Scottish & Southern Electricity Networks

RIIO-ED2 Investment Decision Pack

Power Systems Analysis (PSA)+

Investment Reference No: 39/SSEPD/IT-DSO/PSA+

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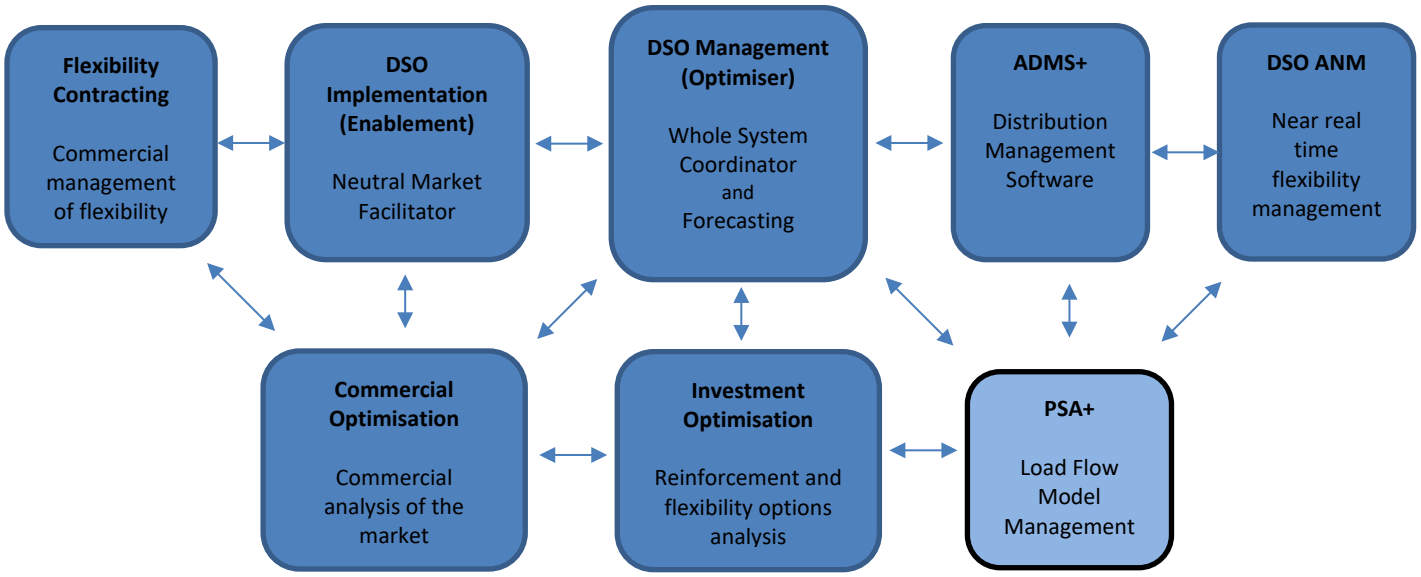
Definitions and Abbreviations	
ADMS	Advanced Distribution Management System
BPDT	Business Plan Data Table
CAPEX	Capital Expenditure
CEG	Community Energy Group
CMZ	Controlled Managed Zones
DER	Distributed Energy Resources
DG	Distributed Generation
DSO	Distribution System Operator
EJP	Engineering Justification Paper
EV	Electric Vehicle
FTE	Full Time Equivalent
GIS	Geographical Information System
IDP	Investment Decision Pack
IT	Information Technology
LCT	Low Carbon Technology
NIC	Network Innovation Competition
NPV	Net Present Value
ODIF	Output Delivery Incentives - Financial
OPEX	Operational Expenditure
PSA	Power System Analysis

1. Executive Summary

Having the ability to complete real-time Power System Analysis (PSA) of the distribution system is a growing essential requirement for all distribution system owners and operators; much needed to properly facilitate customer needs and embrace the principle of 'flexibility first' whilst easily accommodating the connection of new low carbon technologies and the increased complexity they introduce in this space. PSA+ enables a centrally managed whole system impedance model to be maintained efficiently and effectively which can be used across all our systems and necessary timeframes. This project builds on the modelling tools set up in the Investment Optimisation project to ensure that they are updated with the current network configuration through integration with other key tools, in particular our Advanced Distribution Management System (ADMS).

