Unlocking Clean Energy in Greater Manchester: Workstream 2

Detailed Design of Short-Term Renewable Generation Business Models

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SUPPLEMENTARY MATERIAL

- Please note that this report is one of several deliverables from the Unlocking Clean Energy in Greater Manchester project.
- Throughout this report, cross-references are made to other deliverables where applicable.
- The table below outlines other UCEGM deliverables that may be of interest to the reader.

Deliverable Title	Author Organisation
Financing Options Report	Cornwall Insight
Solar Energy Generation: Market Intelligence Report	Procur3d
Local Authority Electricity Forecast Tool	Local Partnerships
Energy Supply Guidance	Local Partnerships
UCEGM Energy Market Modelling	Cornwall Insight
Local Energy Market and ANM Architecture	ESC
Commercial Modelling Tool	ESC
UCEGM Workstream 2 – Improving the Business Case for Renewable Energy	ESC
UCEGM – Improving the business case for local renewable energy projects in the current market and under future market scenarios.	ESC

GLOSSARY

Balancing Responsible Party (BRP)	A company that is responsible for balancing electricity consumption and generation so that the difference is as close to zero as possible. BRPs may trade electricity too.
Internal Rate of Return (IRR)	Internal Rate of Return is a financial metric used to evaluate whether a project (investment) is desirable. Typically, the higher a project's internal rate of return, the more desirable it is to undertake.
Net Present Value (NPV)	Net Present Value is a financial metric that represents the amount of value creation expected for a project (investment). A positive NPV means that the project *could* be worth pursuing.
Payback Time	The length of time that it takes to recover the cost of a project (investment).
Smart Export Guarantee (SEG)	Enables small-scale low carbon generators to receive payments from electricity suppliers for electricity exported to the grid – providing certain criteria are met (OFGEM, 2023).
Distribution Network Operator (DNO)	The DNO is responsible for operating, maintaining, and developing the distribution network within a specific geographic area. DNOs manage the local distribution networks, connect customers to the grid, and ensure the reliable delivery of electricity to end consumers.
Distribution System Operator	Distribution System Operator (DSO) is an entity responsible for operating, controlling, and optimising the distribution system.
Grid Connection Offer	Outlines the work that needs to be undertaken, the cost of delivering said works and the terms and conditions to be applied for the proposed grid connection.
Grid Connection Agreement	An agreement between the connection owner/occupier and network operator which sets out necessary terms and conditions of the connection.
Behind the Meter	Refers to assets which are located on the customer's side of the utility meter.
Take or Pay Clause	Can mitigate revenue risk for generators of renewable generation projects. If a 'take or pay' clause is implemented in contractual arrangements, it means the offtaker would agree to a stipulated volume of energy and pay a penalty if they do not consume it.

CONTENTS

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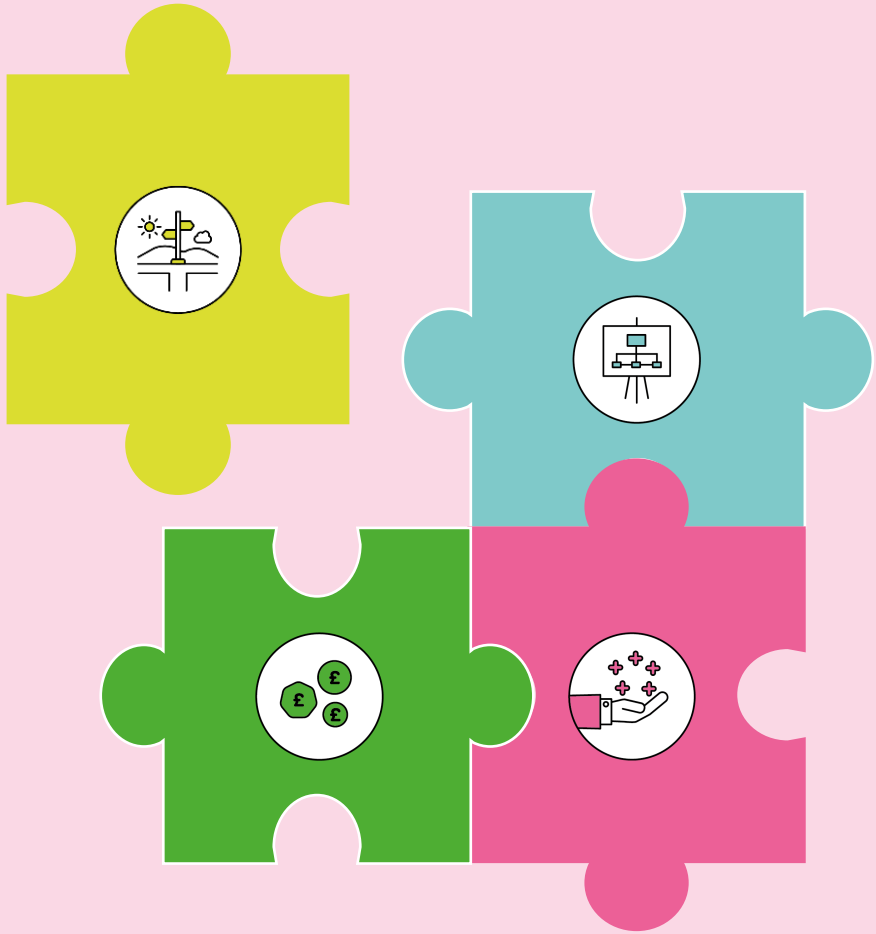


1. EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

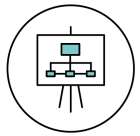
- During Phase 1 of the UCEGM project, Energy Systems Catapult explored a range of innovative business models that could negate the need for grant funding for local authorities considering deploying renewable generation projects.
- The following were identified as business models which could be delivered in the short-term:
    - Sleeved Power Purchasing Agreement
    - Private Wire
    - Storage and Site Optimisation
    - Solar and Storage Licensing Agreement
    - Solar Carport
- This report builds on Phase 1 research by providing a detailed assessment of the previously selected short-term business models.
- The assessment centers around the following three pillars of business model design:
    - Viability – Is the business model commercially viable?
    - Feasibility – What is needed to deliver the business model?
    - Desirability – What is the value of the business model to a local authority?

VIABILITY

- To assess viability, the Catapult explored potential revenue generation and/or cost-saving opportunities for each of the short-term business models (see Section 5).
- Consideration was also given to other factors that can influence the viability of renewable generation projects such as: how well renewable generation and energy demand are matched, the optimisation of integrated systems and the pricing structure adopted.
- Key points for local authorities in relation to viability are summarised below:

1. Reflecting Assumptions in Commercial Models: Each of the short-term business models will require a commercial agreement for the sale of energy. For which, there are numerous pricing structures/ models that are possible. These pricing structures can influence the viability of business models differently. It is therefore important that any assumptions relating to commercial arrangements are reflected in commercial models.
2. Understanding What Revenue Generation/ Cost-Saving Opportunities are Available: To quantify revenue generation and cost-saving opportunities for a given business model, local authorities will need to understand how renewable energy will be used. This will require asset performance data, energy demand data (both current and future), and price forecasts. For more complex renewable generation projects (i.e., those with numerous integrated assets), optimization modelling will be required.
3. Continuously Updating Commercial Models: Commercial models should be continuously updated to reflect any changes to policy and regulation, market conditions and/or contractual arrangements as all of these factors can influence the commercial viability of renewable generation projects.

EXECUTIVE SUMMARY (CONT.)



FEASIBILITY

- To assess feasibility, the Catapult explored key stages of delivery for renewable generation projects. Activities and outputs intrinsic to each stage were highlighted and, where possible, findings and lessons learned from external engagement were shared (See Section 6.B).
- Feasibility considerations specific to each of the short-term business models were also discussed (see Section 6.C).
- Key points for local authorities in relation to feasibility are summarised below:
    1. Considering Feasibility in Parallel with Viability: Local authorities should undertake soft market testing early in the design process to understand the full range of services that are available. As well as affecting viability, the solutions offered by third-party partners could also have different implications for asset ownership, resource requirements and risk. Local authorities should consider these factors in parallel with viability when exploring which solution is best suited for a given business model.
    2. Alignment on Terminology: Through external engagement, the Catapult learned that terminology used in the energy sector is not always consistently applied, especially in relation to Power Purchasing Agreements (PPAs). During soft market testing activities, it is important to ensure that all stakeholders are aligned on terminology to ensure that business model assumptions are accurately reflected in commercial assessments.
    3. Energy Supply Considerations: It is important that local authorities review existing energy supply contracts to understand whether a chosen business model is feasible under their current arrangement and/or whether it is likely to result in a breach of contract. This should be considered in the early stages of project delivery. In some cases, local authorities may have to wait until their energy supply contract is up for renewal before entering commercial arrangements with third party partners.

DESIRABILITY

- To assess desirability, the Catapult explored key considerations that could inform which role, within a particular business model, is most desirable to a local authority (e.g., generator, offtaker, or generator and offtaker). For example, each role has different implications in terms of revenue/cost-saving potential, resource requirements and risks.
- This resulted in the development of 'desirability checklists' which could be used by local authorities during decision making processes.
- Key points for local authorities in relation to desirability are summarised below :
    1. Negotiation Power: For each of the short-term business models, the opportunity to maximise revenue (or cost-savings), to maximise price certainty and/or to mitigate certain risks is (partially) dependent on the pricing structure adopted. Typically, generators have more power when negotiating key terms of commercial arrangements (i.e., pricing structure, contract length, power price) as they have financial metrics that must be achieved to obtain project sign-off. This could be an important consideration for local authorities that wish to have more control over the terms of contractual arrangements.
    2. Benefits of Adopting the Role of Generator and Offtaker: Only by assuming the role of generator and offtaker can local authorities benefit from revenue generation and cost-saving opportunities. If and where required, as generator and offtaker, local authorities can set the price for electricity to whatever aligns best with the underlying (financial) objectives of the project. For example, this could be to maximise revenue generation to invest in future projects or to maximise cost-savings to mitigate against high energy bills.

2. REPORT OVERVIEW

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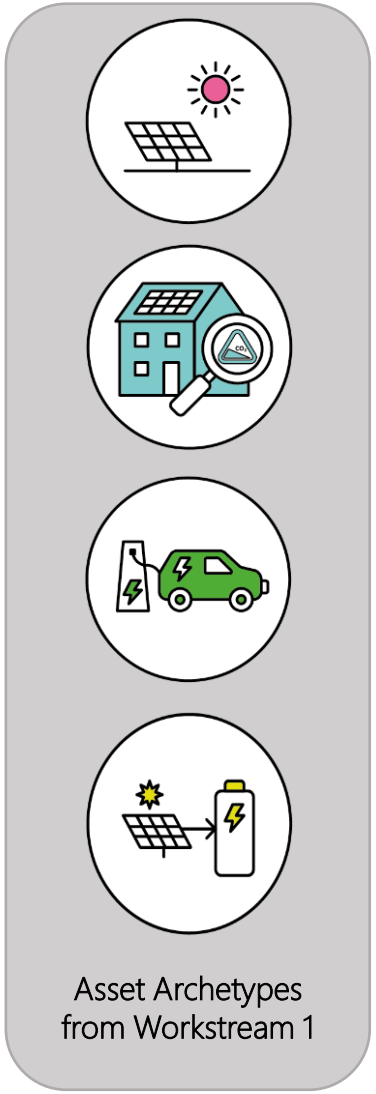
- During Phase 1, the Catapult explored a range of innovative business models that could negate the need for grant funding for local authorities considering deploying renewable generation projects.
- The business models identified were aligned with asset archetypes from UCEGM's Workstream 1 projects.
- An evaluation was performed on each business model using the following criteria:
    - Revenue and Cost Savings – What is the financial return on a local authority's investment?
    - Other (Non-Financial) Benefits – What are the wider benefits to the local area?
    - Scalability – Can the business model be delivered at scale?
    - Project Delivery – How simple (or difficult) is it to deliver the business model?
- This led to the development of a business model shortlist comprising solutions that could be delivered in the 'short' or 'long' term.
- Short term business models refer to solutions that are already possible in current markets and where there is evidence of local authorities adopting these approaches.
- Long term business models refer to emerging concepts that have the potential to generate more value for local authorities but exhibit a greater amount of complexity and uncertainty.
- The short-term business models identified were:
    - Sleeved Power Purchasing Agreement
    - Private Wire
    - Storage and Site Optimisation
    - Solar and Storage Licensing Agreement
    - Solar carport



Asset Archetypes from Workstream 1

REPORT OVERVIEW

PHASE 2 RESEARCH: OBJECTIVES AND RESEARCH QUESTIONS

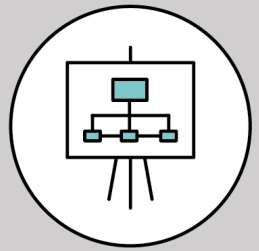
- The objective of Phase 2 was to build on previous research findings by performing a detailed assessment of the short-term business models identified during Phase 1.
- The assessment centered around the following three pillars of business model design:

    1. Viability – Is the business model commercially viable?
    2. Feasibility – What is needed to deliver the business model?
    3. Desirability – What is the potential value of the business model to customers?

- As part of the assessment, the Catapult sought to address the following research questions (for each short-term business model):

    1. What are the financial benefits and how can they be quantified?
    2. What factors influence viability?
    3. How can the business model be delivered/implemented?
        a) What are the key stages of project delivery?
        b) Who are the key stakeholders involved?
        c) What contractual/commercial arrangements are required?
    4. How may the value of the business model change depending on the different roles a local authority could adopt?

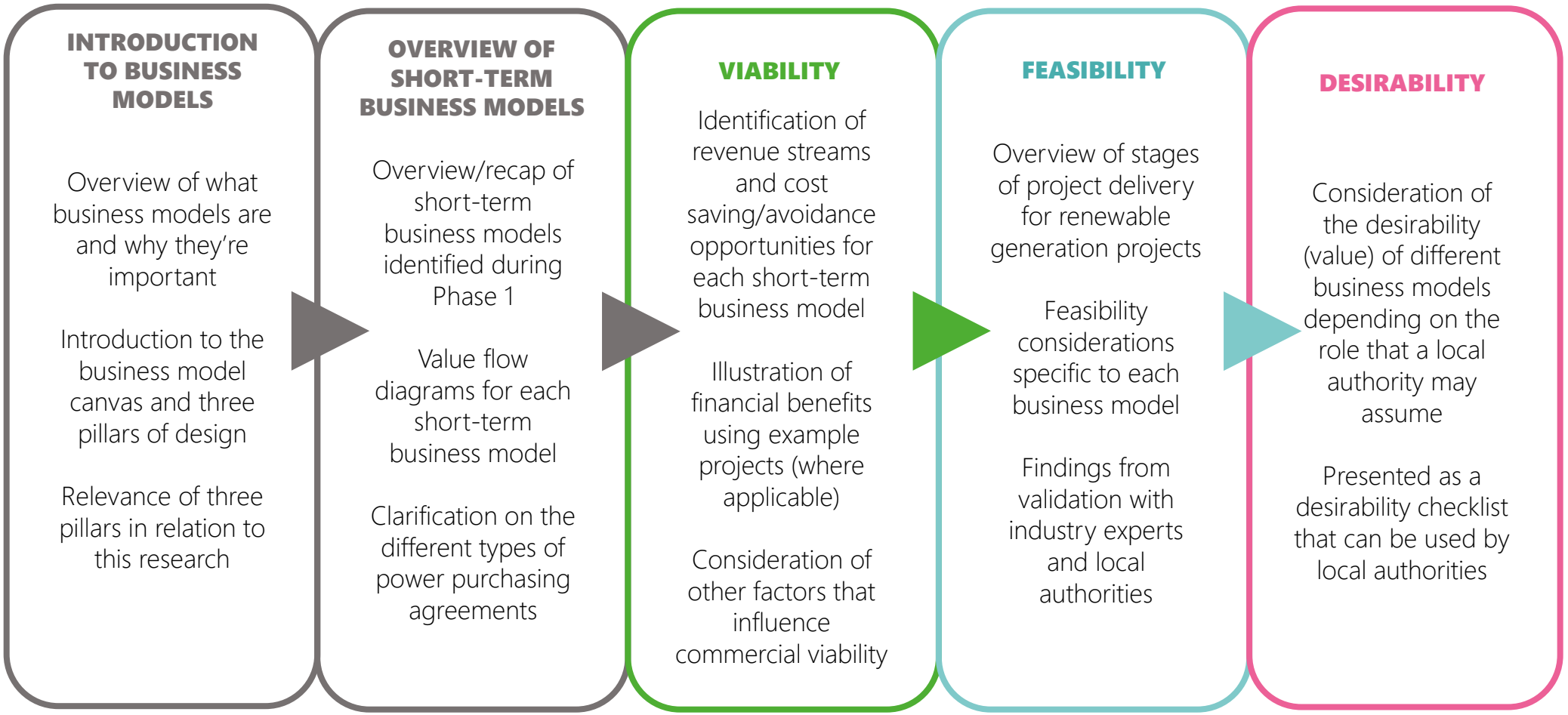
- This report details the findings from the assessment.



Pillars of Business Model Canvas

REPORT OVERVIEW

REPORT STRUCTURE



3. AN INTRODUCTION TO BUSINESS MODELS

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The most effective business model for local authorities to deploy renewable generation projects without grant funding will be dependent on the characteristics of the local area as well as the low carbon interventions most suited to the place. Key considerations for each are documented below.

1

PLACE CHARACTERISTICS

Local Needs and Priorities
- How is energy used by a local authority?
- Can additional value be generated at the same time as decarbonising the site or region?

Spatial
- What space restrictions are there?
- Where can generation be located?
- How close is generation to the demand local authorities are trying to decarbonise?

Resources
- What resources are available for decarbonisation?

Density
- Are buildings in close proximity?
- Can generation opportunities be shared?

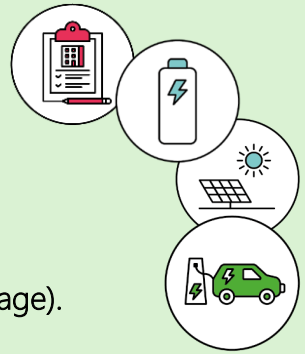
Energy Profile
- What does the local authority's energy demand look like?
- How will the energy profile change over time?

Energy System
- What constraints are there for connecting new generation, or what constraints are there on existing demand?

Future Development Plans
- What does land and/or building use look like in future based on development plans?

2

LOW CARBON SOLUTIONS



- Considers the best technical solution(s) for decarbonising a site or region based on the place/site characteristics
- The low-carbon technologies being considered by local authorities in Workstream 1 (WS1) of the UCEGM project include: **roof top solar, ground mounted solar, solar carports (with EV charging capacity and battery storage).**

3

BUSINESS MODELS

- **Business models should be considered in parallel with place characteristics and low-carbon solutions**
- The right **balance** needs to be struck between **what is technically possible** (i.e., the technical solution), **how value can be maximised** (i.e., does the business model satisfy local needs, priorities and other local characteristics) and **the skills required to deliver the business model** (i.e., are the right skills and resources in place or will partners be required).
- Throughout this report, we provide a detailed analysis of the following business models that could enable the deployment of the asset archetypes from WS1:
  - Sleeved Power Purchasing Agreement (PPA)
  - Private Wire
  - Storage and Site Optimisation
  - Solar and Storage Licensing Agreement
  - Solar carport

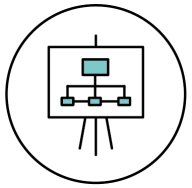
FEASIBILITY, VIABILITY AND DESIRABILITY

- Business models outline **a method on how to create, capture and distribute value.**
- They can be mapped on a structured canvas that consists of nine building blocks (see Appendix 1)
- The canvas can be used as a tool to **understand**, **discuss**, **design** and **invent** business models
- The building blocks cover three main pillars of business model design: viability, feasibility and desirability
- This page outlines what is understood by each component in this project and highlights how they are considered throughout this report

Viability

Is the business model commercially viable?

- Identifying revenue generation streams
- Identifying cost saving/avoidance opportunities
- Investigating other factors that can influence commercial viability
- Illustrating commercial benefits of business models using example projects



Feasibility

What is needed to deliver the business model?

- Mapping out and detailing key stages of project delivery
- Exploring specific feasibility considerations for each business model through desk-based research and external engagement with industry experts
- Exploring lessons learned through external engagement with local authorities

Desirability

What is the value of the business model to a local authority?

- Exploring the value of different roles local authorities may assume in the short-term business models

4. OVERVIEW OF SHORT-TERM BUSINESS MODELS

Before exploring viability, feasibility and desirability in greater detail, this section provides a high-level overview of the short-term business models identified during Phase 1.

4A. POWER PURCHASING AGREEMENTS

THE DIFFERENT TYPES OF PPAs

Recognising that there are numerous types of PPAs, and that terminology is often inconsistently applied, this subsection provides an overview of each PPA type to help alleviate any potential confusion. However, please note that subsequent sections of this report only consider the Sleeved PPA as it was identified as one of the short-term business models.

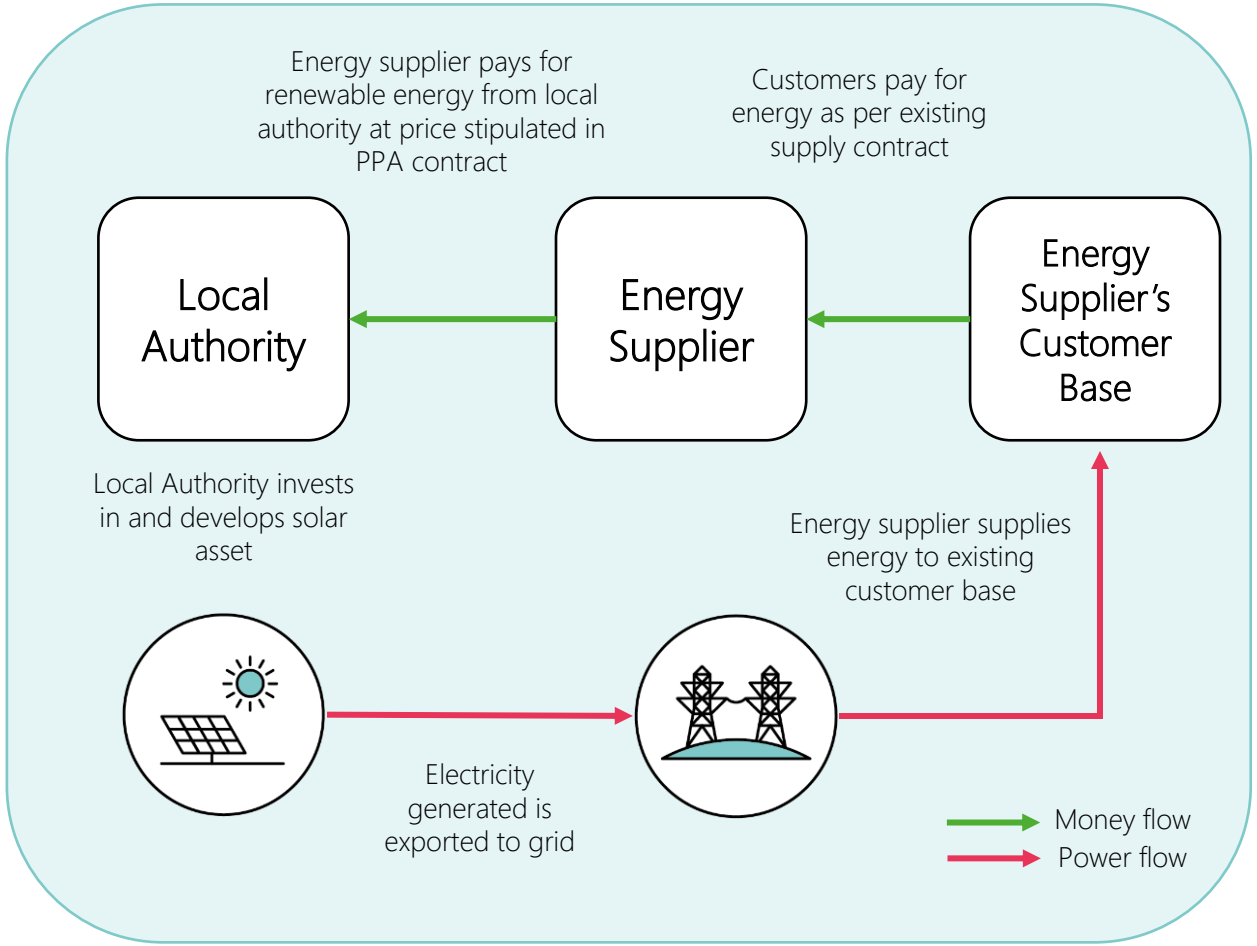
1 UTILITY PPA

Sometimes referred to as a 'Merchant PPA' or 'Export PPA'

A utility PPA is a bilateral agreement between a generator (asset owner) and an energy supplier (or other balancing responsible party).

This model could be enacted by local authorities as follows:

- **Local authority designs, builds** and **commissions solar generation asset.**
- **Renewable energy** generated by the solar asset is **purchased by an energy supplier** at an **agreed** upon **volume and price** (as stipulated in the PPA contract).
- **Electricity generated** is **exported to the power grid.**
- Energy supplier continues to facilitate the supply of energy to their existing customer base as usual.



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2 SLEEVED PPA

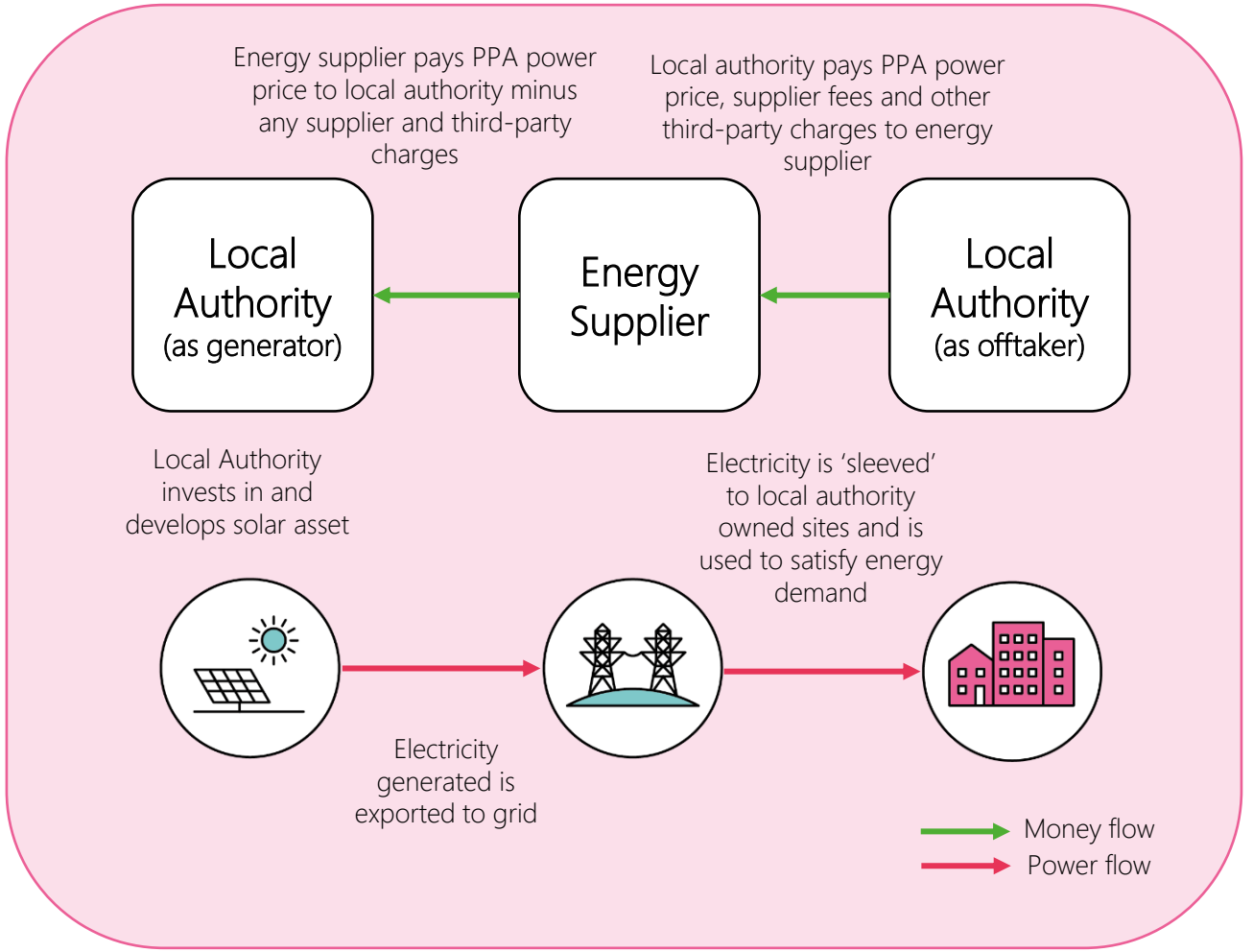
Sometimes referred to as a 'Direct PPA', 'Corporate PPA' or 'Retail PPA'

In a sleeved PPA, electricity generated from a solar asset can be 'sleeved' to other sites despite not being physically connected to the source of demand (via an energy supplier).

This model can be enacted by local authorities as follows:

- **Local authority** (as generator) **designs, builds** and **commissions solar generation asset.**
- **Renewable energy** generated by the solar asset is **purchased by the local authority** (as offtaker) at an agreed upon **volume and price** (as stipulated in the Sleeved PPA contract).
- **Renewable electricity is exported to the grid** and **'sleeved'** to **local authority owned sites.**
    - An **energy supplier** (or other balancing responsible party) is required to **facilitate the 'sleeving'** and will charge a fee for this service.

This arrangement is referred to as a **'Sleeve to Self'** PPA as the local authority assumes the role of generator **and** offtaker*



*Please note that it is also possible for the local authority to act solely as generator or offtaker in this business model. This is discussed further in Section 7. Desirability.

