



**Scottish & Southern**  
Electricity Networks

SHE Transmission

RIIO-T2 Business Plan

# **SHE Transmission RIIO-T2**

## **IT Investment Plan**

### **(Non-Operational Capex)**



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## 1. RIIO-T2 IT INVESTMENT PLAN SUMMARY

SHE Transmission has committed in our Digital Strategy (T2BP-PAP-0006) to become a more fully digitalised business, reflected in integrated data, systems, processes and ways of working, which will support and enable delivery of our strategic objectives. In order to support this, our RIIO-T2 IT Investment Plan will require a capital investment of £53.3m. A detailed cost breakdown and benefits assessment of the investments contained in this plan can be found within RIIO-T2 Non-Op Capex IT Cost Estimate (T2BP-EST-0014).

This investment plan has been informed by focussed Stakeholder engagement, both internal and external, and by the wider Stakeholder engagement which has informed the SHE Transmission RIIO-2 Business Plan. Ongoing engagement with other utilities, both directly and through international benchmarking groups (ITOMS, ITAMS), will continue to inform and check strategy and roadmap development.

In RIIO-T1 we made significant investment into our Information Technology (IT), including core asset and HR systems and Operation Technology (OT), including SCADA, telemetry and network control systems. This investment was to provide a base for the digitisation of our business, improve our asset management performance and to enable us to operate in a world where we would have different drivers than SSE's Distribution businesses, who will move into a System Operator environment during the RIIO-T2 period.

In RIIO-T2 we will continue that move towards digitisation. Our Stakeholders have told us they want to see a "whole system design approach", with "data driven network development". This IT Investment plan has been built to meet those expectations, with activities split into four main categories. These improvements will also ensure all our data will meet the level of maturity regarding its accuracy, completeness and timeliness, as set out in ISO 55000 and ISO 17020.

Our IT investment projects can be classified either as enablers or providers. Providers tend to be the platforms that deliver tangible benefits, whereas enablers are the necessary tools and functions to support those providers. For example, on the Stakeholders, including Customer Connections, side we will upgrade our systems to manage the overall process so that we can provide the information requested by our Stakeholders. Whilst this work has limited direct financial benefit to us, it will enable Connections applicants to obtain the information they require to plan and manage their investments and use their own resources more efficiently.

The improvements we will implement in RIIO-T2 are an evolution on our RIIO-T1 investment, and for the 4 streams are: Stakeholders including Customer Connections (as informed by Stakeholder engagement, and being Stakeholder led, as set out in our Digital Strategy)

- Pre-connection application improvements, both in terms of information provided and process,
- An internal system managing the end-to-end connection process,
- Harmonisation of our customer management systems,
- Improved Stakeholder information driven through our website,
- Enabling our staff and Stakeholders to access up to date information about our network via a simple to use contemporary interface.

Assets, which will both enable efficiencies and provide core information requested by Stakeholders

- Master Data Management and a central 'Data Lake', to provide a base for all other systems (e.g. pre-connection information),
- Investment optimisation tools, covering both existing and new assets, using analytics and Artificial Intelligence,
- Maturing Building Information Modelling (BIM) to Level 2 across the majority of our asset base,
- Enabling technologies, including 3D metal printing and augmented reality,

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### Work Management

- Work management for all our work and assets,
- Inventory management, especially strategic spares,
- Harmonisation of the Environmental ensemble of tools, including engagement, management and marine.

### Operational Technology Control Systems

- Work to support our new control centre, including a new disaster recovery centre,
- Inter control room coordination with National Grid Electricity System Operator (NGESO) and other Transmission Operators (TO's),
- Improved situational awareness with new alarm prioritisation and replacement of obsolete equipment.

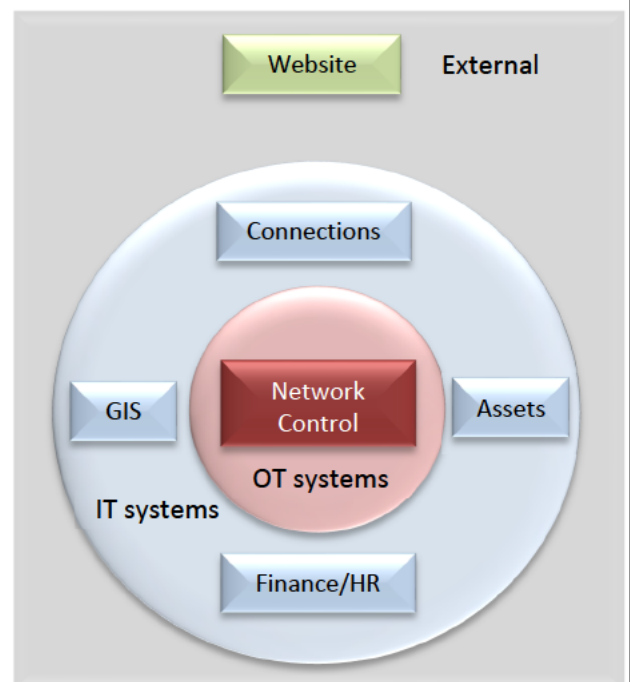
### Our systems exist in three 'zones':

- External facing tools that can be accessed by Stakeholders, such as our website or proposed pre-connection information improvements,
- Internal Information Technology systems that manage the bulk of our day to day tasks,
- Operational Technology Control Systems, that monitor and control our network, and comply with the strict security rules set out in the NIS Regulations 2018, and related initiatives.

Our plan is based on using the most appropriate technology, both making use of tools successfully deployed by similar organisations and using the latest technology where that is beneficial. However, IT is a rapidly developing area, so we will continue to review our plans throughout the RIIO-T2 period, and update these where new technology provides better solutions.

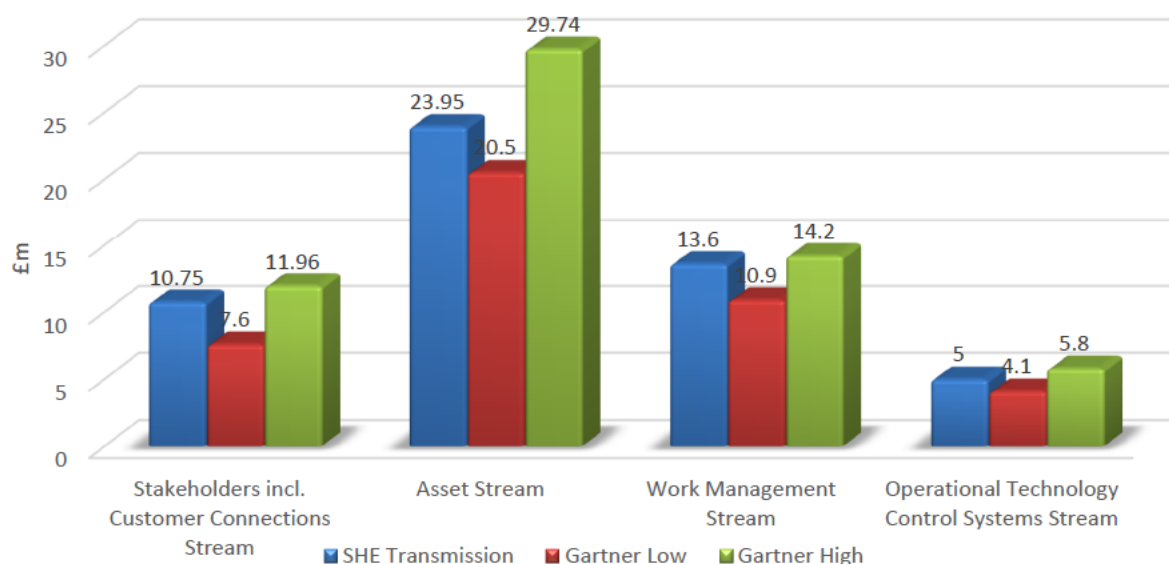
Our CAPEX costings have been built using a 'bottom up' approach, defining the tasks that will be needed in each project, and the resources required to perform those tasks. We have also assessed IT OPEX where that is directly attributable to any project, such as software support for any new applications. [REDACTED]

Our overall approach has been assessed by external technology consultants (Gartner Consulting) who consider the investment plan to be within the expected range. It has been assessed as either following current industry trends or addressing existing shortfalls when compared to peers. The graph below compares our investment against the average investment seen by Gartner in similar companies.



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### SHE Transmission Investment v Gartner Industry Averages



Gartner also assessed our RIIO-T1 investment in IT and found this to be below the level of our peers, although with an increase that is approaching industry averages as the period progressed. Our RIIO-T2 IT Investment plan addresses current shortfall in systems and builds our system towards the digitisation set out in our Digital Strategy.

#### 1.1 Treatment of Benefits

We have made initial assessments of the qualitative and quantitative benefits of our IT Investment Plan. Where IT investments have been Stakeholder led or are required to provide enhanced operational control system stability and functionality, we have not attributed a direct financial benefit where it is recognised that the ambiguity and uncertainty involved in quantifying and assigning a monetary value to intangible items may lead to inaccuracies in our assessments.