The diagram below shows the interactions between the key systems outlined in our IDPs related to DSO. It should be noted that these systems will be integrated with existing key business systems, e.g. our Asset Management Database and Geographic Information System.



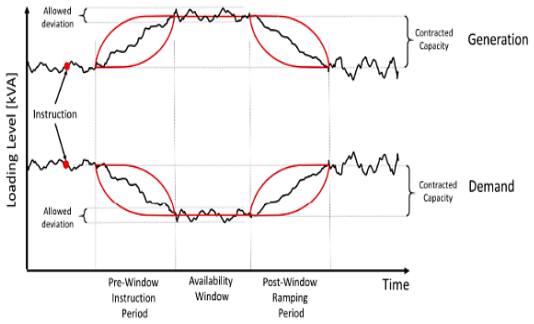
2. Investment Summary Table

Summary Table			
Name of Scheme / Programme	PSA+		
Primary Investment Driver	Progress to Net Zero		
Scheme Reference / Mechanism or Category	39/SSEPD/IT-DSO/PSA+		
Output References / Type			
Cost (CAPEX)	[redacted]		
Delivery Year	RIIO ED2		
Reporting Table	C4		
Outputs Included in RIIO ED1 Business Plan			
Spend Apportionment	**ED1**	**ED2** [redacted]	**ED3**

3. Introduction and Background Information

Power System Analysis (PSA) modelling tools have been critical to the understanding and planning of electricity networks for many years, almost from the start of the availability of computing tools. We currently use several tools, ranging from simple tools used with the low voltage system and enhanced systems used with the high-voltage and extra high-voltage systems. The need to apply the 'flexibility first' principle habitually introduces a new level of complexity in this arena which in-turn supports the need for enhanced tools and systems. We have set out in our Investment Optimisation project how we intend to model our distribution systems to ensure we can continue to service Flexibility in the most affordable way for our customers.

Day to day management of the Market will require regular updating and remodelling of the network, based on the current or expected network connectivity model, generation and demands, all day, time and weather adjusted. This will require not only suitable tools, but validated models for all parts of our network, fed by near real-time data from many of our core systems. Feed systems will include our Advanced Distribution Management System (ADMS), Geographical Information System (GIS), historical records (from our Data Historian, supplemented by our 'Data Lake'); plus, external information inputs such as weather data.



The inputs and outputs of the models must be able to interact with our DSO Management (Optimiser) tools, in particular forecasting. The model management is important to ensure that PSA+ is suitable for all of key processes, from the near real-time instance just discussed through to supporting commercial decision making to finally representing multiple future variations of the model for more traditional planning. This will enable distribution system modelling covering technical requirements and all asset/ technology types. This project covers the establishment of the model

framework, and the necessary integrations with other tools and data and in RIIO-ED2 we expect models to be established covering HV systems and above, plus initial developments for improved LV system analysis.

4. Business Plan Fit

This project can be mapped to following strategic themes:

Progress to Net Zero	Safe, resilient and responsive networks	A trusted and valued service to customers and communities	Positive Impact on Society
✓	✓	✓	✓

5. Optioneering

This area is currently a focus for several NIC (Innovation) projects across the industry, including projects that we are currently managing such as TRANSITION and LEO. Also, the development of PSA is evolving through the new requirements from producing a Network Development Plan (NDP) which will point to specific areas of improvement and fulfil our whole system licence condition requirements and own aspirations. This project will therefore rely on the outputs from these projects, in terms of what will need to be modelled and how. We will work extensively with our supply chain and partners (in particular academia) to ensure the implementation is optimised. Currently we expect the tool(s) and implementation to include:

- Automated capacity modelling to accurately understand impact on the distribution system in real-time via intelligent modelling.
- Load disaggregation modelling to allow load assumptions to be attributed to the lowest possible circuit/ customer level.
- 2-way, 3 phase and unbalanced flow modelling to understand the available system scope.
- Collating information to help mitigate insufficient growth resource expectation with detailed modelling.
- Greater automation of DERs and interactions with markets and disparate control systems to understand widespread system stability and characteristics.
- Using near real time, and at least half hourly, data feeds from:
    - ADMS.
    - Data Historian.
    - GIS.
    - Weather and market forecasts.
    - Other historical data.