4A. POWER PURCHASING AGREEMENTS

THE DIFFERENT TYPES OF PPAs

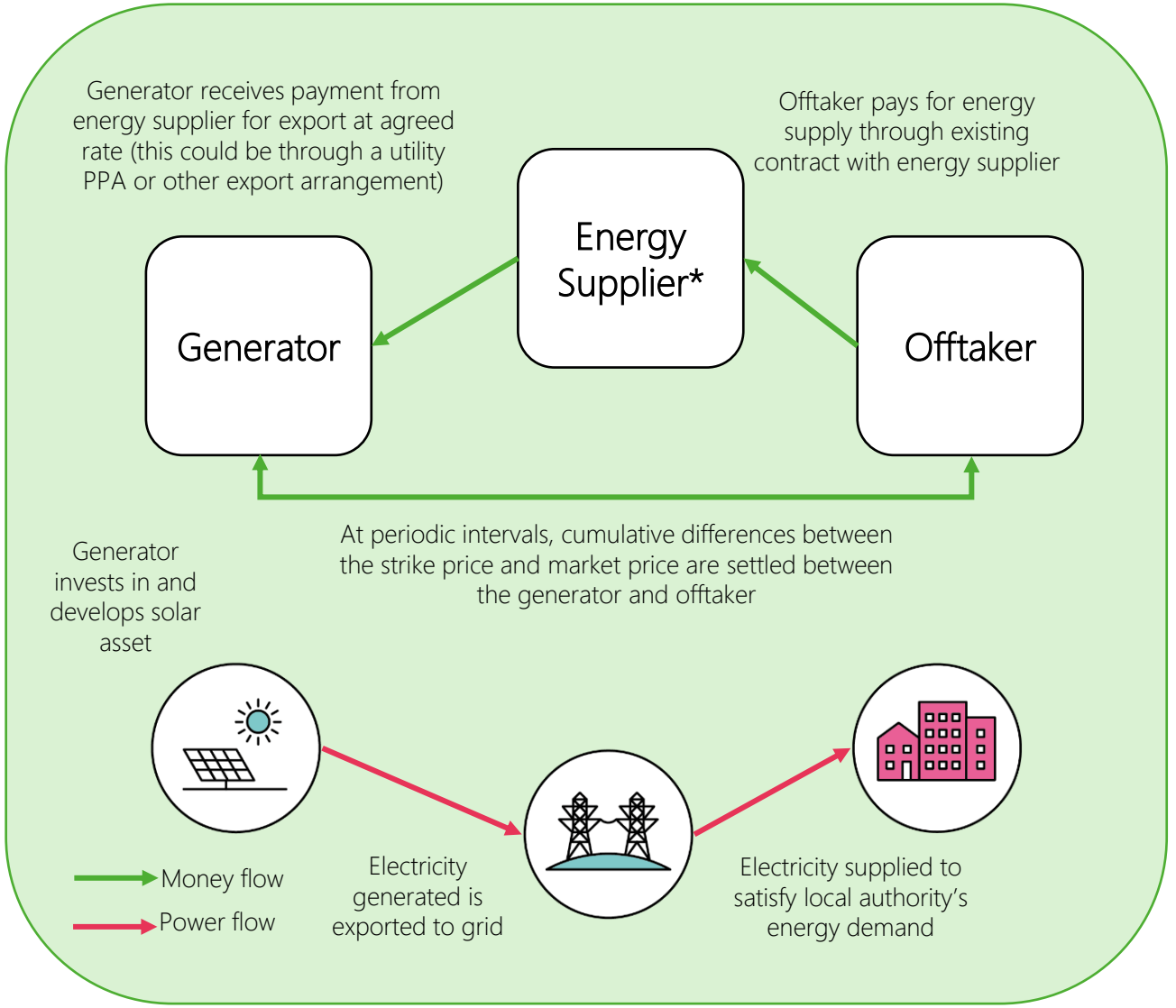
3 VIRTUAL PPA

Sometimes referred to as 'Synthetic PPA'

A virtual PPA is a financial contract between a generator and offtaker that does not include the physical delivery of electricity. Instead, a '**strike-price**' for electricity is agreed between both parties for the lifetime of the PPA.

A local authority may assume the role of generator or offtaker in this business model. This can be enacted as follows:

- **Generator designs, builds** and **commissions solar generation asset**
- Electricity generated is **exported to the grid and payment is received for export (for example through a utility PPA).**
- The offtaker still receives and pays for electricity through their **existing energy supply contract.**
- When the market price for electricity is above the agreed upon 'strike price', the generator must reimburse the offtaker the difference.
- When the market price for electricity is below the agreed upon 'strike price', the offtaker must reimburse the generator the difference.
- As part of the **PPA contract, the generator and offtaker will stipulate how often the cumulative differences are settled.**



*Unlike the sleeved PPA, the energy supplier is not facilitating the physical delivery of power. Therefore, the generator and offtaker may have different energy suppliers.

4B. PRIVATE WIRE

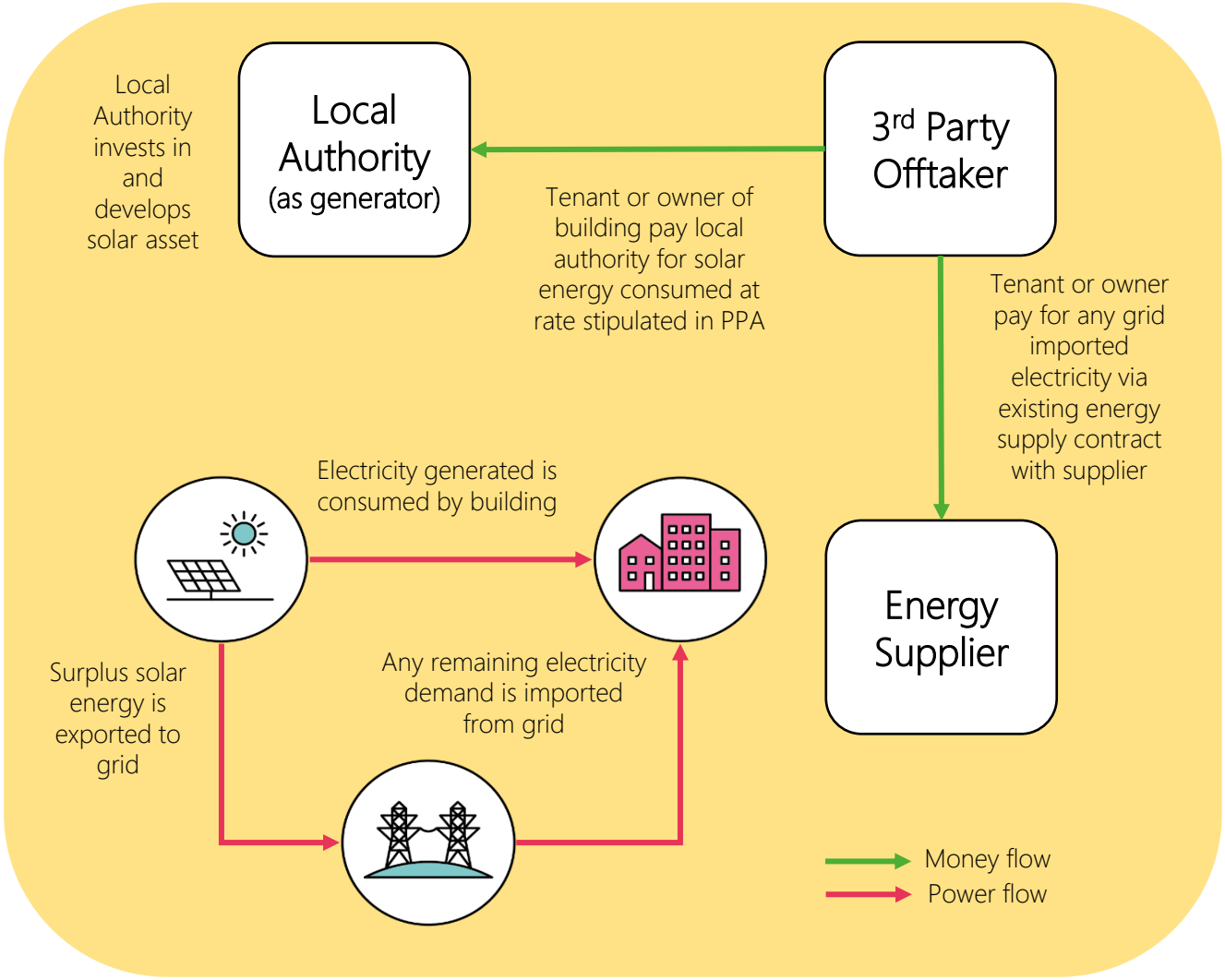
Sometimes referred to as a 'Behind the Meter (BtM) PPA'

MODEL OVERVIEW

In the private wire business model, a solar asset is directly connected to the point of offtake and electricity generated is used to satisfy site demand. Surplus solar generation is exported to the power grid.

This model can be enacted by local authorities as follows:

- Local authority **designs**, **builds** and **commissions solar generation asset** on/ near building.
- Capital and operating costs are recovered through a PPA with a third-party offtaker (most likely a tenant in a local authority owned building but this does not always have to be the case).
- The third-party offtaker pays for any grid imported electricity through their existing supply contract.
- The local authority may generate additional revenue from surplus solar export.
    - This will require an additional export arrangement with a balancing responsible party.



*Please note that it is also possible for the local authority to act solely as the offtaker in this business model. This is discussed further in Section 7. Desirability.

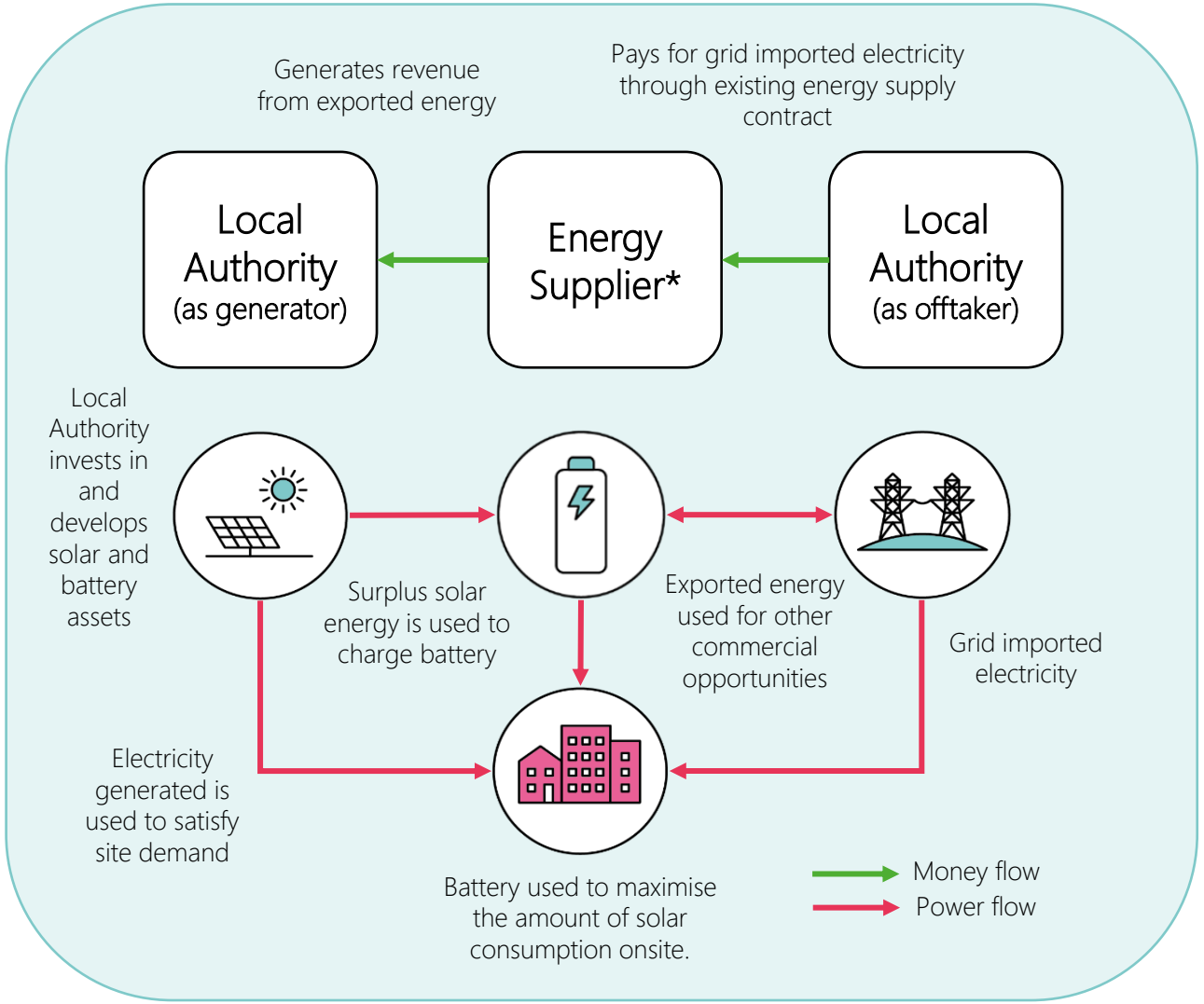
4C. STORAGE AND SITE OPTIMISATION

AN OVERVIEW

In this model, a battery storage asset is installed behind the meter to maximise the use of solar energy generated as well as other commercial opportunities (discussed further in Section 5).
This model can be enacted by local authorities as follows:

- Local authority **designs**, **builds** and **commissions solar and storage generation assets** onsite.
- Solar energy is used to **offset grid imported electricity** which results in **energy bill savings** for the local authority.
- The local authority may also generate additional revenue from exported energy.
    - This will require an export arrangement with a balancing responsible party.

It is possible for the local authority to act solely as the generator or offtaker in this business model. See Section.7 Desirability for further detail.



*For simplicity, the flow diagram shows the same entity for export arrangements and energy supply. This does not have to be the case. For example, a local authority may use a different balancing responsible party (i.e., an aggregator) for commercial export arrangements.

4E. SOLAR AND STORAGE LICENSING AGREEMENT

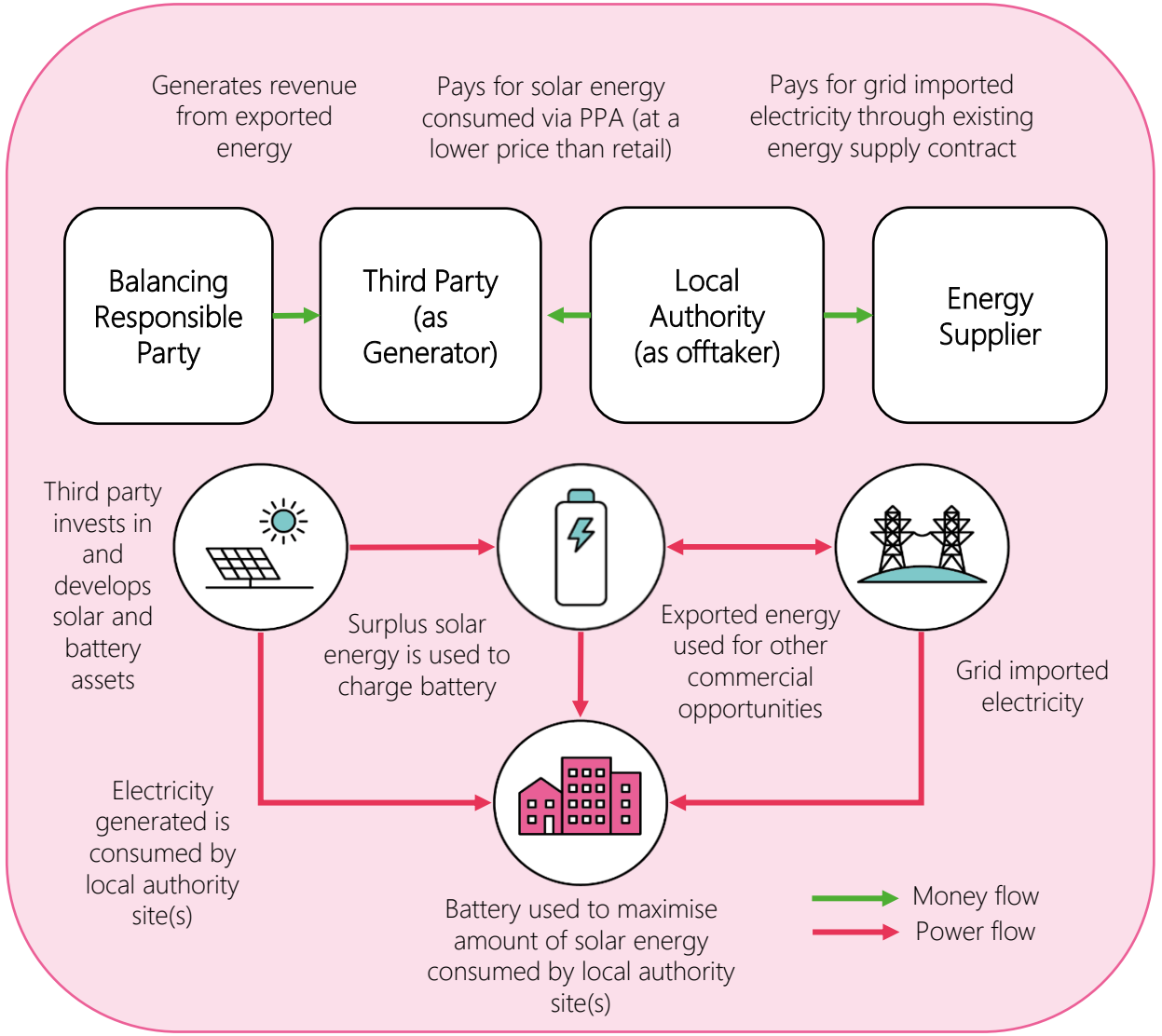
AN OVERVIEW

This model provides local authorities with the opportunity to benefit from solar and storage technologies without having to front the initial capital investment. The installation is covered under a 'licensing agreement', which means that assets are owned by a third party.

This can be enacted as follows:

- Third party **designs**, **builds** and **commissions solar and storage generation assets** onsite.
- Solar energy used onsite is covered under a PPA which should provide a reduction in energy bills for the local authority.
- The asset owner uses revenue from the PPA and other commercial opportunities to recover costs.
    - Any excess revenue is retained by the service provider.

In this model, solar and storage technologies are deployed at scale. This means that the benefits from numerous sites can be aggregated. Adopting this portfolio approach *could* mean that less desirable sites, where the business case for storage and site optimisation may not stack up on its own, are able to be included.



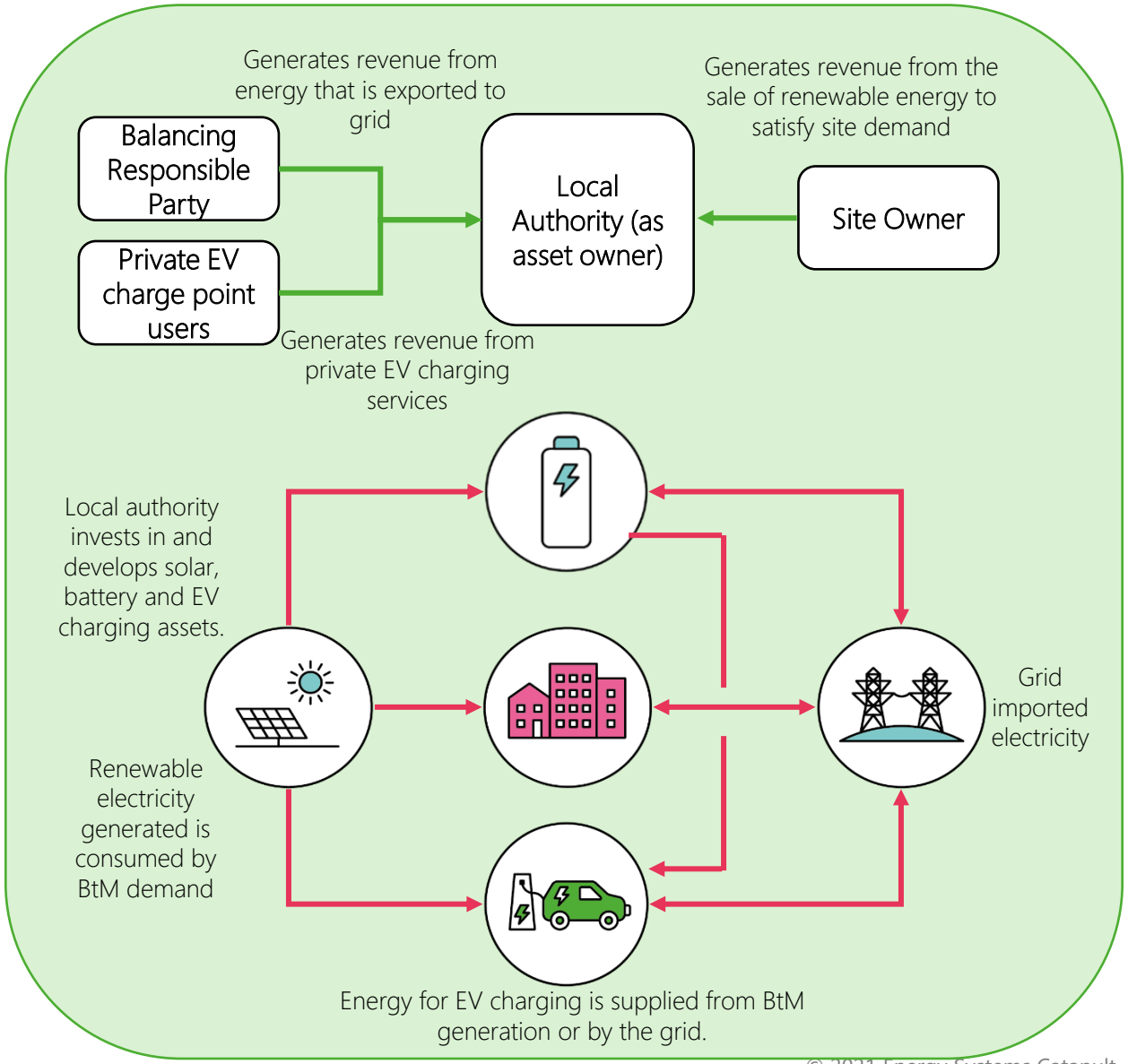
4C. SOLAR CARPORT

AN OVERVIEW

The solar carport model can be operationalised in two ways. In its simplest form, solar canopies can be installed over public car parking spaces to offset grid imported electricity at a nearby site. In a more complex system, EV charging points and battery storage can be integrated with solar to provide EV charging and other services. In this report, our research focuses on the latter.

This model can be enacted by local authorities as follows:

- Local authority **designs**, **builds** and **commissions solar, storage and EV charging assets** at a site.
- Solar energy may be used to provide renewable electricity to the site (if there is existing demand such as a building), to charge batteries and/or to provide EV charging services
    - If EV charging points are made available to the public, a billing solution will be required (this is discussed further in Section 6. Feasibility).
- The local authority may generate additional revenue from exported energy from battery storage
    - This will require an additional commercial arrangement.



Please note that the value flow diagram shows potential revenue streams for the local authority assuming the role of generator. These would change if the local authority assumed the role of generator and offtaker. This is discussed further in Section 6 and Section 7.

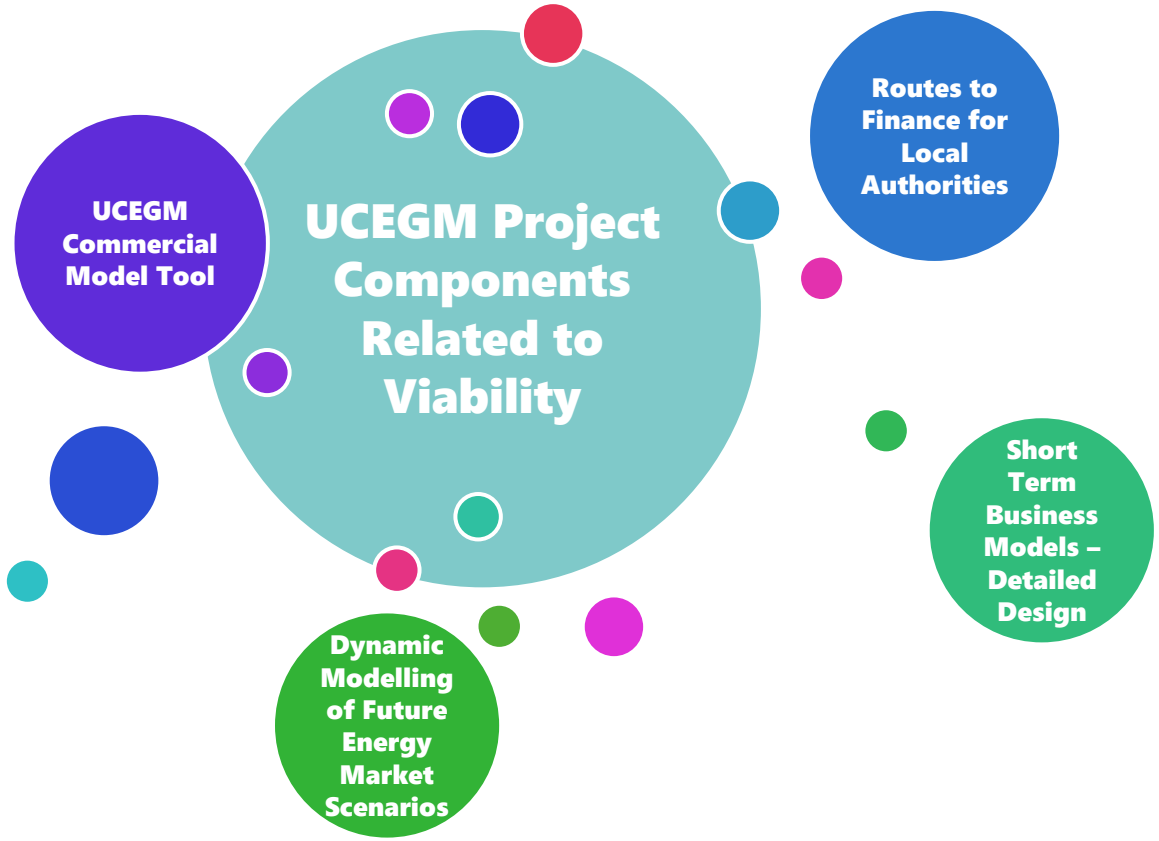
5. VIABILITY

NB: This section of the report references data that was available at the time of writing (e.g., electricity wholesale and retail prices, supplier fees, third party charges etc.)
All data used is subject to change and should only be taken indicatively.
All graphs are included for illustrative purposes only.

5. VIABILITY

5A. SECTION OVERVIEW

- Throughout this section, the viability of each short-term business model is explored by:
  a) Outlining revenue generation, cost savings and/or cost avoidance opportunities
     - And, where possible, illustrating these using example projects.
  b) Highlighting lessons learned and findings from external engagement.
  c) Explaining additional factors that may influence commercial viability such as:
     - How well solar generation and energy demand are matched
     - The optimisation of integrated systems
     - The pricing structure adopted.
- Recognising that the viability for each business model will differ on a project per project basis, financial metrics such as IRR, NPV and payback are not discussed.
- Instead, the purpose of this section is to provide an overview of considerations for each business model that could inform the calculations of such metrics.
- It is recommended that this section is read in conjunction with the 'UCEGM – Improving the business case for local renewable energy projects in the current market and under future market scenarios' deliverable.
  - The document provides a summary of other project work concerned with viability (see image to right).



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- During external engagement, the Catapult learned that there were several difficulties and challenges faced by local authorities in relation to sleeved PPAs (detailed below).

TERMINOLOGY

- The Catapult learned that there was inconsistent terminology used in the energy industry relating to Sleeved PPAs; specifically, what is understood by the term 'Sleeving Fees'
- In some cases, this had caused confusion for local authorities

PPA FEES

- The Catapult learned that some local authorities had faced challenges when trying to understand some of the fees charged by energy suppliers to facilitate Sleeved PPAs
- This is problematic as quotations/ price estimates are necessary to the commercial assessment of potential projects.

VALUE

- The Catapult learned that the potential benefits of Sleeved PPAs in comparison to other types of PPAs weren't always clear to local authorities.
- For example, by assuming the role of generator **and** offtaker in a 'Sleeve to Self' PPA, a local authority could generate revenue **and** still see a reduction in their energy bills.

WHAT DID WE DO?

The Catapult spoke to several industry experts to better understand the different components that make up the total Sleeved PPA price.

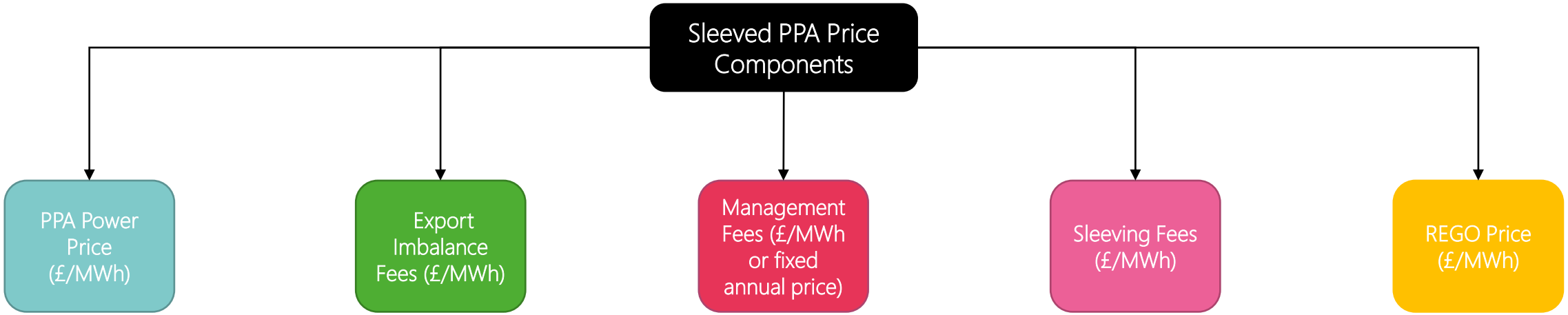
WHAT DID WE DO?

We combined findings from external engagement with data from example projects to illustrate the potential financial benefits of a 'Sleeve to Self' PPA.

5B. SLEEVED PPA

PPA PRICE BREAKDOWN[1]

- The diagram below provides a breakdown of different components that contribute to the total 'Sleeved PPA Price'.