In general, the financial benefits from the solution have been calculated over the year of implementation and the following years of the RIIO-T2 period. This is in line with the SHE Transmission's standard investment and Net Present Value (NPV) investment appraisals based on a 5 year lifecycle (given the typical length of technology being in place before becoming up for renewal or part of BAU). At this stage in the development of the IT Investment Plan, the benefits that will be realised from projects that deliver in the last part of the RIIO-T2 period have not been profiled as benefits for RIIO-T3, although this will continued to be reviewed as the respective projects move towards mobilisation. It is recognised, however, that some benefits may be offset by project cost increases or realised over a longer period of time due to the embedding of technology, changes to the way we work, and general productivity and therefore a 5 year time horizon may be too short or may not capture the longer term benefits from the IT investment.

Savings are not embedded directly in our cost base at this stage particularly given some projects are not in operation until the middle of the price control and are part of our attempts to respond to Stakeholder feedback, reduce costs, drive productivity and implement long term improvements in the way we work.

#### 1.2 IT System Security

The security of our IT and OT systems, along with our assets, is critical. In line with RIIO-T2 submission requirements, we have separate documents that set out our policies and procedures for security, and for that reason security is not covered in detail in this document. Security is of course fundamental to any of our IT systems changes, and all the projects in the document include work, and related costs, for security. Such work is integral to any changes we make to



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systems, so that they are 'secure by design'. For further details about security please see our Cyber Security IT Plan (T2BP-PAP-0003): these documents also set out any costs required to ensure our existing IT systems meet the optimal security requirements.





## 2. INTRODUCTION

This IT Investment paper (part of our Non-Op Capex investment) sets out our plans to deliver the core elements of the journey to a fully digitalised business, including data, systems, processes and ways of working, which support and enable delivery of SHE Transmission's strategic objectives. In RIIO-T2 we have set out four Strategic Themes:



Our plan has been based on our need to continue to move to become a digital business, required/implied by our Stakeholders and in common with our peers. It has been assessed by independent reviewers (Gartner Consulting) as either following current industry trends, or addressing shortfalls compared to peers.

This plan and our overall Digital Strategy has also been, and will continue to be, informed by outputs from the OFGEM and BEIS jointly commissioned Energy Data Taskforce, which published its report, A Strategy for a Modern Digitalised Energy System, in July 2019. The five recommendations in this report have informed and supported SHE Transmission's investment plan and will also be further evaluated through the ENA Data Working Group, which SHE Transmission and Scottish and Southern Power Distribution (SSEPD) have joined.

1. Digitalisation of the Energy System
2. Maximising the value of data
3. Visibility of data: Data Catalogue
4. Coordination of asset registration
5. Visibility of infrastructure and asset: digital system map

## 2.1 Document Content & Structure

The IT Investment Plan is structured as follows:

### Section 3: RIIO-T1 Non-Op Capex Investment Progress and Impact on RIIO-T2

This section provides an explanation of our performance against RIIO-T1 Non-Op Capex outputs and how this has shaped our investment plans for RIIO-T2. It demonstrates where SHE Transmission has went beyond our stated RIIO-T1 obligations to deliver improved asset data systems, work management enablement and independent operational technologies.

### Section 4: RIIO-T2 IT Investment Project Summary

This section provides a breakdown of our capital investment plan at project and category level. All planned investments over the RIIO-T2 period have been captured within the IT Investment Plan. Where appropriate, license requirements have been captured within the IT plan for the anticipated warranty period, beyond which, these costs will transfer to OPEX.

### Section 5: RIIO-T2 Stakeholders including Customer Connections

This section provides a summary of the IT projects identified within our Stakeholder including Customer Connections category. A high-level summary of each project is provided along with the anticipated expenditure requirements and benefits calculation.

### Section 6: RIIO-T2 Asset Projects

This section provides a summary of the IT projects identified within our Asset category. A high-level summary of each project is provided along with the anticipated expenditure requirements and benefits calculation.

### Section 7: RIIO-T2 Work Management Projects

This section provides a summary of the IT projects identified within our Work Management category. A high-level summary of each project is provided along with the anticipated expenditure requirements and benefits calculation.

### Section 8: RIIO T2 Operational Technology Control Systems

This section provides a summary of the IT projects identified within our Operational Technology Control Systems category. A high-level summary of each project is provided along with the anticipated expenditure requirements and benefits calculation.

### Section 9: Conclusion

This section summaries the contents of this document.

### Section 10: Appendix and Key Assumptions

This section provides a view of the key assumptions used in the construction of this RIIO-T2 IT Investment Plan.

### 3. RIIO-T1 NON-OP CAPEX IT EXPENDITURE PROGRESS AND IMPACT ON RIIO-T2

#### 3.1 Summary

We included three named Non-Op CAPEX IT initiatives to be undertaken during the RIIO-T1 period. These were:

- Separation of the Transmission Control System from the Distribution Control System operated by our sister company SHE Power Distribution,
- A new solution for managing the capital project process,
- New back office management systems (Financial Management).

As can be seen from the following sections, we delivered significantly more than set out in our RIIO-T1 plan, providing better data quality and access to Stakeholders. This was in line with our obligations to manage the network effectively and with the regulator's proposed plans on data quality auditing and assurance. Nonetheless our investment was below many of our peers (source: Gartner Consulting), and we have been increasing spend throughout the RIIO-T1 period to ramp up towards this RIIO-T2 IT Investment plan.

#### 3.2 Connections and Customers

During RIIO-T1 we reviewed the internal processes supporting our obligations to customers and connections. This review culminated in the implementation of a new connections database to allow us to better manage, control and report on our obligations.

The review with our Stakeholders highlighted several areas where we can improve the customer experience and several projects have been proposed in RIIO-T2 to supply timelier information to support customer's pre-applications and during the application, acceptance and delivery processes.

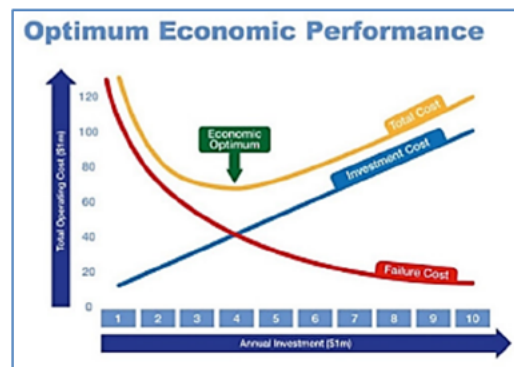
#### 3.3 Assets

##### 3.3.1 Asset Systems

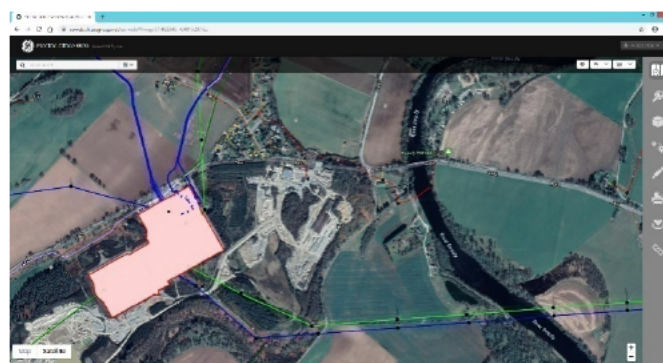
In RIIO-T1 we are implementing a new Transmission Work and Asset Management (WAM) system that will act as our base Asset Register in RIIO-T2. This will be a single source of information for all assets, in terms of their specification and condition, based on manual and drone survey information. In terms of asset health and criticality, it will be linked to our Condition Based Risk Management (CBRM) system that was also implemented in RIIO-T1. CBRM allows us to systematically assess asset health and criticality, based on asset and survey data, along with environmental factors (e.g. location, weather).

We also implemented a new Geographical Information System (GIS), using Smallworld Electric Office, the first instance of this application in Europe. As well as holding the position and connectivity of all assets, it is also linked to the WAM system so that information in both systems is synchronised and will provide network updates for PowerOn (our network control system) in the near future.

These changes have eliminated some instances of silo data recording sources for our asset information, although some areas, particularly regarding video surveys, remain outside of



Output from CBRM



Electric Office screenshot



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core systems: these areas will be addressed in RIIO-T2. Some of the core systems are also not yet integrated, and this will be addressed in RIIO-T2.

### 3.3.2 Investment Systems

Our new systems in RIIO-T1 included the core to enable 3D design. We introduced 3D capabilities within the design teams using an industry leading package, which includes a dedicated design storage solution. This will be an enabler for Building Information Management (BIM) in RIIO-T2. We implemented a tactical collaboration platform to allow the company and supply chain to exchange information related to the capital programme in a controlled way. This platform will be superseded to a large degree in RIIO-T2 as we move to BIM Level 2.

We also updated our modelling systems, with new tools that enable analysis to be applied to any AC or DC network topology and support the simulation of new technologies such as converter-based power generation, HVDC cables and overhead lines, and various types of MW and Mvar controllers.

### 3.3.3 Survey

We increased our range of survey tools in RIIO-T1, including the use of drones. These enable us to have an up-to-date, full visual record of the condition of assets which can be referred to by our asset management and operations teams. The output greatly increases our knowledge of asset condition, whilst reducing risk to our teams, as well as reducing the need for outages for inspection. We are continuing to innovate in the inspection area, including the use of AI controlled robots (<https://sse.com/newsandviews/allarticles/2018/08/robot-trial-takes-sse-innovation-into-the-fast-lane-with-williams/>).



iHawk system screenshot

## 3.4 Environmental Assessment Digitalisation

### 3.4.1 Marine Assessment and Auditing tools

We implemented several new tools and systems in RIIO-T1 that allow us to:

- Map the seabed for proposed and existing cables to demonstrate our compliance with our Marine consents and licence conditions,
- Bring more of this work in house saving on external consultancy fees, use satellite imagery to monitor shipping in the vicinity of cable lines, allowing cable alarms and faults to be pinpointed and assessed in terms of shipping activity,
- Deploy infrastructure to support large scale use of all these tools in both the corporate hubs and local project offices.

