RaaS

Resilience as a Service

Work Package 5

Investor Business Case

(E5.3)

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Contents

List of Abbreviations

BEIS	Department for Business, Energy & Industrial Strategy
BESS	Battery Energy Storage System
CI	Cornwall Insight
DC	Dynamic Containment
DG	Distributed Generation
DNO	Distribution Network Operator
DER	Distributed Energy Resource
EFA	Electricity Forward Agreement
ENA	Energy Networks Association
FEED	Front End Engineering Design
IBC	Investor Business Case
IIS	Interruptions Incentive Scheme
IRR	Internal Rate of Return
KPI	Key Performance Indicator
NG ESO	National Grid Electricity System Operator
NIC	Network Innovation Competition
Ofgem	Office of Gas and Electricity Markets
O&M	Operation and Maintenance
RaaS	Resilience as a Service
SSEN	Scottish & Southern Electricity Networks
VoLL	Value of Lost Load
WP	Work Package

1. Executive Summary

This report explores the business case for Resilience as a Service (RaaS) from a RaaS Investor's perspective, using both the proposed trial site of Drynoch, and a 'Generic Site', as examples for assessment.

The work draws on the outputs of deliverables E2a.1 & E2a.2 (site selection and FEED), E3a.1 to E3a.4 (identification of potential suppliers and BESS detailed design), E4.1 & E4.2/E4.3 (margin from BESS commercial optimisation in Flexibility Services) and E5.1 (investor modelling methodology).Section 3 of the document provides a summary of the RaaS service, the types of Investor who may be interested in RaaS, the location and sizing of the Drynoch BESS, and how it may be used to participate in other Flexibility Services to improve the Investor Business Case and make the RaaS fee more competitive. Section 4 then goes on to describe how the investor business case was assessed, the financial outputs, and what this means for the RaaS project.

The key inputs into the Investor Business Case are:

- The cost of installing and operating the BESS considering site specific factors associated with geographical location
- The length of the RaaS contract
- The margin that can be achieved from the BESS from participation in other Flexibility Services, at the same time as being available for the provision of RaaS
- The availability and cost of land to install the BESS
- The IRR target of the Investor
- The RaaS fee that it would be appropriate (cost effective) for the DNO to offer

Drynoch was modelled on the basis that the required energy capacity would be reserved for RaaS, with the available headroom capacity used to participate in other Flexibility Services. To provide an understanding of what may influence the economics of RaaS for both the Investor and the DNO, the IBC was run using different IRR targets, differing RaaS Product Design Scenarios, and different wholesale and balancing price scenarios, to provide a sensitivity analysis that can inform the future development of RaaS through the project.

Based on the analysis specific to Drynoch, for a 4% IRR, the lowest RaaS fee that could be required by an Investor based on the original RaaS concept was £366,000 in year 1, and at 8% IRR it was £455,000.

Sensitivity analysis was also undertaken to appraise the extent to which key modelling inputs would need to be varied to reduce the required RaaS fee to £200,000 per annum. The four key inputs that were adjusted individually were IRR target, Capex, Flexibility Services margin and Corporation tax. None of the associated changes to these individual variables represents a realistic option for the Investor therefore, to reduce the required RaaS fee a combination of changes would be needed, potentially together with other changes to the DNO specification of RaaS requirements (RaaS product design).

For the Generic Site, each of the RaaS Product Design Scenarios and wholesale and balancing price scenarios were modelled based on a 4% IRR target. The lowest year 1 RaaS fee associated with this assessment was £285,000 and the highest was £375,000.

Again, the four key modelling inputs were varied individually to provide a RaaS fee of £200,000 per annum. This assessment also indicated that to reduce the required RaaS fee a combination of changes would be needed, potentially together with other changes to the RaaS product design.

Whilst it is useful to assess a Generic Site as a comparison for the purposes of this report, it will be necessary to model and assess each potential future site individually, using site specific and Investor specific factors. This will allow each potential RaaS Service Provider to determine the level of RaaS fee that it would be possible to offer to a DNO through the RaaS tendering and procurement process.

The assessments presented in this report provide indicative values for required RaaS fees based on specific inputs and the initial concept for RaaS. It is clear that if it was not possible for the DNO to meet the associated payment levels, it is highly unlikely that an Investor would choose to install a BESS which had a primary function of reserving sufficient capacity to supply the electricity that may be required to meet local demand over a four hour period of time. In this event, a different type of RaaS product design (and DNO specification of RaaS requirements) to those initially defined and assessed through the project, and/or the use of an energy storage scheme installed for a different primary purpose (and so with RaaS as an additional, 'bonus', income), may represent options for the cost effective implementation of a RaaS scheme, improving the attractiveness of RaaS to both an Investor and DNO.

The Investor Business Case presented within this report will be evaluated with the DNO business case assessment undertaken by SSEN, to develop a clear understanding of how the business cases align and the financial viability of the RaaS concept as currently proposed. The project will also seek to identify all ways in which the commercial attractiveness of RaaS to both DNOs and Investors can be maximised.

2. Project Overview and Report Purpose

2.1. Project Overview

The RaaS - Resilience as a Service - project is funded by the Network Innovation Competition (NIC) of the UK's Office of Gas and Electricity Markets (Ofgem). It is being delivered by three partners; Scottish and Southern Electricity Networks (SSEN), E.ON and Costain. SSEN are the Distribution Network Operator (DNO) for the project, evaluating the technical feasibility and financial viability from a DNO perspective; E.ON are an energy solutions provider who are leading the technical delivery of the battery system and developing the investor business case; Costain are a management consultancy acting as programme managers and providing input to the market design assessment. The project has a budget of £10.9m.

The aim of the project is to investigate the technical application and commercial opportunities associated with the provision of a new market-based flexibility service that could be used by DNOs to improve network resilience in remote or rural areas. This service would use a Battery Energy Storage System (BESS) together with local Distributed Energy Resources (DER) to supply customers in the event of a fault on the network.

This project will determine how network resilience can be improved in a cost-effective manner for customers in areas susceptible to power outages, where traditional reinforcement or use of DNO owned standby generation to improve security of supply would be prohibitively costly. This can be achieved by a DNO procuring RaaS from a third-party service provider, who may also stack revenues through participation in other Flexibility Services markets. In addition to developing the technical solution, the project seeks to evaluate the financial case from a DNO perspective while giving insight to RaaS service providers on the investment case, and optimal flexibility markets to operate in.

The first phase of the project focuses on site selection, system design for the chosen demonstration site, and refinement of the business case. This stage will validate whether the concept is technically feasible and financially viable, to inform a Stage Gate decision on whether to proceed with the deployment and operation of a RaaS system at the chosen site for a trial period of up to two years.

The second phase of the project comprises the delivery, installation, commissioning, and operation of the system in a demonstration due to commence in late 2022. This will include monitoring and evaluation of the system's technical performance together with the examination and appraisal of participation in different combinations of additional Flexibility Services.

The concept of RaaS offers a market-based solution to improve operational reliability and provide customers with a low carbon, cost effective and secure electricity supply.

2.2. Report Purpose

This report explores the Investor Business Case (IBC) using the selected trial site of Drynoch on the Isle of Skye, and a 'Generic Site', as examples of the application of RaaS.

The IBC draws on the outputs of deliverables E2a.1[1] & E2a.2[2] (site selection and FEED), E3a.1 to E3a.4[3] (identification of potential suppliers and BESS detailed design), E4.1[4] & E4.2/E4.3[5] (margin from BESS commercial optimisation in Flexibility Services) and E5.1 (investor modelling methodology)[6], with these reports available via the project website www.project-raas.co.uk.

This report provides a summary of the RaaS service, the types of Investor who may be interested in RaaS, the location and sizing of the Drynoch BESS, and how it may be used to participate in other Flexibility Services to improve the Investor Business Case and make the RaaS fee more competitive. The document then goes on to describe how the investor business case was assessed, the financial outputs, and what this means for the RaaS project.

[1] RaaS E2a.1 'Site Selection', E.ON, February 2021
[2] RaaS E2a.2 'Front End Engineering Design', E.ON, February 2021
[3] RaaS E3a.4 'Detailed Design for RaaS BESS & EMS', E.ON, October 2021
[4] RaaS E4.1 'Future Scenarios for Flexibility Markets in which the RaaS Battery System can be Optimised', E.ON, November 2020
[5] RaaS E4.2/E4.3 'Optimisation Assessment for RaaS Battery Operation at the RaaS Trial Site and a generic site', E.ON, August 2021
[6] RaaS E5.1 'Modelling Methodology', E.ON, August 2020

3. Context of the Investor Business Case

A vital element for the successful future adoption of RaaS is the creation of suitable commercial mechanisms which will incentivise investment in batteries capable of providing resilience services to DNOs. A key principle of RaaS is that to deliver best value for a DNO's customers, the RaaS battery must access additional revenues from other Flexibility Services markets when not delivering RaaS. This 'revenue stacking' approach underpins the proposed commercial strategy and relies upon contracting into services which can be operated in tandem with RaaS.