PPA Power Price (£/MWh)

The price per unit of electricity traded

c. £80-90/MWh

- Sensitive to changes in wholesale market electricity prices – (unless opting for a fixed pricing structure)
- In sleeved PPAs, the generator and offtaker will typically negotiate and agree on a PPA Power Price

Export Imbalance Fees (£/MWh)

The price paid for imbalance on the UK's power grid

~2-3% of PPA Power Price

- Sensitive to differences between forecasted and actual volumes of electricity
- This cost is passed through from energy suppliers to customers
- Price will vary depending on the size of the energy supplier and type of generator (i.e., generation profiles from renewable assets can be harder to predict)

Management Fees (£/MWh or fixed annual price)

Administration fees charged by suppliers for account management

c.£0.50-3.00/MWh

- This may be an annual fixed price with the option to upgrade to premium account management packages
- Alternatively, this fee may be charged as a percentage of the PPA Power Price

Sleeving Fees (£/MWh)

Fees charged by suppliers to facilitate the sleeving of energy from one Party to another

~1.5-2.5% of PPA Power Price

- Fee depends on an energy supplier's experience facilitating sleeved PPAs
- This may include shaping and balancing costs which could result in a higher sleeving fee than the estimate shown above

REGO Price (£/MWh)

Renewable Energy Guarantees of Origin issued by OFGEM

c.£4/MWh

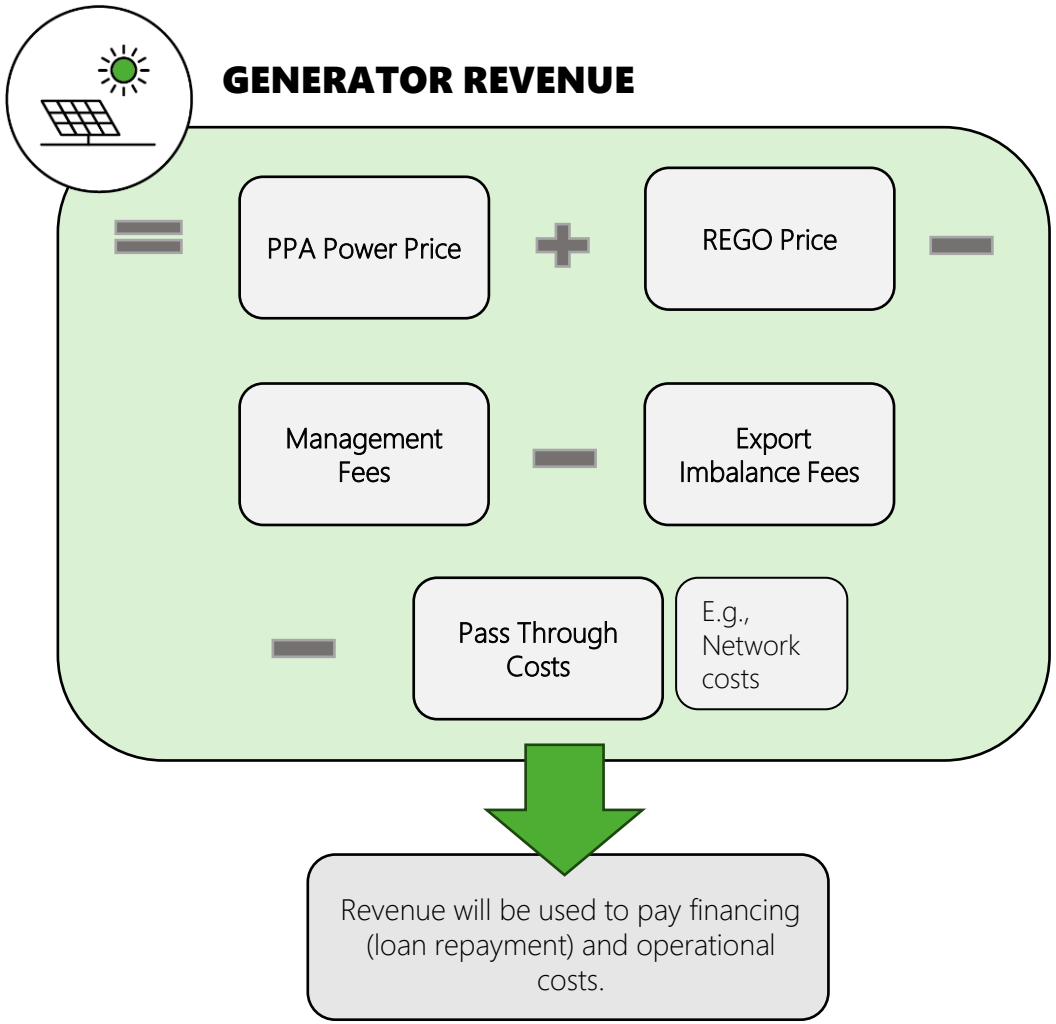
- 1 REGO is issued per 1MWh of renewable power generated
- REGO prices are **highly sensitive to market supply and demand**
- Rising pressures for organisations to decarbonise have driven up market demand for REGOs in recent years
- In sleeved PPAs, the REGO price is ***typically*** fixed throughout the duration of the contract

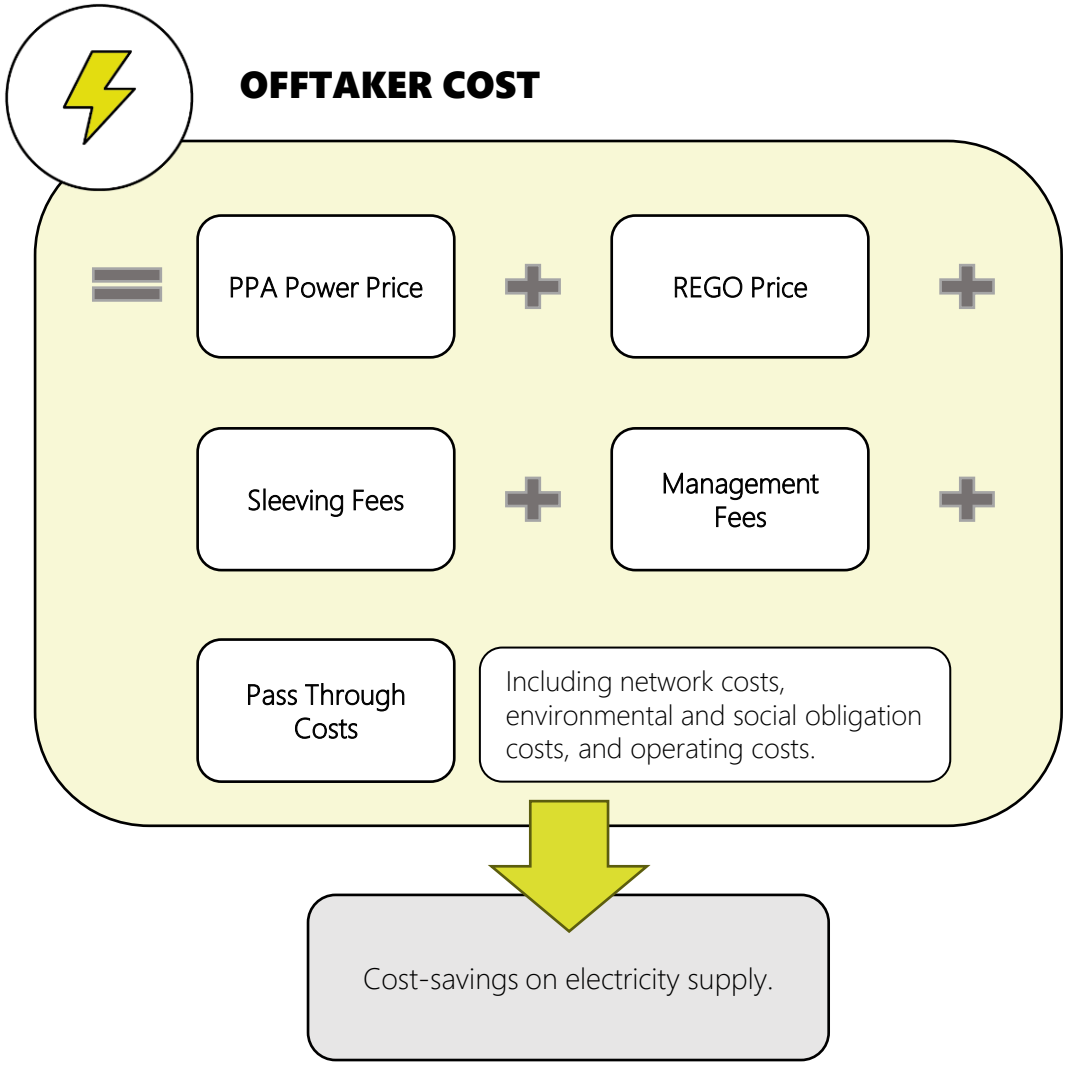
NB: THIS BREAKDOWN DOES NOT INCLUDE OTHER PASS-THROUGH COSTS/THIRD PARTY CHARGES THAT ARE APPLIED TO ENERGY BILLS (SEE NEXT PAGE FOR FURTHER DETAIL).

5B. SLEEVED PPA

PPA PRICE BREAKDOWN (CONT.)

- The images below highlight which Party in a Sleeved PPA agreement would be responsible for paying each price component.





5B. SLEEVED PPA

OVERVIEW OF REVENUE GENERATION AND COST-SAVING OPPORTUNITIES

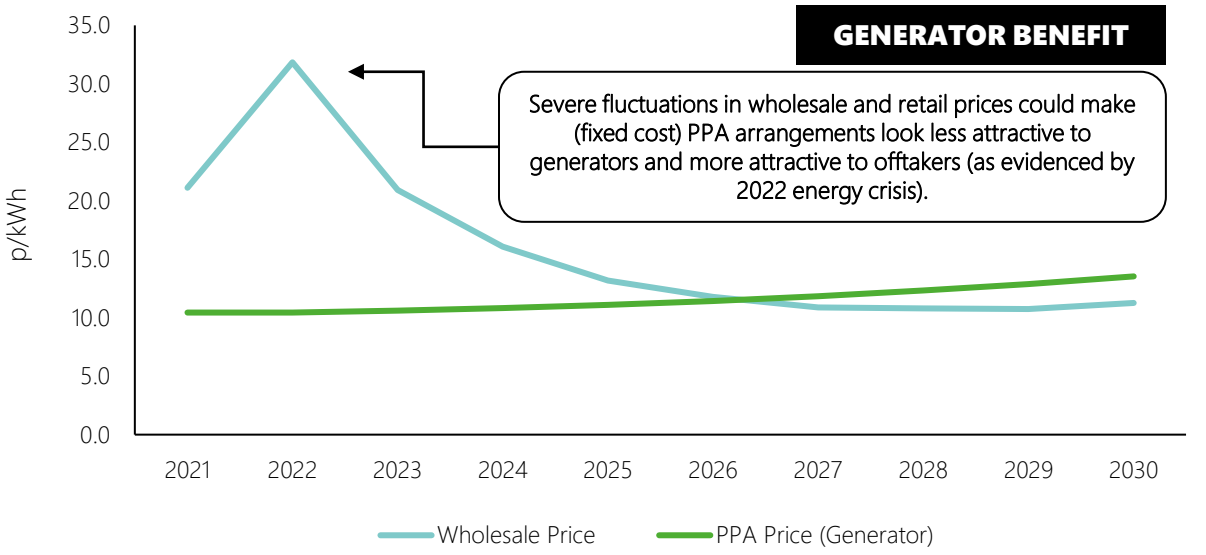
- In a sleeved PPA, renewable energy from a solar generation asset is netted off against an offtaker's energy demand by an energy supplier.
- A 'sleeve to self' arrangement, where the local authority assumes the role of generator and offtaker, allows the local authority to satisfy (some or all of) their energy demand using power from the solar asset(s) they own.
- Some energy suppliers *may* permit local authorities to aggregate multiple generation assets in sleeving agreements.
- The commercial benefits of a sleeved PPA are discussed below from a generator's and offtaker's perspective.

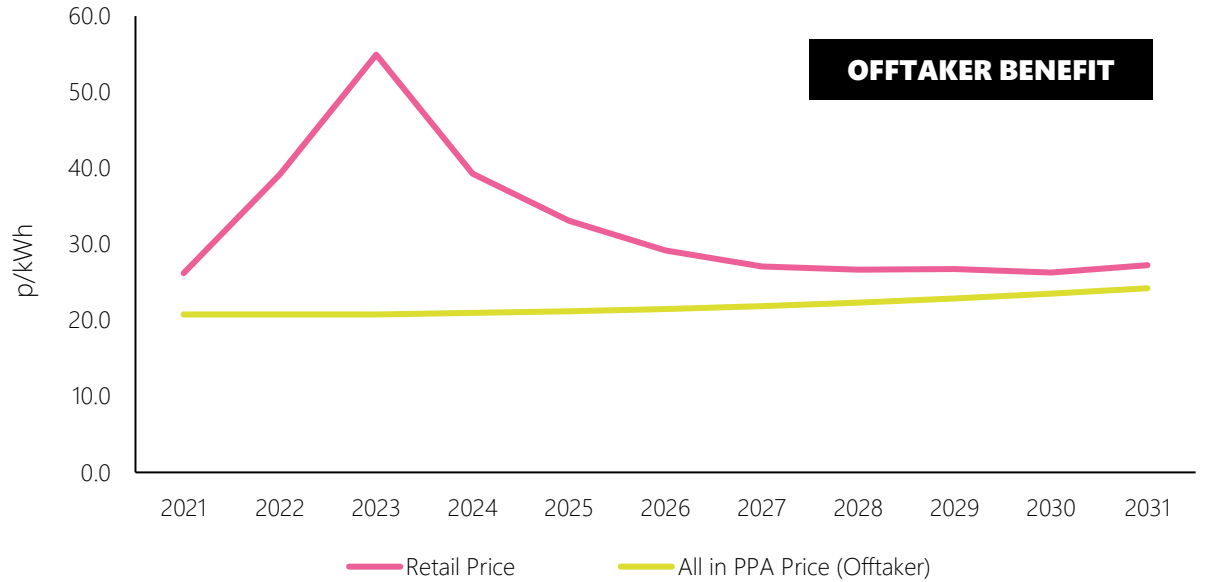
GENERATOR BENEFIT(S)

Revenue Generation: Generator receives payment for power generated; referred to as the 'PPA Price'. This is inclusive of the agreed upon power price (p/kWh) and the REGO price minus any supplier fees and third-party charges.
The PPA price paid to a generator could sometimes be lower than the wholesale price of electricity (see image to right). However, depending on the pricing structure adopted, PPAs can offer a level of price certainty that wholesale market (merchant) trading cannot. Generators typically value certainty over absolute revenue as most generators are financed, requiring scheduled repayments to made each month.
When energy generation is greater than demand, additional revenue may be generated by exporting surplus energy to the grid. This will require an additional export agreement.

OFFTAKER BENEFIT(S)

Cost Savings: The 'PPA Price' is set so that the offtaker (generally) pays less for electricity than the wholesale (commodity) price. In turn, they see a reduction in their electricity bills.
The offtaker is still subject to other non-commodity charges such as network costs, environmental and social obligation costs and sleeving fees.
Offtakers may also be exposed to higher energy supplier fees which should be factored into account to ensure that the PPA delivers overall net savings.

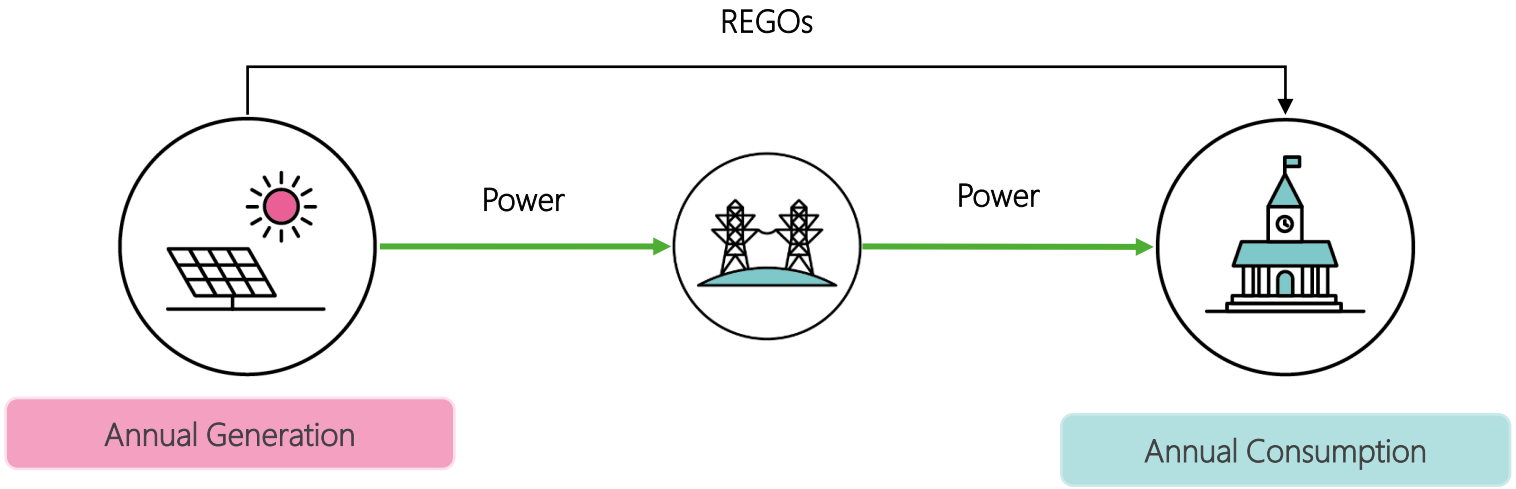




5B. SLEEVED PPA

AN ILLUSTRATIVE EXAMPLE

- Using data from an example project, the image below illustrates the potential financial benefits of a Sleeved PPA for both the generator and offtaker for one given year.
- For simplicity, it is assumed that 100% of the solar generated is sleeved to the offtaker to satisfy ~50% of their total energy demand. However, in reality, this would not be the case due to seasonal variations in both solar generation and power demand.



Generation Capacity: 5.5MWp
Annual Generation: ~4,829MWh

Annual HH Consumption: ~9,650MWh

Generator Revenue

Annual Revenue generation (Export Price of 11p/kWh) = £531,190
Annual Revenue Generation (PPA Price of 12.32/kWh) = £594,933

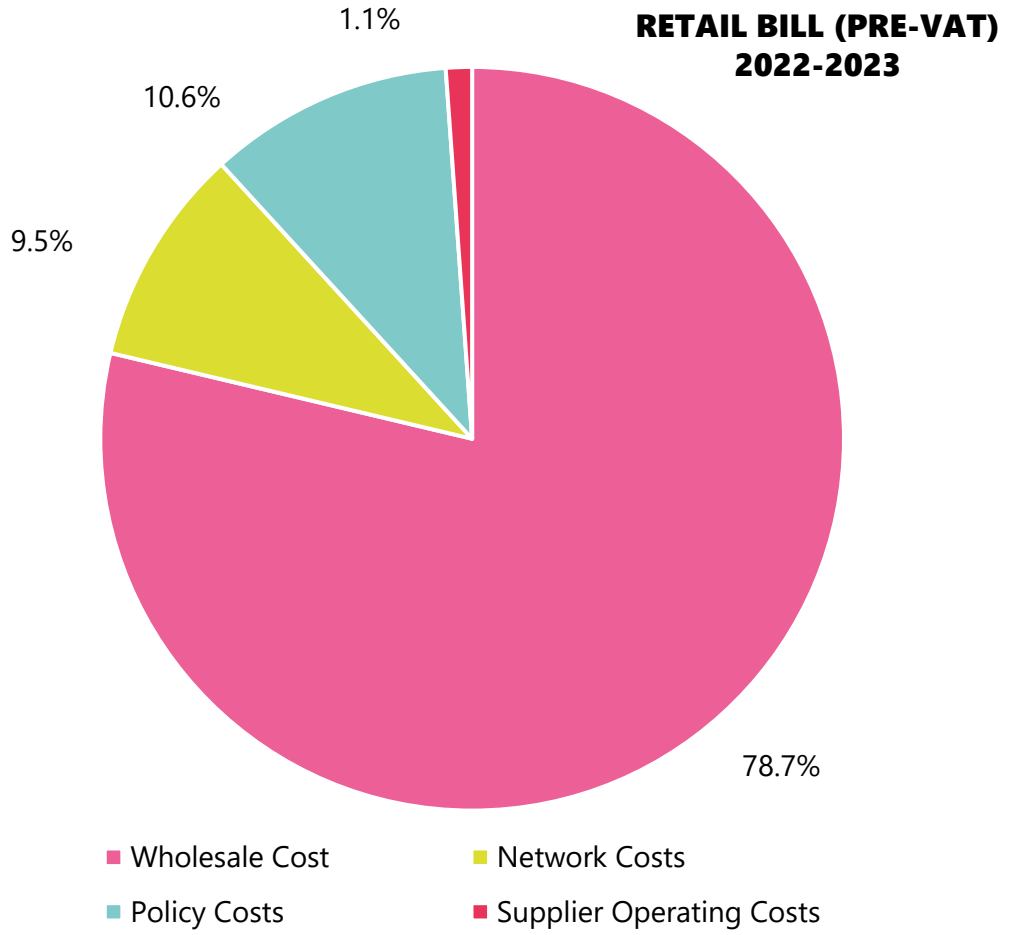
Annual Uplift in Revenue = £63,743

Offtaker Cost Savings

Annual Electricity Costs (retail price of 26.70p/kWh) = £2,576,550
Annual Electricity Costs (Total Sleeved PPA price of 22.34p/kWh) = £2,366,006

Annual Savings = £210,544

- In a private wire arrangement, a solar generation asset is directly connected to the source of off-take.
    - This is different to the Sleeved PPA model where power is first exported to the grid and then 'sleeved' to the offtaker.
- A private wire connection offers cost-savings on the wholesale cost of electricity.
    - Under current regulations, additional cost-savings may also be achieved by avoiding network charges and environmental and social obligation (policy) costs.
- To illustrate these cost-savings, the pie chart on the right highlights components that make up a retail electricity bill in terms of their percentage contribution.
- When setting the price for a private wire PPA, the benefits of these savings are shared between the generator and the offtaker.
- The generator *should* generate more revenue than if they were trading on the wholesale market and the offtaker *should* pay a lower price for electricity than what they would as per their existing retail electricity bill.
    - The generator's revenue will be used to pay financing (loan repayment) and operational costs.



Please note that these component costs are not fixed. The percentages shown may differ year on year. This diagram is for illustrative purposes only. A comparison of how this breakdown has changed in recent years is provided in Appendix 2.

5. VIABILITY

5C. PRIVATE WIRE (CONT.)

When negotiating how the benefits from cost avoidances should be shared between the generator and offtaker, the following factors should be considered:

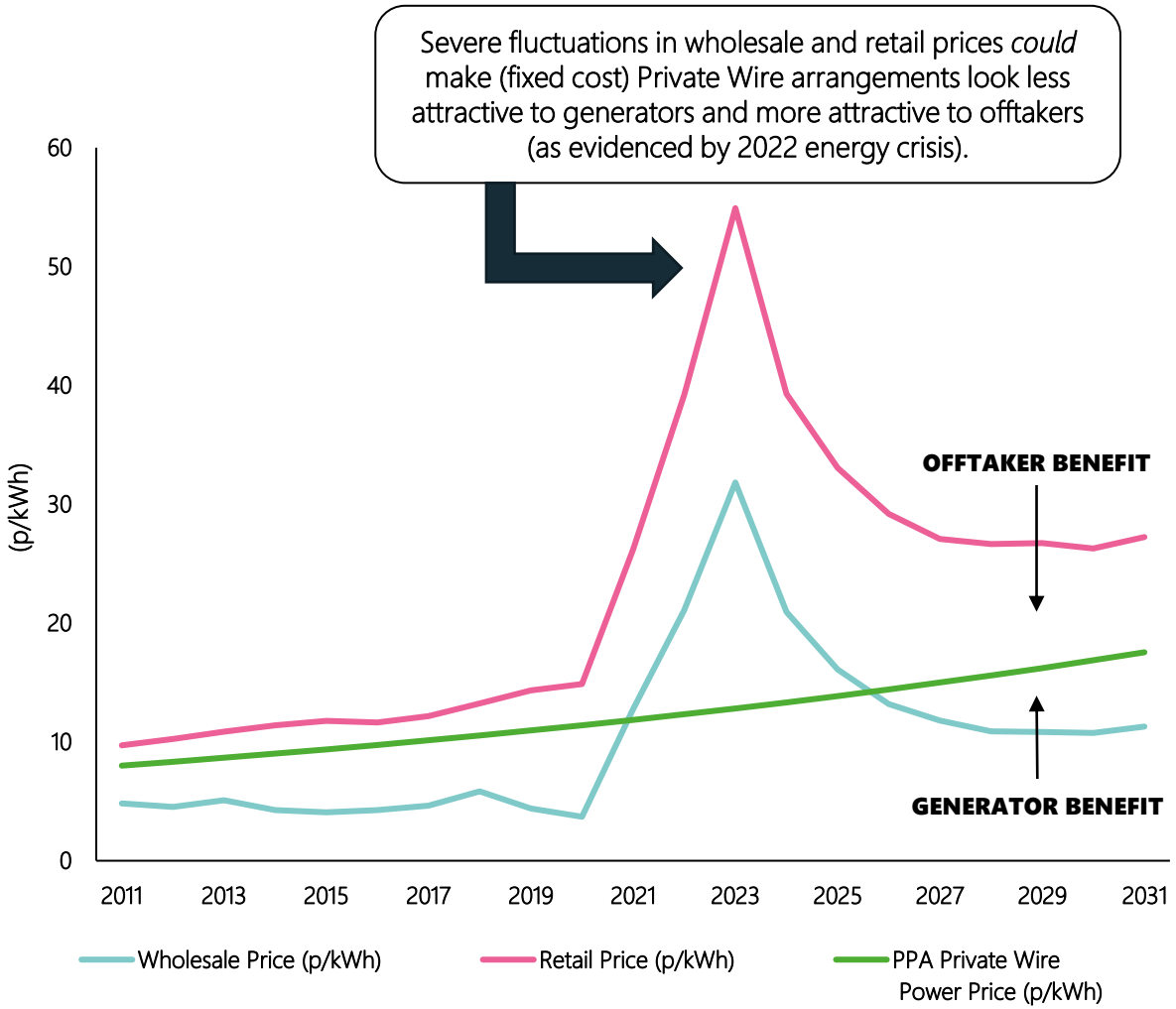
1. What IRR is required by the generator?
   - If a high IRR is required, the private wire power price will be closer to the retail price.
2. What cost-savings are required by the offtaker?
   - If the goal is to maximise cost-savings for the offtaker, the private wire power price will likely be closer to the wholesale price.
3. Will there be a 'take or pay' clause stipulated in the contract?
   - If so, this could reduce the financial risk for the generator and, in turn, a lower private wire power price may be negotiated.

GENERATOR BENEFIT(S)

Revenue Generation: Generator receives payment for power generated; referred to as the 'Private Wire Power Price'. This should be greater than the wholesale cost of electricity on a p/kWh basis.
Like the Sleeved PPA model, at times, this price may look less attractive than the wholesale price for electricity.
When generation is greater than demand, additional revenue may be generated by exporting surplus energy to the grid. This will require an additional export agreement.

OFFTAKER BENEFIT(S)

Cost Savings: Offtaker pays for electricity at a price that is higher than the wholesale cost of electricity yet still lower than the retail price of electricity.

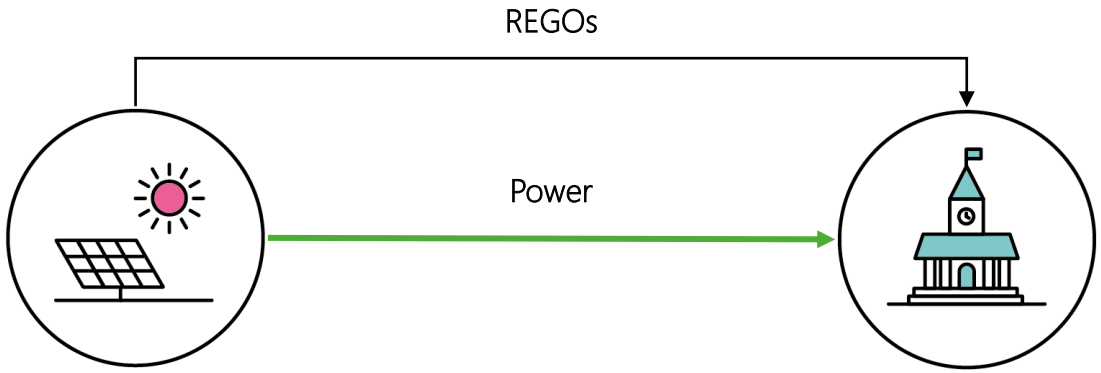


Visual illustration of Private Wire Power price in comparison to wholesale and retail prices for electricity.

5C. PRIVATE WIRE

AN ILLUSTRATIVE EXAMPLE

- Using data from an example project, the image below illustrates the potential financial benefits of the Private Wire business model for both the generator and offtaker.
- The cost avoidance benefits are shared 50:50 between both Parties.
- For simplicity, it is assumed that 100% of the power generated is used to satisfy ~69% of the site's total demand. However, as mentioned, this would not be the case due to seasonal variations in both solar generation and power demand.



Annual Generation

Generation Capacity: 280kWp
Annual Generation: 241831kWh

Annual Consumption

Annual HH Consumption: 348164kWh

Generator Revenue

Annual Revenue generation (Export/ Wholesale Price of 11.78p/kWh) = £28,488
Annual Revenue Generation (Private Wire Power Price of 19.42p/kWh) = £46,964

Annual Uplift in Revenue = £18,476

Offtaker Cost Savings

Annual Electricity Costs (retail price of 27.06p/kWh) = £94,213
Annual Electricity Costs (Private Wire Power Price of 19.42p/kWh) = £75,737

Annual Savings = £18,476

5C. PRIVATE WIRE

OTHER CONSIDERATIONS FOR VIABILITY

POTENTIAL CHANGES TO RETAIL ELECTRICITY BILL COMPONENTS

- As explained, **the commercial viability of private wire business models can be enhanced** by the avoidance of policy and network costs
- This means that the **business model is exposed to policy and regulatory risk**
- Several initiatives that *may* influence the level of cost avoidance achieved through private wire projects in future are outlined in the table to the right
- Although it is not yet known how these initiatives (and their possible outcomes) may influence the commercial viability of private wire projects, **it is important for local authorities to stay up to date on policy changes that may impact the business model**
- It is also important that commercial models for private wire projects are frequently updated to reflect any changes to policies and regulations

Initiative	Brief Summary	Retail Bill Electricity Bill Component of Relevance
DESNZ - Review of Electricity Market Arrangements (REMA) (DESNZ, 2023a)	The wide-ranging review will identify reforms needed to transition to a decarbonised, cost effective and secure electricity system.	Policy and Network Costs
DESNZ - Electricity licence exemptions call for evidence (DESNZ, 2023b)	This call for evidence seeks to understand how exemptions are currently being used and whether changes are needed to reflect policy aims, in particular, ensuring all market participants (including licence exempt) pay their 'fair share' of policy and network costs.	Policy and Network Costs
DESNZ - Powering Up Britain Report (DESNZ, 2023c)	UK government committed to outlining a clear approach to gas vs. electricity 'rebalancing' by the end of 2023/4 and should make significant progress affecting relative prices by the end of 2024.	Policy Costs
Transmission Network Use of Systems Charges (TNUoS) Task Force (Charging Futures, 2022)	The Task Force will examine various aspects of TNUoS methodology, including which elements of TNUoS charges should be paid by distributed generators with a clear, system-based rationale for any differences in treatment between classes of generators.	Network Costs
Ofgem - Distribution Use of System Charges (DUoS) Significant Code Review (Ofgem, 2022)	The review will consider numerous aspects of DUoS, including principles and trade-offs in network charging; distributional impacts, vulnerability, and fairness; and what signals get sent and to whom?	Network Costs

5. VIABILITY

5D. SITE OPTIMISATION AND STORAGE

There are likely to be times when the amount of solar energy generated is greater than site demand. With battery storage, surplus solar energy can be stored and used to generate additional savings (maximising self-consumption). Battery storage can also offer additional benefits when combined with variable tariffs (required for arbitrage) and external control (charging and discharging on demand).