### 3.4.2 Onshore Environmental and Safety Assessment and Auditing tools

We implemented tools to schedule various project and static plant assessments and audits. These tools also allow the digitised collation of results from field team in a central repository.

## 3.5 Operational Technology Control Systems

### 3.5.1 Operational Environment Air-Gapping

During the RIIO-T1 operating period SSEN instigated a Cyber Security programme covering all three of their networks operating business including SHE Transmission. Under this programme we assess all the applications used in the control function and moved them into an environment that was air gapped to the corporate environment used by non-control orientated applications.



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The programme has been split into several phases. By the time we enter the RIIO-T2 period the phases to move applications which use Microsoft Windows as an operating system and those that use Unix on Intel will have been moved into this newly created air gapped environment. Each phase has required all tooling to support the operating systems to be implemented prior to the applications being moved into that environment.

In addition to the Windows and Unix applications, the programme has implemented several security tools that monitor the environment 24/7. These tools use artificial intelligence to review the activity within the Operational Technology Control Systems environment, identify potential threats and report these to the core corporate security team for investigation.

### 3.5.2 Control Room Logical Separation

Traditionally our Transmission Control Centre systems (TCC) system and Distribution Control Centre (DCC) system operated by our sister company, SHE Power Distribution (SHEPD) have shared the same operational infrastructure. (application, servers, SCADA).

We made a commitment in the RIIO-T1 to separate the shared TCC and DCC systems. By the end of the RIIO-T1 period this activity will have been completed with all TCC and DCC control functions being operated via separate systems.

Further work will be undertaken in the RIIO-T2 period to physically separate our TCC facility away from the DCC and make further changes to the underlying SCADA systems to support the TCC being in a separate location.

### 3.6 Delivery of the RIIO-T2 Investment Plan

SHE Transmission reviewed the business operating model in early 2019 and identified the need for a dedicated digital team to own the digital strategy and plan. This team has been established with several well experienced senior staff and will be fully populated in the coming months. Engagement with the business, Group IT and Stakeholders has been described above, and this will continue a planned basis. Roles and responsibilities for digital workstreams are being reviewed, with strong commitments from business and group IT teams.

We will also start the preparations for delivery of this RIIO-T2 plan. This will involve our digital team, along with core people from our business areas and IT, in planning the details for the delivery of our plan. As this plan is an evolution programme, to enable a digital business by the start of RIIO-T3, we need to ensure we have all the necessary elements in place so we can commence delivery in April 2021.

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#### 4. RIIO-T2 IT INVESTMENT PROJECT SUMMARY

We plan to deliver the following projects during the RIIO-T2 price control period:

Internal Cost Estimate Project Ref.	Project Title and Brief	Cost £m
5.2	Pre-connection Application	■
5.3	Connection Case Management	■
5.4	Customer Contact Management	■
5.5	Stakeholder Engagement / Website Upgrades	■
5.6	Transmission Universal Interface	■
	<b>SUBTOTAL</b>	■
6.3	Master Data Management and Data Lake	■
6.4	Data Enrichment and Analytics	■
6.5	Smart System Integration (Smart Monitoring)	■
6.6	Linear Assets – Underground and Subsea	■
6.7	Building Information Modelling	■
6.8	Enabling Technologies	■
6.9	Asset Management Nerve Centre	■
6.10	Investment Optimisation	■
	<b>SUBTOTAL</b>	■
7.2	Total Work Management	■
7.3	Inventory Management System	■
7.4	Environmental Ensemble	■
7.5	Workforce Mobility	■
	<b>SUBTOTAL</b>	■
8.2	Deployment of a New Transmission DR Centre ■	■
8.3	Additional Operational Systems Separation	■
8.4		■



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	Inter-Control Centre Protocol (ICCP) Implementation to National Grid and Scottish Power	
8.5	Alarm Prioritisation and Rationalisation	■
	SUBTOTAL	■
	■	■
	RIIO-T2 IT INVESTMENT TOTAL	53.29

## 5. RIIO-T2 STAKEHOLDERS INCLUDING CUSTOMER CONNECTIONS

### 5.1 Stakeholders including Customer Connections Project Summary

Internal Cost Estimate Project Ref.	Project Title and Brief	Cost £'M
5.2	Pre-Connection Information	■
5.3	Connection Case Management	■
5.4	Customer Contact Management	■
5.5	Website Upgrades	■
5.6	Transmission Universal Interface	■
	<b>Total</b>	■

Our aim is to ensure that the company is transparent in the way it engages with its Stakeholders and customers while operating the Transmission Network in the north of Scotland.

The clear goal under this strategic theme is for every connection to be delivered on time. The RIIO-T2 Commercial and Connections Policy (T2BP-PLC-0001) calls on the need to equip customers with digitised information, and to equip customers with digitised tools, to deliver Ambition 1: Optimal connection solutions. Two key areas have been proposed for improvement:

- Making more information available to scheme developers pre-connection application,
- Improving both the information available and the information exchange mechanism during the application and delivery processes.



## 5.2 Pre-connection Application

Name of Scheme	Pre-connection Application
Strategic Theme(s)	Stakeholder-led Strategy
Cost	██████
Benefit Analysis	██████
Planned Delivery Year	2022/23

During a scheme evaluation our Stakeholders have asked if we can provide high level information about connections at specific points on the network. The aim of this information is to allow them to undertake early scheme appraisals before submitting formal information requests.

It is our intention to build a connection 'heat map' covering the Transmission network, along with a lot of additional information about our current network and future network plans. At a high level this map would show the locations of connection points to the network and present the viewer with a shading between green and red to represent capacity and constraints.

The map would take into account:

- The current capacity of the point of connection,
- The current in use capacity of the point of connection,
- The value of capacity applications that have been accepted but have not been connected,
- The value of capacity applications that have been submitted but are yet to be accepted,
- The impacts of proposed upgrade and re-enforcement work.



Our Stakeholders have told us that being in possession of this information during the initial appraisal process will allow specific schemes to be discounted early saving them money during the early stage of the scheme development.

The Transmission connections team will benefit by pushing the early scheme information into the public domain saving them time and effort having to field requests for information from scheme developers during their appraisal process.

The heat map and all associated information to support the map will be published to a location on our corporate website.

Our work in this area is largely focussed on collating and integrating various sources of information, both IT (e.g. locations, connectivity, asset capacity) and OT (loads, performance). At present much of this information sits in disparate locations, including models and spreadsheets. Bringing this information into central repositories will enable us to service the heat map and supporting information.

### 5.3 Connection Case Management

Name of Scheme	Connection Case Management
Strategic Theme(s)	Stakeholder-led Strategy
Cost	██████
Benefit Analysis	██████
Planned Delivery Year	2022/23

The company is under an obligation to respond and progress grid connection applications that they receive within a formal framework. The framework includes timeframes for responding to the connection request, issuing offers and implementing connections.

Our Stakeholders have requested greater visibility relating to the progress of their connection's applications:

- Where is my application in the process,
- Has an offer been issued,
- Has an offer been accepted,
- When will I be able to connect to the network.

During RIIO-T1 the company implemented a tactical connections database to help the internal connections teams manage the flow of information within the company relating to a connection's application. It is our intention during the RIIO-T2 period to implement a full connections case management solution.

The solution will have both internal and externally facing components.

The internal side of the solution will allow the transmission connection teams to manage connection applications that are received by the company:

- Connection applications will be logged with details of all the Stakeholders who are involved in the specific connection process,
- A delivery framework will be applied to each connection application to monitor the progress of the application against our obligations,
- Issues with the application process can be flagged to the appropriate manager quickly for rectification actions to be instigated,
- All information relating to the connection; documents, conversation notes, meeting minutes, offers, acceptances etc will be held centrally against the connection application,
- Allow us to monitor internal performance metrics to understand issues with specific application which fall outside our delivery window.



The external side of the solution will be driven by a Stakeholder account. The Stakeholder account will show the individual or organisation information relating to the progress of the connection applications that they might be involved in:



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- Where the connection application is in the overall process and when the application is expected to pass to the next stage of the process,
- Allow the Stakeholder to submit additional information that has been requested to support the application,
- View key documents.

This solution will improve the visibility of the connection process to our Stakeholders and reduce the load on the connections team responding to progress queries and chasing scheme developers for information. It will also ensure that information (documents, emails, conversation details) are all held in a single repository so all members of the connections team can quickly understand status of the application when they are required to progress it to the next stage.





#### 5.4 Customer Contact Management

Name of Scheme	Customer Contact Management
Strategic Theme(s)	Stakeholder-led Strategy
Cost	██████
Benefit Analysis	████
Planned Delivery Year	2024/25

One of key drivers is to ensure that we treat customers fairly, if things don't go to plan when working with us while operating or connecting to the Transmission Network in the north of Scotland.

As part of our RIIO-T2 Submission, we believe that by improving our customer contact management processes and systems, this will drive:

- Improved customer experience,
- Improved process transparency,
- Increased customer satisfaction scores,
- A single unified customer view

The improved process and systems would ensure that we track when a customer makes contact from the initial interaction to resolution of their enquiry ensuring that we are fair throughout the process.