This section sets out the context and scope of the IBC assessment, and the considerations which shape the business case from a RaaS Investor's perspective, including:

- Exploration of investor types
- Potential suitable trial locations
- High level BESS technical specification
- Procurement strategy
- Optimisation strategy
- Contracting Strategy

Where material from prior project activities and deliverables is drawn on, a summary of relevant information is provided. Appendix 1 summarises the project activities used to develop the IBC.

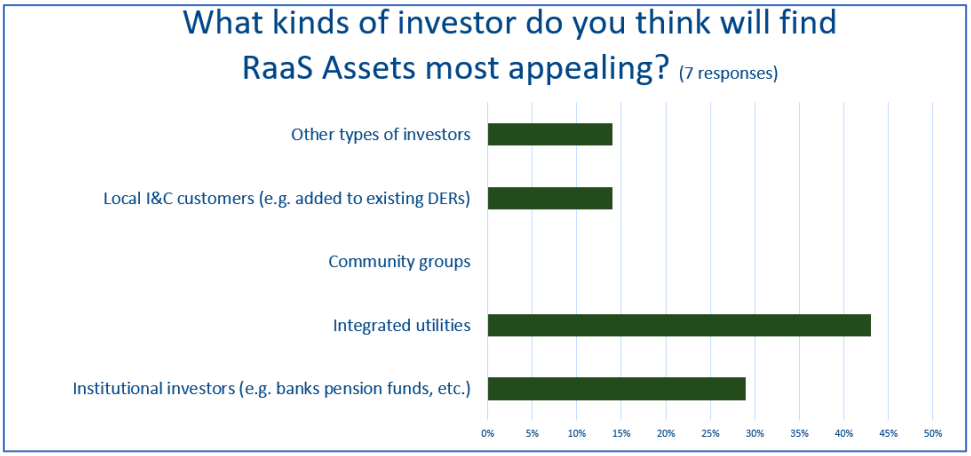
3.1. Investor Types

A range of key potential investor types have been identified through the project. It is recognised that any Investor organisation would need:

- An understanding of the technical and commercial interactions of the solution
- Access to the commercial expertise necessary to participate in all available revenue streams
- An understanding of the associated risks

These were presented during the RaaS Stage Gate Stakeholder Consultation events held in early November 2021, with participants invited to indicate which may be most attracted to RaaS. The results from one of the Slido polls are shown in Figure 1.

Figure 1: Investor Types identified at the Stakeholder Event



The results indicate a recognition that RaaS may be attractive to a range of potential organisations.

Integrated utilities are perhaps best placed to have knowledge and experience relevant to making investment decisions associated with RaaS, at least in the early stages of deployment.

Institutional investors are expected to have the financial resources, though may need to develop their understanding of the concept and risks to support investment.

Industrial & Commercial (I&C) customers with a history of participation in Flexibility Services may be amenable to upgrading or investing in assets capable of also participating in a RaaS service. Similarly, a growing number of I&C customers are opening up to participation in Flexibility Services.

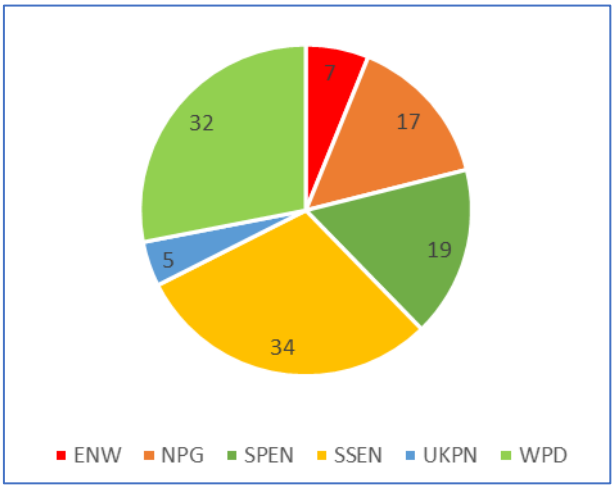
Community groups with an interest in sustainable energy may also have interest in investing in a RaaS asset, particularly where this brings complementary benefits to existing or planned local or renewable energy schemes. It's believed that the results of the poll above are more linked to access to funds or financing, particularly in the early stages of RaaS.

Across all potential Investor groups, uptake will be determined by expertise in, and reliance on, energy, together with an appetite to invest. The UK's drive towards net-zero could provide a catalyst to spark wider adoption of sustainable energy storage solutions which could support the future implementation of RaaS.

3.2. Potential Suitable Locations

The initial assessment used for the RaaS NIC bid submission indicated that over 110 GB primary substation sites may benefit from a RaaS solution. The distribution of these across the DNO regions is shown in Figure 2.

Figure 2: Distribution of potential RaaS sites by DNO



Further, Costain's C6.1[7] report identified additional potential applications of RaaS technology, for example at different voltage levels, or in also supporting other industries. This presents a significant opportunity for both Investors and DNOs to make use of RaaS to improve network reliability for customers.

Focussing on the SSEN area, and as covered in the Site Selection report, the identification of sites suitable for the potential demonstration of RaaS was based on 4 criteria:

- Potential benefits of the solution for the customers connected to the network

[7] RaaS C6.1 'Investigation into the Wider Potential of RaaS', Costain, November 2021

- Suitability for meeting project objectives (including potential incorporation of local Distributed Generation (DG))
- Practicality of delivery and operation within project timeframes and budget
- Technical design and integration

The potential trial site then selected for the project was Drynoch primary substation on the Isle of Skye, which has the following characteristics:

- An average of around 4 outages a year, of durations less than 1 hour (based on historic information)
- Two wind turbines and two reasonably sized non-domestic electrical loads connected to the network
- The proposed location of the battery (next to the primary substation) presents a practical option which would support delivery and assessment of the performance of this initial trial
- A BESS connected to this network would be subject to a 1MW limit on both import and export capacity

The IBC therefore includes an assessment of this specific site.

3.3. High Level BESS Technical Specification

The initial technical specification for the RaaS service was developed through the FEED developed with reference to the Drynoch site. This resulted in the battery parameters presented in Table 1, which have been used for the Investor Business Case assessment[8].

Table 1: Summary of the initial BESS technical specification for Drynoch

Parameter	Description	Additional Information
RaaS Energy Requirement	4.2MWh (with degradation this would still be capable of providing at least 3.5MWh at the end of the assumed 10 year asset life)	To cover 90% of all potential 4-hour outages annually
BESS Rating	1C	To cope with the power and energy demands of RaaS
Invertor Power (max)[9]	4.2MW (power factor increases this to 5.25MVA)	Ultimately a 5MVA was picked as it complies with the component below and is commercially more readily available
Grid Protection and Black Start	5MVA sufficient for safe and stable operation of the 11kW network	Applies to both grid parallel and islanded modes, and when restoring the network under black start conditions
BESS Transformer Sizing	3MVA	Need to meet network protection requirements

[8] note that some of these parameters have subsequently been varied during development of the Detailed Design for RaaS

[9] more detail is contained in the FEED report, section 9.1.2, and Detailed Design Report, section 7.1.2i

When considering a suitable battery size to deliver RaaS, an Investor, working with a RaaS Service Providers, would need to consider:

- The power (MW) that the BESS scheme has to be capable of delivering to trigger network protection schemes, and to be able to perform black-start of the local 11kV network
- The energy ('reserved MWh capacity') required to provide the RaaS service
- The power (MW) levels which the battery can charge / discharge at based on any network constraints at its location
- The energy ('headroom MWh capacity') appropriate to optimise participation in other markets

3.4. Procurement Strategy

The project has identified two key potential routes that Investors may use to procure battery installation, maintenance and operational services from suppliers, as summarised in Table 2. Further, Investors have options for tendering for the supply of associate services, as summarised in Table 3. These represent options available to encourage participation by all Investor types, build a competitive supply chain, and drive best value for DNOs and their customers.