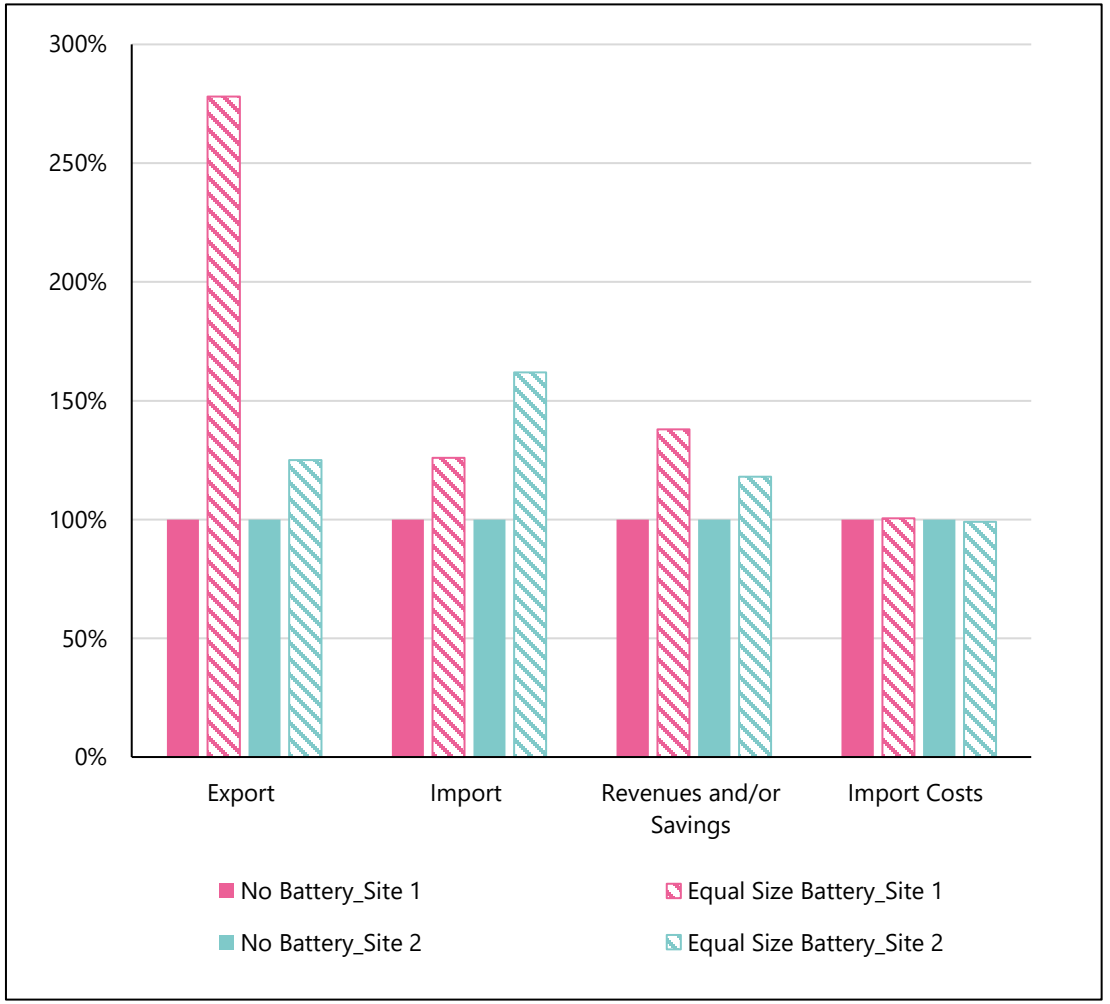
1. Maximising Self Consumption: Storing surplus energy in batteries and discharging to satisfy site demand when solar energy is not available (e.g., at night).
2. Arbitrage: Using battery storage to exploit different prices for electricity between peak and off-peak periods (i.e., charging at low prices and/or discharging at high prices).
3. Flexibility (Grid) Services: Using battery storage to access flexibility markets available through the Electricity System Operator (ESO) or Distribution Network Operator (DNO).

GENERATOR BENEFIT(S)

Revenue Generation: Revenue may be generated from arbitrage or flexibility services. To benefit from arbitrage, a time of use energy tariff or an export arrangement will be required. Likewise, for flexibility services, an export arrangement will be required.
If the generator and offtaker are from different organisations, a private wire agreement (BtM PPA) will be required for the consumption of renewable energy onsite. This would provide an additional revenue stream for the offtaker.

OFFTAKER BENEFIT(S)

Cost Savings: Cost-savings are achieved through energy bill reductions.
If the generator and offtaker are the same entity, cost-savings will be achieved by directly offsetting grid-imported electricity. If they're from different organisations, cost-savings will be achieved by paying a price for renewable electricity (as stipulated Private Wire/BtM PPA) which is lower than the retail price of electricity. The amount of cost-savings will depend on the percentage of self-consumption of renewable energy.



Change in export, import, revenue/ cost savings for two example sites with equal sized battery storage relative to the same sites with no battery storage. Source: Cornwall Insight's 'UCEGM Energy Market Modelling' deliverable.

5D. SITE OPTIMISATION AND STORAGE

OTHER CONSIDERATIONS FOR VIABILITY

- If the battery storage asset is intended to provide flexibility services, it is important to understand what markets are accessible.
- Flexibility markets have different eligibility criteria relating to battery size, discharge rate and other factors (Local Energy Oxfordshire, 2022).
- Third parties such as aggregators and battery storage optimisers can trade energy on behalf of local authorities.
- They understand the complexities of optimising energy storage assets and know which revenue streams to target to maximise returns.
- A commercial arrangement with an aggregator/ battery storage optimser may be required for local authorities with smaller-scale batteries as they are able to pool flexibility from numerous providers which allows collective participation in markets.
- Different types of pricing models may be offered for these type of commercial arrangements; each with their own benefits and considerations
- Examples of some common pricing models are shown to the right[2].

REVENUE SHARE (%)

✓ Opportunity for local authority to benefit from high-market prices (when applicable)	⚑ Third-party and local authority share market risk and are exposed to fluctuations in market prices
✓ Some providers don't charge for their services until the site is live and generating revenue (Flexitricity, n.d.)	⚑ Revenue generation can be inconsistent and unpredictable

FIXED PRICE (£/MWh)

✓ Provides price certainty for exported power throughout the duration of the contract	⚑ Local authority does not benefit from periods of high market prices
✓ Market risk is taken on by third-party provider which provides protection against fluctuations in market prices for the local authority	⚑ To account for market risk, the third party may offer a more conservative price for export (i.e., less than market value).

5E. SOLAR AND STORAGE LICENSING AGREEMENT

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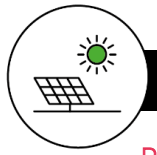
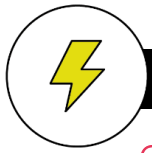
- This business model is similar to Storage and Site Optimisation but differs in two distinct ways.
- First, it is assumed that a third-party invests the necessary capital to deploy solar and storage technologies on behalf of the local authority. In turn, this changes the way in which revenue is obtained by the generator (asset owner).
- Second, in this model, solar and storage technologies are deployed at scale.
- This means that the benefits from numerous sites can be aggregated.
    - For example, adopting a portfolio approach *could* mean that less desirable sites, where the business case for storage and site optimisation may not stack up on its own, are able to be included.
- Deploying assets at scale could also provide greater purchasing power which could result in a lower overall cost.



GENERATOR BENEFIT(S)

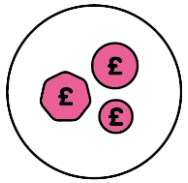
Revenue Generation: To recover the initial capital investment, the generator charges the offtaker for any solar energy they consume through a BtM PPA. Like the storage and site optimisation model, additional revenue may be generated from flexibility services or arbitrage.



OFFTAKER BENEFIT(S)

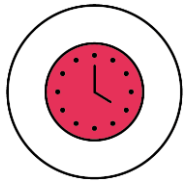
Cost Savings: The price that the offtaker pays for power through the PPA should be less than the retail price of electricity. Accordingly, the offtaker will see a reduction in their energy bills.

FINDINGS FROM EXTERNAL ENGAGEMENT



Implementation Cost

In addition to the capital cost of solar and storage technologies, the third party faces additional costs to access certain flexibility markets. They will also encounter costs when creating virtual power plants (VPPs) to participate in flexibility services. These costs will be factored into the PPA price offered to local authorities.



Contractual Length

The typical contract duration for third-party licensing agreements is up to 25 years. Therefore, a local authority must consider whether they are able to commit to such a long-term agreement. Some third parties may offer contracts with a buy-out clause in which the local authority may pay to exit the contract early.

Viability of Small-Scale Battery Storage

For some sites, it is not possible to make the business case stack up for battery storage. For example, in some cases, the calculated PPA price may be higher than the retail price of electricity. Although adopting a portfolio approach can help mitigate this, it may mean that many assets (tens or hundreds) are required to create an attractive proposition.

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Multi-functional solar carports (i.e., those with integrated solar, battery storage and EV charging point assets) present numerous revenue generation and/or cost-saving opportunities. These opportunities are dependent on how energy is used within the system. Furthermore, revenue and cost-saving opportunities are likely to change over time as demand for EV charging increases (see image to right). With this in mind, some of the potential generator and offtaker benefits are captured below.

GENERATOR BENEFIT(S)

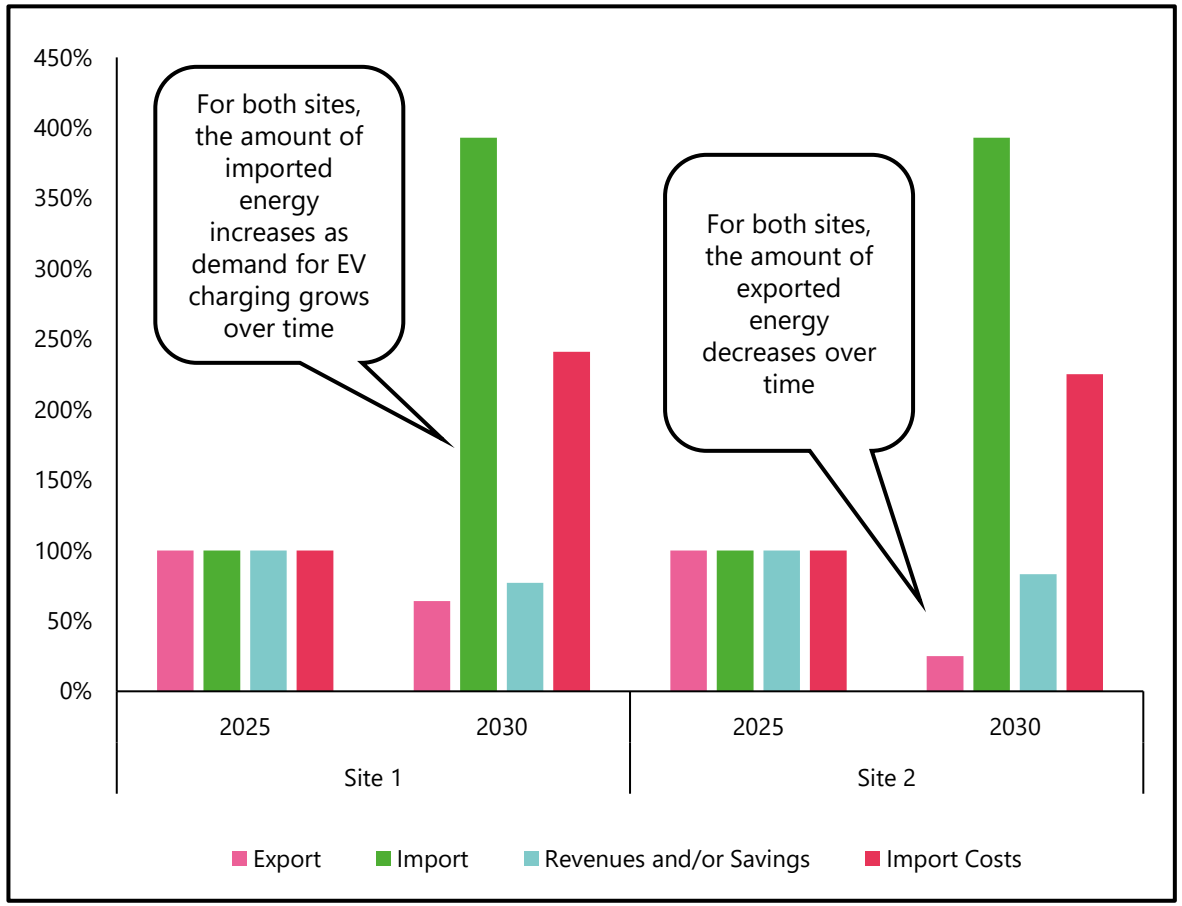
Revenue Generation:

- Revenue may be generated if the battery is used for arbitrage or flexibility services.
- If EV charge points are available for public use, revenue may be generated from charging services. This will require a billing solution which could be facilitated by a charge point operator (CPO).
- Revenue may be generated by selling renewable energy to an offtaker onsite through a Private Wire/ BtM PPA agreement.

OFFTAKER BENEFIT(S)

Cost Savings:

- If solar energy is consumed by a nearby site, the building occupant will see a reduction in their energy bills*
- Cost-savings may be increased by consuming any additional solar energy stored in batteries.
- A reduction in operational spending may be achieved (for a local authority offtaker) if solar energy is used to charge local authority owned vehicles.



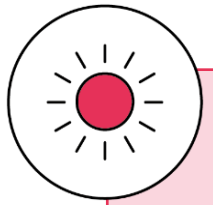
Change in export, import, revenue/ cost savings and import costs for two example solar carport sites (with no battery storage). Source: Source: Cornwall Insight's 'UCEGM Energy Market Modelling' deliverable.

*If the building occupant is the same Party as the generator, cost-savings will be similar to the self-consumption model where grid imported electricity is offset by solar energy. If the two Partys are different, cost-savings would be achieved by paying a price for renewable electricity (as stipulated Private Wire/BtM PPA) which is lower than the retail price of electricity.

5F. SOLAR CARPORT

OTHER CONSIDERATIONS FOR VIABILITY

- To assess the viability of a multi-functional solar carport system, optimisation modelling will be required.
- Although this may be outsourced to a third party, local authorities will still need to provide underlying assumptions that will inform technical modelling work
- This will depend on the underlying objectives for deploying the solar carport (see Section 6.C.5).
- Once it is understood how energy will be used in the system, a local authority can begin to explore the commercial opportunities available.
- Some of the key factors that should be considered in the technical **and** commercial assessments of solar carport projects are outlined on this page.



- Is there a nearby site that can consume renewable electricity that is generated?
- If so, what is the energy demand of the site?
- Is energy demand likely to change in future?
  - If so, how?
- What percentage of self-consumption can be obtained?
- Is the site owned by the local authority?
- If so, what cost savings can be achieved?
- If not, is a private wire/ BtM PPA arrangement required with the offtaker?
  - If so, what will the power price be?

- How (and when) will battery storage technology be used (i.e., maximise self consumption, supply power to EV charge points, flexibility services, arbitrage)?
- What are the potential revenues associated with each of these uses?
- What commercial arrangement will be required for any exported energy?

- What type of vehicles are anticipated to use the charging points?
- What are their anticipated charging schedules and demands?
- What type of EV charging points are required?
- How many EV charging points are required?
- How many EV charging points will be required in future?
- Are EV charging points being deployed to reduce operational spending or to increase revenue generation opportunities?
- What price for EV charging will be set (if applicable)?

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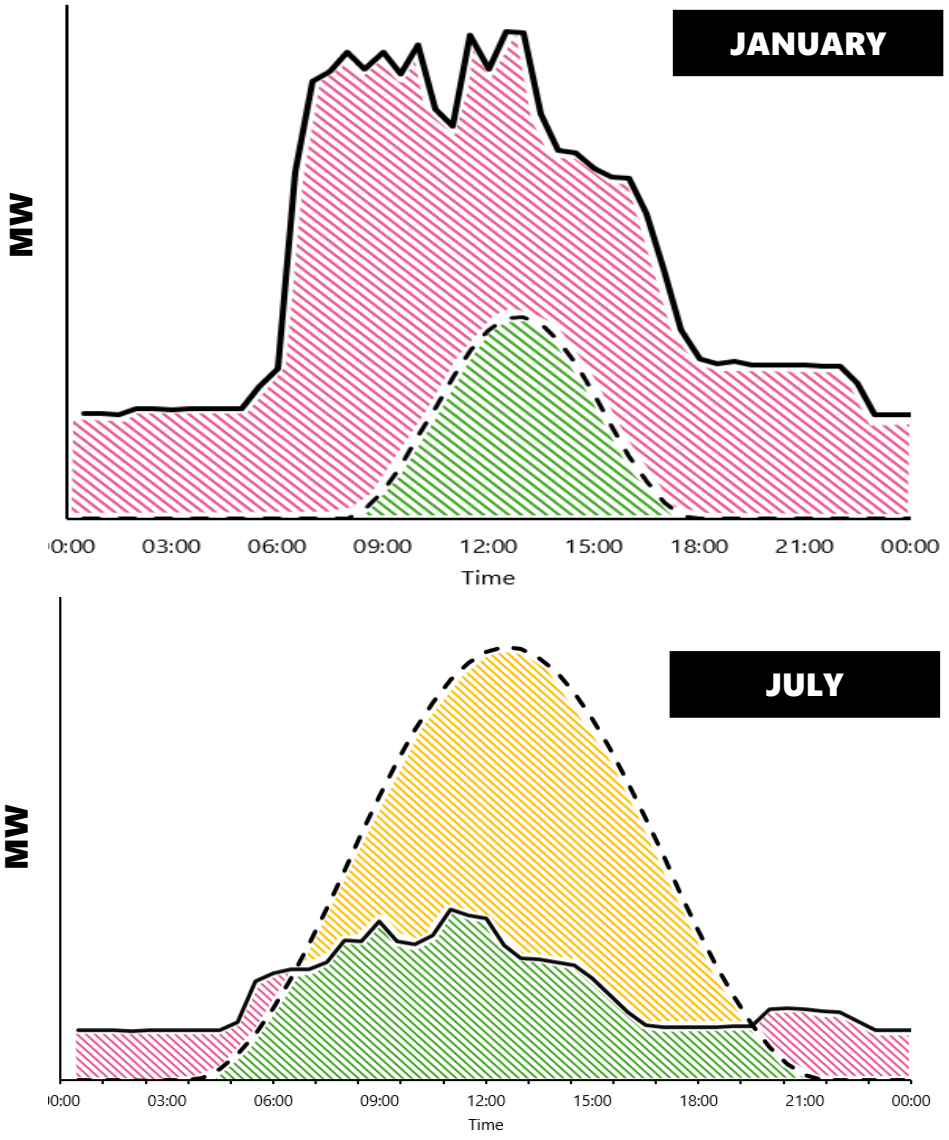
- One of the most important factors to consider in commercial assessments is how well solar generation and energy demand are matched.
- Although often done in high-level calculations, it is not always correct to assume that 100% of power generated from a solar asset will be used to satisfy existing demand; whether this be for an individual site or wider portfolio of sites.
- For example, the images to the right show how solar generation and demand can vary across seasons.
- In summer months, energy demand *tends* to be lower and solar generation tends to be higher.
    - For some buildings, like schools and offices, energy demand will also vary between weekdays and weekends.
- There are therefore likely to be times where generation exceeds demand.
- This means that surplus solar energy will be exported to the grid (unless there are other assets that can consume this energy e.g., an immersion heater in a hot water cylinder).
- The value from solar export will likely be less than other primary revenue streams or cost saving opportunities.
- The amount of solar energy that can satisfy demand vs. the amount of solar export should therefore be considered when assessing the viability of solar projects.

The seasonal variations of solar generation and energy demand are also important to the sizing of renewable generation assets.

(see the 'UCEGM – Improving the business case for local renewable energy projects in the current market and under future market scenarios' deliverable for further detail)



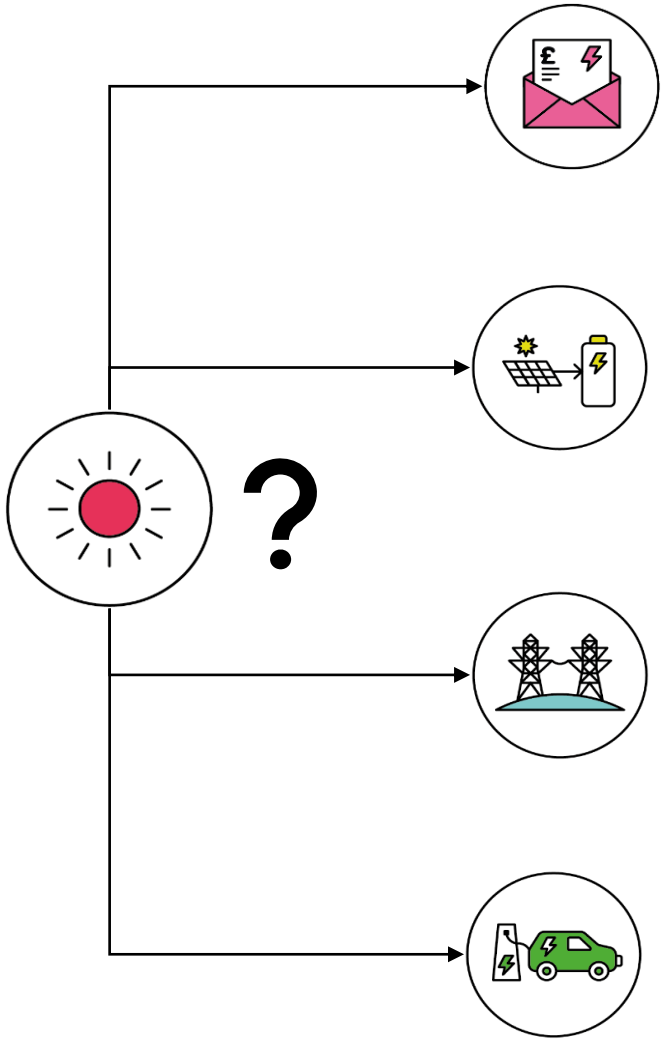
5. VIABILITY

5G. FACTORS THAT CAN INFLUENCE VIABILITY

- For business models that have integrated technologies (site optimisation and storage, solar carport and solar and storage licensing arrangement), there are several ways that revenue generation and/or cost-savings could be achieved.
- It is therefore important to consider the most optimal way to use the energy available from solar generation assets.
- The way in which a system is optimised will depend on the underlying objectives of the project.

- For example, the objective(s) may be to:
  - Maximise revenue generation opportunities to invest in future projects
  - Maximise cost-savings to reduce spending on energy bills
  - Minimise carbon intensity of the site (or portfolio of sites).

- Each of these factors will influence the commercial viability (and feasibility) of projects in different ways.
- The underlying assumptions about how solar energy will be used throughout the lifetime of the project, and associated revenue/cost-saving forecasts, will need to be reflected in the commercial assessments of potential projects.
  - Please note that due to degradation, the performance of assets typically reduces over time. Some components may require periodic replacement.
- This will require future energy demand profiles for sites/ wider energy portfolios, price forecast data and sophisticated optimisation modelling (which may be outsourced to third parties).



DISPLACE GRID IMPORTED ELECTRICITY (BtM ONLY)

Cost saving of c.25-40p/kWh (based on retail price forecast data)

CHARGE BATTERY STORAGE TECHNOLOGY

Revenue/ cost saving dependent on battery function (maximising self-consumption, arbitrage, grid services)

EXPORT TO GRID

Rate dependent on commercial agreement for export (e.g., SEG, optimisation contract, utility PPA).

SUPPLY EV CHARGEPOINTS

49p/kWh for fast charging
59p/kWh for rapid charging
(Based on recent Greater Manchester rates)

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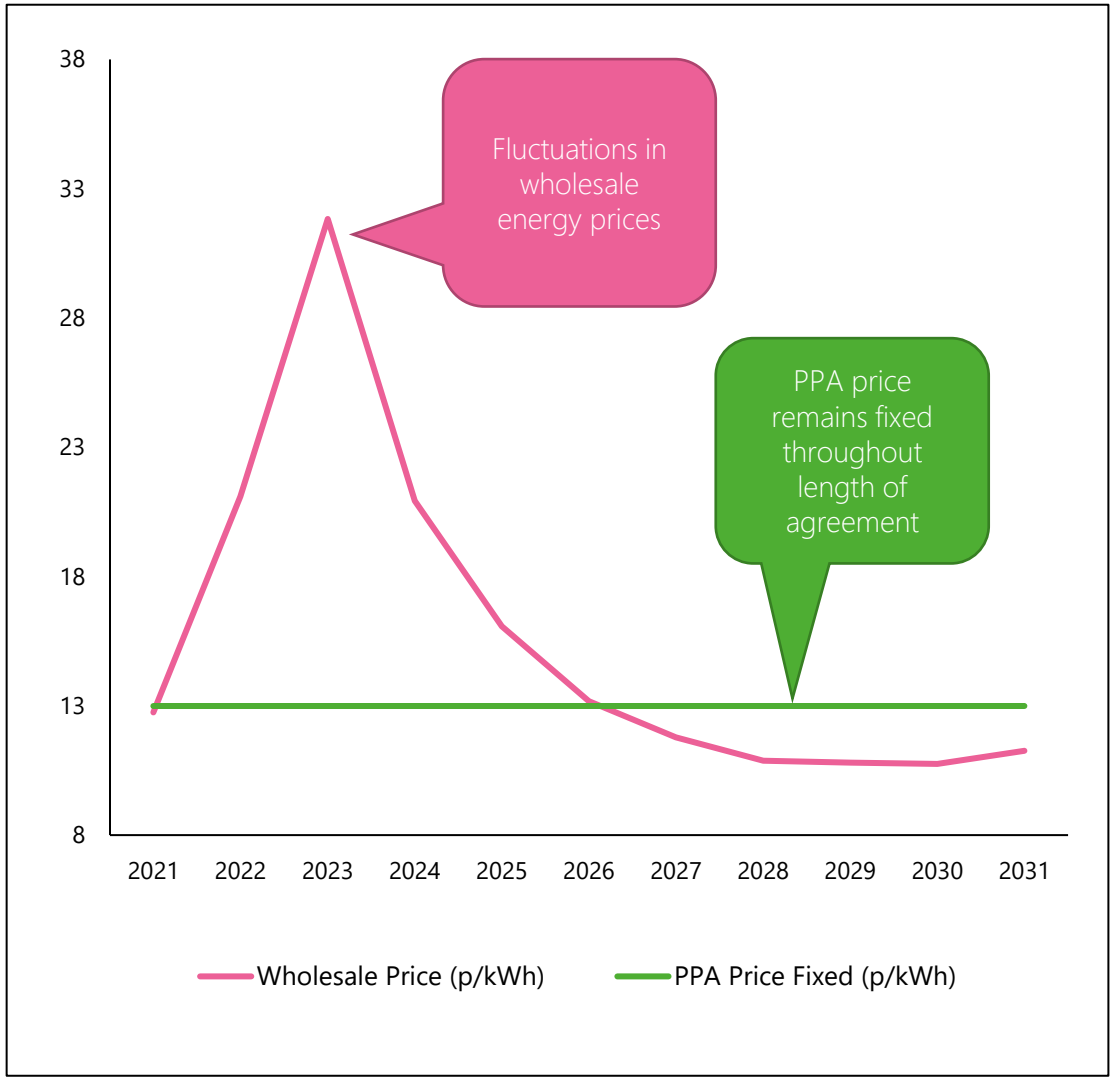
- Another important factor to consider, particularly for the Sleeved PPA and Private Wire business models, is which type of pricing structure is most suitable[2] .
- The best pricing structure for a local authority will be dependent on the role they assume within the business model (i.e., generator, offtaker or both) as well as their attitude towards risk (discussed further in the Desirability section).
- The 'fixed' pricing structure is the most common across Europe (World Business Council for Sustainable Development, 2021) (see image to right)
- In this arrangement, the generator and offtaker set a fixed price for the power generated across the duration of the PPA.
- Key benefits and considerations for this structure are outlined below.