Only by being transparent and recording all contact from customers, can we identity any potential wider impacts on our network or improvement to our processes; which will ensure that we optimise our customers experiences and delivery a first-class service. As such the system fulfils many of the requirements requested by Stakeholders regarding the management of any query.





## 5.5 Stakeholder Engagement

Name of Scheme	Stakeholder Engagement
Strategic Theme(s)	Stakeholder-led Strategy
Cost	██████████
Benefit Analysis	██████████
Planned Delivery Year	2025/26

During RIIO-T1 we created a separate SHE Transmission corporate website to ensure that our Stakeholders have more visibility of, and transparency over, the company's activities.

Based on what our Stakeholders have stated we do not expect to make major changes to the format of the website. The company will continue to add appropriate content to the website to ensure that our Stakeholders continue to be informed about the company's activities and initiatives.

The website will also act as the gateway to many of the portals use to publish and disseminate information to our Stakeholders. These will include the Pre-connection Information and Connection Case Management activities that have been stated above. The project has no measurable benefits, however provide the main portal for our Stakeholders to access the information they have requested.

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### 5.6 Transmission Universal Interface

Name of Scheme	Transmission Universal Interface
Strategic Theme(s)	Stakeholder-led Strategy Safe and Secure Network Operations
Cost	██████
Benefit Analysis	██████
Planned Delivery Year	2025/26

Building on our other improvements, and as a cornerstone to our Digital Strategy, we will build a system that allows interaction with data from all core applications via a touch screen facility. This will equate to a 'network on your phone', allowing all of our staff and Stakeholders to access up to date information about our network via a simple to use graphical interface, with maps at its heart. This information would not only be made available to our staff, but much of it to our Stakeholders, such as Connections Customers and Regulators. Users will not only be able to see current network information, but interact with that information, and 'drill down' to details they need to understand the network. We will also install large touch screens at our depots and offices, allowing teams to interact with live representations of our assets, giving history, planned interactions, live status and future predictions. It will enable users to quickly, and jointly, to address many questions, such as:

- See and interact with a map of the Transmission Network, to be able to obtain the inspection history of a substation, or the load on an overhead line.
- Model the impact of an incoming storm on our overhead Transmission lines based on historical trends, allowing teams to pre-empt any damage arising.
- As a Stakeholder, understand Connections options available.

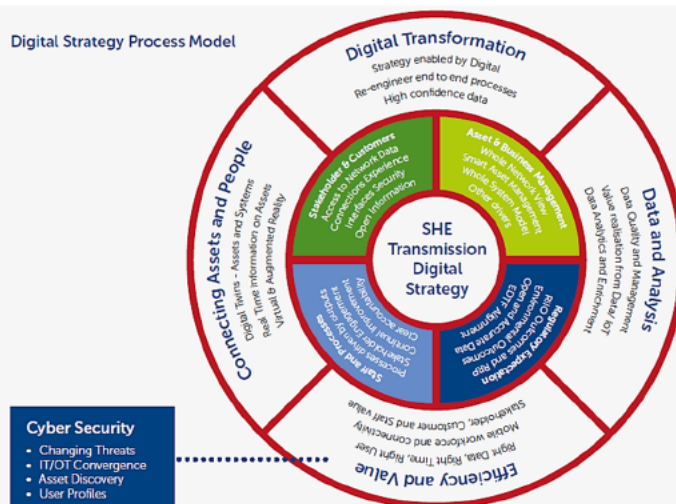
Although to some degree the system could operate on its own, it will be greatly enhanced by the other facilities,



especially the MDM, Data Lake and Analytics, and will be linked to our asset Nerve Centre. Over time we could implement additional benefits to Stakeholders, such as a farmer driving a GPS controlled combine harvester being told the sag and safety clearance on the nearest overhead line, to warn of any danger.

Initially being surfaced via the touch screens, the system could be later deployed via other devices, such as tablets, allowing field teams access to the same information. The system will be driven via APIs and similar interface mechanisms, and we plan to develop this facility using Agile project delivery, so that we can continue to build and improve through the T2 period. This facility, along with others outlined in this document, will be the base to Asset Digital Twins, that we plan to implement, and delivers real time access to information to Stakeholders.

Digital Strategy Process Model



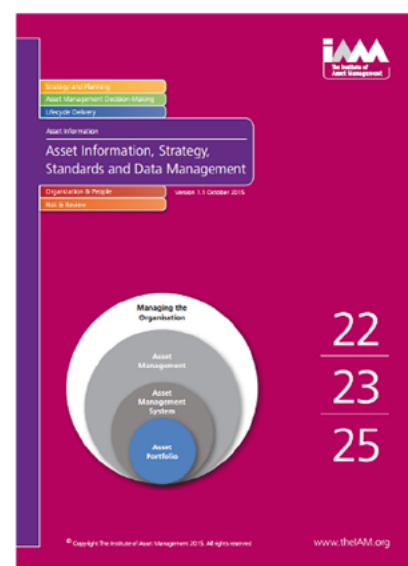
## 6. RIIO-T2 - ASSET PROJECTS

### 6.1 Asset Project Summary

Internal Cost Estimate Project Ref.	Project Title and Brief	Cost £'M
6.3	Master Data Management and Data Lake	■
6.4	Data Enrichment and Analytics	■
6.5	Smart Monitoring (to go to Smart System Monitoring pack)	■
6.6	Linear Assets - Underground and Subsea Cables	■
6.7	BIM	■
6.8	Enabling Technologies	■
6.9	Asset Digital Nerve Centre	■
6.10	Investment Optimisation (Risk Management)	■
	<b>Total</b>	■

### 6.2 Asset Management

Asset Management is a core activity of SHE Transmission and our objective in the Asset stream is to ensure that all information about assets is available for analysis and operational insight in all pertinent areas of the business, especially operational control, maintenance and investment. Subsets of this information must also be available to Stakeholders, especially Connections customers, the ESO, DNO/DSO and statutory bodies, in a form that can be readily used for their needs. We will provide the tools to enable this analysis and sharing of information, some of this in near real time, across the whole business, including our field teams. Data must be reliable and consistent across all systems. We will ensure any new information about assets can be quickly and efficiently stored in systems and shared so that it is available for analysis and operational insight as soon as is practicable, to deliver many benefits including near real time asset information and data for our Network Asset Risks Metrics. We will use industry best practice to drive efficiency and reduce risk across the asset base, as set out in ISO 55000 and IAM guidance.



### 6.3 Master Data Management and Data Lake

Name of Scheme	Master Data Management and Data Lake
Strategic Theme(s)	Stakeholder-led Strategy Safe and Secure Network Operations Sector-Leading Efficiency Leadership in Sustainability
Cost	██████
Benefit Analysis	██████
Planned Delivery Year	2022/23

At the core of our new Asset IT systems will be the need to master data to standards, and to provide a central store that can be used by any authorised user, as set out in the ENA Data Group and Energy Data Taskforce, and Digital Strategy. In RIIO-T1 we deployed several new systems to provide a base for our RIIO-T2 Information & Systems Strategy: this included Maximo for Work and Asset Management, Electric Office for GIS and connectivity, and PowerOn Advantage to manage the network in real time.

In RIIO-T2 we will use this base to inform our investment and maintenance strategies, as well as ensure a step change in how we provide this information to Stakeholders. These improvements will also ensure all of our data will meet the level of maturity expected of a major asset owner, when measured against ISO 55000 and ISO 17020, particularly regarding its accuracy, completeness and timeliness. The core to this transformation will be Master Data Management (MDM) and a 'Data Lake'.

These elements deliver some of the recommendations in the Energy Data Taskforce: A Strategy for a Modern Digitalised Energy System (<https://es.catapult.org.uk/news/energy-data-taskforce-report>) the costed sum includes all necessary Stakeholder consultation. The platform provides a base for many of our RIIO-T2 IT improvements, that will deliver financial benefits, improves our environmental and safety management, and most importantly provides the core for the transparency requested by our Stakeholders.

#### 6.3.1 Master Data Management

Master Data Management (MDM), as set out in ISO 8000 (the global standard for Data Quality and Enterprise Master Data), "...establishes the concept of Portability as a requirement for Enterprise Master Data and is commonly used to manage critical business information...". Our core RIIO-T1 applications already follow this standard, however, some older systems need to be addressed, and all systems must be aligned. Our data needs to be fully shared between many systems, and we propose to use the Common Information Model (CIM) IEC 61970 standard for data exchange. However, whilst these are nominal standards, there are variations across the sector, so we will work with Stakeholders to ensure that the final version(s) we use are suitable for consumption by all, albeit in some cases requiring limited conversion. The core T1 applications all use CIM, however again there are some variations, and we will work with the product vendors to ensure commonality as far as possible. Our aim is to have an overall data model that both supports our T2 objectives, and meets our Stakeholder requirement for portability, in alignment with open data principles.

#### 6.3.2 Data Lake

In terms of using data for analysis and insight, industry best practice is to have a central store where all data is available in a state ready for use. This store therefore must have all pertinent data from multiple systems, refreshed as appropriate for need, from yearly to near real time, so that reporting and analysis is using both historic and current





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data. It will also contain other data needed to aid analysis and reporting, such as weather and environmental data. The advantages of such a store is that all data is already integrated, and any analysis does not place a risk or burden on core systems that are needed for business-critical operations. It will provide a base for many reporting activities (e.g. Business Intelligence, Regulatory reporting, etc.) as well as many forms of analysis.

