, with actors incentivised by the risks they have greatest control over (i.e. contractor bears installation risk)	Pre-contracting of revenue streams / Contracting
Deployable de-risking measures	ESCO-in-a-box®	Best practice applied to the project development process reduces default rate.	All project origination and project development steps

Key decisions for establishing Retrofit Aggregators and their requisite components

Alongside the components outlined above, there are several key decisions to be made when considering establishing Retrofit Aggregators. These will not be prescribed, but highlighted within this section for further consideration:

- 1) **Specialised Geographies:** A fund could work by targeting specific geographies, for example the Mayor's Energy Efficiency Fund, targeting local authorities and other project hosts within London. This can reduce the available market but focus resources, assist with building relationships with Public Bodies as well as Institutional Funders.
- 2) **Technology Targeting:** Targeting a specific technology (or set of technologies), can help to standardise the project development and evaluation processes. Whilst this reduces the available market, it can also support specific retrofit providers and specialised contractors to rapidly grow a targeted offer. The selection of targeted technology must be based on the housing requirements of a particular geography to avoid tensions around the suitability of installations. Discussions with consortium partners highlighted that undue focus on particular technologies may drive less desirable outcomes or reduce project performance.
- 3) **Procurement approach:** The route through which an aggregator procures a project or project funding option can have many downstream impacts. Potential solutions include:
 - o Buy the entire project – once a project is developed to an investment grade appraisal, the aggregator purchases the project and deploys capital, managing the remaining project steps. This can give the aggregator more control over installations and post-project support, but with additional cost.
 - o Just take a fee on each projects – The fund could arrange finance and verify aggregated services in return for an M&V and/or Transactional Fees. This is a middle ground in terms of trading off fund control and transaction costs.
 - o Purchase services/concessions from projects – If a fund would like the lowest transaction costs with minimal control of projects at an operational level, they could offer payments for specific services or concessions from a project, such as the right to monetise anonymised data, operate flexible assets or sell verified health benefits.
- 4) **Collaboration Licensing:** The consortium of collaborating partners will have to decide whether the fund will have an open portal for the submission and assessment of

projects, or whether the fund will license resources and access to their system to collaborating Retrofit Providers only. The latter increases the size of the market but could impact project quality and funder recourse, whilst the latter increases the sharing of IP, but improves the uptake of the fund's development approach and best practice.

Aggregator Business Model

In the first iteration of business modelling, EP had considered a blended-finance approach to individual projects, with funding being aggregated from institutional investors as well as outcomes-based investors. However, conversations with members of the RetroMeter Advisory Group indicated that bringing finance on a project-by-project basis, particularly where institutional capital and outcomes based capital is being blended, is too difficult in practice and that financial investors are less concerned with individual projects than with overall returns and risk profile, which is why the fund structure is common (even for purely financially driven capital).

Following several discussions with the Green Finance Institute (GFI), it was realised that the aggregator resembles, and in practice could well be, a fund manager which assembles the various sources of capital and provides funding to projects from an MES enabled fund. This model is shown in Figure 11.

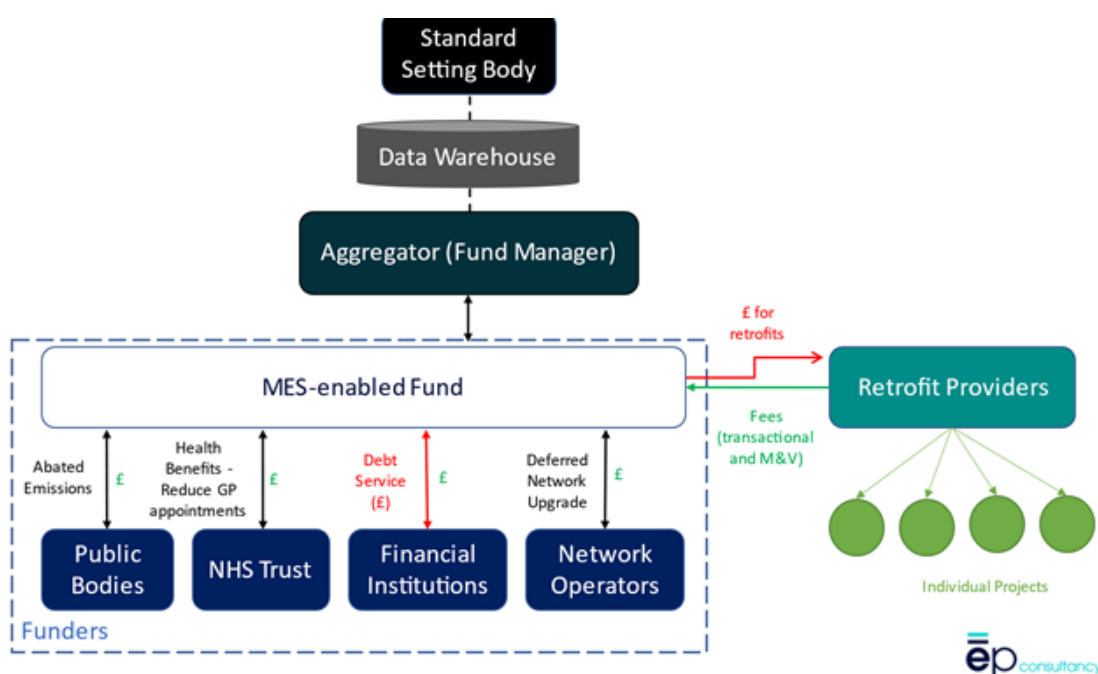


Figure 11: The centralised perspective of an Aggregator (Fund Manager), showing the relationship to Funders (blue), Retrofit Providers (green), the proposed Data Warehouse and Standard Setting Body.

In this model, the Aggregator acts as a Fund Manager for a Metered Energy Savings Fund. Conversations with financiers indicated that most funders were indifferent to the project developer and their project development specification as long as the projects they were investing in were quality assured, and the project outcomes were realised. Therefore, the creation of a fund would mean investors would only be required to conduct due diligence on the fund and the fund manager, rather than individual retrofit projects.