✓ Provides long term cost visibility for offtaker which is beneficial for budgeting and forecasting activities

✓ Provides long term revenue visibility for generator which may assist in obtaining project sign off and securing finance

⚑ Changes in wholesale market prices may make the PPA price look less attractive over time (to both the generator and offtaker)

⚑ Offtaker takes on electricity price risk if wholesale market prices fall (i.e., they could end up paying more for electricity)



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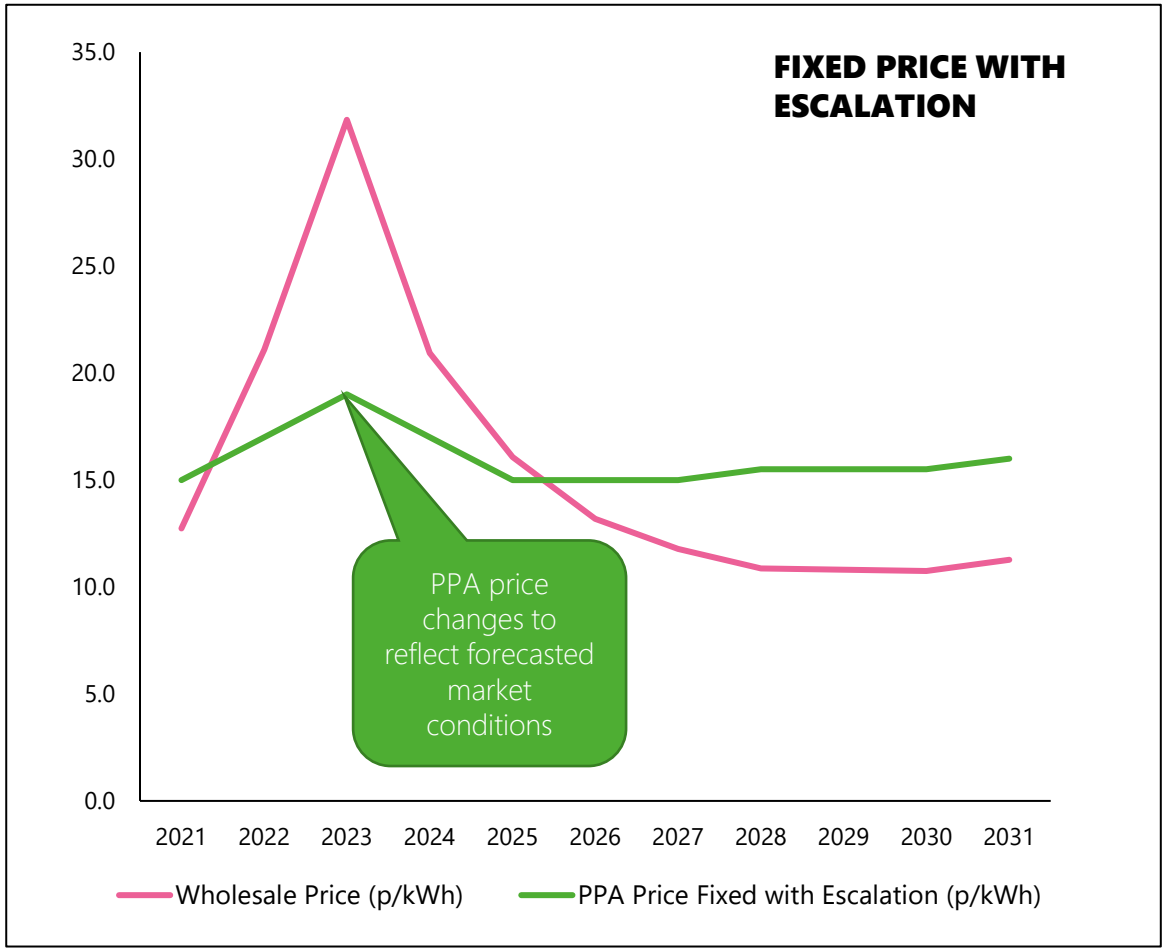
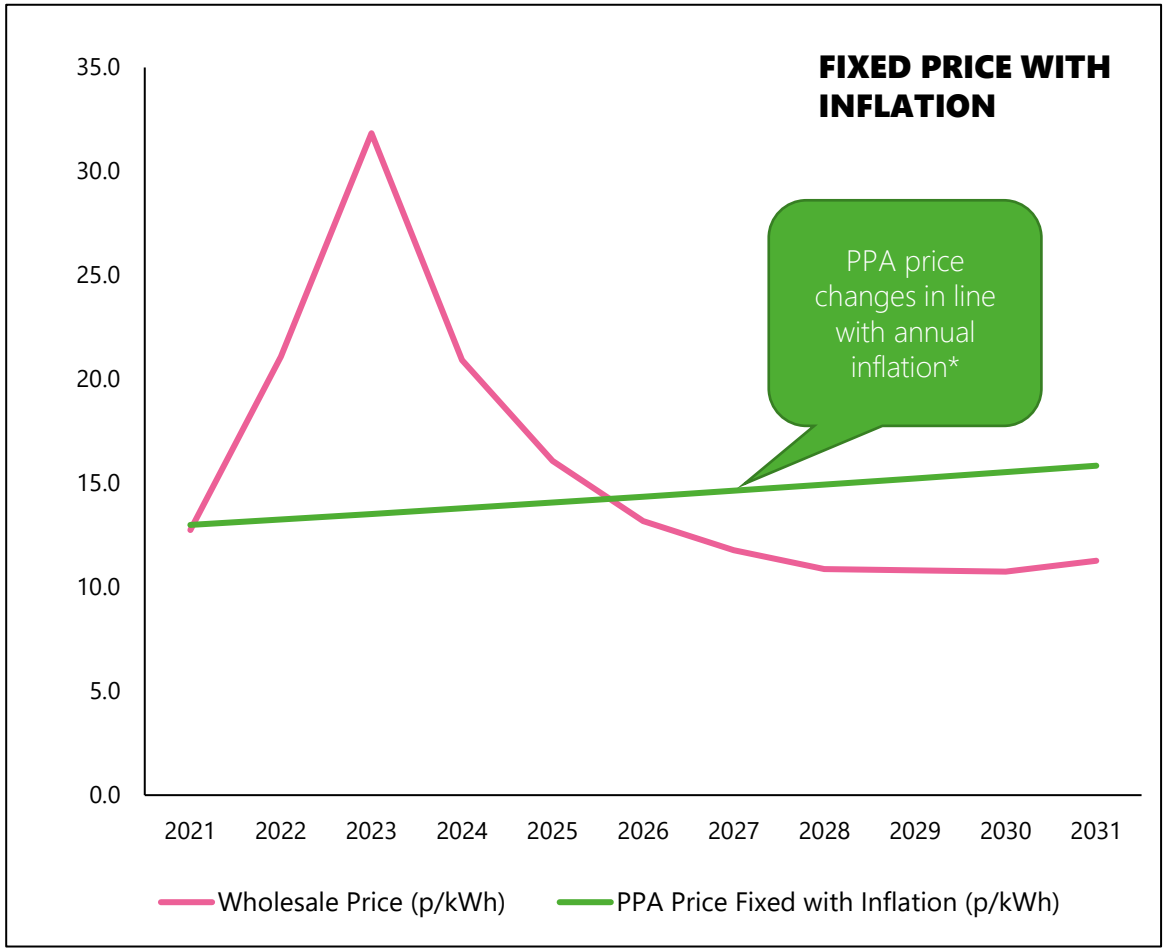
As illustrated below, fixed price with escalation and fixed price with inflation are variations to the fixed pricing structure. These structures may be preferred if a generator is looking to secure a PPA price that is more reflective of forecasted market conditions or annual inflation rates; especially if entering a long-term contract. Like the fixed PPA pricing structure, the market price risk is still taken on by the offtaker.





*Prices could be linked to a publicly available inflationary index (e.g., a Consumer Price Index).

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- As mentioned, in fixed pricing structures, offtakers are subject to market price risk.
- One way to lower this risk is to opt for a discount to market structure with a cap and floor (detailed below).

  Discount to market: Ensures that the offtaker is receiving energy at a price below the market rate (a 5% discount to market is shown in the image to the right)
  Cap: Cap prevents PPA price exceeding a certain limit for offtaker
  Floor: Floor prevents PPA price falling below a certain limit for generator.

- Key benefits and considerations for this structure are outlined below.

✓ Provides protection against **severe fluctuations** in wholesale prices

✓ Electricity price risk is shared between both Parties (unless market prices drop below floor)

⚑ Does not offer price certainty like fixed pricing structures

⚑ In private wire PPAs, extra resource would be required for billing arrangements (i.e., to monitor market prices and calculate the PPA price across periodic intervals)

Sources: World Business Council for Sustainable Development (2021) and Zeigo (2021).

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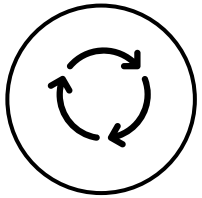
Some of the key points from this section are summarised below.

- Each of the short-term business models will require a contractual agreement that details the commercial arrangements for energy; whether that be for off-take or export.
- There are numerous pricing structures and/or pricing models that are possible; each of which will have their own value and risk.
- These pricing structures can influence the viability of business models differently.
- It is therefore important that any assumptions relating to commercial arrangements are reflected in commercial models.

- It is important to understand how (and when) energy will be used in renewable generation systems as this will dictate what revenue and cost-saving opportunities are available.
- To quantify revenue generation and cost-saving opportunities, local authorities will require asset performance and/or generation data, energy demand data (both present and future), price forecast data as well as sophisticated modelling for more complex systems (i.e., those with integrated battery storage technologies and/ or EV charge points).



- Commercial models should be continuously updated to reflect any changes to policy or regulation, market conditions and/or contractual arrangements as all of these factors will impact the commercial viability of renewable generation projects

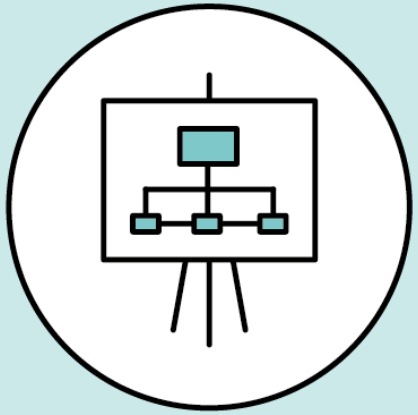
[1]PPA PRICE BREAKDOWN

- The breakdown of the PPA price components provided details the Catapult's findings from external engagement with several industry experts
- Please note that energy suppliers may use different terminology when describing these components and may quote different values to those referenced
- It is important that local authorities clarify what is meant by each cost component when speaking with different energy suppliers (or other balancing responsible parties) during soft-market testing.
- Although local authorities may wish to use this report as a starting point for these discussions, the quantitative information should only be taken indicatively

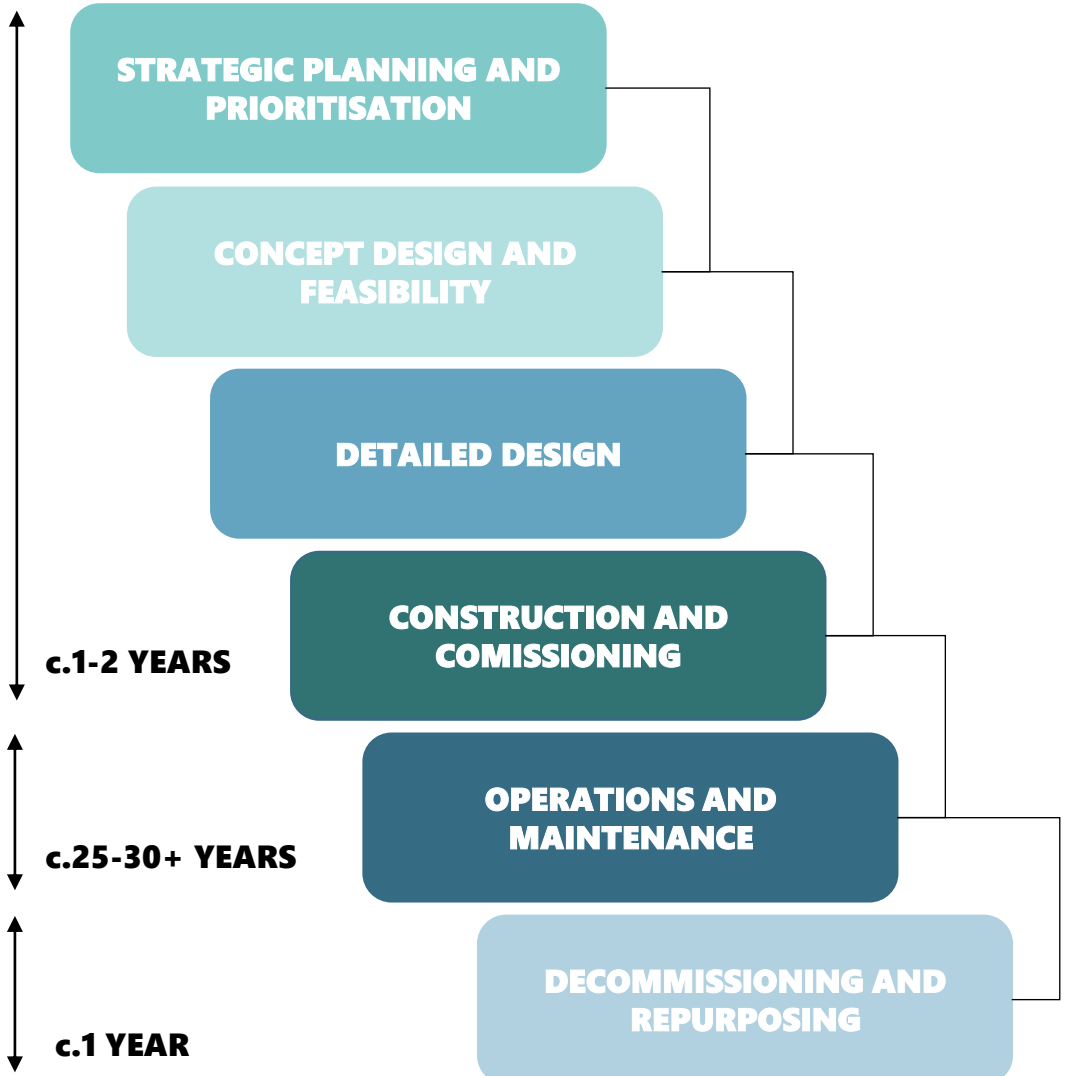
[2]PRICING MODELS AND PRICING STRUCTURES

- The pricing models and pricing structures introduced throughout this report do not provide an exhaustive list of all options available
- For example, when speaking to one local authority, we learned that an energy supplier had offered a pricing structure that was linked to the 'System Sell Price' of electricity.
- The different options were included to provide an overview of factors that a local authority may wish to consider when identifying the best solution for themselves.
- Again, it is important that local authorities explore all options available when speaking to energy suppliers (or other balancing responsible parties).

6. FEASIBILITY



- Feasibility is a crucial component of business model design as it considers what is required for the delivery/ implementation of business models (e.g., infrastructure, resource, activity and partner requirements).
- Throughout the first half of Section 6, an overview of key stages for the delivery of renewable generation projects is provided*. The following topics are considered:
  - Activities and outputs which are intrinsic to each phase
  - Findings and lessons learned from external engagement with industry experts and local authorities (where applicable).
- We build on this in the second half of Section 6 by highlighting feasibility considerations that are specific to each of the short-term business models.



*Please note that this section focuses primarily on the first two stages of project delivery as they are most likely to influence which business model is best suited to a local authority. Though, reference is still made to subsequent stages at a high-level throughout. Further information relating to later stages can be found in the 'UCEGM: Improving the business case for local renewable energy projects in the current market and under future market scenarios' deliverable .

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- Strategic plans (policies) are designed by local authorities to address local priorities (i.e., climate change and decarbonisation of transport).
- They provide direction for 'where things are going' and can assist with the allocation of funds and resources.
- Objectives developed during strategic planning will influence the type of low-carbon project(s)/ technology(ies) that a local authority prioritises during option appraisals.

CORE TASKS/ ACTIVITIES

- Identifying local priorities
- Developing strategic objectives
- Options and/or project appraisal
- Identifying opportunities for collaboration (if applicable)
- Assembling a project team

OUTPUTS

- Strategy document (including clearly defined aims and objectives)
- Identification of potential renewable generation projects

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- During the strategic planning and prioritisation stage, it is also important that a suitable project team is assembled.
- Decarbonisation projects have the potential to span across different directorates, departments and teams within a local authority.
- Departments frequently identified as being involved in the delivery of renewable generation projects, during external engagement, included the following:
    - Legal
    - Estates
    - Energy and Decarbonisation
    - Transport
    - Finance
    - Regeneration
    - Highways and Parking.

LESSON LEARNED

During engagement with the UCEGM district partners, the Catapult learned that some local authorities were considering electrifying their fleets (and by extension interested in exploring the Solar Carport business model further). In the absence of an electrification strategy, the number and type of vehicles to be electrified were unknown. This information, however, is key to determining an optimal design for solar carport systems and to subsequent commercial assessments.

EXTERNAL ENGAGEMENT FINDING

During external engagement, several stakeholders, from the energy industry, explained that they had faced difficulties progressing low-carbon projects with local authorities. Often, this was because they had struggled to get buy-in from key decision makers when trying to advance discussions on potential projects/ opportunities.

This stresses the importance of assembling a suitable project team early during project delivery, which is aligned on objectives and works collaboratively.

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- The concept and feasibility stage is most likely to influence which business model is most suitable for a renewable generation project due to the activities involved (see next page for further detail).
- The primary output of this stage is a feasibility study which can be used to determine whether a project should be progressed.
- Other outputs should feed into this study including locations of optimal sites (and their characteristics), technical characteristics of the project, grid connection offers, and provisional quotations from energy suppliers (or other partners where applicable*).

CORE TASKS/ ACTIVITIES

- Identification of potential site locations
- Asset sizing
- Soft-market testing
- Business model considerations
- Commercial modelling
- Environmental and regulatory considerations

OUTPUTS

- Optimal site(s) identified
- Grid connection offer (in principle)
- Provisional quotes from energy suppliers (or other partners)
- Funding/ finance application
- Feasibility study (techno-economic)

*Partner requirements for each short-term business model are discussed further in the second half of this section.

6B. STAGES OF PROJECT DELIVERY

6B.2 PROJECT CONCEPT AND FEASIBILITY

Activities intrinsic to the project concept and feasibility stage are discussed below. Please note that there is likely to be some iteration between these activities.

- Site(s) Selection: This activity is often performed internally by local authorities but can be outsourced to external consultancies. There are numerous factors that influence the suitability of sites for renewable generation projects including shading, sloping, and proximity to infrastructure.
- Asset Sizing: To size renewable generation assets, an understanding of the following will be required: current (and future) energy demand, percentage of self-consumption (if applicable), technological performance of the asset (e.g., solar generation profiles for solar PV) and available grid connection capacity. More complex projects (i.e., solar carports) will require sophisticated modelling to determine the optimal size of assets.
- Business Model Considerations: The outcomes from previous activities will likely inform which business model is most appropriate for a particular project. For example, if looking to deploy ground mounted solar PV, both the Sleeved PPA and Private Wire business models could be potential options. However, if during site selection, a nearby site is identified which can consume a large percentage of the solar energy, the Private Wire model could be better suited. Business model assumptions should be incorporated in subsequent commercial assessments.
- Soft-Market Testing: Local authorities should engage with necessary stakeholders (e.g., energy suppliers, the DNO, etc.) to understand what products, services and /or solutions are available and at what price. The outcomes from soft-market testing should also feed into commercial assessments.
- Commercial Modelling: Commercial models help assess the viability of a renewable generation project and can be used to calculate financial metrics that may be required for project sign-off.*
- Environmental and Regulatory Considerations: It is important to understand whether planning permission will be required for the renewable generation project. Some roof mounted PV installations *may* not require planning permission. However, all ground mounted installations larger than 9m^2 (approximately 4-5 large solar panels) will require planning permission (The Renewable Energy Hub UK, 2021a).

LESSON LEARNED

The amount of self-consumption of solar energy proposed in some of the Workstream 1 feasibility studies was often greater than calculations that were performed by the Catapult after half-hourly meter data had been obtained. This meant that commercial assessments had to be executed for numerous sites to understand what effect this had on viability.

Feasibility studies should be as accurate as possible to avoid unnecessary costs (due to potential resizing requirements) and unnecessary delays during project delivery. If possible, half hourly data should be obtained for at least one year to accurately model seasonal, weekly and daily consumption patterns.

*For further information on commercial modelling work completed as part of the UCEGM project, please refer to the 'UCEGM: Improving the business case for local renewable energy projects in the current market and under future market scenarios' deliverable.

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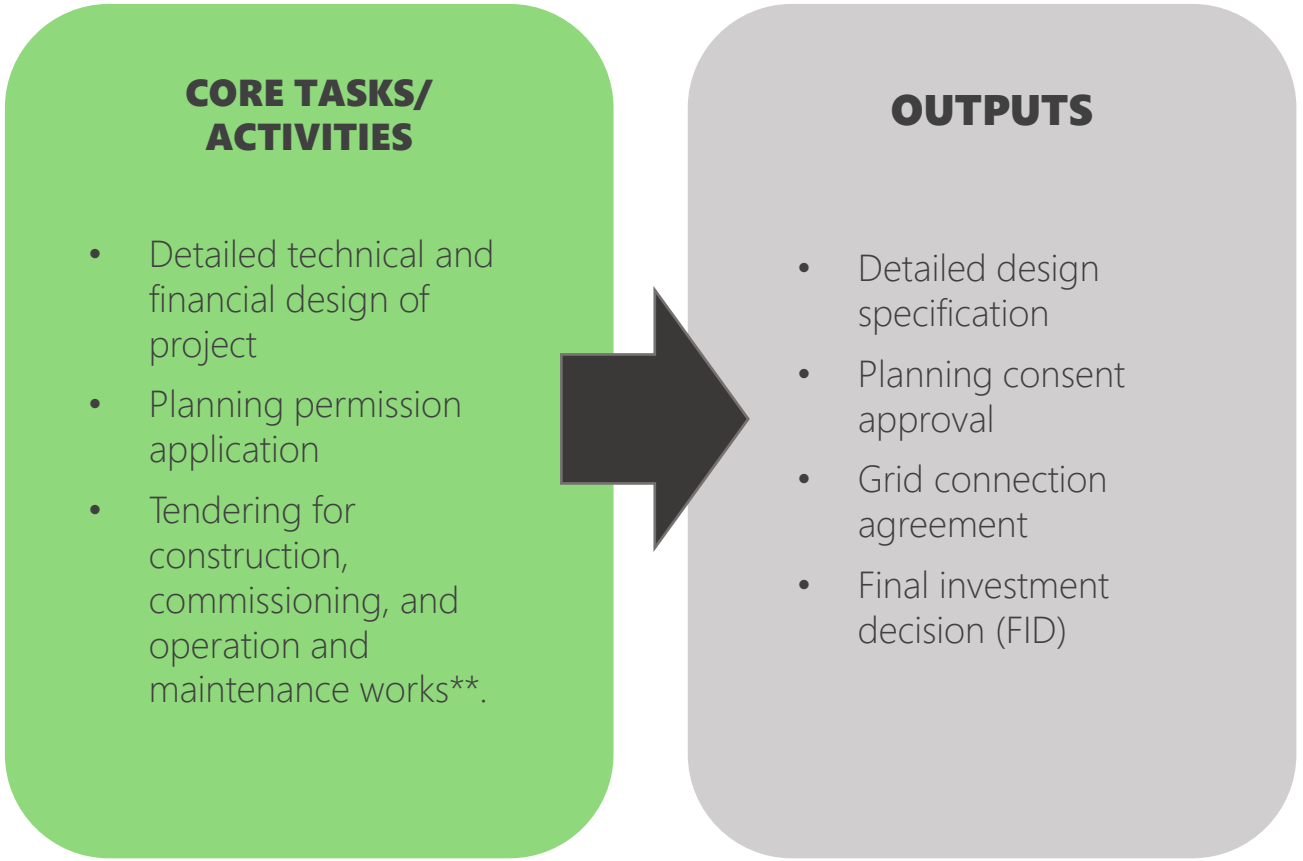
- If a decision has been made to continue with the project after the feasibility stage, it will progress to the detailed design stage.
- This builds on the former stage by designing bespoke solutions specific to a site's physical and technical characteristics.
    - Other activities intrinsic to this stage are shown in the image provided.
- The outputs from activities at this stage, will inform final decisions on whether the project will go ahead.
    - If so, a local authority may then go out to tender for construction, commissioning, and O&M works.
- Please note that the responsibilities (activities) of a local authority at this stage will differ depending on the delivery approach adopted*.



*For further information on the different delivery approaches a local authority may take, please refer to the 'UCEGM: Improving the business case for local renewable energy projects in the current market and under future market scenarios' deliverable.

**Please note that the procurement will only take place if a decision has been made to continue with the project.

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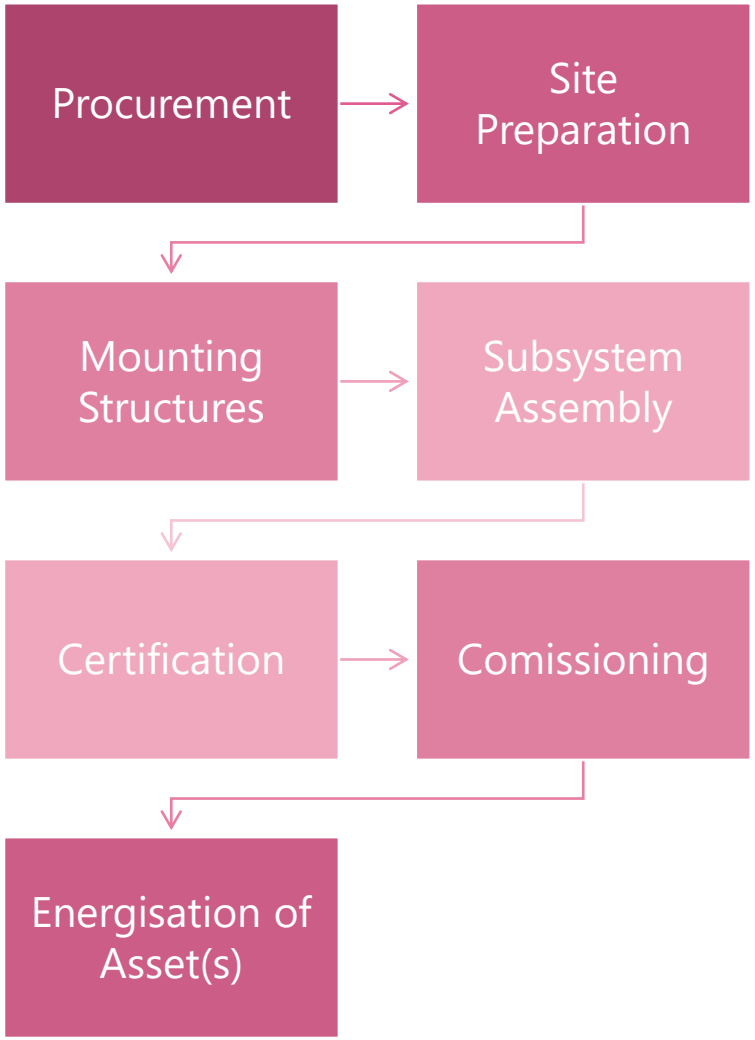
- The construction and commissioning stage involves the physical execution of the project.
- The image provided outlines key activities associated with this stage.
    - Please note that this has a specific solar on ground-mounted solar farms.
- At the end of this stage, renewable generation assets will be energised.
- During external engagement, the Catapult learned that local authorities may not receive **final** quotations from energy suppliers (or other stakeholders required for delivery) until they have a commercial operations date (COD) in date for their asset(s) **and** have also obtained planning permission.
    - It is therefore recommended that sensitivity analyses are performed on revenue and cost assumptions during early commercial assessments to explore whether a project could still be viable if they were to change.
    - Given current inflation levels, the risk of cost increases should be accounted for where possible.



Activities intrinsic to the Construction and Commissioning stage of project delivery.

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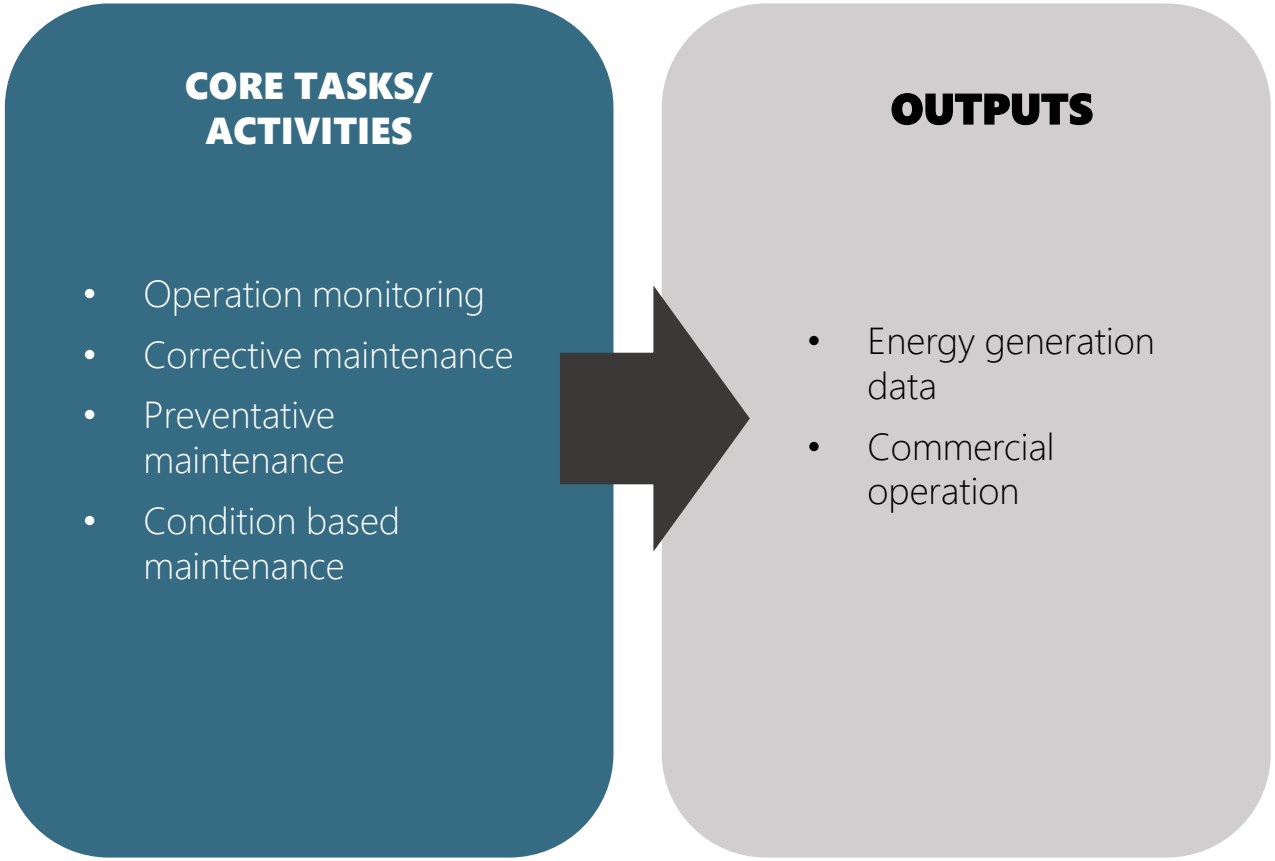
- The O&M stage ensures that assets are functioning properly throughout their usable lifetime.
- Operation related activities include energy monitoring, system performance testing, data analytics and commercial management.
- Some local authorities may consider taking on an asset management role once a project becomes operational.
- Maintenance services can be corrective, preventative and condition based.
    - Please see Appendix 4 for further detail.
- Please note that some maintenance activities may increase as assets age.
    - If maintenance activities are being performed in-house, this increase in activity should be adequately planned for.