We will establish a 'Data Lake' where all information needed for analysis or insight can be sourced, and where pertinent, combined with external data, such as weather or environment. The 'Data Lake' will provide for any reporting or data export to Stakeholders. This work will include some integration between the different core applications, as well as to the Data Lake. This will ensure we can continue to improve our asset data, in line with our Data Assurance Guidance plan, as well as reducing administration burden. We expect a certain amount of data improvement, both through tools and physical survey, will be required as part of the data harmonisation.





## 6.4 Data Enrichment and Analytics

Name of Scheme	Data Enrichment and Analytics
Strategic Theme(s)	Stakeholder-led Strategy Safe and Secure Network Operations Sector-Leading Efficiency Leadership in Sustainability
Cost	██████
Benefit Analysis	██████
Planned Delivery Year	2025/26

Having a copy of data in a centralised store will enable us to deliver a number of the recommendations of the Energy Data Taskforce strategy. Some of these will be delivered by other elements of work, such as optimisation of assets in our Smart Monitoring programme (T2BP-EJP-00). This Data Enrichment and Analytics project will concentrate on overall Operational Optimisation and Open Markets, as well as assisting in Agile Regulation.

As can be seen in the diagram opposite (taken from our November 2017 Supporting a Smarter Electricity System document

(<https://www.ssen.co.uk/SmarterElectricity/Report/>) the Transmission network will be a key element in the overall 'Smart Grid' architecture (developed by the Smart Grid Coordination Group in Europe). As well as being able to provide data to others, including the Energy System Operator (ESO), Distribution System Operator (DSO) and both large and small energy providers, we also need to have far greater understanding of the operation of our network on a day to day basis. This will help us to manage our network so that supplies can be optimised for the demands, and to understand constraints, both temporary and long-term. Temporary constraints will inform our operations, and can be passed to others, potentially through new systems such as Inter-Control Centre Communications Protocol (ICCP) and Neutral Market Facilitator (NMF). Long-term constraints will be managed through our investment programme.

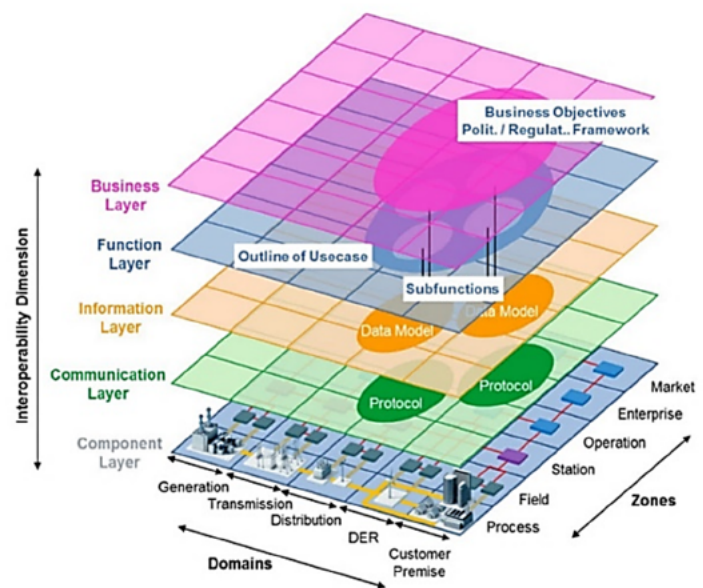
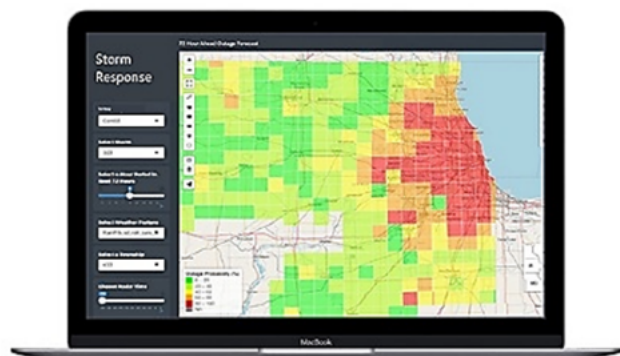


Figure 3: Diagrammatic representation of the Smart Grid Architecture Model

**Smart Grid Architecture Model**

our



**Storm Response Analysis**

In order to deliver these benefits, we will need the collation of static and dynamic data, delivered through the Data Lake, integration of some siloed data sources, and analytics to drive understanding. We propose to use Advanced Analytics including Artificial Intelligence tools to provide the necessary insights. The tools will use the static data (information about asset location, connectivity, specification, health, criticality, etc.) and dynamic data (telemetry, Internet of Things, weather, etc.) to build insights on how the network is performing, given the demands and energy sources over time. This analysis will build on existing facilities, such as storm planning (opposite), to give a more accurate picture of our network in near real time. These tools will also help us to identify where data is limited, hence focussing survey and data gathering to areas of real benefit. Where such

tools have been deployed, they have shown real benefits (e.g. [https://www.bentley.com/en/project-profiles/sa\\_water\\_adelaide\\_metro](https://www.bentley.com/en/project-profiles/sa_water_adelaide_metro)).

We proposed to develop these tools in a staged approach, improving knowledge over a 3-year period. After each deployment we will hold reviews, both internally and with Stakeholders where output is shared, so that subsequent deployments can benefit from learnings.

## 6.5 Smart System Integration (Smart Monitoring)

Name of Scheme	Smart System Integration (Smart Monitoring)
Strategic Theme(s)	Safe and Secure Network Operations Sector-Leading Efficiency
Cost	██████████
Benefit Analysis	██████████
Planned Delivery Year	2023/24

We have proposed a major upgrade in this area. To make the best use of this new sensor information and deliver the expected benefits we will need additional IT facilities, and the IT elements set out below support the overall Smart Monitoring programme.

The core work in the IT side of Smart Monitoring will be building the necessary systems, integrating these feeds to the Data Lake and/or relevant systems, and developing the analysis algorithms. Our Smart Monitoring IT systems will include web servers, analysis engine servers and a broker. We are currently preparing trials for Smart Monitoring in 2020, using the latest sensors at three representative sites, as well as two differing IT packages, so that we have a better understanding of the best tools and techniques to deploy in RIIO-T2. For RIIO T2 we are assuming 20 use cases, that will include single and multiple gas projections, asset health in real time (moisture, furans, temperature, etc.), as well as others that will be determined as part of the trials. These will help inform best deployment of some of the asset interventions proposed within our RIIO-T2 Draft Business Plan, and support to the Non-Load/Asset Intervention Plan. Along with other initiatives, particularly some of the improvements in our Operational Technology systems, the output will help us supply the information that a Whole System world will demand, giving better projections (e.g. supply and demand forecasting, system inertia, etc.).

As well as reducing risk, a prime benefit of our Smart Monitoring initiative is to optimise our replacement and maintenance programmes. Our inspection and maintenance costs have increased

██████████. Although we are ranked reasonably within the International Transmission Operations and Maintenance Study (ITOMS) benchmarking, we are striving to become upper quartile, and this can only be achieved through better cost performance. This programme will not only deliver the benefits we need to become upper quartile, but also help to deliver the transparency about our assets that has been demanded by our Stakeholders. Smart Monitoring will build on our RIIO-T1 Condition Based Risk Management (CBRM) tool, to further ensure assets are only replaced at end of life, but before they have an adverse effect on our Network Asset Risk Metric (NARM).





## 6.6 Linear Assets – Underground and Subsea

Name of Scheme	Linear Assets – Underground and Subsea
Strategic Theme(s)	Safe and Secure Network Operations
Cost	██████████
Benefit Analysis	██████████
Planned Delivery Year	2023/24

Our linear assets, Overhead lines, Subsea Cables and Underground Cables, are critical, but also present challenges in terms of monitoring and planning. In RIIO-T1 we implemented tools that enabled us to more closely survey our overhead lines, including the use of drones. We also continued to monitor the condition of undersea cables, as far as possible, using a variety of survey techniques. At present however our ability to monitor the risk and likely condition of our underground cables is extremely limited. New tools are now becoming available that will enable us to make far more informed assessments of both underground and subsea cables, using a wider range of information. This information includes:

- Peat sampling and cable depth of burial in peat terrain models from public domain data,
- Videos and photos for cable routes, joint bays and terminations,
- Multibeam bathymetry data,
- Subsea video or still photographs,
- Terrestrial video or still photographs for landfalls.



Whilst most of this information is obtained as part of our asset management work, currently it is held in standalone stores, where it is difficult to quickly source and link to other asset data. The work in this area therefore is to collate this information and use the new tools to better understand the risk, and appropriate intervention strategies, for these assets. We will also link these tools and information to other core systems, such as Work and Asset Management.

Much of the above information produces very large computer files. To make the best use of the information, we need to both increase the network storage and provide tools for our staff that enables them to both view existing and record new information, including in the field. Our proposed system will include the necessary tools for recording, assessing and viewing this information, and linking the information to our existing core applications. It will be based around central servers, with backup, as well as local servers at ██████████ and ██████████ to enable work to be undertaken at those locations. We will also provide the necessary base for mobile working, although the details and costs for actual field tools we have included in our mobile work management section.