As a result, the MES retrofit programme could be incorporated into the fund, which would then bundle retrofit projects together to build an economy of scale.

Under this model, the Aggregator would provide value to two distinct customer segments: **The Funders** and **the Retrofit Providers**.

The Funders include traditional financial institutions, (driven primarily by financial returns), as well as outcome-based funding from impact investors such as network operators, public bodies and the NHS Trust, who may be willing to invest in the MES-enabled fund to address their wider strategic objectives.

At a high-level, the Aggregator would be able to provide the following gain creators and pain relievers to the first of our two customer segments, Funders:

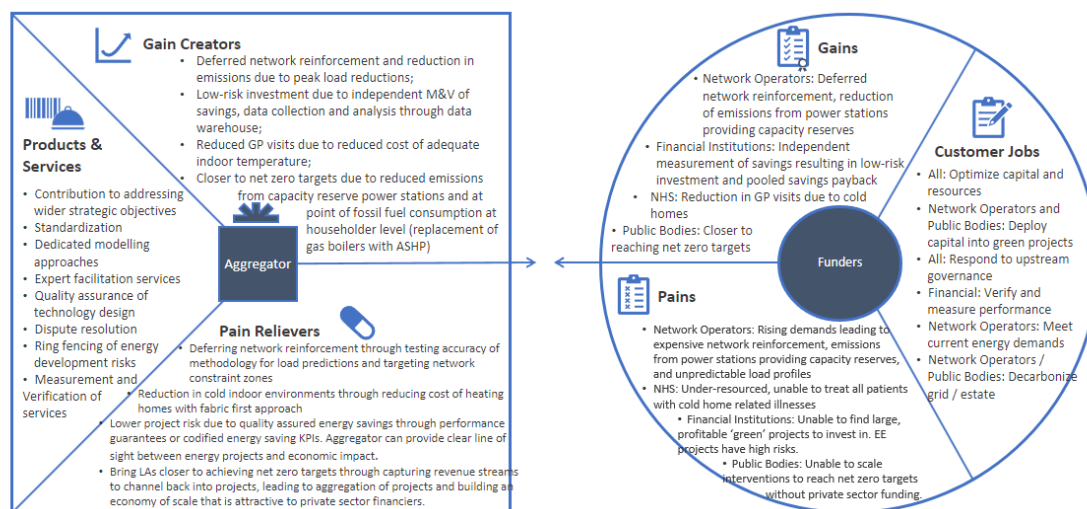


Figure 8: A value proposition canvas summary of the proposed aggregator business model defining the services and value provided to Funders

The Aggregator does this by offering the following services:

- Define and align the needs of institutional funders into the retrofit scheme designs and implementation;
- Ensure retrofit scheme meets criteria of funders;
- Oversee the finance qualification process, which includes the utilisation of several tools and standards to store retrofit historic data to build more credible business cases for MES-enabled retrofits overtime;
- Deploy standardised, third-party measurement and verification to validate the financial, social, and environmental impacts of the retrofit, the cost of which is covered through standard M&V fees charged to the retrofit providers by the Fund Manager. This process ensures all systems are performing as specified and identifies any anomalies in equipment and/or user habits in the year after construction is complete. Depending on the type of retrofit scheme being deployed, the validation process may look at existing standards such as the International Performance, Measurement and Verification Protocol (IPMVP), British Standard BS40101 or PAS2035;
- Develop dedicated modelling approaches to validating retrofit performance;
- Deploy expert facilitation services and quality assurance of the technology design to ensure project outcomes are realised;
- Develop dispute resolution mechanisms;
- Unify and redistribute the risks associated with the retrofits across the various project stakeholders.

All together these services come together to enable the Aggregator to address the wider strategic goals of each institutional investor, such as validating the reduction in peak loads to enable DNOs to defer network reinforcement, validating the reduction in emissions so that

investors can reduce carbon from their loan books and local authorities can meet their net zero targets, or validating the reduction of GP visits at a particular NHS clinic due to fewer cold-home related illnesses from the retrofits delivered.

This, in turn, proves to be beneficial to the Retrofit Providers or one-stop-shops that facilitate retrofits, through the following high-level value proposition (shown in Figure 16):

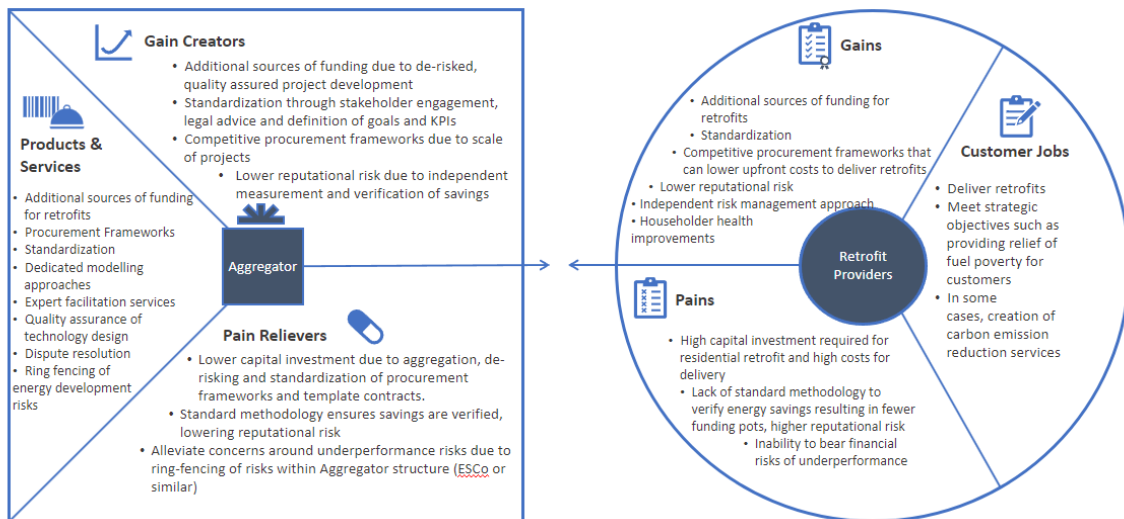


Figure 13: A value proposition canvas summary of the proposed aggregator business model defining the services and value provided to Retrofit Providers