Table 2: Possible Procurement Routes

Procurement Route	Benefits	Disadvantages
Separate Work Packages	• Removes reliance on a single entity • Individual work package suppliers can be replaced	• Multiple interfaces to manage • Procurement costs likely to be higher • Scope must be highly defined for each supplier, no variance in submission permitted
Single BESS Supplier	• Easier to leverage savings through economies of scale • Increased management efficiency (single point of contracting, ordering and account management) • Responsibility for delivery is clear	• Difficult to find a single supplier able to provide a full RaaS/ Flexibility Service

Table 3: Tendering Processes

Tender Process	Benefits	Disadvantages
Framework	• Will establish a supplier (or shortlist of suppliers) via a thorough exercise with detailed understanding of the whole project	• Prices will be reflective of the market at the time of establishing the framework (i.e. may not remain best value) • Constrains participation to only those on the framework
By Project	• Could lead to delivery of the best price available at each procurement round • Ability to capitalise on market innovation	• Resource intensive for both the suppliers and tenderers • Higher risk for suppliers – likely to price this in • If a supplier continues to be unsuccessful, they may refuse to participate in further tenders

A key aim of the RaaS project is to explore and build confidence across the potential supply chain for RaaS. During Phase 1 C6.1 'Investigation into the Wider Potential of RaaS' has supported that work, and during Phase 2 stakeholder engagement will continue and be used to develop the detail of the RaaS market, its participants, and their interactions at present and as the concept evolves over time.

3.5. Revenue Optimisation Strategy

The Investor's BESS revenue optimisation strategy will revolve around revenue stacking across various markets. The current likely markets, identified through the work undertaken by Cornwall Insight for E4.2/E4.3, are outlined Table 4.

Table 4: Flexible Services Markets

Product	Description	Award	Value	Penalties
Dynamic Containment (NG ESO)	Battery is set to follow system frequency	Blind pay as clear auction at day ahead	Availability only – circa £17/MW/hr Market currently circa 1,000MW	Clawback of payment based on accuracy of delivery over the day
Wholesale Market / Balancing Mechanism[10]	Battery to deliver a traded MW amount over a traded period of time	Volume traded from D-1	As traded Market size is not limited	Delivery is capped and under delivery is cashed out
RaaS	Delivery of support following DNO outages	Commercial Contract	Would be determined on a site-by-site basis, and influenced by the number of RaaS events	Potential penalty structures to be further evaluated during Phase 2 of the RaaS project

Alongside the above, at present NG ESO, currently the largest buyer of Flexibility Services in the UK, is undertaking an extensive redesign of their response and reserve products to better match the future needs of the system they manage. These include the introduction of:

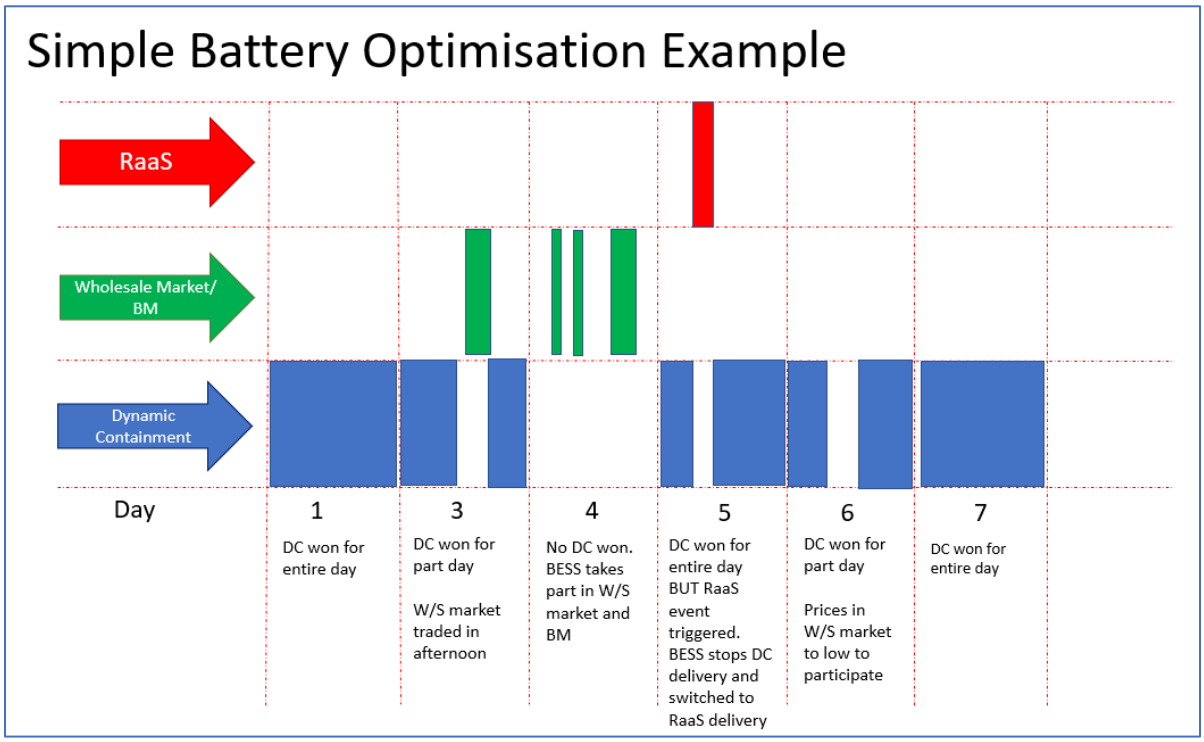
- Dynamic Containment – now implemented
- Dynamic Moderation – in consultation, launch expected Q2 2022
- Dynamic Regulation – in consultation, launch expected Q2 2022
- Reserve (Positive) – expected in 2022
- Reserve (Negative) – expected in 2022

In order to maintain optimal revenues over time, the RaaS BESS should be planned with capability to provide a route to market across as many products as possible, allowing the asset to adapt to changing conditions in other markets, to 'follow the highest value'. It is also acknowledged that NG ESO contract on a competitive basis, and so a clear view of the different markets and their relative values will be required by Investors as part of their optimisation strategy.

[10] whilst the wholesale market and Balancing Mechanism are two distinct markets, they are enacted and rewarded in virtually identical ways

A simple example of the commercial optimisation of a BESS capable of providing RaaS is shown in Figure 3. Note that when transitioning between products, the Flexibility Services provider must ensure sufficient time to allow the battery to charge to the required level.

Figure 3: BESS Optimisation Example



Based on the current product mix in the market the optimisation process would be determined at the day ahead stage – this is due to the tendering cycles of the primary commercial product, Dynamic Containment (DC).

It is notable to consider the events of Day 5:

- Contracted to deliver DC all day
- RaaS event triggered and BESS starts to support the DNO, connection to wider grid lost due to the fault which triggered the RaaS response
- Flexibility Services control device (owned by the RaaS Service Provider) takes care of the necessary communication with NG ESO about DC
- RaaS event passes and the 11kV network is restored to normal grid supply
- Flexibility Services control device returns sufficient charge to the BESS to allow a return to DC
- NG ESO informed and DC delivery recommences

In tendering for DC the RaaS Service Provider is making a commitment to NG ESO to deliver the service for the tendered window. However, under the circumstances, and regardless of whether the battery was contracted to RaaS, if the network went down the provision of the DC service would have to cease (along with payment for the associated period).

The products described above have different structures and requirements for participation, which need to be understood by those participating in the markets to support decisions on optimisation of revenue stacking. Accordingly, as reported in E4.1, three RaaS Product Design Scenarios were defined to explore how differing levels of granularity in a DNO's specification of RaaS service level requirements may affect the optimisation of the battery in other markets, as summarised in Table 5. For the IBC

assessment, Scenario 2 (with EFA blocks representing medium granularity) has been chosen as the most likely option at present, due to providing reasonable and practical flexibility but without a need for enhanced forecasting capability by the DNO.

Table 5: RaaS Product Design Scenarios

RaaS Product Scenarios	Service Window	Service Level Notification Period	Duration of Service
Scenario 1 (lower granularity)	4 seasons with a split between working days and non-working days	Contractually fixed	4h
Scenario 2 (medium granularity)	4 seasons with a split between working days and non-working days and the day split into 4-hour EFA blocks	Contractually fixed	4h
Scenario 3 (higher granularity)	4 seasons with a split between working days and non-working days and the day split into 4-hour EFA blocks	Dynamic	4h

Table 6 below then outlines how the RaaS product will interact with some of the current Flexibility Services markets.