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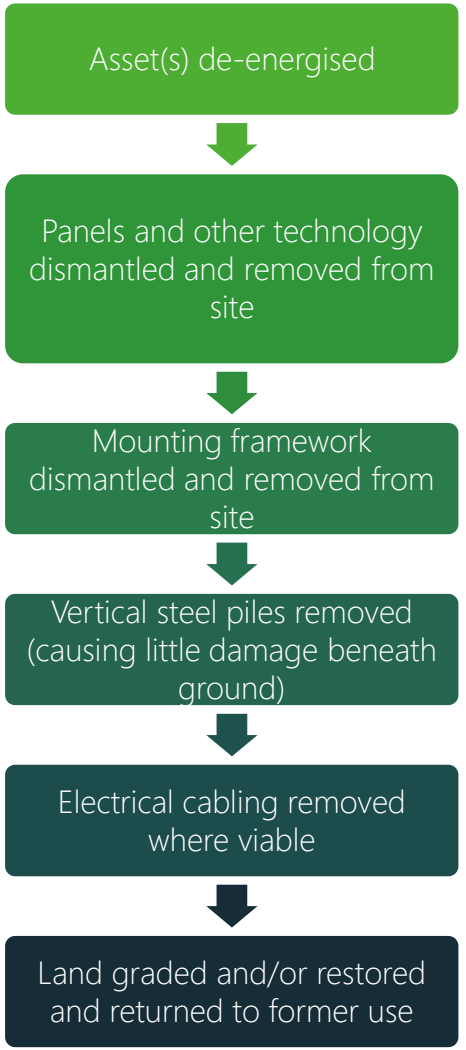
- The decommissioning and repurposing stage takes roughly 6-12 months depending on the size of the asset(s).
- The image provided outlines key activities associated with this stage.
    - Please note that this has a specific solar on ground-mounted solar farms.
    - Additional stages may be required for renewable generation projects that contain other assets such as batteries.
    - For example, some used batteries are considered hazardous waste and must be correctly disposed of.
- At the end of this stage, where applicable, land should be restored and returned to its former use (e.g., for agriculture).
- Where possible, materials should be recycled or repurposed.
    - In most cases, 98% of a solar panel is recyclable (Solar Energy, 2022).



Activities intrinsic to the Decommissioning and Repurposing stage of project delivery. Source: Solar Energy (2022).

- There are different stakeholders required for the delivery of each short-term business model.
    - These stakeholders and their potential role in project delivery are summarised throughout this subsection for each business model.
- During external engagement and desk-based research activities, the Catapult identified specific feasibility considerations for each short-term business model.
    - These could significantly influence the suitability of a business model to a local authority and should therefore be considered in parallel with viability.
    - Feasibility considerations across a range of themes are discussed for each business model throughout this subsection.

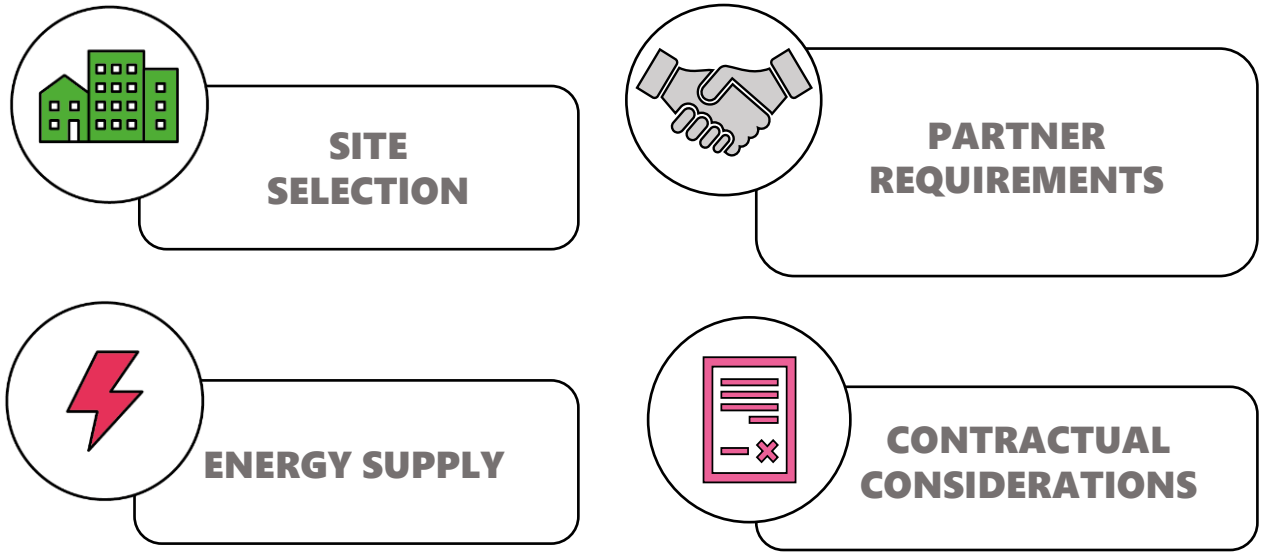


Illustration of themes considered when analysing the feasibility of each short-term business model.

6C.1 SLEEVED PPA

STAKEHOLDERS INVOLVED WITH PROJECT DELIVERY

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Generator

- Designs, develops, constructs, and oversees the operation and maintenance of a renewable generation project (some of these activities may be outsourced to third-party organisations).
- Owns the asset(s) of a renewable generation project.

DNO

- Provides grid connection offers and grid connection agreements for sites (depending on the stage of project delivery).

Funding/ Finance Provider

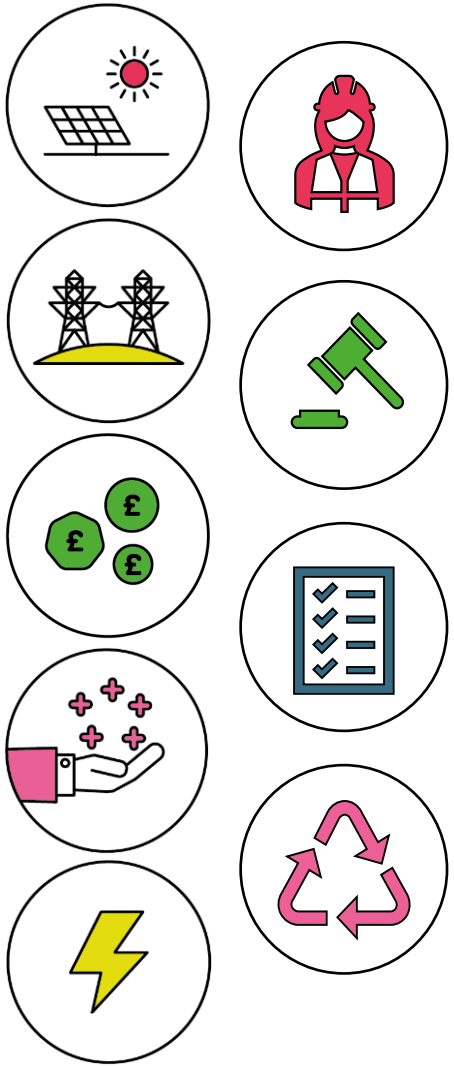
- Advises on eligibility, loan structures and repayment terms.
- Provides the necessary funds to cover project costs through a contractual agreement with the generator.

Offtaker

- Purchases and consumes electricity from the generator (asset owner) of the renewable generation asset(s) through a Sleeved PPA.

Energy Supplier (and/or other BRP)

- Facilitates the 'sleeving' of energy between the generator and offtaker of the renewable generation system.
- Purchases surplus solar energy that is exported to grid from the generator (this may be a different company to that facilitating the Sleeved PPA).
- Provides balancing services and charges the offtaker for any additional power not met through the Sleeved PPA.



Delivery Contractor

- Responsible for the design and/or build of the renewable generation project (depending on the delivery approach chosen)*
- Some delivery contractors may also take on O&M responsibilities.
- Some activities may be subcontracted to other companies.

Legal Advisor

- Provides legal guidance on the contractual elements of project delivery (e.g., energy supply contracts, Sleeved PPA contract).

O&M Contractor

- Responsible for managing the operations and maintenance of a renewable generation asset on behalf of the generator.
- Some activities may be subcontracted to other companies.

Decommissioning Contractor

- Responsible for the decommissioning of the renewable system once it has reached the end of its usable life.
- Responsible for repurposing the site.
- Some activities may be subcontracted to other companies.

*Please refer to the 'UCEGM: Improving the business case for local renewable energy projects in the current market and under future market scenarios' deliverable for further detail on different delivery approaches.

6C.1 SLEEVED PPA

FEASIBILITY CONSIDERATIONS: SITE SELECTION

- In a sleeved PPA, the solar asset is not physically connected to the point of energy off-take (the site). This means that there is some flexibility when identifying an optimal generation site.
    - For example, if a local authority is constrained by land availability, they may wish to explore the suitability of sites outside of the area.
- When undergoing site selection exercises for solar farms, the following factors should be considered:
    - Land Size – As a rule of thumb, roughly 5 acres of land will be required per 1MW of renewable generation capacity.
    - Land Condition – Clear, flat land with minimal decline is preferred.
    - Infrastructure Proximity – Good accessibility to roads and closeness to existing grid infrastructure is recommended to keep project costs down (The Renewable Energy Hub UK, 2021b).
- Brownfield sites are *generally* considered good locations for solar development projects due to their proximity to existing infrastructure.
- Several local authorities have developed solar projects on brownfield sites including Cambridgeshire County Council (Soar Power Portal, 2021) and West Sussex County Council (West Sussex County Council, 2022).
- Desk-based research shows that local authorities which have secured sleeved PPAs (i.e., Warrington Council and West Sussex County Council), have done so for ground-mounted solar PV farms at the megawatt scale.

CASE STUDY: WOLVERHAMPTION CITY COUNCIL

Wolverhampton City council partnered with Royal Wolverhampton NHS Trust to develop a solar farm on an unused, publicly owned brownfield site.

The solar farm will supply 6.9MWp directly to New Cross Hospital (CLES, 2019).

The project received funding through Salix Finance.

The project could save approximately 1,450 tonnes of carbon each year.

It is envisioned that the solar farm will save the NHS Trust between £15-20m over the next twenty years which will be invested back into healthcare (Vital Energi, n.d.).

6C.1 SLEEVED PPA

FEASIBILITY CONSIDERATIONS: ENERGY SUPPLY

- It can take between 6-18 months for a sleeved PPA agreement to be implemented. Findings from external engagement suggest that procurement and legal consultations account for a significant portion of this time.
- Where possible, the PPA start date should align with the energisation date of the asset; especially if commercial modelling is based on this assumption.
- Findings from external engagement also suggest that it is possible for local authorities to secure temporary export arrangements whilst waiting for PPA agreements to be finalised.
    - Where this is the case, the local authority should check whether the temporary agreement aligns with funding stipulations (if applicable).
- The implementation of PPAs may also need to align with the renewal of energy supply contracts. For example, some existing energy supply contracts may not permit sleeving meaning that the local authority may have to wait until their existing contract comes to an end before securing a PPA with an alternative supplier.
- If the length of an energy supply contract is shorter in duration than the PPA contract, provisions should be made to 'port' balancing and shaping responsibilities (typical supplier tasks associated with facilitating a sleeved PPA) to a new electricity supplier (Crown Commercial Service, 2020).

UCEGM PROJECT FINDING

One project partner learned that, due to funding stipulations, only sites where the local authority is responsible for paying for electricity directly (i.e., does not rebill tenants) could benefit from a sleeved PPA. This meant that some sites had to be excluded from the sleeving arrangement.

If required, it is recommended that local authorities check whether energy suppliers can offer tailored solutions like that mentioned above. It is also important to determine whether there will be any additional fees associated with such a request and to explore what influence these may have on viability.

This situation may not arise for solar projects that are delivered without grant funding. However, where a local authority wishes to include sites that are rebilled for energy (i.e., schools and leisure centres) in sleeving arrangements, they may instead wish to consider how benefits of the Sleeved PPA (e.g., energy bill reductions) could be shared.

6C.1 SLEEVED PPA

FEASIBILITY CONSIDERATIONS: SOFT MARKET TESTING

- It is important that local authorities engage with energy suppliers as early as possible during project delivery to understand what products and services are available (e.g., are they able facilitate a sleeved PPA and at what cost?).
- During external engagement, ESC learned that terminology used by energy suppliers in relation to PPAs differed considerably; both in terms of what was understood by the PPA type (i.e., sleeved PPA, utility PPA, etc.) and what was understood by certain fees (i.e., sleeving fees, shaping fees, etc.). This could make it difficult for local authorities to compare products and services on a like-for-like basis.
- The deliverables from the UCEGM project may be used to provide structure to early conversations with energy suppliers. It is important to ensure that all stakeholders are aligned on terminology as assumptions around the PPA type, pricing structure and other fees will feed into subsequent commercial assessments.
- To provide quotations for their services, an energy supplier will likely require data such as annual solar generation forecasts and half-hourly energy demand data from sites to be included in the Sleeved PPA arrangement. Having access to such data as early as possible can help avoid unnecessary project delays.

UCEGM PROJECT FINDING

During discussions with an energy supplier, one project partner was informed that a sleeved PPA agreement would only be possible if the solar asset's generation exceeded 50GWh per annum.

Instead, the energy supplier offered a utility PPA, linked to wholesale market electricity prices, with the option for the local authority to trade or retain REGOs.

This finding shows that sleeved PPAs are not necessarily readily available from all energy suppliers.

6C.1 SLEEVED PPA

FEASIBILITY CONSIDERATIONS: PARTNER REQUIREMENTS AND CONTRACTUAL CONSIDERATIONS

- To enact the Sleeved PPA model, the following contracts are likely to be required:
  - Sleeved PPA contract between the generator and offtaker that stipulates key terms (e.g., PPA price, volume and contract duration).
  - Contract between the generator and energy supplier that makes provisions for the transfer of energy and REGOs (if the generator is not retaining REGOs for themselves).
  - Contract between the energy supplier and offtaker, which makes provisions for the transfer of REGOs (if applicable) and outlines how the output of the generation facility will be credited against the offtaker's electricity demand.
- An additional commercial agreement between the generator and a balancing responsible party will be required for any surplus solar energy that is exported to grid.
  - If the asset is under 5MWp, it may be eligible for Smart Export Guarantee.
  - SEG licensees are obliged to offer tariffs and pay eligible generators for exported energy (Ofgem, 2023). In turn, they are responsible for choosing the tariff rate, contract length and other key terms.
- Findings from external engagement indicate that there is currently a high demand for PPAs in the UK and Europe more widely.
- During external engagement it was also explained that some public sector organisations, in the past, have received limited tender responses when looking to procure PPAs from third party generators.
- However, there are still some examples of public sector organisations that have successfully procured renewable energy through a sleeved PPA.
  - This includes the City of London Corporation (Voltalia, 2022) and a group of twenty UK universities (as part of an aggregated PPA with Statkraft) (Current News, 2019).

- In a sleeved PPA, the generator and offtaker are responsible for negotiating a suitable contract duration for both parties (as well as other key terms and conditions).
- The length of Sleeved PPA contracts can range from 1-25+ years.
- With a fixed pricing structure, long term agreements can provide revenue visibility for the generator and cost-visibility for the offtaker, which could inform forecasting and budgeting activities.
- Long-term agreements may be preferred by local authorities who value revenue/ cost certainty over maximising revenue/ cost saving potential.
  - This is discussed in further detail in the Desirability section.
- Short-term agreements may be preferred where key changes to contractual terms are likely to be required.
  - For example, during periods of severe wholesale market volatility, short term PPAs could prevent Parties from being locked in at an unfavourable PPA price for extended periods*.
  - There may also be changes to energy generation and/or energy demand that could require energy volume clauses to be renegotiated.

*This risk could also be mitigated, to some degree, by implementing a 'cap and floor' pricing mechanism.

6C.2 PRIVATE WIRE

STAKEHOLDERS INVOLVED WITH PROJECT DELIVERY

Generator

- Designs, develops, constructs, and oversees the operation and maintenance of a renewable generation project (some of these activities may be outsourced to third-party organisations).
- Owns the asset(s) of a renewable generation project.

DNO

- Provides grid connection offers and grid connection agreements for sites (depending on the stage of project delivery).

Funding/ Finance Provider

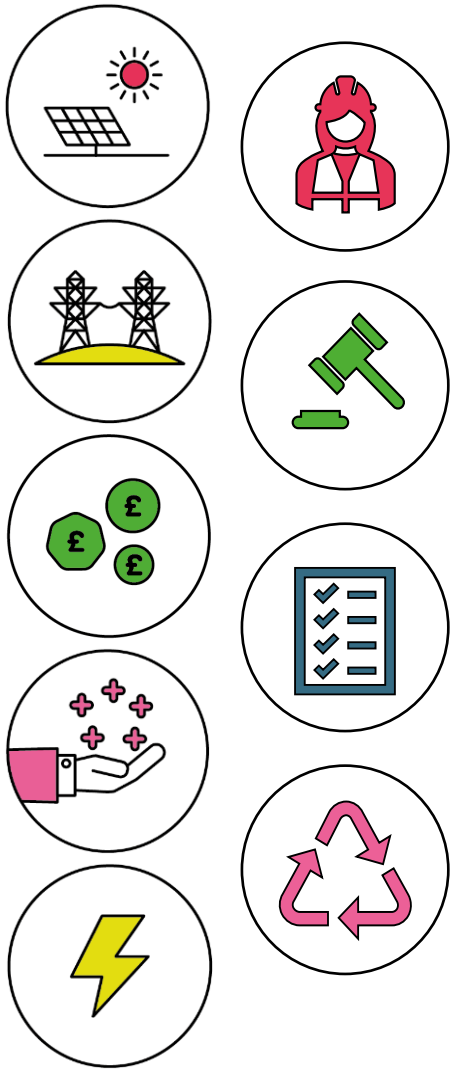
- Advises on eligibility, loan structures and repayment terms.
- Provides the necessary funds to cover project costs through a contractual agreement with the generator.

Offtaker

- Purchases and directly consumes electricity from the generator (asset owner) of the renewable generation asset(s) through a Private Wire agreement.

Energy Supplier (or other BRP)

- Purchases surplus solar energy that is exported to grid from the generator.
- Provides a potential route to new flexibility markets (which could be offered from the DSO or ESO).



Delivery Contractor

- Responsible for the design and/or build of the renewable generation project (depending on the delivery approach chosen)*
- Some delivery contractors may also take on O&M responsibilities.
- Some activities may be subcontracted to other companies.

Legal Advisor

- Provides legal guidance on the contractual elements of project delivery (e.g., private wire contract and supply licence exemptions).

O&M Contractor

- Responsible for managing the operations and maintenance of renewable generation assets on behalf of the generator.
- Some activities may be subcontracted to other companies.

Decommissioning Contractor

- Responsible for the decommissioning renewable generation assets once they have reached the end of their usable life.
- Responsible for repurposing the site.
- Some activities may be subcontracted to other companies.

*Please refer to the 'UCEGM: Improving the business case for local renewable energy projects in the current market and under future market scenarios' deliverable for further detail on different delivery approaches.

6C.2 PRIVATE WIRE

FEASIBILITY CONSIDERATIONS: SITE SELECTION AND GRID CONNECTION

- When identifying potential site locations for private wire schemes, **the length of the private wire connection required is a crucial factor to consider.**
    - Costs for a 1km private wire connection can be up to £250k* (see Appendix 3) (Energy Local Scotland, 2020).
- It is also important to know the energy demand of potential sites that are being considered to understand how well energy generation and demand are matched.
    - **It is good practice to perform calculations, to understand the percentage of self-consumption, as accurately as possible (and as soon as possible in the design process) to minimise any unforeseen costs (i.e., due to potential resizing requirements) and to avoid unnecessary project delays.**

- For private wire installations, consideration needs to be given to where the scheme will connect to the grid (e.g., at the offtaker's site or at the generation site).
- The most common arrangement is for the grid connection point to be located at the offtaker's site.
- This means that the offtaker can still have a separate supply arrangement with an energy supplier which may be required for the following reasons:
    - To supply energy to match any site demand that can't be met by solar asset output.
    - To account for any planned (or unplanned) shutdowns.
- Where this is the case, the generator should consider what contingencies they need to have in place should access to the grid connection point become no longer available (i.e., the offtaker moves premises).
- If the grid connection point is located at the generation station, the DNO **may** require this to become the offtaker's only point of electricity supply (Welsh Government Energy Service, 2021).
    - This could result in energy supply risks for the offtaker (depending on how well-matched generation and demand profiles are).

*Based on 2020 prices.

FEASIBILITY CONSIDERATIONS: ENERGY SUPPLY

European Union
European Regional Development Fund
NORTHERN POWERHOUSE HM Government
CATAPULT Energy Systems

- To supply electricity to an offtaker, via Private Wire, the generator would either need to be a licensed electricity supplier or fall under one of the exemptions in The Electricity (Class Exemptions from the Requirement for a Licence) Order 2001 (HM Government, 2001).
- Legal support will be required to determine whether compliance has been met and which Class exemption is applicable.

- There may be times that excess power is generated from the solar asset and needs to be exported to the grid.
- This will require a separate export agreement with a balancing responsible party.
- If the solar asset is under 5MWp, it may be eligible for Smart Export Guarantee (SEG) (OFGEM, 2023).
- As an alternative to SEG, the generator may secure a PPA with an energy supplier for solar export.
- During external engagement, the Catapult learned that one local authority had secured an export arrangement for their aggregated surplus solar at a rate higher than most SEG providers.
- Soft market testing with suppliers will be required to ensure that the best possible rate (p/kWh) is obtained for surplus solar export.

- At the end of the private wire arrangement, the offtaker may not wish to renew the contract.
- In this case, the generator may choose to export all solar energy to the grid by securing an export agreement with a balancing responsible party.
- This could be a complex process if the grid connection is under ownership of the offtaker.
- For example, the generator may be required to pay rent or usage fees to continue using the connection point.

6C.2 PRIVATE WIRE

FEASIBILITY CONSIDERATIONS: PARTNER REQUIREMENTS AND CONTRACTUAL CONSIDERATIONS

- To enact this model, a private wire agreement between the generator and offtaker that stipulates key terms (e.g., power price, volume and contract duration) will be required.
- An additional commercial agreement between the generator and a balancing responsible party (BRP) will be required for any surplus solar energy exported to grid.
- If the asset is under 5MWp, it may be eligible for Smart Export Guarantee.
- Potential offtakers will be identified during site selection activities - this may or may not be a local authority owned site.
    - The opportunity for a local authority to secure a private wire arrangement as an offtaker will depend on the proximity of the local authority's site to the renewable generation site **and** how well generation and energy demand profiles are matched.

Contract Length

- Because the solar generation asset is directly connected to the source of consumption, viability of the private wire business model is primarily dependent the price paid for energy by the offtaker across the lifetime of the asset.
- This means that long-term contractual arrangements (c.15 years) are often required.
    - Please note that although contracts have ranged up to 15 years in the past, more recently, they have been shorter.
    - Long-term contracts can provide revenue certainty but may be harder to obtain under current market conditions.

Energy Volume Considerations

- The generator should make clear to the offtaker the anticipated volume of energy that will be supplied to the site (taking variability and asset degradation into account).
    - To reduce supply risk, the offtaker may wish to include a 'minimum supply volume' clause in the contract that outlines penalties for the generator if the asset does not perform as expected.
- It is also possible that the offtaker's energy demand profile may change over time (due to operational changes or the installation of energy efficiency technologies).
    - To minimise revenue risk, the generator may wish to include a 'take or pay' clause in the contract.
    - This means that the offtaker would agree to a stipulated volume of energy and pay a penalty if it is not consumed onsite.

6C.3 STORAGE AND SITE OPTIMISATION

STAKEHOLDERS INVOLVED WITH PROJECT DELIVERY

European Union
European Regional Development Fund

NORTHERN POWERHOUSE HM Government

CATAPULT Energy Systems

Generator

- Designs, develops, constructs, and oversees the operation and maintenance of a renewable generation project (some of these activities may be outsourced to third-party organisations).
- Owns the assets of a renewable generation project.

DNO

- Provides grid connection offers and grid connection agreements for sites (depending on the stage of project delivery).
- Approval for battery storage requires submission to DNO, which when combined with solar (and export limitations), *could* be considered more favorable.

Funding/ Finance Provider

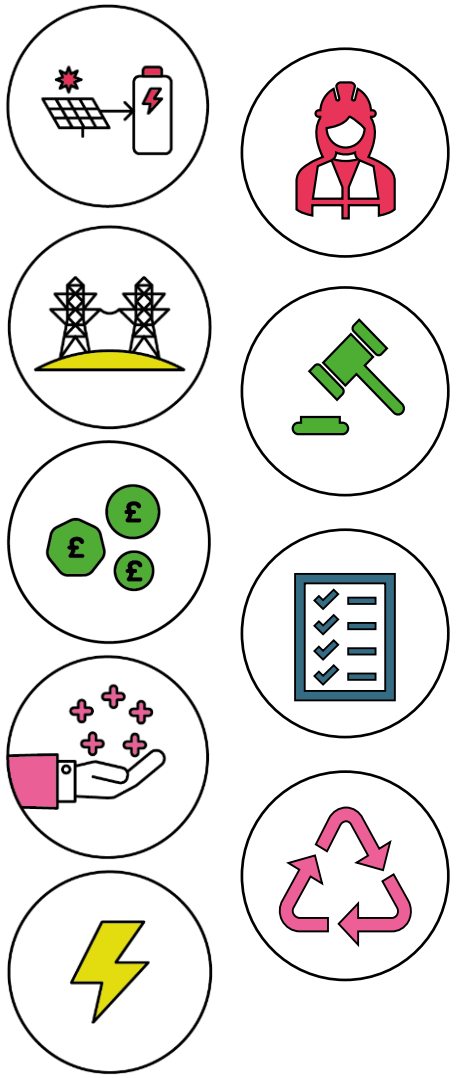
- Advises on eligibility, loan structures and repayment terms.
- Provides the necessary funds to cover project costs through a contractual agreement with the generator.

Offtaker

- If the generator and offtaker are from separate organisations, the offtaker will purchase and directly consume electricity from the generator (asset owner) of the renewable generation assets.

Aggregator/ Battery Storage Optimiser

- May be required to trade energy (from battery export) on behalf of the asset owner*.
- Provides a potential route to new flexibility markets (which could be offered from the DSO or ESO).



Delivery Contractor

- Responsible for the design and/or build of the renewable generation project (depending on the delivery approach chosen)**
- Some delivery contractors may also take on O&M responsibilities.
- Some activities may be subcontracted to other companies.

Legal Advisor

- Provides legal guidance on the contractual elements of project delivery.

O&M Contractor

- Responsible for managing the operations and maintenance of renewable generation assets on behalf of the generator.
- Some activities may be subcontracted to other companies.

Decommissioning Contractor

- Responsible for the decommissioning of renewable generation assets once they have reached the end of their usable life.
- Some activities may be subcontracted to other companies.

*Please note that if the generator is unable to secure an export agreement with an aggregator/ battery storage optimiser, a 'solar storage' tariff with a licensed SEG provider may be an alternative option. This is discussed further throughout this subsection.
**Please refer to the 'UCEGM: Improving the business case for local renewable energy projects in the current market and under future market scenarios' deliverable for further detail on different delivery approaches.

6C.3 STORAGE AND SITE OPTIMISATION

FEASIBILITY CONSIDERATIONS: PARTNER REQUIREMENTS

Please note that despite making efforts to reach out to numerous aggregators and optimisation providers, no interviews were obtained. Therefore, the findings presented in relation to the feasibility of this business model are based solely on desk-based research.

Export from Battery Storage

- 'Stacking' is often performed to maximise revenue generation from eligible markets.
- A commercial agreement (optimisation contract) with an aggregator or battery storage optimiser is often required to trade energy on behalf of an asset owner as they understand the complexities of optimising energy storage assets and know which revenue streams to target to maximise returns.
- Although there are examples of local authorities that have secured optimisation contracts, they have typically been for large-scale storage assets (either stand-alone or are co-located with solar farms).
    - For example, South Somerset District Council secured an optimisation contract with Limejump for 90MW of battery storage assets that they own across two sites (Limejump, 2022).
    - Warrington Borough Council also secured an optimisation agreement with Statkraft for their 23MWp solar farm and 10MW battery storage facility (Statkraft, 2022).
- If unable to secure a commercial arrangement with an aggregator/ battery storage optimiser, a 'solar storage' tariff with a licensed SEG provider may be an alternative option.
    - Please note that some providers may only pay for electricity that is produced by onsite generation assets and not for electricity that was originally imported from the grid and exported later (Energy Saving Trust, 2023).

Renewable Energy Consumption onsite

- If the generator and offtaker are from different organisations, a private wire agreement will also be required for the consumption of renewable energy onsite.

6C.3 STORAGE AND SITE OPTIMISATION

FEASIBILITY CONSIDERATIONS: CONTRACTUAL CONSIDERATIONS

Contract Length

- Longer contractual arrangements with aggregators and battery storage optimisers *could* help increase investor confidence and the likelihood of obtaining finance.
- However, findings from desk-based research suggest that optimisation contracts **typically** last 12-24 months.
- Although there are some cases of organisations securing longer-term optimisation contracts, the contracts awarded have been for large-scale battery storage assets.
    - For example, Centrica Business Solutions have agreed to a 10-year contract for the optimisation of three battery storage plants (totalling 89MW) developed by Arlington Energy (Arlington Energy, 2022).

Asset Control and Prioritisation

- There are several ways that a battery storage asset can generate revenue and/or cost savings.
- Accordingly, it is important that Parties agree on how the asset will be optimised throughout the duration of the contract.
    - For example, some contracts may stipulate that the asset owner obtains the priority right to any stored energy from the battery (e.g., to satisfy onsite energy demand).
    - When they do not require energy from the asset, provisions may be made to allow the aggregator/battery storage optimiser to generate revenue from export opportunities (PWC, 2021).
- Having visibility on asset availability allows third party organisations to optimise which revenue streams to target.
    - This is particularly important for organisations that access markets where assets must be available for dispatch upon request.

Asset Performance

- During discussions with aggregators/ battery storage optimisers, asset owners should also discuss the effect that optimisation could have on asset degradation and how asset performance risks will be addressed.