In this case, the Aggregator provides the Retrofit Providers will the following services:

- Origination of retrofit projects in collaboration with the retrofit project developers and retrofit providers;
- Access to additional sources of funding for retrofits;
- The development of standardised procurement frameworks and contracts with the local supply chain, including project developers, contractors, and installers, resulting in competitive procurements that could lower the costs of capital for retrofit projects. It should be noted that standardization may limit the retrofit providers' ability to provide collaborative and flexible procurements to their supply chain, however, it is vital to unlocking investment into retrofits as it ensures the contracting, accreditations and estimation approach de-risk the project and enable recourse in the case of an underperformance. While utilising these standardised frameworks and contracts may not be mandatory, retrofit providers' own procurement frameworks may not be acceptable to private financiers in cases where the schemes are deemed to be too 'risky' or lack quality assurance;
- Post project support, which includes independent measurement and verification of savings and dispute resolution mechanisms, lowering the reputational risks associated with underperformance and providing technology providers with an opportunity to prove their technology works, which enables them to promote their products against their competitors. It should be noted that different retrofit providers may currently have engagement activities that revolve around the validation of energy savings, therefore, the aggregator's role will either be to provide advice to those providers or, where feasible, adapt the current model to integrate householder management processes;

- Deploying expert facilitation services and quality assurance of the technology design to ensure project outcomes are realised, through the selection of credible contractors, as well as approved products with warranties, discussions with householders regarding additional ventilation requirements and high-quality finishes. As more actuarial evidence is collected through the data warehouse, the requirements for this may change to promote specific contractors or providers that have resulted in high-quality retrofits. In time, this will increase the credibility of the provider and the public's confidence around retrofits;
- Providing access to new parts of the market;

In return for these services, the Aggregator would charge the retrofit providers transactional and M&V fees to underpin the ongoing services arranged through the body, which include access to the Data Warehouse & Standard Setting Body. The fees, alongside the financial returns from the retrofits, also enable the MES Fund to meet the returns expectations of the investors. A breakdown of these transactions can be found in the diagram provided in Appendix 3.

The value propositions, key services and customer relationships for the Aggregator can be summarised by the following business model canvas:

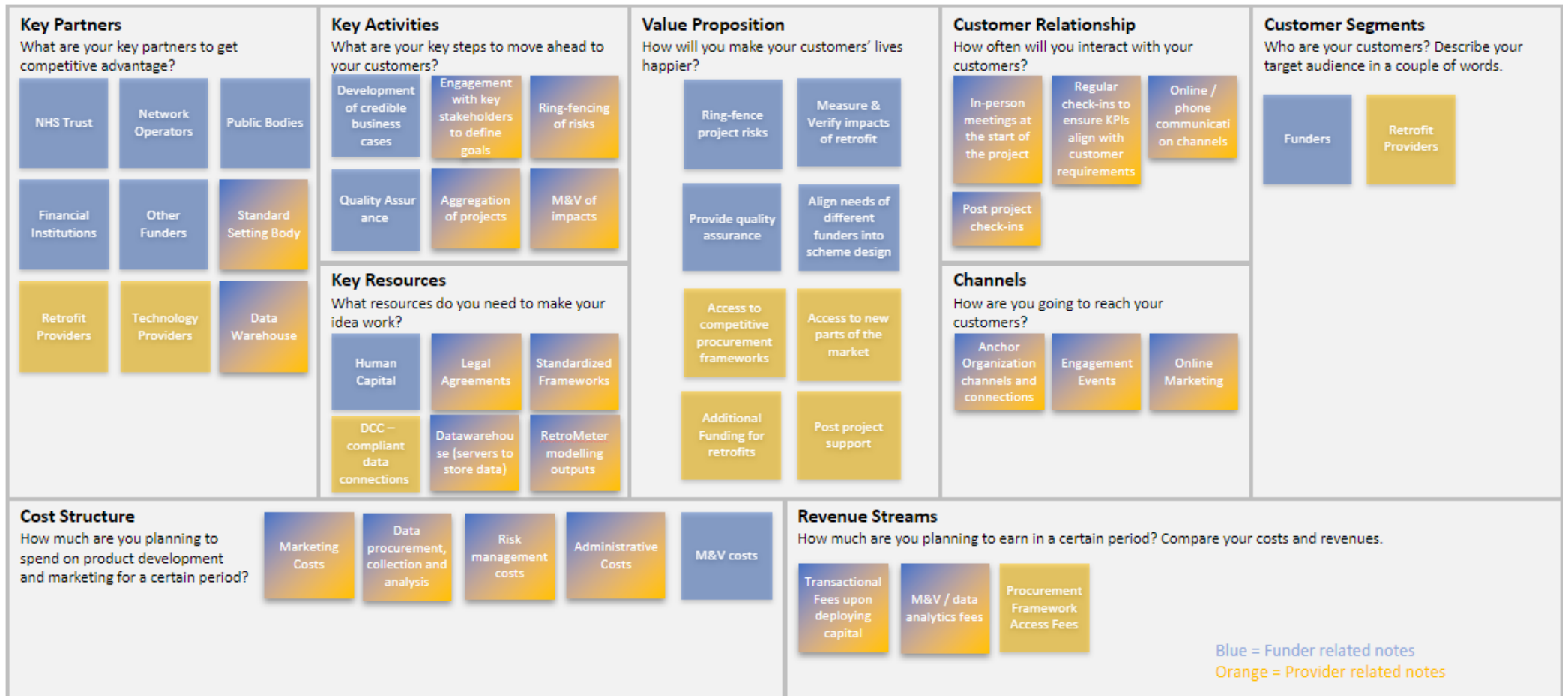


Figure 14: A business model canvas summary of the proposed aggregator business model defining the services and value provided to Funders (colour coded blue) and Retrofit Providers (colour coded orange). Where an aspect supports both these customer segments, it is colour coded with a gradient of orange and blue.