Table 6: RaaS Interaction with other Flexibility Services

Product	RaaS Event	Penalty	Mitigation
Dynamic Containment (DC)	Frequency following ceases and the BESS will switch to grid forming / load following	DC contract will fall out of tolerance and a proportion of revenue earned will be recovered by NG ESO	If correct communication of the unavailability for DC is followed(as prescribed in the DC terms) the impact is restricted to non-payment during the period of unavailability
Wholesale Market / Balancing Mechanism	Flat MW delivery ceases and the BESS will switch to grid forming / load following	Shortfall will be cashed out, however noting that in the event of a fault on the higher voltage network in the absence of RaaS, a BESS wouldn't be able to access the wholesale market for the duration of the fault	None

3.6. Contract Strategy

Since commencement of the RaaS project, the Energy Networks Association's Open Networks project has developed a Standard Agreement for Procuring Flexibility Services[11] as a common contract for use by all DNOs to provide consistency which will support increased engagement by third parties with DNO flexibility services. Accordingly, it is appropriate that this should also be adopted (and adapted where necessary) for the future procurement of RaaS.

To ensure the suitability of this standard agreement for use with RaaS, a number of proposed changes have been identified, as reported in E5.4[12] 'Heads of Terms', and summarised below:

- Add a definition of RaaS activation and its service requirement - RaaS is distinctly different to the four key DNO Flexibility Services defined by the Open Networks project, and so the differences need to be reflected within the standard agreement, for example, the RaaS response will be automatic, rather than based on a process of the DNO 'informing' a RaaS Service Provider of the need to respond
- Add key performance indicators which reflect the complexity of variable durations of response and reserved capacity required for RaaS
- Add DNO obligations associated with the provision of a RaaS service (including, potentially, consideration of aspects related to the installation of DNO side elements of a RaaS scheme, interfacing the DNO and third party systems & joint commissioning, monitoring, and investigation & resolution of any issues with system operation)
- At present, the standard agreement refers to auctions and utilisation if successful, however as RaaS provides a geographically specific solution for resilience, likely needing investment in a new BESS asset, an Investor would require a commitment from the DNO as to the contract term - it is unlikely, at least during the early stages of RaaS deployment, that an Investor would be prepared to enter regular auctions for RaaS unless they are highly confident that they can recover their investment through other Flexibility Services
- Careful consideration needs to be given to the role of contractual obligations verses performance incentives/penalties, likewise to the balance of e.g. fixed, availability and utilisation payments, further, it is recognised that different approaches may be preferred by different types of Investor, and so the standard agreement would need to reflect and accommodate all suitable options - this area will be explored further through stakeholder engagement during Phase 2 of the RaaS project, subject to a positive Stage Gate decision

These points will be raised with the ENA Open Networks project during Phase 2 of RaaS, and discussed with the appropriate work streams to reach an industry consensus which ensures that the standard agreement will be suitable for the future BAU roll out of RaaS.

It is also appropriate to note that the RaaS trial scheme at Drynoch will sit under the RaaS project Collaboration Agreement, which takes into account other specific obligations associated with the trial of a scheme as part of a funded NIC project. These include terms relating to the period of operation, the ownership of any payment for the BESS, and the use of the battery to explore different approaches to participation with other markets.

[11] Standard Agreement for Procuring Flexibility Services, ENA Open Networks project, www.energynetworks.org/creating-tomorrows-networks/open-networks/flexibility-services

[12] RaaS E5.4 'Heads of Terms', E.ON, January 2022

4. Investor Business Case - Drynoch and Generic Site

This section describes the inputs and calculations used to assess the Investor Business Case and explores the financial outputs from the assessment of the Drynoch Site and a 'Generic Site'. The Generic Site has been modelled to provide a comparison to Drynoch based on different characteristics such as, BESS size, BESS cost, grid import/export limits and geographical location, to explore the impact on RaaS fee. A 2.5MW/3.5MWH BESS was chosen for this assessment as a reasonable assumption for a number of the sites assessed during the project's trial site selection process. It is assumed that there are no import/export limits, and that the BESS is serving the East Midlands distribution network region as this represents a median network charging arrangement.

The project acknowledges that for the future roll out of RaaS, the Investor and RaaS Service Provider may not be the same entity, as an Investor may employ a third party to install a BESS and operate it to fulfil a RaaS contract, however, to avoid the need to refer to the Investor and RaaS Service Provider separately, here the Investor is referred to as the RaaS Service Provider.

4.1. Investor Business Case - Inputs

Table 7 lists the inputs that have been used to evaluate the IBC, together with descriptions and indications of why these are relevant points to incorporate.

Table 7: Description of Investor Business Case inputs

Input	Description	Relevance to IBC
BESS Size	The MW and MWh specification of the BESS	The BESS size determines the capex/O&M costs, and the margin that can be generated from Flexibility Services
BESS Life	The number of years the BESS can operate for at the required service levels	This determines how many years the asset could provide RaaS and participate in other Flexibility Services for
Grid Import and Export Capacity	Local factors (e.g. network constraints) may limit how much power the battery can import from the grid to charge the battery, and/or the amount of power it can export to provide Flexibility Services at any given time	Any import or export constraints could influence the margin that can be generated from Flexibility Services
RaaS Fee	The amount the RaaS Service Provider will charge the DNO per annum for the agreed RaaS service level	This forms part of the total revenue the RaaS Service Provider will receive per annum - if a RaaS Fee is known, this can be used to evaluate the potential IRR, however, for this analysis the IBC model has been used to derive a figure for the indicative RaaS Fee required to achieve the IRR based on other financial inputs
RaaS Fee Inflation	The RaaS fee is inflated annually by a fixed percentage	Inflation is expected to apply to the RaaS fee year on year
Flexibility Services Margin	The financial margin the BESS can achieve from providing other Flexibility Services, based on the BESS size (and so capacity available for participation in other markets), asset life, import/export	This margin reflects the combination of revenues available to the RaaS Service Provider for providing other Flexibility Services, and the costs of charging the BESS, and will/may influence an Investor's decisions re required RaaS fees - for the

	capacity/limits, and optimisation of BESS across the different flexibility markets	RaaS project forecasts have been provided by Cornwall Insight as part of deliverable E4.2/E4.3
BESS Cost	The Capex cost for purchasing and installing the BESS	This forms part of the total costs of providing RaaS and other Flexibility Services
O&M (Operation and Maintenance) Cost	The cost of operating and maintaining the BESS over its operational life to ensure it can deliver the required service levels - this includes servicing, replacing parts and performance monitoring - there may be a number of O&M costs e.g. associated with Suppliers, the RaaS Service Provider, monitoring, comms or data services, etc.	This forms part of the total costs of providing RaaS and other Flexibility Services
CPI (Consumer Price Index)	CPI is the rate at which the price of goods and services rise or fall and is estimated using price indices - the annual movement is used in the IBC	O&M costs are typically inflated by CPI annually, so this will increase/decrease the O&M cost over the life of the BESS
Corporation Tax	Tax payable to the government on the profits made by the RaaS Service Provider	A cost to the RaaS Service Provider on the profit it makes from providing RaaS and Flexibility Services
Written Down Allowances (WDA)	An amount that can be deducted from annual profits before tax based on the cost of the BESS	This is offset against the amount of profit made by the RaaS Service Provider which reduces the amount of tax they pay
RaaS Contract Length	The number of years the DNO would like to procure the RaaS service for	This influences how much revenue the RaaS Service Provider will make from RaaS overall, and influences the revenue that can be made from other Flexibility Services
RaaS Service Provider financial return expectations	For Investors a KPI of financial return is the Internal Rate of Return (IRR) which reflects the profitability of a scheme - IRR may be compared to the cost of financing an investment, or some other hurdle rate defined by the organisation, and where the IRR exceeds the target it is considered a worthwhile, profitable investment	Different Investor types will have different IRR targets, but IRR targets will determine the RaaS fee level they would seek from a DNO to ensure the BESS investment achieves the required IRR
RaaS Service Level	This is the level of service that the DNO requires from the RaaS scheme, and reflects the duration of RaaS service expected and the local electricity demand patterns	The required RaaS service level will determine the reserved capacity required for RaaS at any point in time, and therefore the headroom capacity available to participate in other Flexibility Services, thereby impacting the margin the RaaS Service Provider can make
Land Lease Fee	A fee that a RaaS Service Provider would pay for leasing the land required to install the BESS	A land lease fee would be a cost to the RaaS Service Provider

Aggregator Fee	The employment of a specialist organisation who will operate the BESS in the Flexibility Services markets to maximise revenues	This would be a cost to the RaaS Service Provider

4.2. Investor Business Case - Assumptions

Table 8 below sets out the assumptions made in the IBC for both Drynoch and the Generic Site, also indicating the level of certainty there may be in the inputs.