Simple access to this information not only helps to improve our work efficiency, but also reduces health and safety risk, including ESQCR reporting and CDM Health and Safety Files. It will be another core element in our Strategy for a Modern Digitalised Energy System and aid us in delivering information to Stakeholders to the level of detail demanded in the RIIO-T2 period.



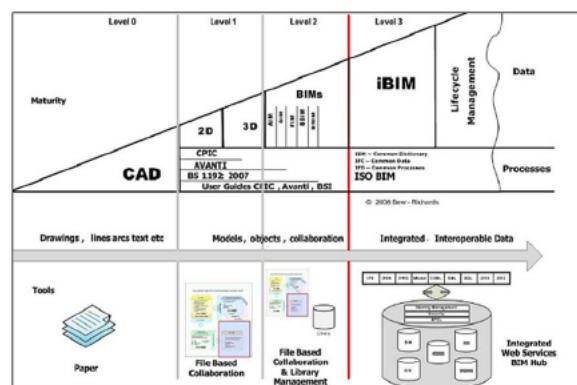
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### 6.7 Building Information Modelling

Name of Scheme	Building Information Modelling
Strategic Theme(s)	Safe and Secure Network Operations Sector-Leading Efficiency
Cost	██████
Benefit Analysis	██████
Planned Delivery Year	2023/24

Building Information Modelling (BIM) has been in existence for almost 20 years and is now a cornerstone of the UK Government's Construction Strategy. BIM Level 2 (see <https://bim-level2.org/en/faqs/>) is now seen as the recommended standard for all involved in construction to adopt. The BS EN ISO 19650 series will shortly be in force and will further drive the industry to adopt the practice. The business benefits of using BIM have been well documented (<https://www.cdbb.cam.ac.uk/BIM/BBM>) and National Grid have reported significant savings in their capital programme through the use of BIM (e.g.

[https://www.nationalgrid.com/sites/default/files/documents/Building Information Modelling %28BIM%29 at Bacton %2C Peterborough %26 Huntingdon.pdf](https://www.nationalgrid.com/sites/default/files/documents/Building%20Information%20Modelling%20BIM%29%20at%20Bacton%20Peterborough%20Huntingdon.pdf)).



In T1 we started to introduce the tools and concepts of BIM into our capital programme. In T2 we intend to build on that base so that we can reach Level 2 within the period. The BIM level tool not only includes the 3D CAD standards and models, but also collaborative working. The Scottish Futures Trust describe it as "...an information exchange process which is specific to that project and coordinated between various systems and project participants" (Source: <https://bimportal.scottishfuturestrust.org.uk/page/standards-level-2>). BIM will therefore become a cornerstone in our capital delivery programme.

In order to reach BIM Level 2, we will need to set up the necessary systems, build 'digital twin' models, and agree optimal communication routes and standards with contractors and the supply chain. The systems will need appropriate processing power and storage for the 3D models, as well as allow for coordination with Stakeholders. In terms of models, we have already developed these for some sub-stations, and in RIIO-T2 will extend these to most sites, incorporating supply chain standard models where available (e.g.

<https://www.se.com/uk/en/work/support/bim/>). These

benefits of BIM are substantial, however are dependent on a number of our other elements of our IT programme, in particular the integration of all core applications, both existing and proposed. BIM will also support other activities, such

as 3D printing, and is central to our Digital Network.





#### 6.7.1 BIM Support

In order to maximise the benefit of BIM in RIIO-T2 we need to build 3D BIM models or digital twins of our existing sites and assets. This work will enable us to both use these models to assess options for changes, such as the fit of a replacement transformer, and to pass models of sites where asset changes are proposed to external design companies, significantly reducing their design costs.

We will need to scan the existing sites, using laser or similar technology, and use these 3D scans as the basis for the digital twin. We will use specialist consultants for this work, as it is a one-off exercise. In terms of assessing the work involved, 20 of our sites would be large packages of work, 40 medium and the remaining 109 will be small packages. Where available, we will use BIM model elements from vendors (e.g. <https://www.se.com/uk/en/work/support/bim/>) to simplify the model builds, and to ensure standardisation.



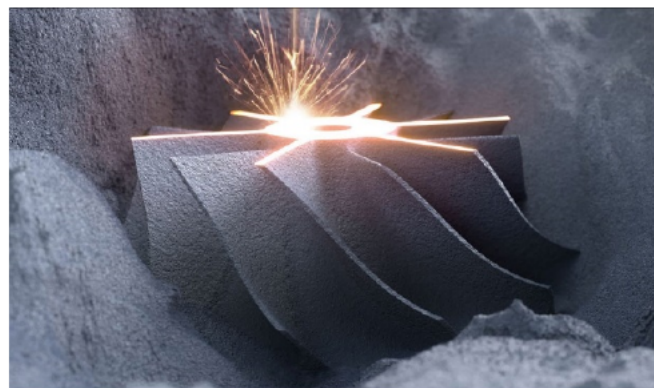
## 6.8 Enabling Technologies

Name of Scheme	Enabling Technologies
Strategic Theme(s)	Stakeholder-led Strategy Safe and Secure Network Operations
Cost	██████████
Benefit Analysis	██████████
Planned Delivery Year	2025/26

Technology is advancing at a very fast pace and predicting what may be available and useful to us during the RIIO-T2 period is difficult. We have therefore taken a pragmatic view on enabling technologies that we have included in our plan and have centred these around two proven but new technologies, namely 3D metal printing and Augmented Reality.

### 6.8.1 3D Printing

An area of concern to us is the increasing difficulty we have in sourcing small spares for older equipment. These include small mechanical parts from plant such as switchgear. Failure of these parts can render this equipment unusable, requiring us to either run plant at increased risk (i.e. less redundancy) until the spares can be obtained, or to replace assets completely. 3D metal printing will enable us to be able to quickly produce these parts, based on vendor or self-produced (e.g. BIM) models. Currently printers using powder and lasers offer the best option for producing parts of sufficient size and quality, and these range in price between £150k-£300k. We are looking to install 2 machines during RIIO T2, one in the south and one in the north of our area ██████████



Direct Metal Laser Sintering

Our work on this facility also includes for the initial build or obtaining of models, as well as supporting hardware and software.

### 6.8.2 Augmented Reality (AR)

Although initially viewed as a gaming tool, AR is increasingly being used by industries for many tasks. We intend to use the technology in RIIO-T2 to aid operations and maintenance tasks. For example, core documentation for common tasks will be transcribed to the systems, such as maintenance checks on switchgear. As the technology progresses, we expect that towards the end of RIIO-T2 that Artificial Intelligence (AI) tools that come as part of these systems will have been 'trained' to recognise typical defects, that will aid our field staff to quickly identify any risks and deal with these whilst on site. At present we have assumed tools such as Microsoft HoloLens 2 would be used, however, given the pace of change in this area the actual tools used may be different to that currently scoped. To support the use of these tools we will undertake some level of geo-tagging, both through



Microsoft HoloLens AR Viewing



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data enrichment and using physical tags on site (e.g. plates, barcodes, RFID). This will enable to AR tools to quickly identify the plant being inspected.

**6.8.3 Additional Enabling Technologies**

At present we have only allowed for 3D metal printing and Augmented Reality in our submission. It is more than likely that technological changes will occur that show potential for our sector. Our present plan is to manage such opportunities through the Innovation stream.





## 6.9 Asset Management Nerve Centre

Name of Scheme	Asset Management Nerve Centre
Strategic Theme(s)	Safe and Secure Network Operations
Cost	██████
Benefit Analysis	██████
Planned Delivery Year	2024/25

To make best use of the information being provided by our new asset IT systems, we propose to set up an Asset Management Nerve Centre. This will be aligned to our new Operational Control Room. All of the asset feed from analytics and related tools will be fed into large multiple displays where specialists will be able to assess the outputs. These will provide information about possible failures before they occur, so that maintenance staff can be sent to sites to prevent any disruption. To date, our record of outage has been good, but we are conscious that we have both an expanding and aging asset base. Furthermore the increasingly diverse energy generation model brings additional risks, such as lack of system inertia. It is vital therefore that we develop our systems and processes to ensure that we can maintain a very reliable network. This Nerve Centre will be core to maintaining our assets on a day to day basis, as well as supporting investment decisions. Note that this facility is related to asset management, and not to our new Control Room.



## 6.10 Investment Optimisation

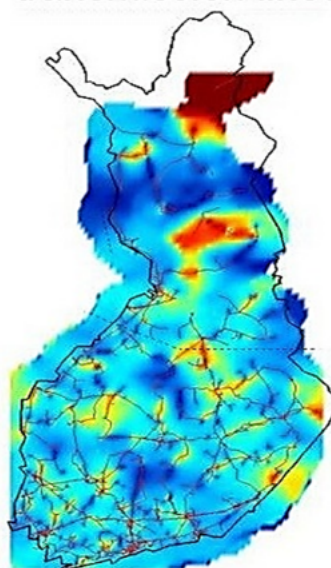
Name of Scheme	Investment Optimisation
Strategic Theme(s)	Safe and Secure Network Operations Sector-Leading Efficiency
Cost	██████
Benefit Analysis	██████
Planned Delivery Year	2025/26

All of the analytics outlined in the above sections cover the health and performance of individual assets or small groups of assets. Sector best practice however also considers the health and performance of the network as a whole, so that global risk can be understood and managed, both for day to day management and future planning. Once the core systems are in place, we will be setting up cross network analytics so that we can truly understand the status of our network. Some of these tools will be within our Operational Technology Control Systems area, however additional information, such as the current health of individual assets, is needed to build a holistic view of the whole network.