The output from the tool(s) will also help inform the analysis behind the heat maps and the production of the NDP we will deploy in other projects (e.g. Open Door) to aid flexibility opportunities. This project is based on several assumptions which will be made firm when learning from research projects and/or experience in this field is obtained. In addition, we will continue to work with others to ensure our RIIO-ED2 implementation is optimised and the best value solutions are developed to benefit our customers and stakeholders.

5.1.1 Alternative Options

Power System Analysis is a key enabler for DSO, so must be provided to support the Flexibility Markets. However, it is vital that the system is keep up to date with the current operational status of the network, so that Flexibility is maximised at all times. To do this manually would require a vast number of specialists (see Benefits), and in reality, coordinating that number of people would be extremely difficult. A manual system has therefore been discounted.

Given the pace of development in IT solutions, the market will be re-examined throughout the project lifecycle to ensure the best value solutions at that time are chosen for delivery.

6. Stakeholder Evidence

Stakeholder requirements have historically driven Network Development Plan (NDP) requirements and now there are also whole system, flexibility and connection requirements which all need to be fully understood when predicting distribution system impact. This development will enable this more complex and sophisticated analysis to be completed in an efficient and effective manner.

Much of our stakeholder engagement for DSO has been through Open Networks as this is where we have been putting forward the industry position to gain stakeholder feedback in a consistent and efficient way for the industry. There is related work around real time data exchange that has been developed in WS1b (https://www.energynetworks.org/creating-tomorrows-networks/open-networks/). PSA+ underpins key stakeholder requests relating to better visibility of our distribution systems and it is a fundamental aspect of enabling DSO. In our ***Digital Investment (Annex 5.2)*** we run through our stakeholder evidence and triangulation in detail.

7. Analysis and Cost

Costs have been developed using a bottom up approach and have been based on the best currently available solutions. IT systems in this space are developing at a rapid pace and therefore we will continue to review the market for the best value option to meet the requirements set out above. The project has been assessed over a 5-year lifecycle, with both Opex and Benefits equated for that operational period, as IT projects often need updating after 5 years. NPVs of both 5 and 45 years have therefore been quoted below.

7.1 Cost Profile

This project has the following cost profile and will be a waterfall project. For comparison an alternative manual option has been used in the CBA, however in practice this would not be able to deliver the timeliness of response necessary to maximise the potential of Flexibility. The full build-up of costs is contained in the ED2 IT Investment Plan (Non-Op Capex) Cost Estimate spreadsheet.

	Total £'M	2023/24 £'M	2024/25 £'M	2025/26 £'M	2026/27 £'M	2027/28 £'M
CAPEX	[redacted]			[redacted]	[redacted]	
ED2 OPEX	[redacted]				[redacted]	[redacted]
ED2 Benefits	[redacted]				[redacted]	[redacted]
5 Year OPEX	[redacted]					
5 Year Benefits	[redacted]					
NPV 5 Year (Recommended Option)	[redacted]					
NPV 45 Year (Recommended Option)	[redacted]					
NPV 5 Year (Alternative Option)	[redacted]					
NPV 45 Year (Alternative Option)	[redacted]					

7.2 Benefits

7.2.1 Financial Benefits

The benefits below will commence from go live of the system.