Table 8: Drynoch and Generic Site Investor Business Case Assumptions

Input Name	Assumption	Certainty	Comments
BESS Size	4.2MW/4.2MWh for Drynoch 2.5MW/3.5MWh for Generic Site	100%	The Drynoch BESS size requirement was established through the design work undertaken for the RaaS project The BESS size for the Generic Site is an estimate of the typical size required at sites that may benefit from RaaS across the UK
BESS Life	10 Years	100%	BESS manufacturers provide an 8,000 cycle/10 year warranty
Grid Import Capacity	1.5MVA for Drynoch 3.5MVA for Generic Site	70% for Drynoch n/a for Generic Site as no limit assumed	Drynoch limit provided by SSEN but to be confirmed through detailed modelling The Generic Site is assumed to have no limit but this may not be the case on specific sites
Grid Export Capacity	2.5MVA for Drynoch 3.5MVA for Generic Site	70% for Drynoch n/a for Generic Site as no limit assumed	Drynoch limit provided by SSEN but to be confirmed through detailed modelling The Generic Site is assumed to have no limit but this may not be the case on specific sites
RaaS Fee	Scenario dependant	100%	Determined by IRR expectations
RaaS Fee Inflation	2% p.a.	70%	This would be determined by a RaaS Service Provider, and could be linked to other inflation indices
Flexibility Services Margin	Scenario dependant	60%	Margin projection is based on a 10 year forecast of future market conditions which could vary greatly
BESS Cost	£3.0m	70%	Based on indicative information from potential suppliers - final prices for Drynoch to be established during the Phase 2 tendering processes
O&M Cost	£30,000 p.a.	70%	Based on similar sized projects - cost for Drynoch to be confirmed through the Phase 2 tendering processes

CPI	2.5% p.a.	70%	The average movement between 2008 and 2020 was 2.4% - same rate applied for 10 years
Corporation Tax Rate	25%	70%	Based on 2021 actual - same rate applied for 10 years
Written Down Allowances	18%	70%	Based on 2021 actual - same rate applied for 10 years
RaaS Contract Length	5 or 10 years	70%	The 5 year contract assumes that for the latter 5 year of BESS asset life the RaaS Service Provider participates in other Flexibility Services only
RaaS Service Provider financial return expectations	Examples of 4% and 8% IRR have been provided for each scenario assessed	70%	These would be determined by the RaaS Service Provider
RaaS Service Level	Three Product Design Scenarios have been evaluated to explore differences	70%	RaaS Product Design Scenarios were agreed between E.ON and SSEN as a means to explore different options within the project, it's acknowledged that there are other ways in which the RaaS product design could be adapted for future roll out, and/or evolve over time
Land Lease Fee	N/A for Drynoch as sited on SSEN land £2,000 in year 1 for Generic site	0%	It has been assumed that a BESS would be installed on land which has limited or no current use, which should keep the cost low - this may not be the case for all potential sites, further, Wayleaves fees may be required in the event that e.g. cabling would need to cross another third party's land
Aggregator Fee	10%	60%	Where the services of an Aggregator are employed to manage participation of a BESS in Flexibility Services, Aggregator fees are usually defined as a percentage of revenue generated - typically between 5% and 10%
RaaS events per year	Zero	0%	Zero activations were chosen to reflect the lowest RaaS fee option - the number of RaaS events in any year would change the income received from the DNO, according to the RaaS payment structure applied (i.e. balance of fixed, availability and utilisation payments)

4.3. Investor Business Case - Outputs

Table 9 describes the outputs from the IBC assessment, linking these back to the inputs and providing a brief description of how the output values are derived

Table 9: Investor Business Case Output

Output	Description	Inputs
RaaS Fee	Where a RaaS Fee is known, this can be used to evaluate the associated IRR, alternatively, the IBC model can be used to derive a figure for the indicative RaaS Fee required to achieve the specified IRR, based on the other financial inputs	RaaS Contract Length Flexibility Services Margin All Costs RaaS Service Provider IRR target
RaaS Revenue	The revenue received from the DNO for the provision of RaaS	RaaS Fee Contract Length RaaS Fee Inflation
BESS O&M Costs	The overall cost of operating and maintaining the BESS	Supplier O&M Cost RaaS Service Provider O&M Cost CPI BESS Life
Aggregator Fee Cost	The cost of employing an Aggregator to manage participation of the BESS in other Flexibility Services (if required)	Flexibility Services Revenue Aggregator Fee
Lease Fee Cost	The overall cost payable to a third party to lease their land for installation of the BESS	Land Lease Fee Wayleaves Fee
Depreciation	Release of the BESS capex cost to the profit and loss account over the life of battery	BESS Cost BESS Life
Earnings before interest, tax and depreciation (EBITDA)	Revenue less costs, with Interest, Tax and Depreciation excluded	RaaS Revenue Flexibility Services Margin Battery O&M Costs Aggregator Fee Land lease costs
Earnings before interest and tax (EBIT)	Revenue less costs less Depreciation, with Interest and Tax excluded	EBITDA Depreciation
Corporation Tax	Corporation Tax owed on EBITDA less WDA	EBITDA WDA Corporation Tax Rate
Cashflow	EBITDA less Corporation Tax less Capex	EBITDA Corporation Tax Capex
Payback Period	The time it takes for the BESS investment to breakeven	Cashflow
Internal Rate of Return (IRR)	A measure of the return on investment used to evaluate the profitability of a scheme and determine (e.g. through comparison with a target, or 'hurdle', rate) whether an investment is worthwhile	Cashflow

4.4. Investor Business Case - Modelling Results

The following section presents the financial output of the IBC for Drynoch and the Generic Site.

The outputs for Drynoch are presented under three categories:

- IRR – this is the rate at which the net present value of future cashflows equals zero. If the IRR % is greater than the RaaS Service Provider's cost of funding (equity + debt) %, the project would be profitable and worth investing in.
- Cornwall Insight Flexibility Services Price Scenarios – as presented in deliverables E4.2/E4.3 Cornwall Insight have forecast the Flexibility Services margin from the BESS using three price scenarios - Low, Central and High - to reflect variances in assumptions on future wholesale market and balancing services prices. The Drynoch assessment is based on the Central scenario.
- RaaS Contract Length – the IBC compares the RaaS fees associated with both a 5 year and a 10 year contract length.

Drynoch

The financial outputs for Drynoch are presented in Table 10 using 4% and 8% IRRs. The two rates provide sensitivity analysis, as it is recognised that different Investors will have different costs of finance, and so may require different rates of return.

Table 10: Drynoch IBC Financial Outputs

	4% IRR		8% IRR	
Cornwall Insight Price Scenario	**Central**	**Central**	**Central**	**Central**
RaaS Service Provider IRR Target	4%	4%	8%	8%
RaaS Contract Length	5 Years	10 Years	5 Years	10 Years
Payback (Years)	5.1	8.1	4.3	6.7
Cumulative Cashflow	£0.435m	£0.653m	£0.865m	£1.385m
Capex	£3.000m	£3.000m	£3.000m	£3.000m
Year 1 RaaS Fee	£0.630m	£0.366m	£0.740m	£0.455m
Year 1 Flex Margin	£0.094m	£0.094m	£0.094m	£0.094m
RaaS Fee as % of total Revenue	75%	64%	78%	69%

The key variable in this assessment is the RaaS fee, which is the value adjusted to achieve the 4% or 8% IRR.

This shows that if the RaaS Service Provider could accept a 4% IRR, then they would seek a RaaS fee of between £366k and £630k in year 1, depending on the margin they anticipated from participation in other Flexibility Services, and the RaaS contract length. If the RaaS Service Provider needed to make an 8% IRR to cover their cost of funding, they would seek a RaaS fee of between £455k and £740k in year 1.

The above outputs identifies that the IBC for Drynoch relies heavily on the RaaS fee (with this representing around 60% to 80% of the overall income), and so it is clear that a RaaS Service Provider would not install a 4.2MW battery in that location without that level of RaaS fee.

Figure 4 shows the cumulative cashflow of the RaaS Service Provider using the 4% and 8% IRR scenarios, 10 year RaaS contract, and 'Central' wholesale and balancing price scenario. In the scenario where the RaaS Service Provider charges a higher RaaS fee to achieve an 8% IRR their cashflow becomes positive after 6.7 years in comparison to 8.1 years.

The BESS has an assumed 10 year asset life, and the later the payback the more risky the investment would be.