6C.4 SOLAR AND STORAGE LICENSING AGREEMENT

STAKEHOLDERS INVOLVED WITH PROJECT DELIVERY

European Union
European Regional Development Fund

NORTHERN POWERHOUSE HM Government

CATAPULT Energy Systems

Generator (Third-Party Provider)

- Designs, develops, constructs, and oversees the operation and maintenance of solar and storage assets.
- The third-party provider also trades surplus energy on behalf of the local authority which removes the need for additional contractual arrangements for export.
- Owns the asset(s) of a renewable generation project (at least) for the duration of the licensing agreement.

DNO

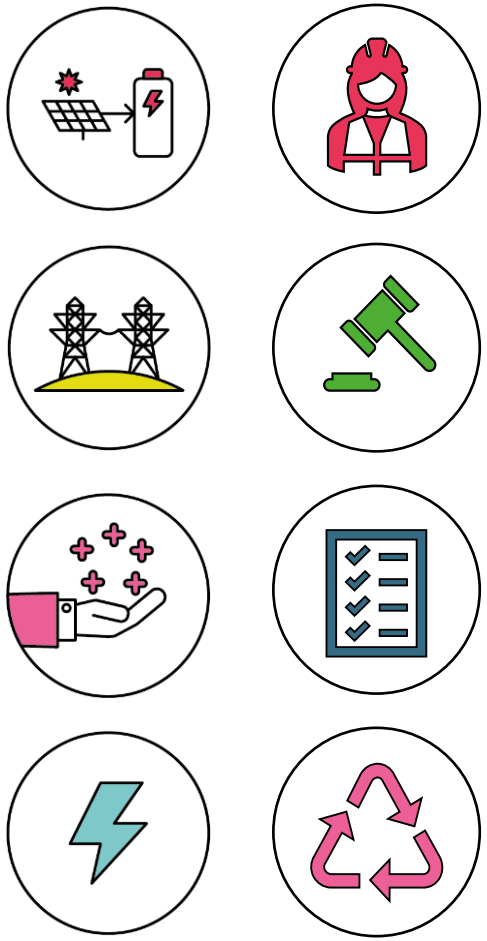
- Provides grid connection offers and grid connection agreements for sites (depending on the stage of project delivery).

Offtaker

- Purchases and directly consumes electricity from assets owned by the third-party provider through a PPA.
- Tri-Party agreements may be required for sites that are owned by local authorities but tenanted by other organisations (i.e., leisure centers, schools, etc.)

Energy Supplier

- Can advise on whether the proposed deployment of solar and storage assets could result in breaching existing energy supply contracts.



Delivery Contractor

- Responsible for the design and/or build of the renewable generation assets
- Some delivery contractors may also take on O&M responsibilities.
- The third-party provider will be responsible for deciding whether they wish to procure a delivery contractor.

Legal Advisor

- Provides legal guidance on the contractual elements of the solar and storage licensing agreement.

O&M Contractor

- Responsible for managing the operations and maintenance of a renewable generation asset on behalf of the generator.
- Some activities may be subcontracted to other companies.
- The third-party provider will be responsible for deciding whether they wish to procure an O&M contactor.

Decommissioning Contractor

- Responsible for the decommissioning of renewable generation assets once they have reached the end of their usable life.
- Depending on who obtains ownership of the assets at the end of the licensing agreement, the local authority or the third-party may be responsible for deciding whether they wish to procure a decommissioning contractor.

6C.4 SOLAR AND STORAGE LICENSING AGREEMENT

FEASIBILITY CONSIDERATIONS: RESOURCE REQUIREMENTS AND ENERGY SUPPLY

European Union
European Regional Development Fund
NORTHERN POWERHOUSE HM Government
CATAPULT Energy Systems

- In this model, design, installation, operation, and maintenance activities are undertaken by a third-party provider. This significantly reduces resource requirements for the offtaker (local authority) for the following reasons:
  - Third-party undertakes optimisation and design activities for all sites.
  - Third-party is responsible for procuring and installing assets.
  - Third-party trades surplus energy on behalf of the local authority which removes the need for additional contractual arrangements for export.
- This may be desirable to local authorities that have limited in-house expertise regarding integrated solar and battery storage projects and/or have limited resource available to deliver renewable generation projects.

- Battery storage assets may be used to maximise the self-consumption of renewable energy from solar.
- However, if solar and storage assets are deployed across numerous sites, it is possible that this could interfere with a local authority's existing electricity supply contract.
- To elaborate, electricity supply contracts may contain volume tolerance clauses where, if the amount of electricity consumed by the local authority differs from the minimum volume stipulated in their contract, penalties may be incurred.
- Accordingly, it is recommended that local authorities contact their energy supplier to see whether the installation of solar and storage assets could result in a breach of their existing contract (if looking to enact this business model).
- If the proposed installation is likely to result in a breach of contract, the local authority may need to wait until their energy supply contract is up for renewal before operationalising the assets.
  - This could lead to significant project delays.

6C.4 SOLAR AND STORAGE LICENSING AGREEMENT

FEASIBILITY CONSIDERATIONS: CONTRACTUAL CONSIDERATIONS

European Union
European Regional Development Fund
NORTHERN POWERHOUSE HM Government
CATAPULT Energy Systems

To enact this model, the local authority would need a contractual arrangement with the third-party provider that stipulates key terms of the solar and storage licensing agreement (typically up to 25 years). During external engagement, the Catapult spoke to organisations that had experience delivering solar (and in one case solar and storage) projects for third party customers. Several contractual considerations were raised and are highlighted on this page.

Performance Guarantee

- The amount of energy bill reductions available to the local authority is dependent on the volume of renewable energy consumed at the agreed upon PPA price.
- Local authorities may wish to explore whether the third-party provider is willing to include a performance guarantee in the PPA contract.

Buy-Out Clauses

- Some third-party organisations may offer 'buy-out' opportunities at periodic intervals throughout the duration of the contract (calculated based on the present value of the assets at the time of 'buy-out').
- If a local authority decides to pursue this option, they will obtain ownership of the assets.
- This means they would be responsible for operating and maintaining the assets as well as decommissioning the assets at the end of their usable life.

Tenanted Buildings

- Contractual arrangements can become inherently more complex for sites that are owned by local authorities but tenanted by other organisations (i.e., leisure centers, schools, etc.)
- Findings from external engagement suggest that one of the main reasons for this is debt risk (e.g., who takes on risk if the tenant is at risk of defaulting on their payments?)
- If the local authority (as building owner) is not able to act as a guarantor for the tenant, tri-Party agreements between the local authority, the-third party license provider and tenants may be required.
- Debt management should therefore be a key consideration during initial conversations with third-party installers to avoid unnecessary project delays.

Asset Ownership

- Although the third-party provider retains ownership of the assets throughout the duration of the contract, ownership *could* be transferred to the local authority at the end of the agreement.
- This would allow the local authority to fully benefit from any renewable energy consumed at site (e.g., offset grid imported electricity).
- In turn, the local authority would be responsible for operating and maintaining the assets as well as decommissioning the assets at the end of their usable life.
- If the third-party provider retains ownership of the assets at the end of the contract, local authorities should check who is responsible for decommissioning the assets and repairing any potential damage as a result.
- Desk-based research suggests that the third party would take on this responsibility, but this should be confirmed during contract negotiations.

6C.5 SOLAR CARPORT

STAKEHOLDERS INVOLVED WITH PROJECT DELIVERY

European Union
European Regional Development Fund
NORTHERN POWERHOUSE HM Government
CATAPULT Energy Systems

Generator

- Designs, develops, constructs, and oversees the operation and maintenance of the solar carport (some of these activities may be outsourced to third-party organisations).

DNO

- Provides grid connection offers and grid connection agreements for sites (depending on the stage of project delivery).

Offtaker

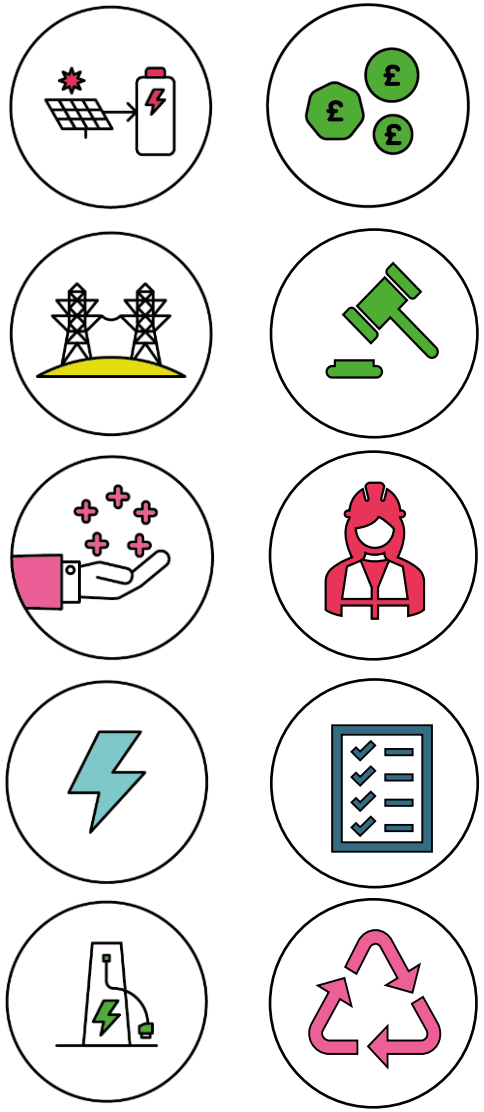
- If there is a nearby building that can consume renewable energy from the solar carport, a private wire agreement with the building occupier (offtaker) may be required.

Aggregator/ Batter Storage Optimiser (or SEG Provider)

- May be required to trade energy (from battery export) on behalf of the asset owner*.
- Could provide a potential route to new flexibility markets (which could be offered from the DSO or ESO).

Charge Point Operator

- May be required to implement billing services for EV charging points.



Funding/ Finance Provider

- Advises on eligibility, loan structures and repayment terms.
- Provides the necessary funds to cover project costs through a contractual agreement with the generator.

Legal Advisor

- Provides legal guidance on the contractual elements of project delivery.

Delivery Contractor (or Turn-Key Provider)

- Responsible for the design and/or build of the renewable system (depending on the delivery approach chosen)*
- Some delivery contractors may also take on O&M responsibilities.
- Some activities may be subcontracted to other companies.

O&M Contractor

- Responsible for managing the operations and maintenance of the solar carport on behalf of the generator.
- Some activities may be subcontracted to other companies.

Decommissioning Contractor

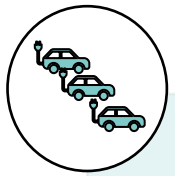
- Responsible for the decommissioning of the solar carport once it has reached the end of its usable life.
- Responsible for repurposing the site.
- Some activities may be subcontracted to other companies.

*Please note that if the generator is unable to secure an export agreement with an aggregator/ battery storage optimiser, a 'solar storage' tariff with a licensed SEG provider may be an alternative option. This is discussed further throughout this subsection.
**Please refer to the 'UCEGM: Improving the business case for local renewable energy projects in the current market and under future market scenarios' deliverable for further detail on different delivery approaches.

6C.5 SOLAR CARPORT

FEASIBILITY CONSIDERATIONS: SITE SELECTION AND CAR PARK TYPE

- Before identifying suitable sites for solar carport projects, local authorities should be clear on the underlying objectives of the project.
    - For example, local authorities should consider whether EV charging points are intended to be used primarily by the public (to improve access to EV charging facilities) or whether they will be used primarily by the local authority (to charge their own fleet).
- If looking to deploy solar carports for the benefit of the public, characteristics of optimal sites include the following:
    - High level of irradiance
    - High number of EVs passing through the area (footfall)
    - Sufficient/ large area to accommodate solar canopy structures.
- If looking to charge electric fleet vehicles, the number of potential sites could be constrained by the number of council-owned depots and car parks available (where fleet vehicles can return to charge overnight).
- Although there may be limited freedom in choosing a suitable site, in comparison to deploying carports for public use, this option could provide an added degree of certainty relating to utilisation.
- For example, if the number of EV fleet vehicles, their charging requirements, their charging patterns, and access times are known, it can help ensure that the assets are optimally sized.



- Typically, solar carports are installed at surface car park sites.
- They may also be installed at multi-storey car parks.
- However, this type of arrangement is considered more complex due to health and safety requirements.
- To minimise project costs, long, double rows of flat surface parking, which are adjacent to sources of energy demand (sites), are preferred for solar carport sites.
- Hospitals, airports, large commercial premises, and retail parks lend themselves to this type of arrangement (BRE, 2018).

6C.5 SOLAR CARPORT

FEASIBILITY CONSIDERATIONS: FUTURE PROOFING THE SYSTEM

European Union
European Regional Development Fund
NORTHERN POWERHOUSE HM Government
CATAPULT Energy Systems

- The number of charging points required at sites will increase in line with EV uptake.
- Future proofing the system at the initial design stage can help minimise retrofit requirements as more EV charging points are installed.
- If and as the number of EV charging points increases, the energy demand of the site will also increase.
- When designing a solar carport project, consideration should be given to how the optimal use of renewable energy may change in line with future increases in energy demand as this could influence which revenue/ cost-saving opportunities are available.

CASE STUDY: STOURTON PARK AND RIDE

- The Stourton Park and Ride solar carport site was developed by Leeds City Council.
- Consultation, design and construction activities were undertaken by EvoEnergy.
- EvoEnergy also secured a five-year operation and maintenance contract for the site (EvoEnergy, 2023a).
- The site was designed with future proofing in mind.
  - For example, EV feed pillars and electrical distribution were built with 25% redundancy for the future retrofit of more EV charging points.
  - Furthermore, battery storage is currently used to maximise the self-consumption of renewable energy onsite.
  - However, over time, different options for battery operation are possible such as flexibility services and arbitrage.

Scale of Deployment

Solar Generation Capacity	1.2 MW
Battery Size	500kW/950kWh
EV Charging Units	26
Annual Carbon Dioxide Savings	471,000 kg

European Union
European Regional Development Fund
NORTHERN POWERHOUSE HM Government
CATAPULT Energy Systems

FEASIBILITY CONSIDERATIONS: COMMERCIAL ARRANGEMENTS WITH CHARGEPOINT OPERATORS (CPOs)

If providing EV charging services to the public, the generator *may* need to procure a charge point operator as a delivery partner for billing purposes.There are a range of potential commercial arrangements with CPOs which have different implications for revenue generation, resource requirements, and site selection. These are discussed below.

CPO Funded

- Some CPOs offer EV charging point installation, commissioning, and maintenance at no upfront cost to customers.
- In this arrangement, the CPO usually retains ownership of the assets and the grid connection.
- In turn, the CPO would pay the customer for use of their site. This may be in the form of a rent fee (for using the land) or a percentage share of profit.
- Generators are likely to have limited control over where charge points are installed if pursuing this arrangement.

Match Funded

- In this arrangement, capital and operational costs are shared between the generator and the CPO.
- Again, CPOs will undertake operation and maintenance activities throughout the duration of the contract.
- During contract negotiations, both Parties will need to reach an agreement on who will obtain ownership of the assets (Energy Saving Trust, 2019).
- In this arrangement, the generator will receive a revenue share based on their contribution to project costs.

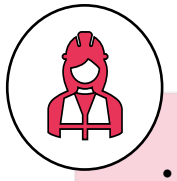
Generator Funded

- In this arrangement, the generator is responsible for paying all capital and operational costs associated with EV charging points.
- In turn, they would receive 100% of the revenue generated.
- Operation and maintenance activities may be subcontracted to CPOs for a fee.
- This may be better suited to generators that wish to have greater control over site selection and EV charging tariff rates.
    - Generators may wish to provide variable pricing structures for public charging that are matched to renewable generation or off-peak tariffs.

6C.5 SOLAR CARPORT

FEASIBILITY CONSIDERATIONS: PARTNER REQUIREMENTS AND TURNKEY PROVIDERS

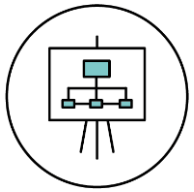
- The contracts required to enact this model will depend on the revenue stream/cost-saving opportunities available.
- The following *may* be required:
  - Private wire arrangement between the generator and offtaker for energy that is supplied to satisfy nearby building demand.
  - Contractual arrangement between the generator and third-party organisation for exported energy (i.e., with an aggregator/battery storage optimiser or with a licensed SEG provider).
  - Contractual arrangement between the generator and CPO if billing for EV charging services.
- At the City of York Council's HyperHub site, the battery storage asset generates revenue from grid services through the aggregator Grid Beyond (Evo Energy, 2023b).
- This suggests that there are opportunities for local authorities to secure optimisation contracts for solar carport systems with third party aggregators/ battery storage optimisers.



- Delivering a solar carport system can be complex due to optimisation modelling requirements and the (potential) need to secure numerous commercial arrangements with third-party organisations (aggregators/ battery storage optimisers, charge point operators, energy suppliers, etc.).
- Local authorities may consider procuring a turn-key solution provider to deliver the project on their behalf to reduce resource requirements.
- Desk-based research indicates that there are some organisations that can provide turn-key solar carport solutions for local authorities.
- For example, Evo Energy undertook design, development, and construction activities for two solar carport projects on behalf of Leeds City Council and the City of York Council (Evo Energy, 2023a; Evo Energy, 2023b).
  - EvoEnergy are also currently responsible for operating and maintaining the systems.

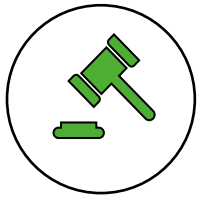
The key points from this section are summarised below.

- Through external engagement, the Catapult learned that terminology used in the energy sector, especially relating to PPAs, is not always consistently applied.
- During soft-market testing activities, it is important to ensure that all stakeholders are aligned on terminology to ensure that business model assumptions are accurately reflected in commercial assessments.



- Local authorities should engage with third party organisations as early as possible during project delivery to understand the full range of services that are available.
- As well as affecting viability, the solutions offered by third-party partners could also have different implications for asset ownership, resource requirements and risk.
- Local authorities should consider these factors in parallel with viability when considering which solution is best suited to deliver a chosen business model.

- It is important that local authorities review existing energy supply contracts to understand whether a chosen business model is feasible under their current agreement and/or whether it is likely to result in a breach of contract. This should be considered in the early stages of project delivery.
- In some cases, local authorities may have to wait until their energy supply contract is up for renewal before entering commercial arrangements with third party partners.
  - This *could* lead to project delays.



- All short-term business models discussed throughout this section require at least one contractual arrangement with a third-party partner.
- It is therefore strongly recommended that local authorities seek legal advice to ensure that the clauses stipulated in contracts are fair for all Parties.
- Please note that legal fees associated with project delivery should be factored into commercial assessments.

7. DESIRABILITY

7. DESIRABILITY

7A. SECTION OVERVIEW

- There are different roles that a local authority could adopt within each of the short-term business models (e.g., generator, offtaker or generator **and** offtaker).
- The role adopted within a business model will have different implications for viability (e.g., revenue generation, cost-savings, price certainty) and feasibility (e.g., resource requirements).
    - It will also have its own level of risk (e.g., market (price) risk, revenue risk, operational (volume) risk and counter-party risk).
- As a result, some roles may be more desirable (of more value) than others to a local authority.
- This section summarises key considerations that could inform which role, within a particular business model, is most desirable to a local authority.
    - The considerations are presented as 'desirability checklists' which *could* assist in decision making.
    - Please note that for two of the short-term business models, some roles have been omitted*.
    - To avoid duplication, there are several cross-references amongst the desirability checklists in this section.
    - Where possible, the desirability checklists have been made to fit to one page. However, this was not possible for all.

GENERATOR

- As a generator (asset owner), the local authority would design, develop, construct, and oversee the operation and maintenance of a renewable generation system.
- The local authority would sell any renewable energy generated to a third-party organisation.

OFFTAKER

- As an offtaker, the local authority would pay for electricity generated from a renewable generation project through a commercial arrangement with a third-party organisation.
- The renewable generation asset would be owned by the third-party organisation.

GENERATOR AND OFFTAKER

- As generator and offtaker, the local authority would design, develop, construct and oversee the operation and maintenance of a renewable generation system.
- The local authority would also consume renewable energy generated by the asset(s).

*Please refer to Section 7.E and Section 7.F for further discussion.

7B. SLEEVED PPA

LOCAL AUHORITY AS GENERATOR

	Desirability Checklist	Considerations

Revenue Generation	Do you value revenue generation more than reducing costs?	• As generator, the local authority will not benefit from cost savings as they are not purchasing and consuming renewable energy from the asset.
		• Instead, they would have access to the following two revenue streams:
		  • **Primary Revenue Stream:** Selling renewable energy to a third party offtaker as per the Sleeved PPA agreement.
		  • **Additional Revenue Stream(s):** Exporting (and selling) surplus renewable energy to the grid (if applicable).

	How much do you value the opportunity to maximise revenue generation potential?	• **The value of the primary revenue stream is highly likely to be greater than the additional revenue stream** on a **p/kWh basis**. Therefore, revenue generation potential depends on how well renewable energy produced by the generator and energy demand of the offtaker are matched (i.e., how much energy is sold through the Sleeved PPA). • However, revenue generation potential also depends on the pricing structure adopted. • Pricing structures that are linked to wholesale market prices (e.g., dynamic pricing) allow the local authority to benefit financially when wholesale electricity prices are high. • However, market volatility *could* affect revenue generation potential significantly throughout the duration of the PPA agreement.
Price Certainty	Do you value revenue and cost certainty?	• Revenue certainty is influenced by the length of the PPA contract (which can last from 1-25 years) and the pricing structure adopted. • Longer term contracts in combination with certain pricing structures can provide greater revenue visibility for the local authority, which could increase investor confidence. • The fixed pricing structure is most common and offers the greatest level of revenue certainty. • If opting for a fixed pricing structure, the local authority would not benefit financially if wholesale electricity prices rose higher than the PPA power price. The local authority will therefore need to consider the potential **trade-off between revenue generation potential and revenue certainty**. • Typically, generators have more negotiation power when agreeing upon the desired power price, pricing structure and contract length as they have certain financial metrics that must be achieved. • As generator, the local authority would be responsible for paying imbalance costs to an energy supplier (or other BRP). • The total imbalance cost depends on how much actual generation (from the asset) differs from forecasted generation. There is therefore a degree of uncertainty associated with this cost.
Risks	Are you willing to take on some risk?	• As generator, the local authority takes on some volume risk. For example, if they are unable to supply the volume of energy as stipulated in the PPA contract, they may face financial penalties. • If opting for a pricing structure that is linked to wholesale electricity prices, the local authority would also be exposed to market (price) risks.
Resource Requirements	Do you have the resource and expertise available to deliver renewable generation projects?	• As generator, the local authority would be responsible for designing, building, commissioning, operating, maintaining and decommissioning the asset(s)*. • If carried out internally, this will require significant resource. Though, these activities may be subcontracted to third-party organisations at a cost. • The local authority will also need to undertake commercial modelling to understand what PPA price is necessary to achieve desired financial metrics for project sign-off.
	Do you have access to legal support?	• Legal support, either in-house or external, would be required for negotiating key contractual terms with the offtaker (e.g., price, contract length and volume).

*This is applicable to all business models where the local authority assumes the role of generator and is not repeated to avoid duplication.

7B. SLEEVED PPA

LOCAL AUHORITY AS OFFTAKER

	Desirability Checklist	Considerations
Cost Savings	Do you value cost savings more than generating revenue?	• As an offtaker in a Sleeved PPA, the local authority would not generate revenue as they are not selling renewable energy to a third-party organisation. • Instead, they *should* achieve cost savings by purchasing electricity, via the PPA, at a lower cost than the retail price of electricity (on a p/kWh basis).
	How much do you value the opportunity to maximise cost-savings?	• Cost savings achieved in the Sleeved PPA will likely be less than those from a private wire arrangement (see Private Wire – Local Authority as Offtaker). ◦ For example, as offtaker, the local authority would still be responsible for paying sleeving fees (as well as other energy supplier fees and pass-through costs). • Sleeving fees can vary significantly amongst energy suppliers, and higher fees will reduce the amount of cost savings available to the local authority.
Price Certainty	Do you value cost certainty?	• Cost certainty depends on the length of the PPA contract (which can last from 1-25+ years) and the pricing structure adopted. • Longer term contracts in combination with certain pricing structures can increase cost visibility for the local authority which can inform budgeting and forecasting activities. • For example, the fixed pricing structure is most common and offers the greatest level of cost certainty.
Risks	Are you willing to take on some risk?	• If opting for a fixed pricing structure, the local authority will be exposed to market risk. • If wholesale electricity prices fall, the local authority could end up paying more for electricity through the Sleeved PPA than they may at the retail rate (on a p/kWh basis). • This is an important consideration at present as wholesale market electricity prices have fallen recently since record breaking peaks were observed during the energy crisis.
Resource Requirements and Expertise	Do you have time and resource available to undergo soft-market testing?	• The local authority will need to undertake soft market testing with energy suppliers (or other BRPs) to find the best value quotation for sleeving services. • The terminology used by suppliers may differ, which could make it difficult to compare quotes on a like-for-like basis and could make this activity time intensive.
	Do you have access to legal support?	• Legal support will be required to implement the Sleeved PPA. • For example, the local authority's existing energy supply contract will need to be reviewed to understand whether sleeving is permitted. • If the local authority's current energy supply contract does not permit sleeving, they may need to wait until their contract is up for renewal before entering into a PPA. • There is a risk that this may not align with the anticipated delivery timelines of the third-party generator and could result in the agreement falling through.

7B. SLEEVED PPA

LOCAL AUHORITY AS GENERATOR AND OFFTAKER

- Most points from 'Local Authority as Generator' and 'Local Authority as Offtaker' are still applicable if the local authority assumes both roles (i.e., generator and offtaker)
- However, there are some distinct considerations associated with adopting both roles.
- These are discussed in the table below.

	Desirability Checklist	Considerations
Revenue Generation and Cost-Savings	Do you value generating revenue and reducing costs?	• When assuming the roles of generator and offtaker, the local authority will benefit from revenue generation and cost savings. • This allows the local authority to set the PPA price to whatever best aligns with the underlying objectives of the project. • For example, the price could be set so that cost savings are maximised (so long as the project pays back) or so that revenue generation is maximised for investment in future decarbonisation projects. • Energy supplier, sleeving, and pass through costs should still be considered when determining the optimal PPA price during commercial modelling exercises.
Price Certainty	Do you value price certainty?	• Price (revenue and cost) certainty is dependent on the length of the PPA contract, and the pricing structure adopted. • As generator and offtaker, the local authority can agree upon a contract length and pricing structure that is best suited towards their appetite for risk. • Longer term contracts with a fixed pricing structure can maximise price certainty for the local authority.
Risks	Are you willing to take on some risk?	• All risks previously identified could still be applicable to local authority assuming the role of generator and offtaker. • Though, please note that some depend on the pricing structure adopted.

Resource Requirements	Do you have the resource and expertise available to deliver renewable generation projects?	• All activities previously identified for 'Local Authority as Generator' and 'Local Authority as Offtaker' are still applicable to the local authority adopting both roles.
		  • Resource requirements will be considerable as a result.
		• Although the local authority will still need to undertake soft-market testing with energy suppliers (or other BRPs), they will not be required to go out to tender for a suitable third-party PPA partner (e.g., generator or offtaker).
		  • For example, as a generator, the local authority would need to go out to tender for a third-party offtaker.
		  • Similarly, as an offtaker, the local authority would need to go out to tender for a third-party generator.

7C. PRIVATE WIRE

LOCAL AUHORITY AS GENERATOR (PART 1 OF 2)

	Desirability Checklist	Considerations

Revenue Generation	Do you value revenue generation more than reducing costs?	• As generator, the local authority will not benefit from cost savings as they are not purchasing and consuming renewable energy from the asset. Instead, they would have access to the following two revenue streams:
		  • Primary Revenue Stream: Selling renewable energy to third party offtaker as per the Private Wire agreement.
		  • Additional Revenue Stream(s): Exporting (and selling) surplus renewable energy to the grid (if applicable).

	How much do you value the opportunity to maximise revenue generation potential?	• The value of the primary revenue stream will be greater on a p/kWh basis. Therefore, revenue generation potential depends on how well renewable energy produced by the generator and energy demand of the offtaker are matched. • As well as the wholesale cost of electricity, under current regulations, certain policy and network costs can also be avoided in Private Wire arrangements. • The amount of revenue generated therefore also depends on how the benefits of these cost avoidances are shared between both Parties when negotiating the private wire power price. • Revenue generation potential also depends on the pricing structure adopted.
Price Certainty	Do you value revenue certainty?	• Revenue certainty is influenced by the length of the private wire contract (typically up to 15 years) and the pricing structure adopted. • Longer-term contracts in combination with certain pricing structures can provide greater revenue visibility for the local authority, which could increase investor confidence. • If opting for fixed pricing structure, the local authority would not benefit financially if wholesale electricity prices rose higher than the private wire power price. • The local authority may therefore experience trade-off between revenue generation potential and revenue certainty. • Typically, generators have more negotiation power when agreeing upon the desired power price, pricing structure and contract length as they have certain financial metrics that must be achieved for project sign-off.

7C. PRIVATE WIRE

LOCAL AUHORITY AS GENERATOR (PART 2 OF 2)

	Desirability Checklist	Considerations

Risks	Are you comfortable with risk?	• The private wire business model is exposed to policy and regulatory risk. Changes to existing regulations could influence what cost avoidances are achievable.
		  • In turn, this could influence the commercial viability of the business model.
		• The local authority will also be exposed to counterparty risk.
		  • As a mitigation measure, counter party due diligence can be performed to determine whether the offtaker is at risk of defaulting on payments.
		  • This risk is especially important for private wire agreements where the primary revenue stream is dependent on the supply of energy to a particular site.
		• The local authority will also be exposed to some volume risk.
		  • For example, if the local authority is unable to supply the volume of energy as stipulated in the private wire contract, they may face financial penalties.
		• If the offtaker's energy demand profile changes over time, the local authority could also be exposed to revenue risk.
		  • For example, changes to energy demand could influence how well generation and demand are matched.
		  • This may be mitigated by implementing a 'take or pay' clause.
		• If opting for a pricing structure that is linked to wholesale electricity prices (e.g., dynamic pricing), the local authority would also be exposed to market (price) risks.