Conclusion

This report identified the key stakeholders for an MES-enabled retrofit, outlining their roles and responsibilities through a series of project development stages focused on identifying and managing the localised risks, issues, and barriers to investment in energy efficiency projects. It also addresses the challenges related to performance guarantees, complex APIs and the aggregation of finance from multiple institutional investors.

In particular, the report explores the need for aggregation, addressing the key responsibilities and components of a successful aggregator. This leads to the development of a business model that involves aggregators, funders, and retrofit providers, aiming to align the needs of various stakeholders to facilitate the deployment of funds towards MES-enabled retrofits. In this model the functions of the aggregator resemble those of a conventional fund manager, in this case one that is managing a fund comprising financial driven investments and outcomes driven investments. The model addresses standardization, financial returns, and future development planning, ensuring that the interests of all partners are considered whilst integrating the economic, environmental, and social impacts of a retrofit to unlock several value streams.

In conclusion, this report lays out high-level business models behind capturing the value streams and unlocking substantial investment into the UK retrofit market. The next steps will involve defining the proposed market channels and stakeholder unique selling points, thus exploring the routes to market. This will lead to the creation of a Milestone 3 report focused on exploring how the business model can be adopted and upscaled by area-based retrofit facilitators or one-stop shops around the UK.

Whilst out of the scope for the SIF Alpha Phase project, future work should involve exploring the roles and responsibilities of an Aggregator in deploying finance for commercial retrofits, thus unlocking a series of completely different value streams and business cases for energy efficient retrofits.

References

- Scottish Futures Trust Public Sector Delivery Structures for Low Carbon Investment Final Report. (2013). Available at: <https://www.scottishfuturestrust.org.uk/publications/documents/sft-delivery-structures-2013> [Accessed 20 Feb. 2024].
- Tantau, A. (2020). Sustainable business models for retrofitting and their benefits for historical buildings energy performance. *International Journal of Smart Grid and Clean Energy*, pp.795–804. doi:<https://doi.org/10.12720/sgce.9.4.795-804>.
- Watson, M. (17AD) *Entire – Latest learning on DNO led DSR: LCNI 2017 Telford Exhibition Centre, Energy Networks*. Available at: Entire – Latest learning on DNO led DSR LCNI 2017 Telford Exhibition Centre (Accessed: 29 February 2024).
- Xue, Y., Temeljotov-Salaj, A. and Lindkvist, C.M. (2022). Renovating the retrofit process: People-centered business models and co-created partnerships for low-energy buildings in Norway. *Energy Research & Social Science*, 85, p.102406. doi:<https://doi.org/10.1016/j.erss.2021.102406>.

Appendices

- Appendix 1: This appendix provides a summary of key activities, stakeholder responsibilities and activity barriers mapped across all five project development stages
- Appendix 2: This appendix provides a mapping of decision point stages and initial proposed decisions supporting the decision tree presented in the body of this report.
- Appendix 3: This appendix provides a chart showing the detailed view of an Aggregator's perspective, along with connections to the funder and retrofit provider customer segments.

Appendix 1: A summary of key activities, stakeholder responsibilities and activity barriers mapped across the various project development stages

Table 4: A summary of key activities, stakeholder responsibilities and activity barriers mapped across the pre-development lifecycle stage.

Project Stage	Stage Activities	Relevant Stakeholders	Description of Stakeholder Responsibilities	Key Activity Barriers
Stakeholder engagement	Initial outreach and engagement	All partners	<ul style="list-style-type: none"> From a roster of stakeholders for further engagement Identify relevant contacts in each stakeholder organisation 	<ul style="list-style-type: none"> Stakeholders are not responsive, or the wrong contact is engaged
	Session hosting / administration	Public Bodies; Retrofit Provider	<ul style="list-style-type: none"> Arrange a digital or physical space to host the stakeholder engagement session Formulate an initial project concept or agenda to enable discussion 	<ul style="list-style-type: none"> The stakeholder session, developed at risk, does not yield any further collaboration
Definition of strategic goals and scheme vision	Definition of normative goals	Public Bodies; Householder; DNO	<ul style="list-style-type: none"> Defining the goals that the retrofit scheme should aim to achieve. 	<ul style="list-style-type: none"> The partners fail to capture a key strategic goal present within the target area, or the goals set do not lead to equitable outcomes
	Definition of instrumental goals	Retrofit Provider; Standard Setting Body; DNO	<ul style="list-style-type: none"> Defining how the retrofit scheme could best achieve its normative goals. 	<ul style="list-style-type: none"> The partners select an instrumental approach which is not appropriate or cost-effective.
	Feedback (all partners)	All partners	<ul style="list-style-type: none"> The partners should review and critique the normative and instrumental goals 	<ul style="list-style-type: none"> Some partners fail to feedback in a timely manner
Contracting within delivery consortium	Defining Non-disclosure agreements & collaborative contracting	Public Bodies; Retrofit Provider	<ul style="list-style-type: none"> Defining and drafting all relevant contracts to enable ongoing collaboration 	<ul style="list-style-type: none"> Contracting adds additional legal development costs before the scheme launches, which must be funded at risk The contracting delays the scheme launch.
	Contribution of signatures, schedules and feedback	All partners	<ul style="list-style-type: none"> All partners review contracts, providing schedules, feedback and signatures 	<ul style="list-style-type: none"> The review and signing of contracts delays the scheme launch Schedules do not fully distribute risk and liability