The system will not only ensure that we are maximising the potential of our network to meet Stakeholder daily expectation, but also focus investment on areas of weakness, based on actual performance data. Based on the experience of transmission operators who have implemented similar systems, we expect this to have dual benefits:

- Allow some connections earlier than originally planned, through better understanding of risk.
- Ensure investment is focussed on the areas of greatest opportunity for our Stakeholders, through earlier removal of 'pinch points'.

Relative load of  
transmission lines



Source: Fingrid

## 7. RIIO-T2 WORK MANAGEMENT

### 7.1 Work Management Project Summary

Internal Cost Estimate Project Ref.	Project Title and Brief	Cost £'M
7.2	Total Work Management	██████
7.3	Inventory Management System	██████
7.4.1	Environmental Management Solution	██████
7.4.2	Environmental Data Aggregation	██████
7.4.3	Marine Survey Tooling	██████
7.4.4	Footprinting	██████
7.5.1	Workforce Mobility	██████
7.5.2	Network Switching	██████
	<b>Total</b>	██████

### 7.2 Total Work Management

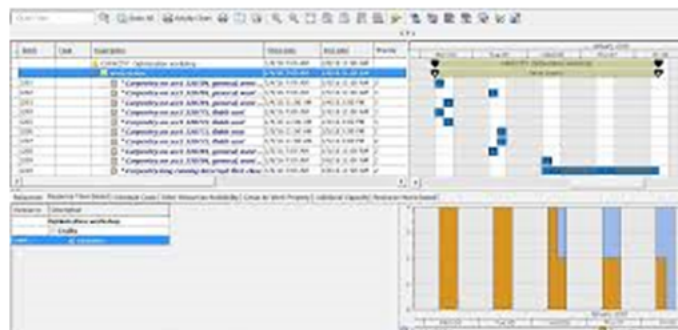
Name of Scheme	Total Work Management
Strategic Theme(s)	Safe and Secure Network Operations Sector-Leading Efficiency Leadership in Sustainability
Cost	██████
Benefit Analysis	██████
Planned Delivery Year	2023/24

In RIIO-T1 all of our lead assets will have been placed into an industry leading Work and Asset Management (WAM) application. We also have a new Geographical Information System (GIS) giving staff, both in the office and field, access to asset details and connectivity, as well as giving additional views, such as Street and Satellite. This has given us a good base from which to manage all works.

In RIIO-T2 we intend to extend these facilities to include all internal works and scheduling. This would include:

## SHE Transmission RIIO-T2 IT Investment Plan

- Most Operational and Capital works undertaken by our own staff,
- The details of works optioneered by our teams,
- Outline details of other capital works,
- Schedules for future works, including planned outages,
- Access to asset information held in complementary systems.

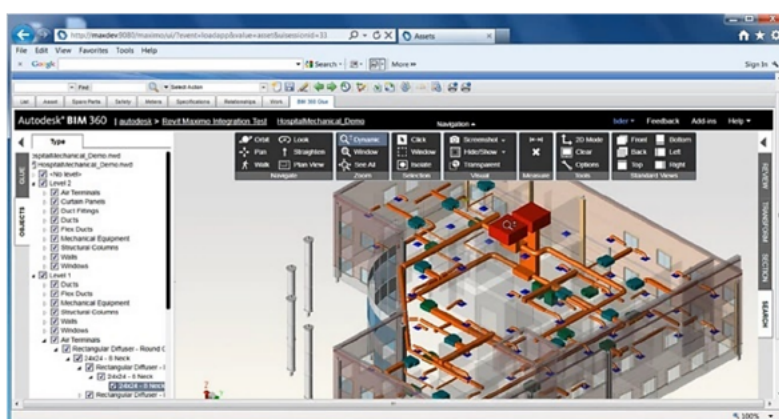


**Maximo Work Management**

This system will be linked to our Human Resources system so that staff details, in particular skills, permissions and availability are always correct. It will be the major access to assess information for all staff, with links to survey and asset health information, and in particular BIM. It will not hold granular details of work undertaken by our contractors, as it would be uneconomic to expect them to use our systems to manage their works, however using tools such as BIM we can rapidly incorporate any changes necessitated by site conditions and other constraints into our core WAM system. It will also be linked to the Inventory Management System (Section 4.2), which in turn will be linked to our Finance and Procurement systems. It will be available to our field staff: see Section 4.4.1.

Overall the system will deliver:

- A clear future programme of work available to all our staff,
- Greater efficiency, through coordination of all works in a single system,
- Better coordination of all works, especially regarding Stakeholder requirements,
- More granularity of actual work costs, greatly aiding planning of future works, both operational and investment,
- Incorporation of our standards and processes into the system, so that these are easily available to all staff undertaking work,
- Simple access to other asset information held in complementary systems, such as BIM, survey, etc.,
- Greater transparency about our future work programme for Stakeholders.



**Maximo BIM Viewer**



## SHE Transmission RIIO-T2 IT Investment Plan

### 7.3 Inventory Management System

Name of Scheme	Inventory Management System
Strategic Theme(s)	Safe and Secure Network Operations
Cost	
Benefit Analysis	
Planned Delivery Year	2022/23

Our business has moved from a largely 132 / 275kV network to a multi voltage system with assets from 11kV to 400kV including HVDC within the RIIO-T1 period. Further changes and complexity will happen during the RIIO-T2 period.

As a result of this increased complexity we will be required to hold more spares for long lead time items and critical items need for the network. Our inventory management system is targeted to improve the SHE Transmission's efficiencies in three distinct areas:

- Controlling long lead item spares and critical spares when they are purchased by the company and where these spares are being stored within the various store locations operated by the company,
- Improving visibility across multiple locations and condition of all spares being held by SHE Transmission,
- Providing information on obsolete spare parts, which can be disposed of either through controlled scrappage or sale to another company. Thus, improving financial management of assets,
- Tagging all critical and long lead spares with industry standard bar / QR codes for quick identification by operational teams.

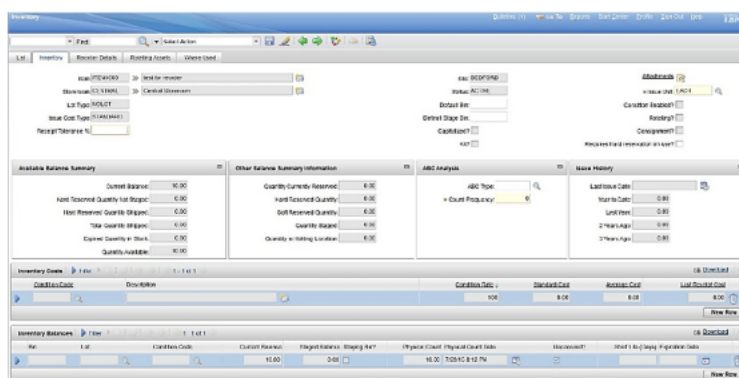
The new solution will aid the movement of long lead items' spares into two new central store facilities that will begin construction in 2021 with the aim of being in use during the 2023/24 financial year.

#### 7.3.1 Controlling Long Lead Item Spares and Critical Spares

Many of the core assets/components we use on our network have long lead manufacturer/delivery time frames. Lead times of between 9 – 18 months is not uncommon on many of these items. The lead times require us to hold a level of these items in stock, which in turn ties up working capital in a potentially depreciating asset.

Our new inventory management system will hold location, quantity and condition details of each long lead item spare held by the business. The system will allow an economic quantity to be maintained by the business. Long lead item spares will be automatically re-ordered based on automated re-ordering stock levels.

The system will automatically identify items that have been held in the stores for a period of time ensuring that the oldest parts are dispatched to the field units when required, thus ensuring that all spares are retained in a condition that is 'fit for purpose'. Where



**Maximo Inventory Management**

the condition of an asset has deteriorated below the minimum threshold required by our stock holding policies, we will be able to make the decision to remediate the asset back in to a condition that is 'fit for purpose'.

### 7.3.2 Asset Location and Condition

It is important for our engineering team to understand the current condition and location of the spares relating to long term lead and critical items. Spares are acquired by the business in three specific ways:

- They are purchased as part of the project cycle that installed or refurbished the assets. These spares are then put into storage until they are required.
- They are recycled from assets that are de-energised and decommissioned from the network. Again, these spares are then put into storage until they are required.
- They are purchased by the business to replace a long lead stock item that has been installed to an operational asset.

We will need to undertake a full inventory of the long lead items and critical items to ensure the current location and an appraisal of the condition of the asset is recorded. The inventory will help us establish the:

- Spares rationalisation,
- Based on condition if the spares are beyond economical life or need remediation before they can be installed on the network,
- Which of the new central stores location the spares should be moved to following the facilities coming on stream,
- Using bar / QR code standards to allow quick identification of the spare part by the field teams when required and tracking the items to an installed location.

### 7.3.3 Spares obsolescence

As our network grows to meet the demands placed on it by our Stakeholders', specific assets will be replaced with assets that can meet the projected future demand. The spares associated with these assets will be:

- Re-distributed to locations still operating similar assets to the assets that have been removed,
- Or deemed as operational but surplus to Transmission's requirements and therefore available for sale to another operator,
- Or deemed as scrap and available for disposal.