	Total	Year 1	Year 2	Year 3	Year 4	Year 5
This development will remove the need for new manual resources to model and conclude the system planning requirements for c.300CMZs. This is an equivalent of 114 FTEs in the final year of ED2 (SS08 rate used). Note that 25% of the estimated benefit of PSA+ has been assigned to the DSO Management (Optimiser) project, as PSA+ cannot operate without that tool. A further 15%	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

	Total	Year 1	Year 2	Year 3	Year 4	Year 5
has been attributed to Connectivity++ as without it being linked connectivity model it would take a significant amount of additional time to maintain the models.						

This project is fundamental for the efficient and effective use of the 'flexible first' principle and it will help negate the need for the related system reinforcement. We estimate that we will have c.1600 flexibility contracts through the ED2 period ranging significantly in size, complexity and value. Some of the key benefits are:

- More granular information to make investment decisions.
- Capability to understand the loading of assets to support more targeted maintenance and replacement of assets.
- Due to its near real-time nature, supports pre-emptive decision making to avoid damage to equipment and meet customer requirements in good time.
- Reduces the need for a significant increase in highly skilled system planning Engineers and other such experts.

7.2.2 Non-Financial Benefits

The tool(s) are a major foundation for Flexibility markets, which cannot operate without such analysis in near real time. This enables more granular analysis needed to serve our customers and stakeholders. Some of the other key benefits from more timely and accurate analysis of our network includes:

- Improved flow of information to customers during supply interruptions.
- Provides a core foundation for managing Flexibility.
- Provides a much richer source of information for Stakeholders and Partners.
- Reduction in business carbon footprint.
- Reduction is waste to landfill and hazardous waste volumes and disposal needs.

7.2.2.1 Foundation to other Projects/Initiatives

None.

7.3 Key Assumptions

The current programme and costings assume that all planned RIIO-ED1 system changes will be complete before the start of RIIO-ED2. If some of the current planned application changes are not completed, this will increase the complexity, and hence cost and timescale, of this project.

Asset and connectivity data accuracy is vital.

Current tools are unlikely to be fully adequate, so will need new tools.

7.4 High Level Dependencies

This project is dependent on a number of other projects, in particular the Connectivity++ project for network connectivity accuracy, the MDM, Data Lake & Analytics project for external data, and the Investment Optimisation project for the 'next gen' modelling tool(s).

Our suite of DSO projects all rely on each other to create an optimised and holistic approach to DSO. If any one of these are unable to be delivered it would undermine our DSO capability leading to an increase in resources needed to undertake the capabilities manually while reducing our agility and scope for optimisation.

The project is also dependent on the various research (Innovation) projects currently in progress.

7.5 Deliverability & Risk

Our deliverability strategy [chapter 18] describes our approach to evidencing the deliverability of our overall plan as a package, and its individual components. Testing of our EJPs has prioritised assessment of efficiency and capacity, and this has ensured that we can demonstrate a credible plan to move from SSEN's ED1 performance to our target ED2 efficiency. We have also demonstrated that SSEN's in house and contractor options can, or will through investment or managed change, provide the capacity and skills at the right time, in the right locations. This assessment has been part of the regular assessment of our EJPs, IDPs and BPDTs. Our ***Deliverability Strategy (Annex 16.1)*** and ***Supply Chain Strategy (Annex 16.2)*** are included in the Business plan Submission.

Our deliverability testing has identified a major strategic opportunity which is relevant to all EJPs.

- In ED2 SSEN will change the way Capital Expenditure is delivered, maximising synergies within the network to minimise disruptions for our customers. This is particularly relevant for a Price Control period where volumes of work are increasing across all work types.
- The principle is to develop and deliver Programmes of work, manage risk and complexity at Programme level and to develop strategic relationships with our Suppliers and Partners to enable efficiency realisation.

8. Conclusion

This project will deliver the Power System Analysis ability we need to serve our customers and stakeholders by ensuring distribution system models are updated in real-time with accurate information. All of this is needed to facilitate our aspirations for the habitual adoption and application of 'flexibility first', our Net Zero commitments and increased value for our customers and stakeholders. A manual alternative would be far more costly than the proposed system and would limit the potential of Flexibility due to slower response to network changes.