Long listing criteria based on model requirements and strategic goals	Definition of model requirements	Standard Setting Body; Data Warehouse	<ul style="list-style-type: none"> • SSB: Outline the confidence intervals required by the proposed model and strategic goals. • DW: Outline the available data or data sources to provide the input data required to satisfy the SSB's desired confidence intervals 	<ul style="list-style-type: none"> • SSB: Confidence intervals are too onerous or reduce the ability of the consortium to access specific value stacks • DW: The data sources selected are not sufficient, or large data gaps persist into the data collection phase.
	Definition of non-modelling longlisting criteria	Retrofit Provider; Public Bodies	<ul style="list-style-type: none"> • Delivery Organisation: Defining the minimum input data requirements and household attributes needed to satisfy the model requirements. • Public Bodies: Definition of any specific criteria or exceptions thereof to enable household participation. 	<ul style="list-style-type: none"> • Delivery Organisation: The minimum data requirements are overly onerous or do not fully satisfy the model requirements • Public Bodies: Defined criteria or exceptions are appropriate and do not lead to monetised revenue streams.
Modelling and targeting of specific geographies and housing archetypes	Data input	Data Warehouse; Public Bodies	<ul style="list-style-type: none"> • Data Warehouse: Arranging secure data connections and input procedures such as anonymisation • Public Bodies: Arranging data export and access to metering 	<ul style="list-style-type: none"> • Data connections are not appropriate or timely access to data and metering cannot be arranged
	Modelling and synthesis	Retrofit Provider; Standard Setting Body	<ul style="list-style-type: none"> • Retrofit Provider: Modelling of the normalised energy consumption alongside scheme interventions and household impacts, revealing saving estimates and any non-routine consumption • SSB: Specification of pre-retrofit model outputs and acceptance of non-routine energy profiles. 	<ul style="list-style-type: none"> • Retrofit Provider: Modelling approach leads to inaccurate or biased results • SSB: Model output specifications or acceptance of non-routine energy profiles are not appropriate or aligned with the scheme design
	Network constraint zone input	DNO	<ul style="list-style-type: none"> • Overlay network constrained zones on the geography of selected households 	<ul style="list-style-type: none"> • Local network constraints are insufficient or not aligned with the contracting of localised flexibility or demand reduction services.

Table 5: A summary of key activities, stakeholder responsibilities and activity barriers mapped across the project origination lifecycle stage.

Project Stage	Stage Activities	Relevant Stakeholders	Description of Stakeholder Responsibilities	Key Activity Barriers
Site shortlisting	Apply criteria for shortlisting of sites	Retrofit Provider; Public Bodies	<ul style="list-style-type: none"> Generate a shortlist of households and sites based on prior criteria and modelling 	<ul style="list-style-type: none"> Inclusion of unsuitable homes in the shortlist will raise development costs
Household discussions	Discussions with shortlisted households	Retrofit Provider; Standard Setting Body	<ul style="list-style-type: none"> Standard Setting Body: Specify the confidence required to consider specific assets and revenue streams at the level of individual homes Retrofit Provider: Conduct householder discussions to narrow down on the interventions and revenues they would like to integrate in their retrofit design. Acceptance of a standardised retrofit design. 	<ul style="list-style-type: none"> Standard Setting Body: The assets or revenue streams are over specified, or overly conservative, damaging the project financials. Retrofit Provider: The discussions result in householder expectations that are not appropriate/aligned with the proposed scheme design. The information asymmetry leads to the householder feeling like they did not receive the retrofit they were promised.
	Gathering of legal approval and initial permissions	Retrofit Provider; Public Bodies; Standard Setting Body	<ul style="list-style-type: none"> Retrofit Provider: Gathering approvals for site / data access and permissions for specified / ancillary works Public Bodies: Completing or supporting planning approvals Standard Setting Body: Specifying the letters of authority and data rights agreements that the Retrofit Provider should gather from the homeowner. 	<ul style="list-style-type: none"> Legal permissions are not suitable, miss key schedules/clauses, or have gaps and missing permissions.
Confirmation of specification of works	Definition of Contractor Capabilities (con)	Contractor	<ul style="list-style-type: none"> Contractor outlines the interventions they would be willing to install, along with any quality assured services or ongoing services such as operation and maintenance support 	<ul style="list-style-type: none"> Contractor capabilities are not described accurately or are not sufficient for de-risked project delivery.

	Modelled impact validation	Contractor; Retrofit Provider; Standard Setting Body	<ul style="list-style-type: none"> Contractor: Provide modelling, saving estimations and data inputs for validation Retrofit Provider and Standard Setting Body: Validate the modelling of impact, input assumptions and savings estimations 	<ul style="list-style-type: none"> Contractor models or savings estimates are not accurate. Modelled impact is not validated correctly The modelled impact cannot be verified by the RetroMeter solution
	Approval for specific works within area-based scheme	Household	<ul style="list-style-type: none"> Provide approval for specified works 	<ul style="list-style-type: none"> Household does not accept specified works and requests to leave the scheme or be provided with a custom specification.
Confirmation of funding approach	Definition of funding parameters, cost of capital and available funding	Investor	<ul style="list-style-type: none"> Provide a clear specification of funding parameters along with the amount of funding available with associated funding terms and capital costs 	<ul style="list-style-type: none"> The specification of funding is not suitable or sufficient for the given project or portfolio
	Discussion of self-funding and ability to pay	Household, Retrofit Provider	<ul style="list-style-type: none"> Retrofit Provider to communicate funding options to household Household to review funding options, seek financial advice as needed, and provide outline feedback & acceptance. 	<ul style="list-style-type: none"> There is a miscommunication regarding the funding package The household's ability to borrow changes between this stage and confirmation of finance
	Assembly of proposed funding solutions	Retrofit Provider / Public Bodies	<ul style="list-style-type: none"> A funding / finance package is assembled based on household contributions and specified funding parameters from partner financiers 	<ul style="list-style-type: none"> The funding parameters or household contributions change, impacting the number of retrofits that can be funded
KPI commitments: Detailed modelling of impact and codification of project performance	Definition of acceptable risk and confidence thresholds for performance guarantees	Retrofit Provider	<ul style="list-style-type: none"> If the Retrofit Provider wishes to offer performance guarantees to motivate financier or stakeholder engagement, they will define risk and confidence thresholds under which these can be offered at this stage 	<ul style="list-style-type: none"> Performance guarantees expose Retrofit Provider to undue risk. The Retrofit Provider has not sufficiently de-risked the development approach to offer performance guarantees. Performance guarantees can only be offered to a subset of retrofit sites, which may impact equitable outcomes

	Definition of model output confidence	Standard Setting Body; DNO	<ul style="list-style-type: none"> The minimum level of model output confidence to form the baseline and post-installation reference against which impact is measured is defined. 	<ul style="list-style-type: none"> The minimum level of model confidence is not achievable or discounts a significant number of homes from accessing retrofit or key retrofit value streams.
	Feedback on feasibility of KPIs and performance commitments	All Partners	<ul style="list-style-type: none"> All partners to provide feedback on feasibility of KPIs and performance commitments 	<ul style="list-style-type: none"> Feedback is not timely or fails to capture key concerns

Table 6: A summary of key activities, stakeholder responsibilities and activity barriers mapped across the project development lifecycle stage.