Figure 4: Drynoch Cumulative Cashflow at 4% and 8% IRR

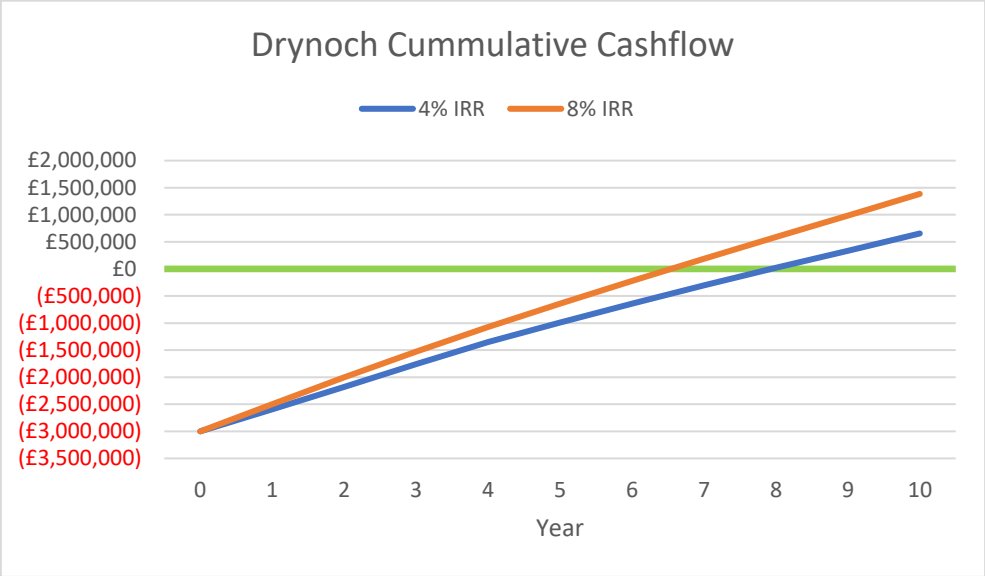


Figure 5 shows the margin from other Flexibility Services generated each year. The margin reduces over time primarily due to assumptions regarding the degradation of the BESS, which affects the capacity it has available to participate in other Flexibility Services whilst maintaining the level of reserved capacity required for RaaS. This contributes to the larger reliance on the RaaS fee over the life of the project.

Figure 5: Drynoch Flexibility Services margin per year based on Cornwall Insight Central price scenario

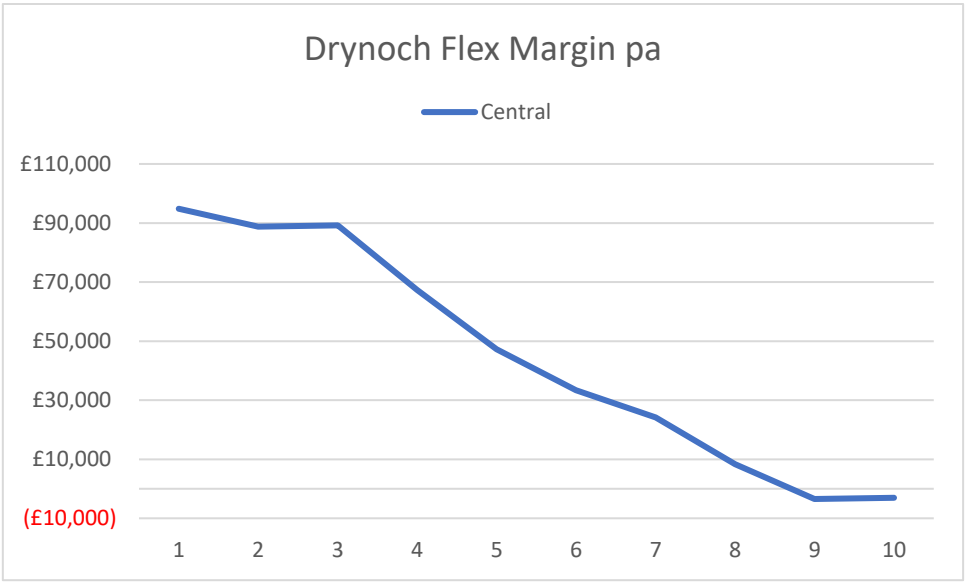
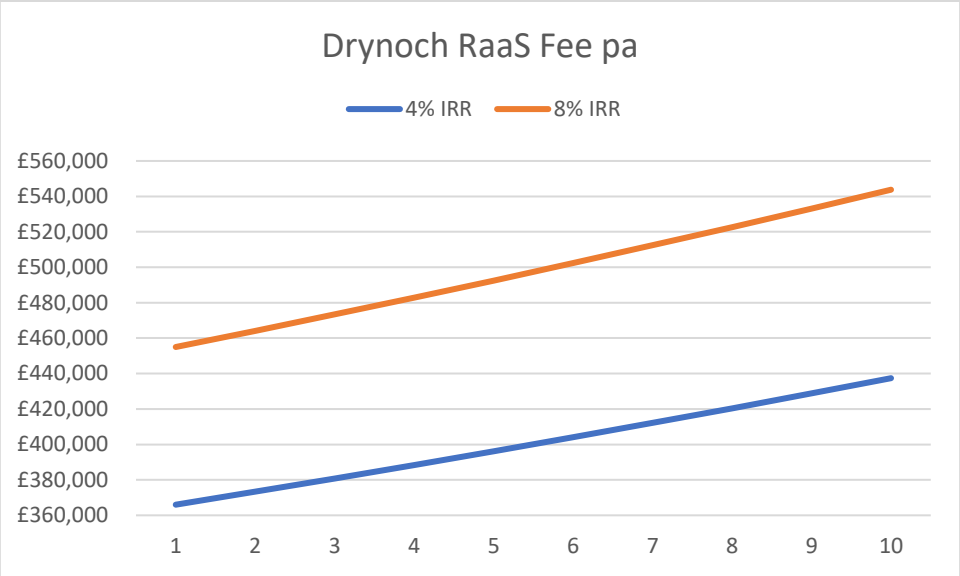


Figure 6 shows how the RaaS fee increases yearly based on the 2% annual inflation used in the IBC based on the wholesale and balancing price scenarios. Here, the RaaS fees are based on the 4% IRR scenario, and clearly the lower the wholesale and balancing prices, the higher the RaaS fees would need to be.

Figure 6: Drynoch RaaS fee per year based on 4% and 8% IRR scenarios



Generic Site

Table 11 shows the financial outputs of the Generic Site at 4% IRR using the 'Central' wholesale and balancing price scenario, and comparing the three different RaaS Product Design Scenarios; 1 – fixed capacity reserved for RaaS by day, by season for 4 hour duration, 2 – fixed capacity reserved for RaaS by EFA block, by day, by season for 4 hour duration, 3 – variable capacity and duration reserved day ahead based on conditions that cause a network outage e.g. weather. The RaaS Product Design Scenarios are described in more detail in section 3.5 'Project OverviewRevenue Optimisation Strategy'.

Table 11: Generic Site IBC financial outputs based on 4% IRR and 'Central' wholesale price scenario

RaaS Product Design Scenario	4% IRR		
	1	2	3
Cornwall Insight Price Scenario	Central	Central	Central
IRR	4%	4%	4%
Payback (Years)	8.0	8.0	8.0
Cumulative Cashflow	£0.756m	£0.758m	£0.770m
Capex	£3.374m	£3.374m	£3.374m
Year 1 RaaS Fee	£0.340m	£0.342m	£0.324m
Year 1 Flex Margin	£0.138m	£0.137m	£0.153m
RaaS Fee as % of total Revenue	64%	65%	60%

The outputs show that if the DNO could operate under Product Design Scenario 3 with day ahead capacity/duration reservation, this allows the greatest margin from other Flexibility Services, thus allowing the RaaS Service provider to require a lower RaaS fee.

The IBC for the Generic Site assumes there is no import/export limit, which increases the Flexibility Services margins when compared to Drynoch which has assumed limits of 1MVA for import and export.

4.5. RaaS Fee - Key Input Variables

Section 4.4 shows what the required RaaS fee at Drynoch would be based on the 4% and 8% IRR and five and ten year contract lengths.

Sensitivity analysis using the IBC model indicates that the four inputs which could have the most significant impact on the RaaS fee are:

- IRR – the lower the IRR, the lower the potential RaaS fee required
- Capex – the lower the capex cost for purchasing and installing the BESS, the lower the potential RaaS fee required
- Flexibility Services Margin – if the RaaS Service Provider could generate a higher margin from other Flexibility Services, this would reduce the level of RaaS fee required
- Corporation Tax – this is currently at 25%, and a lower rate over the course the contract may enable the RaaS Service Provider to reduce their required RaaS fee

The two subsections below indicate the level to which each of these inputs would need to be varied to reduce the associated RaaS fee.