Resource Requirements	Do you have the resource and expertise available to deliver renewable generation projects?	• As generator, the local authority will be required to identify suitable sites for the private wire installation. • This activity is crucial to understanding the commercial viability of the project as it will determine how well generation and demand are matched as well as the length of the private wire connection required. • Commercial modelling will also be required to understand what power price (and pricing structure and contract length) is necessary to achieve the financial metrics required for project sign-off.
	Do you have access to legal support?	• Legal support will be required for negotiating key contractual terms with the third-party offtaker (i.e., contract length, power price, volume). • Negotiations should also include grid connection considerations (e.g., what provisions will be put in place for access to the connection point at the end of the agreement – if the grid connection is at the offtaker's site?). • Legal support will also be required to check whether the project complies with Supply Licence Exemption regulations.

7C. PRIVATE WIRE

LOCAL AUHORITY AS OFFTAKER

	Desirability Checklist	Considerations
Cost Savings	Do you value cost savings more than generating revenue?	• As an offtaker in a Private Wire arrangement, the local authority would not generate revenue as they are not selling renewable energy to a third-party organisation. • Instead, they *should* achieve cost savings by purchasing electricity at a lower cost than the retail price of electricity (on a p/kWh basis).
	How much do you value the opportunity to maximise cost-savings?	• The amount of cost savings available to the local authority as offtaker will depend on how the cost avoidance benefits are shared between both Parties. • Unlike the Sleeved PPA business model, an energy supplier is not required to facilitate the transfer of energy in a Private Wire arrangement. • As a result, the local authority is not responsible for paying supplier (sleeving) fees. • Cost savings from a Private Wire arrangement *could* therefore be greater than a sleeved PPA. • Though, still, they will not be as high as those from directly offsetting grid imported electricity (which would only be possible if the local authority assumed the role of generator and offtaker).
Price Certainty	Do you value cost certainty?	• Cost certainty depends on the length of the PPA contract (typically up to 15 years), and the pricing structure adopted. • Longer term contracts in combination with certain pricing structures can increase cost visibility for the local authority which can inform budgeting and forecasting activities. • The fixed pricing structure is most common and offers the greatest level of cost certainty.

Risks	Are you willing to take on some risk?	• If opting for a fixed pricing structure, the local authority, as offtaker, will take on market (price) risk.
		• The local authority will also take on some volume risk as offtaker.
		  • For example, the actual volume of energy available may differ to that stipulated in the Private Wire contact.
		  • This could limit the amount of cost-savings that are available to the local authority.
		  • To mitigate this risk, the local authority could consider including penalty clauses in the Private Wire contract in case the renewable generation asset does not perform as expected.

Resource Requirements	Do you have access to legal support?	• Legal support will be required for negotiating key contractual terms with third-party generator (i.e., price, volume, and contract length).

7C. PRIVATE WIRE

LOCAL AUHORITY AS GENERATOR AND OFFTAKER

- If the local authority assumes the role of generator and offtaker, the private wire business model would essentially become a self-consumption and export model where:
  - Commercial viability is primarily dependent on the cost-savings achieved by offsetting grid imported electricity.
  - Further revenue may be generated from surplus solar energy that is exported to grid (at a lower price on a p/kWh basis).*
- The table below highlights considerations for this arrangement.

	Desirability Checklist	Considerations
Revenue Generation and Cost-Savings	Do you value both generating revenue and reducing costs?	• The generator and offtaker may be from different departments within the local authority which have different budgets. • The departments may therefore need to agree and set a price for electricity internally (e.g., it may be necessary to demonstrate that certain financial metrics can be achieved to obtain project sign off). • Where this is the case, the local authority could set the power price to whatever best aligns with the underlying objectives of the project. • There may be times where the site does not require/ cannot consume energy from the renewable generation asset. • Where this is the case, additional revenue may be generated from a commercial arrangement with a licensed SEG provider.
Price Certainty	Do you value price certainty?	• As generator and offtaker, the local authority can agree upon a contract length and pricing structure that is best suited towards their appetite for risk (if necessary).
Risks	Are you willing to take on some risk?	• The local authority in their capacity as offtaker will still be exposed to market (price) risk if opting for a fixed pricing structure. • In the absence of a formal contractual agreement (the Private Wire contact), volume and counter-party risks would be minimised.
Resource Requirements	Do you have the resource and expertise available to deliver renewable generation projects?	• As generator and offtaker, resource requirements for the local authority would still be considerable as they are still responsible for delivering the project. • However, in the absence of a formal contractual agreement, the amount of legal support may be reduced.

* For further information relating to the self-consumption and export model, please refer to the 'UCEGM Workstream 2 – Improving the Business Case for Renewable Energy' deliverable.

7D. STORAGE AND SITE OPTIMISATION

LOCAL AUHORITY AS GENERATOR (PART 1 OF 2)

	Desirability Checklist	Considerations

Revenue Generation	Do you value revenue generation more than reducing costs?	• As generator, the local authority will not benefit from cost savings as they are not consuming renewable energy from the asset. Instead, they would have access to the following two revenue streams:
		  • **Primary Revenue Stream:** Selling renewable energy to third party offtaker – likely through a Private Wire/BtM PPA arrangement.
		  • **Additional Revenue Stream(s):** Selling surplus energy to aggregator/ battery storage optimiser (for arbitrage or flexibility services).
		• If unable to secure a commercial arrangement with an aggregator/ battery storage optimiser, a 'solar storage' tariff with a licensed SEG provider may be an alternative option.

	How much do you value the opportunity to maximise revenue generation potential?	• One of the key factors that will influence revenue generation potential in this model is the way in which the battery is optimised to perform.
		• Findings from desk-based research indicate that, for behind the meter systems, batteries are most often optimised to maximise the consumption of solar generation.
		  • Please refer to 'Private Wire – Local Authority as Generator' for further information on how revenue generation could be maximised under the Private Wire/ BtM PPA arrangement.
		• Revenue generation potential from arbitrage and flexibility services will be influenced by the following factors:
		  • The volume of energy that is exported (kWh)
		  • The markets that the aggregator/ battery storage optimiser accesses on behalf of the local authority (some markets are more volatile than others).
		  • The structure of the commercial arrangement with the aggregator/ battery storage optimiser.
		• If adopting a revenue share model with an aggregator/ battery storage optimiser, the local authority will be exposed to fluctuations in market prices meaning that revenue generation potential could vary significantly.

Price Certainty	Do you value revenue certainty?	• In combination with a fixed pricing structure, long-term arrangements with the offtaker can help increase price certainty for the local authority.
		• Longer-term contracts *could* improve revenue certainty for commercial arrangements with aggregators/ battery storage providers (depending on the pricing structure adopted).
		  • However, it may be difficult to secure a long-term agreement with such stakeholders.
		• As more battery storage assets come online, market saturation *could* occur for some DNO and ESO services (Cornwall Insight, 2023).
		  • This could change the way in which revenue streams are stacked by aggregators/ battery storage optimisers which, in turn, could also affect revenue certainty.

7D. STORAGE AND SITE OPTIMISATION

LOCAL AUHORITY AS GENERATOR (PART 2 OF 2)

	Desirability Checklist	Considerations
Risks	Are you willing to take on some risk?	• If opting for a revenue share model with the aggregator/ battery storage optimiser, the local authority would be exposed to market (price) risk. • Although this could be partially mitigated by instead opting for fixed pricing structure, the local authority would still face some market risk due to potential market saturation in future. • Depending on the contractual arrangement with the aggregator/ battery storage optimiser, there may be stipulations relating to the availability of the battery storage asset and the volume of energy available. • Where this is the case, the local authority could also be exposed to some volume risk. • For risks relating to the Private Wire/ BtM PPA arrangement, please refer to 'Private Wire – Local Authority as Generator'.
Resource Requirements	Do you have the resource and expertise available to deliver renewable generation projects?	• The local authority will need to undertake sophisticated technical and commercial modelling to determine the optimal size of the renewable generation assets, the viability of the business model and how sensitive it is to changes in key parameters. • This activity could be subcontracted to third-party organisations at a cost.
	Do you have resource available to undergo soft-market testing?	• Optimisation contracts with aggregators/ battery storage optimisers typically last 12-24 months. • If unable to secure a longer-term agreement, the local authority would need to go out to tender numerous times for optimisation contracts throughout the lifetime of the project. • Each time, commercial models would need to be updated to reflect any changes to commercial arrangements and assumptions.
	Do you have access to legal support?	• Legal support will be required when negotiating both contractual arrangements (i.e., the Private Wire/BtM PPA agreement with the third-party offtaker and the optimisation agreement with the aggregator/battery storage optimiser).

7D. STORAGE AND SITE OPTIMISATION

LOCAL AUHORITY AS OFFTAKER

	Desirability Checklist	Considerations
Cost Savings	Do you value cost savings more than generating revenue?	• As an offtaker in the Storage and Site Optimisation model, the local authority would not generate revenue as they are not selling renewable energy to a third-party organisation. • Instead, they *should* achieve cost savings by purchasing electricity from the generator at a lower cost than the retail price of electricity (on a p/kWh basis).

	How much do you value the opportunity to maximise cost-savings?	• The amount of cost savings available to local authority as offtaker will depend on how the cost avoidance benefits, from the Private Wire/ BtM PPA arrangement, are shared between both Parties.
		• The amount of cost-savings achievable will also depend on the volume of renewable energy that is consumed at the power price (p/kWh).
		  • If the battery storage asset is prioritised to maximise self-consumption, cost-savings could be maximised.
		  • However, please note that the generator may offer a higher price for electricity to account for the additional capital expense of battery storage assets.

Price Certainty	Do you value cost certainty?	• Cost certainty depends on the length of the Private Wire/ BtM PPA contract (typically up to 15 years) and the pricing structure adopted. • Longer term contracts in combination with certain pricing structures can increase cost visibility for the local authority which can inform budgeting and forecasting activities. • The fixed pricing structure is most common and offers the greatest level of cost certainty.
Risks	Are you willing to take on some risk?	• If opting for a fixed pricing structure, the local authority, as offtaker, will take on market (price) risk. • The local authority will also take on some volume risk as offtaker (see 'Private Wire – Local Authority as Offtaker'). • To mitigate this risk, the local authority could include penalty clauses in the contractual arrangement with the generator in case the asset does not perform as expected.
Resource Requirements	Do you have access to legal support?	• Legal support will be required for negotiating key contractual terms with the third-party generator (i.e., price, volume, and contract length).

7D. STORAGE AND SITE OPTIMISATION

LOCAL AUHORITY AS GENERATOR AND OFFTAKER

- By assuming the role of generator **and** offtaker, this business model would become an extension of the self-consumption and export model (see 'Private Wire – Local Authority as Generator and Offtaker'.
- The integration of the battery storage asset results in additional considerations for each of the factors explored.
- These are discussed in the table below.

	Desirability Checklist	Considerations
Revenue Generation and Cost-Savings	Do you value both generating revenue and reducing costs?	• There may be times where the site does not require/ cannot consume energy from the battery storage asset. • Where this is the case, additional revenue may be generated from a commercial arrangement with an aggregator/ battery storage optimiser. • If unable to secure a commercial arrangement with an aggregator/ battery storage optimiser, a 'solar storage' tariff with a licensed SEG provider could be an alternative option for generating additional revenue from export.
Price Certainty	Do you value price certainty?	• Price certainty could be limited for commercial agreements with the aggregator/ battery storage optimiser (see 'Local Authority as Generator').
Risks	Are you willing to take on some risk?	• The local authority would be exposed to risks associated with the commercial agreement with an aggregator/ battery storage optimiser (see 'Local Authority as Generator').
Resource Requirements	Do you have resource available to undergo soft-market testing?	• As generator **and** offtaker, the local authority *may* still need to go out to tender numerous times for optimisation contracts throughout the lifetime of the project – this will depend on the length of the optimisation contract secured..
	Do you have experience deploying energy storage assets?	• As generator and offtaker, the local authority will need to undertake sophisticated technical and commercial modelling to determine the optimal size of the renewable generation assets, the viability of the business model and how sensitive it is to changes in key parameters.
	Do you have access to legal support?	• Legal support will still be required when negotiating key contractual terms with the aggregator/ battery storage optimiser.

7E. SOLAR AND STORAGE LICENSING AGREEMENT

LOCAL AUHORITY AS OFFTAKER

- This model was included as a potential option for local authorities that have limited access to capital but still wish to benefit from the decarbonisation opportunities afforded by deploying renewable generation assets. For this reason, only the role of 'Local Authority as offtaker' is considered.

	Desirability Checklist	Considerations

Cost Savings	Do you value cost savings more than generating revenue?	• The local authority would not generate revenue throughout the duration of the contract with the third-party provider as they are not selling the renewable electricity generated.
		• Instead, they *should* achieve cost savings by purchasing electricity, via the PPA agreement with the third-party provider, at a lower cost than the retail price of electricity (on a p/kWh basis).
		• Please note that the local authority *may* be able to obtain ownership of the assets at the end of the contractual arrangement with the third-party provider.
		  • In this case, the local authority *could* generate revenue from energy exported to the grid.
		  • This would require a commercial agreement with an aggregator/ optimisation provider or a licensed SEG provider (see 'Storage and Site Optimisation – Local Authority as Generator').

	How much do you value the opportunity to maximise cost-savings?	• The amount of cost-savings achievable will depend on the PPA price (p/kWh) set by the third-party provider.
		  • This price will factor in capital costs of the solar and storage technologies as well as costs associated with setting up virtual power plants and participating in flexibility markets.
		• The amount of cost-savings achievable will also depend on the volume of renewable energy that is consumed across sites at the PPA price.
		  • If the battery storage assets are prioritised to maximise self-consumption, cost-savings could be maximised for the local authority.
		• If the local authority obtains ownership of the assets at the end of the contractual arrangement, any renewable energy consumed across sites will directly offset grid imported electricity; offering the maximum level of cost-savings.

Price Certainty	Do you value cost certainty?	• Contractual arrangements for this business model are typically up to 25 years long. • Long-term arrangements, in combination with fixed pricing structures, can increase cost-visibility for the local authority which could inform budgeting and forecasting activities. • Though please note that the third-party provider will likely have more negotiation power when agreeing upon the contract length and pricing structure.
Risks	Are you willing to take on some risk?	• If opting for a fixed pricing structure, the local authority will take on market (price) risk. • As offtaker, the local authority will also be exposed to some volume risk (see 'Storage and Site Optimisation – Local Authority as Offtaker').
Resource Requirements	Do you have access to legal support?	• Legal support will be required for negotiating key contractual terms with the third-party provider. • There are several key factors that should be discussed during contract negotiations including asset ownership, asset control, and performance guarantees. • Contractual arrangements may also become inherently more complex if tri-Party agreements are required with tenants. • Legal support will also be required to explore whether the Solar and Storage Licensing Arrangement puts the local authority at risk of breaching their existing energy supply contract (due to potential volume tolerance clauses).
	Do you have experience relating to the operation, maintenance and decommissioning of renewable generation assets?	• One of the key benefits of this business model for local authorities is its potential to reduce resource requirements. • However, *if* the local authority does obtain ownership of the assets are the end of the contract, they would be responsible for operation, maintenance, and decommissioning activities (once the assets reach the end of their usable life).

7F. SOLAR CARPORT

POTENTIAL ROLES A LOCAL AUTHORITY MAY ASSUME

- As discussed in Section 6, solar carports may be deployed to decarbonise local authority owned fleets or to provide access to EV charging facilities for the wider public.
    - For the former, the local authority is likely to assume the role of generator **and** offtaker.
    - For the latter, the local authority will likely assume the role of generator (though may still use the charging facilities onsite).
- Desirability considerations for each of these roles are discussed throughout this subsection.

WHAT ABOUT THE ROLE OF OFFTAKER?

- To act solely as an offtaker in this business model, the local authority would require a commercial arrangement with a third-party organisation that was willing to fund the capital and operational costs associated with the solar carport project.
- Similar to the Solar and Storage Licensing Agreement, the third party would recover these costs through a PPA with the local authority.
- As mentioned in Section 6, there are some CPOs that provide fully funded solutions for EV charging infrastructure.
- Likewise, there are some third-party organisations that provide fully funded solutions for solar and/or battery storage systems.
- However, during desk-based research and external engagement, there were no examples found of an integrated solar carport (solar, EV charging and battery storage) being delivered at no-upfront cost to local authorities.
- Whilst this may be an option that emerges in future, the role of 'Local Authority as offtaker' is not considered in this subsection.

7F. SOLAR CARPORT

LOCAL AUHORITY AS GENERATOR

	Desirability Checklist	Considerations

Revenue Generation	Do you value revenue generation more than reducing costs?	• As generator, the local authority will not benefit from cost savings as they are not consuming renewable energy from the asset.
		• Instead, they *could* have access to the following revenue streams (this will depend heavily on how energy is used within the solar carport system and how this may change over time):
		  • Selling renewable energy to third-party offtaker onsite through a Private Wire agreement.
		  • Selling surplus energy to aggregator/ battery storage optimiser (for arbitrage or flexibility services).
		  • Selling energy to public for EV charging provisions (a CPO may be required to facilitate this).

	How much do you value the opportunity to maximise revenue generation potential?	• As well as the frequency of utilisation, revenue generation potential from EV charging services will also depend on the tariff set (p/kWh). • As mentioned in Section 6, the local authority will have the freedom to set the price of the tariff if they own the charging points. • However, if opting for a match funded (revenue share) arrangement with a CPO, the CPO is likely to have more negotiation power in how the price is set to ensure financial metrics are obtained. • For considerations specific to the (potential) Private Wire arrangement, please refer to 'Private Wire – Local Authority as Generator'. • For considerations specific to the commercial arrangement with an aggregator/ battery storage optimiser, please refer to 'Storage and Site Optimisation – Local Authority as Generator'.

Price Certainty	Do you value revenue certainty?	• The optimal way in which renewable energy is used in the solar carport system may change over time if the uptake of EV charging increases.
		  • In turn, this could change which revenue streams are accessible to the local authority.
		  • Revenue certainty, across the lifetime of the project, could therefore be limited.
		• For other short-term business models, it was mentioned that longer-term commercial arrangements, in combination with fixed pricing structures, with third-party organisations could increase revenue certainty.
		  • However, given that the optimal use of energy may change over time for solar carports, local authorities should consider whether longer-term contracts are appropriate for this business model; especially if minimum supply clauses are included.

Risks	Are you willing to take on some risk?	• As generator, the local authority will be exposed to revenue risk stemming from uncertainty relating to the utilisation of EV charging points. • For risks specific to the Private Wire business model, please refer to 'Private Wire – Local Authority as Generator'. • For risks specific to the commercial arrangement with an aggregator/ battery storage optimiser, please refer to 'Storage and Site Optimisation – Local Authority as Generator'.

Resource Requirements	Do you have experience delivering renewable generation projects with integrated assets?	• If done in-house, the resource requirements and level of expertise required to deliver an integrated solar carport system could be considerably high.
		• Sophisticated technical modelling would be required to determine the optimal sizing and configuration of the solar carport system.
		  • Outputs from the modelling would then need to be integrated with commercial models to understand the viability of the project.
		  • Modelling would also need to consider how energy use in the system may change over time.
		• In a similar vein, technical designs would need to consider how the system could adapt to/accommodate changes in energy demand, and use, in future.
		• Local authorities may choose to procure a turn-key solution provider to reduce resource requirements.

	Do you have access to legal support?	• Legal support will be required for the negotiation of key contractual terms for any commercial arrangements with third-party organisations. • If and where there are numerous arrangements, asset control and prioritisation will be critical to discussions.

7F. SOLAR CARPORT

LOCAL AUHORITY AS GENERATOR AND OFFTAKER

- If assuming the role of generator **and** offtaker, this model would become an extension of the self-consumption and export model*.
- The integration of the battery storage and EV charging assets results in additional considerations for each of the factors explored.
- These are discussed in the table below.

	Desirability Checklist	Considerations
Revenue Generation and Cost-Savings	Do you value both generating revenue and reducing costs?	• The generator and offtaker, although both from the same local authority, may be from different departments with different budgets. • Accordingly, a price for renewable energy consumed onsite (from the building and/or from EV charging points) may need to be set and agreed upon. • Where this is the case, the local authority could set the power price to whatever best aligns with the underlying objectives of the project. • There may be times where the site does not require/ cannot consume energy from the battery storage asset. • Where this is the case, revenue could be generated through a commercial arrangement with an aggregator/ battery storage optimiser (see 'Storage and Site Optimisation – Local Authority as Generator'.) • If unable to secure a commercial arrangement with an aggregator/ battery storage optimiser, a 'solar storage' tariff with a licensed SEG provider could be an alternative option for generating revenue from export.
Price Certainty	Do you value price certainty?	• If necessary, the local authority can agree on a contract length and pricing structure that is best suited towards their appetite for risk. • If the number of local authority owned EVs (both current and those required in future), their charging requirements, and their charging patterns are known, current and future energy demands of the solar carport system can be better understood. ◦ In turn, the local authority will have a clearer indication of the potential revenue and cost-saving opportunities throughout the lifetime of the project. • For considerations specific to the commercial arrangement with an aggregator/ battery storage optimiser, please refer to 'Storage and Site Optimisation – Local Authority as Generator'.
Risks	Are you willing to take on some risk?	• If it is necessary for the local authority to set a tariff for EV charging points, revenue risk, related to uncertainty of utilisation could be mitigated if the charging requirements of local authority owned EVs are known. • For risks specific to the commercial arrangement with an aggregator/ battery storage optimiser, please refer to 'Storage and Site Optimisation – Local Authority as Generator'.
Resource Requirements	Do you have experience delivering renewable generation projects with integrated assets?	• If done in-house, the resource requirements and level of expertise required to deliver an integrated solar carport system would be considerably high (see 'Local Authority as Generator' for further detail)
	Do you have access to legal support?	• Legal support will be required for negotiating key contractual terms with the aggregator/ battery storage optimiser.

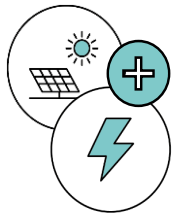
*Renewable energy supplied to the EV charging points is still considered as self-consumption if the charging points are installed BtM.

7G. SUMMARY

The key points from this section are summarised below.

- There are numerous roles that local authorities could adopt in the delivery of the short-term business models explored throughout this report.
- Each role has different implications in terms of revenue/cost-saving potential, resource requirements and risks.
- The desirability checklists presented throughout this section can be used by local authorities to help inform decisions about which role may be most desirable for a given business model.

- For each of the short-term business models, the opportunity to maximise revenue (or cost-savings), to maximise price certainty and/or to mitigate certain risks is (partially) dependent on the pricing structure adopted.
- *Typically*, generators have more power when negotiating key terms of commercial arrangements (i.e., pricing structure, contract length, power price) as they have financial metrics that must be achieved to obtain project sign-off.
- This could be an important consideration for local authorities that wish to have more control over the terms of contractual arrangements.



- Only by assuming the role of generator **and** offtaker can local authorities benefit from revenue generation **and** cost-saving opportunities.
- If and where required, as generator and offtaker, local authorities can set the price for electricity to whatever aligns best with the underlying (financial) objectives of the project.
  - For example, this could be to maximise revenue generation to invest in future projects or to maximise cost-savings to mitigate against high energy bills.
- Local authorities can also set a pricing structure that is more aligned with their appetite for risk*.
- Though, please note that resource requirements should also be considered in parallel when exploring the desirability of the 'generator **and** offtaker' role.

*Please note that this does not apply to commercial agreements with third-party organisations for export. It applies only to renewable energy that is generated and consumed by the local authority.

8. APPENDICES

APPENDIX 1. THE BUSINESS MODEL CANVAS

European Union
European Regional Development Fund

NORTHERN POWERHOUSE

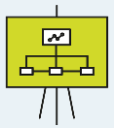
CATAPULT Energy Systems

Feasibility

Key Partners

What networks of suppliers and partners are required to make the business model work?

Key Activities



What key things are required to make the business model work?

Key Resources

What are the most important assets required to make the business model work?

Value Propositions

What value can be created for customers based on the products and services available? (This may be different for each customer segment)

Customer Relationships

What type of relationship will be established with customers?

Channels

Through which touchpoints will value be delivered to the customer?

Customer Segments

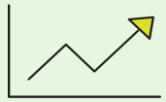
Which people and/or organisations does the business model aim to reach and serve?

Desirability

Cost Structure

What costs are incurred when operating the business model?

Revenue Streams



Through which pricing mechanism(s) is revenue generated?

Viability

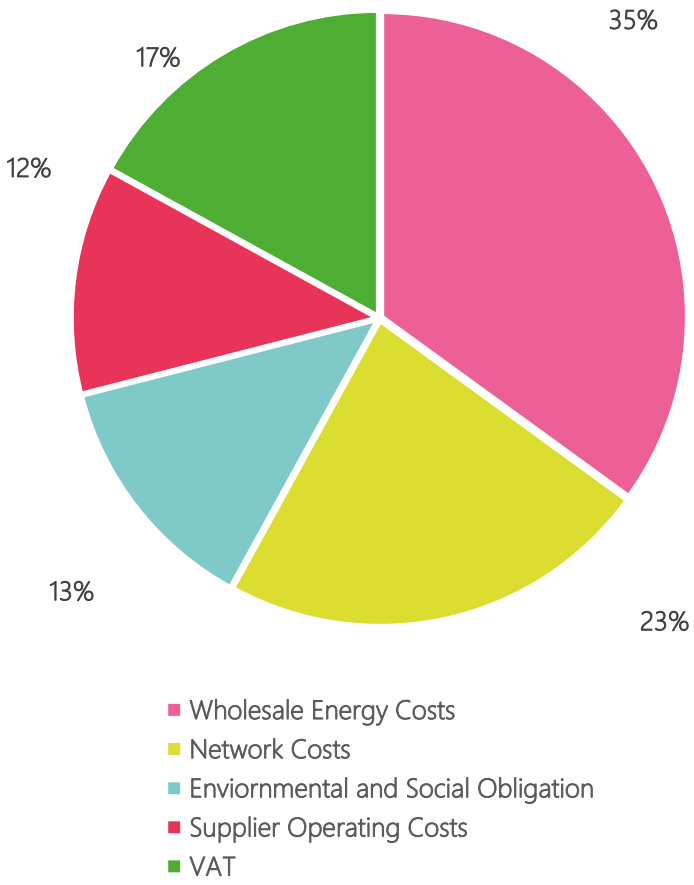
APPENDIX 2. BREAKDOWN OF RETAIL ELECTRICITY BILL COMPONENTS

European Union
European Regional Development Fund

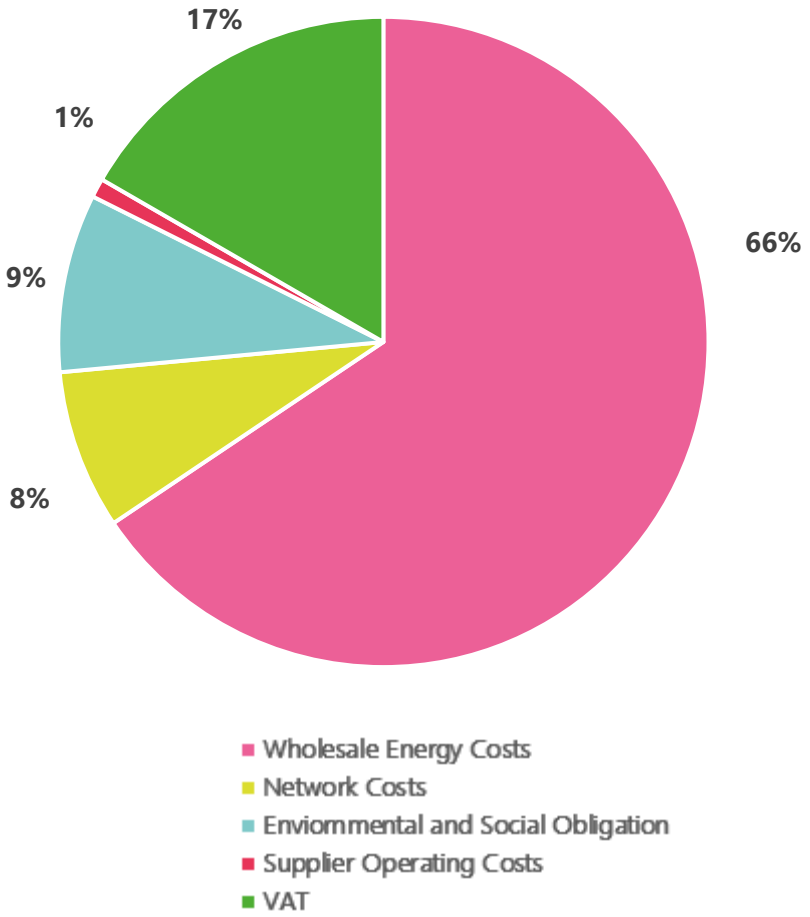
NORTHERN POWERHOUSE

CATAPULT Energy Systems

2014-2015



2022-2023



Source: Business Juice (2015) and Cornwall Insight's 'UCEGM Energy Market Modelling' deliverable.

APPENDIX 3. PRIVATE WIRE INSTALLATION COST BREAKDOWN (FOR 1KM CONNECTION)

- In this example, the costs amount to approximately £250,000 for a 1km private wire connection.
- Please note that the costs listed are site specific and are subject to change based on the following:
  - Distance of generation asset to site (point of offtake)
  - Legal costs
  - Network reinforcement requirements.

Private Wire Connection Requirements	Typical Cost ($£_{2020}$)
Switchgear	~£5,000
Transformer	~£12,000
Connection	~£120,000 (roughly £120/m)
Switchroom	~£24,000-30,000
Exporting	~£15,000
Ancillary Connection Requirements	~£21,000
Legals	~£25,000
Contingency	~25% of cost

Source: Local Energy Scotland (2020).

APPENDIX 4. DETAILED LIST OF OPERATION AND MAINTENANCE ACTIVITIES (FOR GROUND MOUNTED SOLAR PROJECTS).

OPERATION RELATED SERVICES

- Operation monitoring
  - Energy monitoring services
  - Monitoring and production reporting
  - System performance testing
  - Site security services
  - Data analytics services
  - Commercial management services
- Additional Services
  - Training services
  - Energy audit services
  - Authorities interfacing services
  - Warranty management

MAINTENANCE RELATED SERVICES

- Corrective Maintenance
  - onsite monitoring/ mitigation
  - Critical reactive repair
  - Non-critical reactive repair
  - Warranty enforcement
- Preventative Maintenance
  - Panel cleaning
  - Vegetation management
  - Wildlife prevention
  - Water drainage/ snow removal
  - Retro-commissioning
  - Upkeep of data acquisition and monitoring systems
- Condition-Based Maintenance
  - Equipment replacement
  - Warranty enforcement
  - Rehabilitation and renovation services
  - Active monitoring and diagnosis

Source: Camarinha-Matos et al., (2017)

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