Project Stage	Stage Activities	Relevant Stakeholders	Description of Stakeholder Responsibilities	Key Activity Barriers
Baseline data collection and sufficiency testing	Establish data connections and test data sufficiency (1 year of historic energy consumption data)	Retrofit Provider; Standard Setting Body	<ul style="list-style-type: none"> Put in place APIs to gather, transform and assess the sufficiency of input data. Define data sufficiency requirements 	<ul style="list-style-type: none"> APIs are complex to develop. Input data sources are not interoperable. The data sufficiency requirements are too onerous.
	Provision of any remaining data access permissions	Household; Retrofit Provider	<ul style="list-style-type: none"> Household/Retrofit Provider work together to secure remaining data access permissions 	<ul style="list-style-type: none"> Household refuses to grant data access permissions and cannot proceed Data access permissions do not reflect necessary data rights, impacting household trust or requiring re-engagement.
Technical and Economic Development	Economic and technical modelling	Retrofit Provider; Public Bodies	<ul style="list-style-type: none"> Retrofit Provider or Public Bodies to consolidate technical modelling to date with an economic overview, codifying the expected financial and non-financial impacts 	<ul style="list-style-type: none"> Modelling to date is inaccurate, or relied on assumptions which do not hold true or cannot be evidenced to financiers / funding stakeholders

	Drafting of financial case or investment-grade appraisal	Retrofit Provider; Public Bodies; Investor	<ul style="list-style-type: none"> Retrofit Provider or Public Bodies to convert economic and technical modelling into a financial case or investment grade appraisal Investor to provide iterative feedback 	<ul style="list-style-type: none"> The financial case is not strong enough for an investment to proceed Iterative feedback delays the retrofit project's development and deployment
Planning and Consent: Applications for licenses or regulatory approval	Applications for licenses and regulatory compliance	Retrofit Provider	<ul style="list-style-type: none"> Retrofit Provider to apply and gather relevant approvals and licenses for the planned works specifications 	<ul style="list-style-type: none"> Licenses are not granted or incur delays or adaptations to the specified works
	Review of licenses and approval for any remaining permissions	Household; Public Bodies	<ul style="list-style-type: none"> All remaining licenses and permission approvals to be provided by the Household 	<ul style="list-style-type: none"> Licenses are not granted or incur delays or adaptations to the specified works
Pre-contracting of revenue streams	Assessment and confirmation of revenue feasibility	Standard Setting Body; Data Warehouse; Retrofit Provider	<ul style="list-style-type: none"> The financial case, relevant licenses and stakeholder confidence thresholds are used to assess and confirm feasible revenue streams for the scheme or specific sites 	<ul style="list-style-type: none"> The underlying modelling or assumptions are incorrect and therefore revenues are not feasible in practice
	Feedback and contracting	All partners	<ul style="list-style-type: none"> All partners provide feedback on the feasible revenue streams and the key contracts and schedules underpinning their deployment 	<ul style="list-style-type: none"> Feedback is not timely or fails to capture key concerns Iterative feedback and adaptation of contracts or schedules incurs expensive legal fees which increase development/transaction costs of retrofit
Procurement Methodology	Contractor responds to defined specification of work	Contractor	<ul style="list-style-type: none"> Contractor to provide a quote in response to the work specification outlining aspects such as itemised cost, selected technology models and system designs, related warranties, guarantees and maintenance services etc. 	<ul style="list-style-type: none"> Contractor does not complete their specified quote, or the costs, design specifications, guarantees or savings estimations are not accurate
	Selection of contractor	Retrofit Provider; Household	<ul style="list-style-type: none"> Retrofit Provider works with household or group of households to explain various quotes and their distinguishing 	<ul style="list-style-type: none"> Information asymmetry persists between Retrofit Provider and Household

	quotes and responses		<p>factors and relative advantages or disadvantages. This may help with the selection or acceptance of specified works, with the latter acceptance key where quotes have been pre-procured or pre-selected, as with an area-based scheme.</p> <ul style="list-style-type: none"> Householder(s) works with Retrofit Provider to select/approve preferred contractor(s) where this has not been pre-defined or pre-procured (as with an area-based scheme), 	<ul style="list-style-type: none"> Household does not select any quotes presented
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Table 7: A summary of key activities, stakeholder responsibilities and activity barriers mapped across the project deployment lifecycle stage.

Project Stage	Stage Activities	Relevant Stakeholders	Description of Stakeholder Responsibilities	Key Activity Barriers
Investment Decision	Investor receives & responds to the financial cases or investment grade appraisals on an individual or portfolio/bundled basis	Investor	<ul style="list-style-type: none"> Respond to the financial cases or investment grade appraisals on an individual or portfolio/bundled basis, providing confirmation of acceptance / rejection and related feedback 	<ul style="list-style-type: none"> Investor does not have sufficient information or confidence in the underlying financial case to fund the relevant projects
Funding Deployment	Reviews & approval of project-level funding solutions	Investor; Retrofit Provider	<ul style="list-style-type: none"> Retrofit Provider selects from financiers and funders where more than one funding solution is feasible, communicating this to relevant parties Investors provide counter-offers or confirmation in response to their selection or non-selection 	<ul style="list-style-type: none"> One or more funders drops out and so the funding solution must be revisited or reconciled
	Financial countersigning	Public Bodies/ Retrofit	<ul style="list-style-type: none"> All relevant parties sign and counter-sign financial agreements 	<ul style="list-style-type: none"> Signatures are not timely and delay project deployment