Drynoch

The four inputs highlighted above were adjusted individually to see the extent to which each would need to be adjusted (with no changes to other inputs) so that the required RaaS fee would be £200k p.a. or lower. The results are shown in

Table 12.

Table 12: Drynoch £200k RaaS fee variables

Input	Value	Comments
IRR	<0%	With a £200k RaaS fee p.a. the project would have a negative IRR
Capex	£1,750,000	42% reduction on the assumed £3.0m budget
Flexibility Margin	407% increase	Flexibility margin would need to increase from £0.4m to £2.3m over 10 years, based on the 'Central' wholesale and balancing price scenario
Corporation Tax	<0%	Not viable

In summary, to reduce the required RaaS fee a combination of changes would be needed, as no one variable alone could achieve a reduction in fee to £200k.

Generic Site

Considering the Generic Site, Table 13 presents the Year 1 and 10 Year Total RaaS fees for each of the three RaaS Product Design Scenarios and under each of the Low, Medium and High wholesale and balancing price scenarios based on a 4% IRR target. Table 13 compares the figures for the Flexibility Services margins under each scenarios.

Table 12: Generic Site Year 1 and 10 Year Total RaaS fees by RaaS Product Design and wholesale price scenario

Price Scenario	RaaS Fee					
	Year 1			10 Year Total		
	1	2	3	1	2	3
Low	£375,000	£375,000	£356,000	£4,106,145	£4,106,145	£3,898,101
Central	£340,000	£342,000	£324,000	£3,722,905	£3,744,805	£3,547,710
High	£300,000	£302,000	£285,000	£3,284,916	£3,306,816	£3,120,670

Table 13: Generic Site year 1 and 10 Year Total Flexibility Services margin by RaaS Product Design and wholesale price scenario

Price Scenario	Flexibility Services Margin					
	Year 1			10 Year Total		
	1	2	3	1	2	3
Low	£134,212	£133,432	£149,254	£1,688,981	£1,667,992	£1,939,970
Central	£137,736	£137,283	£153,294	£2,072,265	£2,043,442	£2,328,450
High	£147,664	£146,904	£163,542	£2,657,581	£2,619,498	£2,916,923

As to be expected the 'Low' wholesale and balancing price scenarios generate the lowest Flexibility Services margins, and therefore equate to the highest RaaS fee, conversely for the Cornwall Insight 'High' price scenarios. Importantly, RaaS Product Design Scenario 3 results in the highest Flexibility Services margin, and therefore provides the lowest RaaS fee option to the DNO. This indicates two key potential opportunities for improving the economics and financial attractiveness of RaaS:

- Adaptation of the approach used to define a DNO's requirements for RaaS services levels
- Potential benefits from enhanced forecasting capability

As with Drynoch, the four key inputs noted above were adjusted individually to see the extent to which each would need to be adjusted (with no changes to other inputs) so that the associated RaaS fee would be £200k p.a. or lower.

Table 14: Generic Site £200k RaaS fee variables

Input	Value	Comments
IRR	<0%	At £200k RaaS fee pa the project would make a negative IRR
Capex	£2,430,000	28% reduction on £3.4m budget
Flexibility Margin	88% increase	Flexibility margin would need to increase from £1.5m to £2.9m over 10 years, based on the 'Central' wholesale and balancing price scenario
Corporation Tax	<0%	Not viable

Again, a combination of changes would be needed to reduce the required RaaS fee to £200k, although the changes would be less than indicated with the Drynoch assessment.

5. Investor Business Case Summary and Conclusions

It is clear that the Investor Business Case for RaaS will depend on the specific location and requirements of a site, and whether the proposed RaaS fee is attractive to the DNO.

The key inputs into the IBC are:

- The cost of installing and operating the BESS considering site specific factors associated with geographical location
- The length of the RaaS contract
- The margin that can be achieved from the BESS from participation in other Flexibility Services, at the same time as being available for the provision of RaaS
- The availability and cost of land to install the BESS
- The IRR target of the Investor
- The RaaS fee that it would be appropriate (cost effective) for the DNO to offer

Drynoch was modelled on the basis that the required energy capacity would be reserved for RaaS, with the available headroom capacity used to participate in other Flexibility Services. To provide an understanding of what may influence the economics of RaaS for both the Investor and the DNO, the IBC was run using different IRR targets, differing RaaS Product Design Scenarios, and different wholesale and balancing price scenarios, to provide a sensitivity analysis that can inform the future development of RaaS through the project.

Based on the analysis specific to Drynoch, for a 4% IRR, the lowest RaaS fee that could be required by an Investor based on the original RaaS concept was £366,000 in year 1, and at 8% IRR it was £455,000. If it was not possible for the DNO to meet this payment level, it is highly unlikely that an Investor would choose to install a BESS which had a primary function of reserving sufficient capacity to supply the electricity that may be required to meet local demand over a four hour period of time. In this event, a different RaaS Product Design Scenario to those initially assessed through the project, and/or the use of an energy storage scheme installed for a different primary purpose (and so with RaaS as an additional, 'bonus', income), may be options for the cost effective implementation of a RaaS scheme.

For the Generic Site each of the RaaS Product Design Scenarios, and wholesale market and balancing price scenarios, were modelled based on a 4% IRR target. The lowest year 1 RaaS fee was £285,000 and the highest was £375,000.

For both Drynoch and the Generic Site, key inputs were changed within the IBC model to see how the RaaS fee could be reduced to £200k when considering the original RaaS concept of reserving sufficient capacity to provide a 4 hour RaaS response, and though in both instances this may be possible through a combination of changes in costs or income from other Flexibility Services, the required changes may be considered unrealistic at present. Again, this indicates that changes to the RaaS product design (and DNO specification of RaaS requirements) may be beneficial for improving the attractiveness of RaaS to both an Investor and DNO.

Whilst it is useful to also assess a Generic Site as a comparison for the purposes of this report, it will be important that each potential future site is assessed and modelled individually, using site specific and Investor specific factors. This will allow each potential RaaS Service Provider to determine the level of RaaS fee that it would be possible to offer to a DNO through the RaaS tendering and procurement process.

This report has provided indicative values based on specific inputs and the initial concept for RaaS, but it is clear that each revenue or cost creates a risk or opportunity to the Investor Business Case, and

therefore to the RaaS fee. For example lower BESS costs would reduce the RaaS fee, and higher or lower Flexibility Services margins would reduce or increase the required RaaS fee respectively.

The key outcomes from this report are:

- Each site would have to be assessed individually, though programmes of RaaS deployment may factor into those assessments (e.g. due to economies of scale in the purchase of BESS assets or other associated services)
- Keeping BESS costs as low as possible and maximising Flexibility Services margins are key to reducing the RaaS fee and making RaaS most financially attractive for both the Investor and DNO
- Investors with lower IRR targets will be more competitive, this will typically be based on their cost to fund investments
- For any site, the DNO is expected to evaluate the RaaS fee proposed by the Investor against Interruption Incentive Scheme (IIS) costs, Value of Lost Load (VoLL) impacts, or network reinforcement costs, other benefits may also be considered by the DNO (e.g. commitments to improve service to their customers, or to support wider social and government aspirations such as Net Zero), and so these factors must also be taken into considered when evaluating the benefits of and business case for RaaS

6. Risks and Opportunities associated with the Investor Business Case

Table 15 presents key items identified as creating a risk or opportunity for the IBC or the RaaS Fee, and provides an indication of their materiality in the view of the RaaS project team. These factors should be considered by both Investors and DNOs when evaluating suitable locations for RaaS.