		Provider; Household		<ul style="list-style-type: none"> Iterative feedback and adaptation of financing contracts or schedules incurs expensive legal fees which increase development/transaction costs of retrofit
Installation and Completion Testing	Completion of installation	Contractor	<ul style="list-style-type: none"> Contractor completes works to a high quality 	<ul style="list-style-type: none"> Contractor does not follow their own quote or work specification; Installation is not of a sufficient quality
	Completion testing	Retrofit Provider; Contractor	<ul style="list-style-type: none"> Retrofit Provider oversees completion testing by primary or secondary contractor, or undertakes completion testing themselves 	<ul style="list-style-type: none"> Completion testing raises snags to be addressed Completion testing identifies a low-quality or non-compliant installation based on the agreed quote or works specification
	Provision of feedback	Household	<ul style="list-style-type: none"> Household feeds back any snags, underperformances or technology issues at the earliest stage Household receives induction to their new installed technologies and feeds back any remaining questions or clarifications 	<ul style="list-style-type: none"> Snags, underperformances or technology issues are not identified at the earliest stage, creating a potential underperformance in the future Household is not suitably inducted into how to operate and maintain their new assets creating a potential underperformance in the future

Table 8: A summary of key activities, stakeholder responsibilities and activity barriers mapped across the post-project support lifecycle stage.

Project Stage	Stage Activities	Relevant Stakeholders	Description of Stakeholder Responsibilities	Key Activity Barriers
Collection of post-implementation data	Collection of post-implementation data and maintenance of data connections	Data Warehouse; Retrofit Provider/ Public Bodies	<ul style="list-style-type: none"> Public Bodies or Retrofit Provider to connect smart meters or consumer access devices provide post-implementation data using the format or API specified by the Data Warehouse 	<ul style="list-style-type: none"> Data Warehouse may have to provide advice and support on connecting devices, leading to additional cost or delays Incorrect or unmaintained data connections lead to data drop-outs and insufficiencies
	Reporting of Non-routine Events	Household	<ul style="list-style-type: none"> Households report non-routine events as they occur. A framework 	<ul style="list-style-type: none"> Non-routine events or technology issues are not identified at the earliest stage,

			for such reporting will require development, it is likely that this will form part of the commentary of ongoing engagement deliverables within Work Package 5 of this project.	<p>creating a potential underperformance in the future</p> <ul style="list-style-type: none"> • Persistent issues or non-routine events could damage household trust
Ongoing O&M, M&V, Flexible control	Operation and Maintenance	Household / Contractor	<ul style="list-style-type: none"> • Household or contractor conduct operation and maintenance activities as needed and specified, for example inspecting and cleaning heat pump filters 	<ul style="list-style-type: none"> • Household is not suitably inducted into how to operate and maintain their new assets creating a potential underperformance in the future • Insufficient operation and maintenance by contractors causes a technology underperformance.
	Measurement and Verification (M&V)	Retrofit Provider; Data Warehouse; Standard Setting Body; DNO	<ul style="list-style-type: none"> • Baseline and post-implementation models and metered data are compared to determine the model fit, confidence and “measured” savings • Data warehouse conducts analysis or stores pre-analysed performance data • DNO deploys payments for deferred network reinforcement based on the verified load reduction. These payments could be composed of arming / availability fees, utilisation fees and a “full delivery incentive” where payments are clawed back in the case of under-delivery (Watson, 2017), foregrounding the value of verification. 	<ul style="list-style-type: none"> • The wrong M&V approaches are applied, hampering the confidence and verification of metered savings • The models are not appropriately adjusted or normalised, leading to under or over estimation of the resultant savings • The DNO challenges the M&V approach, delaying deferred reinforcement payments
	Flexible Operation and Optimisation	Household; Public Bodies; DNO; Retrofit Provider	<ul style="list-style-type: none"> • DNO establishes contracts and specifications for explicit flexibility, deploying flexibility requests 	<ul style="list-style-type: none"> • Flexibility requests are not aligned with automated or manual flexibility responses

			<ul style="list-style-type: none"> Household conducts demand response (for implicit or explicit flexibility calls) or provides approval for the Retrofit Provider or Public Bodies to operate assets on their behalf in response to flexibility calls. 	<ul style="list-style-type: none"> The expected demand response cannot be verified by the DNO Household does not provide approval for automated asset operation and fails to conduct their own demand response.
Self-evaluation of scheme impact against codified project performance and KPI commitments	Evaluation management	Retrofit Provider	<ul style="list-style-type: none"> Retrofit Provider manages evaluation process, ensuring household feels supported and heard. Retrofit Provider investigates satisfaction of KPI commitments 	<ul style="list-style-type: none"> Evaluation shortfalls or miscommunications could damage household trust KPI shortfalls lead to adaptations to retrofit scheme or top-up measures.
Reporting of M&V	Reporting of any performance issues	Household	<ul style="list-style-type: none"> Household reports any remaining performance issues in a timely manner 	<ul style="list-style-type: none"> Failure to report performance issues could leave households with an asset which is not operating correctly, damaging long-term energy savings and financial returns
	Verification of network services	DNO	<ul style="list-style-type: none"> Measured and verified network payments are reported to the DNO, who validates and dispatches related payments 	<ul style="list-style-type: none"> The DNO challenges the M&V approach, delaying deferred network reinforcement / flexibility payments
Surplus Distribution and Ongoing Financial Returns	Negotiation of surplus distribution	All partners	<ul style="list-style-type: none"> All partners discuss how any surplus (profit) could be distributed, if this has not already been codified 	<ul style="list-style-type: none"> Disagreements as to how to distribute surplus hamper ongoing or future collaborations
	Receipt of financial returns	Investor(s)	<ul style="list-style-type: none"> Financiers receive payment against their expected financial returns 	<ul style="list-style-type: none"> Financiers do not receive timely returns from their creditors, and are less likely to participate or fund projects moving forwards
Future development planning	Discussion and planning of future works or developments	All partners	<ul style="list-style-type: none"> All partners discuss potential scheme developments or follow on works (such as electrification of heating following a fabric first approach) 	<ul style="list-style-type: none"> A single partner takes forward the potential future works outside of an MES scheme or collaborative structure

	<p>Aggregation and monetisation of project attributes and data</p>	<p>Data Warehouse; Retrofit Provider; Public Bodies</p>	<ul style="list-style-type: none"> • Data Warehouse anonymises, aggregates and monetises retrofit scheme data as appropriate and permitted under household data rights agreements. Payments may be made to Retrofit Providers or Public Bodies, or fees for capturing and maintaining evaluation data may be waived 	<ul style="list-style-type: none"> • Inappropriate monetisation or insufficient anonymisation/aggregation could breach in privacy or data rights agreements, leading to reputational and legislative risk.
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Appendix 2: A description of decision point stages

Table 9: A mapping of decision point stages and initial proposed decisions supporting the decision tree presented in the body of this report.