Table 15: IBC and RaaS fee Risks and Opportunities

Item	Risk or Opportunity	Description	Impact (RaaS Fee and/or Investor)	Materiality
Grid Import/Export Limits	Risk	These limits will govern the point in time charging and discharging capability of the BESS, which in turn may impact the MWs available for the provision of other Flexibility Services	**RaaS Fee** Anything that reduces the margin available from other Flexibility Services will increase the RaaS fee Conversely, where a DNO is able to reduce or remove import/export limits for all of, or a certain proportion of, the time, this would represent an opportunity for RaaS	High where applicable (not all sites will be subject to limits which restrict the commercial optimisation of the battery)
Flexibility Services Prices	Both	Prices across different markets can be volatile and difficult to forecast - regulation, legislation, power demand and electrification, growth in renewables, and impacts of climate change will each continue to have an impact on prices and on the potential structure of different Flexibility Services	**RaaS Fee** The volatility may result in the RaaS Service Provider requiring a higher RaaS fee to mitigate against lower revenues from other Flexibility Services, conversely an increase in the wider use of Flexibility Services to support network operation, local use of sustainable energy sources, etc. may result in increased income from other markets thereby requiring a lower income from RaaS **Investor** If Flexibility Service prices drop or	High

			increase over the course of a RaaS contract, this may influence the commercial optimisation strategy required for the BESS, or may impact the IRR	
BESS Cost	Both	The BESS capex cost is a key driver of the RaaS fee, and the opex cost is also an important consideration	**RaaS Fee** A reduction in BESS cost (e.g. through economies of scale or technology development over time) will result in a lower RaaS fee **Investor** Where a RaaS contract has been awarded, negotiations regarding the BESS costs or efficiencies in operation will result in a higher than forecast IRR	High
RaaS Contract Length	Both	The DNO will determine the RaaS contract length, however a BESS is expected to have at least a 10 year life during which it would be available for RaaS and/or other Flexibility Services	**RaaS Fee** If the RaaS Service Provider is not guaranteed a 10 year contract and cannot make their target IRR from other Flexibility Services then they will require a higher RaaS fee **Investor** The RaaS Contract Length will influence investment decisions, and factors such as a 'rolling RaaS contract' would need to be taken into consideration	High
Land Lease Fee	Both	The RaaS Service Provider may need to lease land for	**RaaS Fee** High lease fees will increase costs for the RaaS Service	Medium

		installation of the BESS, or they may have low cost available access to suitable land (e.g. sites associated with I&C or renewable generation schemes)	Provider and to influence the RaaS fee required	
Aggregator Fee	Both	At present Aggregator contracts are typically for <5 years	**Investor** It usual to contract with an Aggregator for 2/3 years - where needed for RaaS (i.e. where this function can't be provided by the RaaS Service Provider) an increase in the fee percentage at renewal would have a negative impact on the RaaS Service Provider's IRR, and vice versa	Medium
Number of RaaS events per year	Risk	The uncertainty inherent in the occurrence of faults on the network means that it is not possible to predict the number of RaaS events that will occur in any given year, and therefore the associated income from utilisation payments (and suspension of participation in other Flexibility Services and markets - this must be factored into a RaaS Service Provider's RaaS fee pricing	**RaaS Fee** The RaaS Service Provider's perceptions of and appetite for risk will influence the payment structure that they may seek for RaaS (i.e. balance of fixed, availability, and utilisation payments) **Investor** Significant variances to the expected/assumed number of RaaS events over a given period of time may impact the Investor's IRR	Medium

The Investor risks associated with RaaS are largely dependent on which costs/benefits are firm and agreed in advance of project implementation.

Of the risks identified above, the potential revenue from other Flexibility Services presents potentially the most volatile (and therefore key) risk to Investors. The value that the BESS can realise in non-RaaS markets is largely dependent on service auctions and market conditions.

As it is not readily possible for either of these elements to be influenced by the RaaS Service Provider at present, they may opt to:

- Add a pricing premium to their proposed RaaS fee (or other Flexibility Services prices) to reflect some of the market price variability risk, particularly where the required RaaS fee is relatively low, in effect sharing some of this risk with the DNO
- Ensure the BESS can access value across multiple current (and upcoming) Flexibility Services revenue streams, with an active development program to identify and capitalise on participation in all suitable markets

It is recommended that potential Investors and RaaS Service Providers participate in industry initiatives such as the ENA's Open Networks project, or by responding to industry consultations published by individual DNOs, NG ESO, Ofgem, or other industry organisations, to ensure that their views are represented and reflected as Flexibility Services product continue to be developed and refined. Accordingly, the RaaS project will continue engagement with the potential supply chain during Phase 2 of the project, subject to a positive stage gate decision.

7. Impact of Findings on Subsequent Project Work

The Investor Business Case presented within this report will be evaluated with the DNO business case assessment undertaken by SSEN, to develop a clear understanding of how the business cases align and the financial viability of the RaaS concept as currently proposed. The project will also seek to identify all ways in which the commercial attractiveness of RaaS to both DNOs and Investors can be maximised.

The business case evaluation, together with the detail design work undertaken in Phase 1 of the project, will be used to inform the project's Stage Gate Decision Point regarding the progression to Phase 2 of the project and the installation and trial of a RaaS solution on SSEN's network.

Subject to a positive Stage Gate decision, the project should consider:

- Actions to minimise BESS costs, including:
  - BESS sizing factors driven by network protection requirements, rather than capacity to deliver RaaS (or other Flexibility Services)
  - Other potential technologies to trigger network protection and their relative financial impact
  - Connection costs
- Actions to maximise revenues from wider Flexibility Services, including:
  - Continued investigation of all sources of potential revenue for the BESS - this will provide a mitigation to the fluctuating value in the various Flexible Services markets
  - A review of the DNO specification of RaaS service level requirements
  - Investigation of opportunities for optimising the connection import and export capacity (i.e. reducing or removing constraints) to allow the BESS maximum revenue generating opportunities
- A detailed appraisal of SSEN primary substations where interruptions are highest, including, if possible, an appraisal of the necessary associated fault level and protection scheme requirements which will have an influence on the size and capabilities of the BESS

Costain's ongoing stakeholder engagement activities during Phase 2 will also be used to further explore and obtain valuable insight from the wider industry, with findings incorporated into the business case evaluation, and other project activities, where applicable.

Appendix 1 - Supporting project activities used to develop the Investor Business Case

The table below lists the prior project activities which have supported development of the Investor Business Case.

IBC Section	Contribution from Deliverables or Work Packages (WP)
RaaS Introduction	n/a
Investor Types	C5.1 'Costain commercial input into investment and business case construction', Costain, July 2020
Suitable Locations	E2a.1 'Site Selection', E.ON, February 2021 E2a.2 'Front End Engineering Design', E.ON, February 2021
Technical Specification	E2a.1 'Site Selection', E.ON, February 2021 E2a.2 'Front End Engineering Design', E.ON, February 2021
Procurement Strategy	E3a.1 'Identification and qualification of longlist of potential suppliers for components in scope of E.ON', E.ON, December 2020 E3a.4 'Detailed Design for RaaS BESS & EMS', E.ON, October 2021 C6.1 'Investigation into the Wider Potential of RaaS', Costain, November 2021 C6.2 'Risk rating and suggested procurement method for each role', Costain, April 2021
Revenue Optimisation	E4.1 'Future Scenarios for Flexibility Markets in which the RaaS Battery System can be Optimised', E.ON, November 2020 E4.2/E4.3 'Optimisation Assessment for RaaS Battery Operation at the RaaS Trial Site and a generic site', E.ON, August 2021 C4.1 'Costain review and contribute to market analysis and flexibility markets assumptions based on stakeholder engagement with range of potential future market operators, Costain, July 2020 E5.1 'Modelling Methodology', E.ON, August 2020
Contract Strategy	Work Package 2: Front End Engineering Design Work Package 3: Detailed Design Work Package 4: Operational Commercial Optimisation Work Package 5: Business Model Work Package 6: Supply Chain Engagement
Business Case Assumptions	Work Package 2: Front End Engineering Design Work Package 3: Detailed Design Work Package 4: Operational Commercial Optimisation Work Package 5: Business Model Work Package 6: Supply Chain Engagement

Cost Breakdown	Work Package 2: Front End Engineering Design Work Package 3: Detailed Design Work Package 6: Supply Chain Engagement
Financial Business Case	Work Package 2: Front End Engineering Design Work Package 3: Detailed Design Work Package 4: Operational Commercial Optimisation Work Package 5: Business Model Work Package 6: Supply Chain Engagement
Scenario Matrix	Work Package 2: Front End Engineering Design Work Package 3: Detailed Design Work Package 4: Operational Commercial Optimisation Work Package 5: Business Model Work Package 6: Supply Chain Engagement
Risks & Opportunities	Work Package 2: Front End Engineering Design Work Package 3: Detailed Design Work Package 4: Operational Commercial Optimisation Work Package 5: Business Model Work Package 6: Supply Chain Engagement
Summary & Conclusions	Work Package 2: Front End Engineering Design Work Package 3: Detailed Design Work Package 4: Operational Commercial Optimisation Work Package 5: Business Model Work Package 6: Supply Chain Engagement