#	Value Stream Description	Decision Point Stage	What is the decision?
1	Load Reduction (Energy cost savings)	Modelling and targeting of specific geographies and housing archetypes	Are there sufficient potential load reductions and efficiency gains to justify the provision of a retrofit scheme within the region in question?
2	Identification of Non-Routine Consumption	Baseline data collection and sufficiency testing	Can we accurately identify underheating or non-routine consumption within the baseline data provided?
3	Increase in real estate / rental value	Detailed modelling of impact, codification of project performance and KPI commitments	Can we determine the likely impact on energy bills or heating demand? Is the determined reduction sufficient for an uplift in real estate value or EPC rating?
4	EPC Uplift	Detailed modelling of impact, codification of project performance and KPI commitments	Can we determine the likely impact on energy bills or heating demand? Is the determined reduction sufficient for an uplift in real estate value or EPC rating?
5	Health Improvements (improved indoor environment for given heat demand) – For NHS to reduce GP visits	Definition of strategic goals and scheme vision	Is there an NHS trust or health care partner willing to participate and pay for healthcare improvements within the region targeted by the retrofit scheme?
6	Comfort-takeback – For occupants	Site selection and householder discussions	Are the householders in question willing and able to pay for comfort takeback?
7	Emissions Reductions (including Air Quality)	Definition of strategic goals and scheme vision	Is the abatement of greenhouse gas emissions and local air pollution a key strategic goal?
8	Deferred Network Reinforcement (Load Reductions)	Detailed modelling of impact, codification of project performance and KPI commitments	Will the planned retrofit works provide sufficient load reduction and confidence to defer local forecast network reinforcement requirements (if any exists)?
9	Peak Capacity Uplift / Load Shaping (deferred network reinforcement)	Detailed modelling of impact, codification of project performance and KPI commitments	Will the planned retrofit works provide sufficient load shifts/peak capacity reductions and resultant confidence to defer local forecast network reinforcement requirements (if any exists)?
10	Provision of Implicit Flexibility (relating to heat demand)	Ongoing O&M, M&V and Flexible Control	Will the homeowner switch to a tariff and shift the consumption required to access implicit flexibility revenues?
11	Provision of Explicit Flexibility	Confirmation and Contracting of revenue streams	Is the retrofit occurring in a constraint management zone? Are there assets present which enable flexible control? Will the planned retrofit works provide sufficient flexibility and resultant confidence for contracting to occur?
12	Reduced Public Infrastructure Costs due to improved forecasting	Modelling and targeting of specific geographies and housing archetypes	Would additional information about forecast energy consumption within the retrofit area assist with reducing public infrastructure costs (such as the deferral or avoidance of grid reinforcement)?
13	Avoided connection charges and private infrastructure costs	Modelling and targeting of specific geographies and housing archetypes	Would additional information about forecast energy consumption within the retrofit area assist with reducing private infrastructure costs (such as the improved self-consumption or avoided demand charges)?

Appendix 3: Business Model Canvas for Aggregator, with a focus on the interactions and flow of funds between stakeholders.

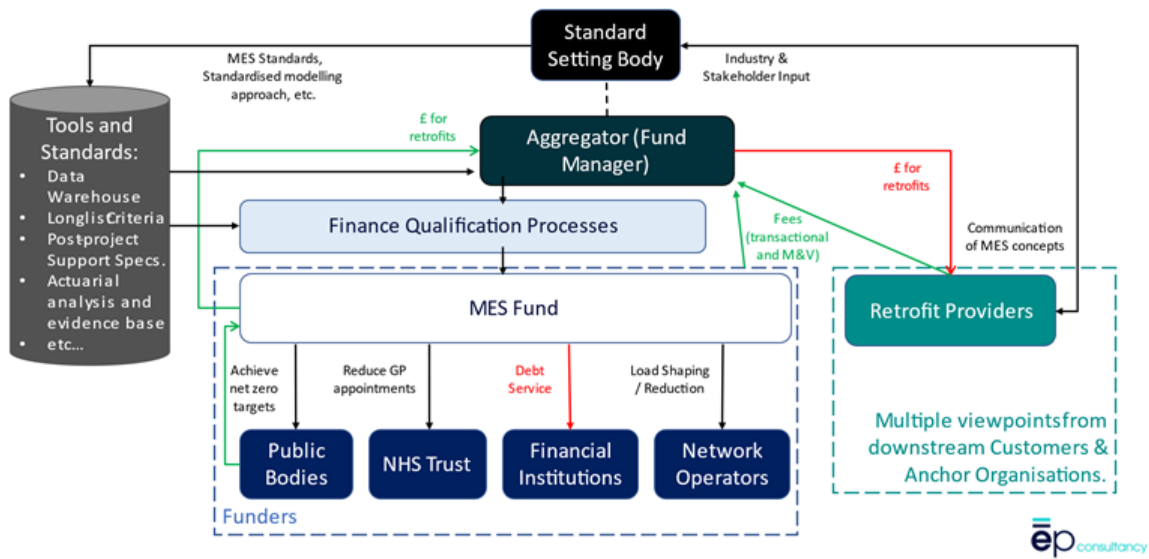


Figure 9: A chart showing the detailed view of an Aggregator's perspective, along with connections to the funder and retrofit provider customer segments.

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