If assets meet the final two obsolescence criteria, we can release the working capital represented by the assets.

### 7.3.4 Benefits of Inventory Management

Implementation of a new inventory management will increase the efficiency over the holding of long lead/critical items asset spares by:

- Improving Network Security by ensuring the company holds sufficient spares for long lead item spares,
- Efficient spares holding quantities. Enabling SHE Transmission to determine the correct economic quantity of long lead item/ critical items spares to be held by the company, and the updating of the policy covering spares replenishment should an item be used,
- Enabling efficient reuse of long lead items harvested from assets removed from the network which can be catalogued, condition appraised and stored, preventing the need to purchase additional spares to support specific asset types,
- Improved Financial Management of Stock and Assets.



#### 7.4 Environmental Ensemble

Our Environmental teams are responsible for managing the company's environmental obligations while operating in Scotland's most precious landscapes.

RIIO-T1 saw the company invest heavily in the Transmission network with a large capital programme which has now transitioned into business as usual. [REDACTED]

[REDACTED] The Environmental team constantly monitor the capital program to ensure that the company is complying with consents and licences and ensuring that our social obligations to be a responsible builder are maintained.

During consultation our Stakeholders have told us to work on biodiversity value and adopting flexible approaches to environmental issues. Given the increase in assets and network complexity they have also told us that business as usual activities are as important as capital investment and development schemes.

In order to ensure the company delivers on its environmental credentials our environmental teams rely on a series of technology systems that have been implemented organically as the company has grown. However, the growth has meant that these systems are now inefficient often duplicating effort as data has to be manually moved between these systems.

During RIIO-T2 the environmental team will consolidate these existing systems into a solution that will manage the environmental audit process, hold the data collated from various audits and surveys and manage the reporting of obligation compliance.

## SHE Transmission RIIO-T2 IT Investment Plan

### 7.4.1 Environmental Management Solution

Name of Scheme	Environmental Management Solution
Strategic Theme(s)	Safe and Secure Network Operations Leadership in Sustainability
Cost	██████
Benefit Analysis	██████
Planned Delivery Year	2023/24

Our environment management solution is aimed at consolidating multiple environmental systems used in both the capital delivery process and general network operation. Key features of the new solution will be:

- Audit and survey calendars: Efficiently managing the workload (i.e. better scheduling) through the team while ensuring that our internal and external Stakeholders are aware of the work that we are undertaking and the timescales that we are working to,
- Better landowner information, so that our teams know who to contact and when.

In addition, we will ensure our collaboration with Stakeholders is improved, through such mechanisms as:

- Data sharing: Ensure that data available to all Stakeholders in a timely and efficient way. (e.g. improved reporting storage and enabling automated KPI Reporting), with simple navigation,
- Transparency: Ensuring that our environmental credentials are backed up with transparent information sharing with our Stakeholders, including Environmental Impact Assessments (EIA) with 3D interactive models and mapping for larger works,
- Interaction: Using the corporate website as a gateway to an online portal, allowing Stakeholders to view interactive environmental information as it is published.



In addition to changing the working environment for our team we will introduce new techniques for conducting the surveys we are required to undertake.

We will also build on our RIIO-T1 improvements in the management of geospatial information, that supports all our Operational and Investment activities. This will include:

- Providing hosting services to project teams (including external contractors) to access their spatial data,
- Using 3D analysis of spatial data for desktop route/site selection analysis,
- Importing/exporting and converting of spatial datasets between ourselves and 3<sup>rd</sup> party organisations (statutory bodies, contractors, consultants, etc.)
- Management of land owner boundaries, basemaps, site photos, LIDAR and other imagery.
- Production of high-quality customisable maps for internal and external comms, reports, planning applications, embedded web maps on the public Transmission website, posters for public consultations and management dashboards, etc



#### 7.4.2 Environmental Data Aggregation

Name of Scheme	Environmental Data Aggregation
Strategic Theme(s)	Safe and Secure Network Operations Leadership in Sustainability
Cost	██████
Benefit Analysis	██████
Planned Delivery Year	2023/24

In addition to changing the working environment for our team we will introduce new techniques for conducting the surveys we are required to undertake.

Data will be aggregated from multiple sources varying from:

- Satellite, Remote sensing and Synthetic aperture data,
- Infield data collection via tablets (ecology/habitat surveys) and syncing to GIS systems,
- Business level Global GIS layers for survey information (from contractors),
- Mapping/storage of forestry felling and replanting (area, volume etc...),
- Biodiversity unit calculations (pre, during, post construction),
- Areas for offset and allocation to different projects,
- Automated reporting on Forestry and biodiversity data.

The results of the analytical work that is undertaken will allow impact assessments to be made without the need for members of the environmental team having to go to site.

As with the management solution, the results of the analysis can be shared with external Stakeholders, providing them with quick access to data that will allow informed decision making to be undertaken early in the process to which the assessment relates. Note that field tools would be delivered under Workforce Mobility.



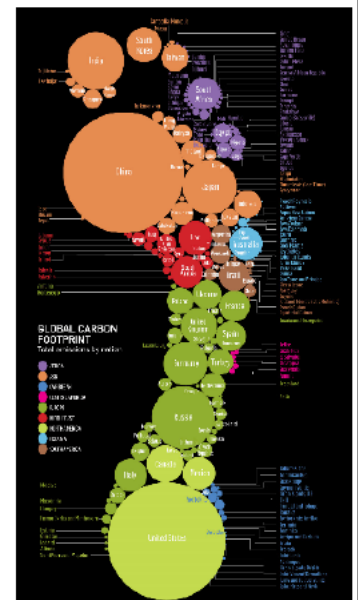
#### 7.4.4 Footprinting

Name of Scheme	Footprinting
Strategic Theme(s)	Safe and Secure Network Operations Leadership in Sustainability
Cost	██████
Benefit Analysis	████
Planned Delivery Year	2024/25

In order to both meet our Stakeholder expectations and the minimum environmental reporting requirements we will need to be able to collect carbon, waste, resource use and local content reporting for our supply chain. There are very complex calculations surrounding the ‘footprinting’ (i.e. total environmental footprint) of any company and its products, back by a lot of data. Fortunately, there are a number of software packages that provide this functionality, although careful selection is required to ensure that the output meets current requirements.

We will therefore source a suitable package and use this to assess the impact of all of our works, including anything provided by our supply chain. Such packages will enable us to:

- Model and analyse complex life cycles in a systematic and transparent way.
- Measure the environmental impact of our products and services across all life cycle stages.
- Consider the impact of our whole supply chain, from extraction of raw materials to manufacturing, distribution, use, and disposal.



## 7.5 Workforce Mobility

Providing information to our very dispersed workforce is critical to the success of our RIIO-T2 plans. We have split this package into two areas, general Information Technology systems (such as WAM) and Operational Technology (such as switching). Where technically feasible all of our mobile facilities will retain information on the devices even when they are unable to connect to networks, a not uncommon situation in Scotland.

### 7.5.1 Workforce Mobility

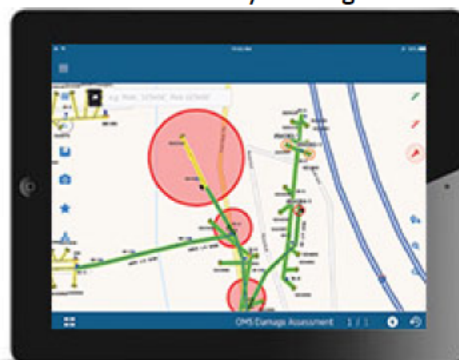
Name of Scheme	Workforce Mobility
Strategic Theme(s)	Safe and Secure Network Operations
Cost	██████
Benefit Analysis	██████
Planned Delivery Year	2025/26

Throughout this document we have shared how we intend to improve information on our assets and works, both on-going and proposed, for all Stakeholders. It is vital that our teams in the field also have access to this information. In RIIO-T1 we delivered many improvements to our field teams, especially in regard to survey and mobile GIS.

In RIIO-T2 we will ensure that as much information as possible and desirable is shared with our field teams, and that they can provide updates to information from the field. Mobile technology, both in terms of hardware and software, is advancing rapidly, so it is likely that the actual RIIO-T2 deployment may be different than currently envisaged. At present we are assuming that the following elements will be deployed:

- Mobile GIS (existing facility, with some RIIO-T2 enhancements)
- Work and Asset Management, including Inventory,
- Additional survey tools,
- Environmental tools,
- Some elements of Augmented Reality support (e.g. operations and maintenance guidance),
- Mobile switching (see below).

We currently expected that most of these facilities will be deployed on tablets and have allowed for some new units to cover staff who will not already have been issued with units in RIIO T1: primarily these are in the environmental and asset investment areas. We are also expecting to use mobile extensions to our existing applications, however in a rapidly changing market will use 'best value' tools at the time of deployment.





**SHE Transmission RIIO-T2 IT Investment Plan**
**7.5.2 Network Switching**

Name of Scheme	Network Switching
Strategic Theme(s)	Safe and Secure Network Operations
Cost	██████
Benefit Analysis	████
Planned Delivery Year	2021/22

We will move to issuing network information and instructions to the operational field teams using mobile devices. This The field team can interrogate the transmission network schematic to understand the current situation of the network,

- Instructions can be issued to the teams securely and with certainty. These can be acknowledged digitally by the field teams to indicate acceptance and execution,
- They can allow teams to lock control of segments in the control systems to stop re-energisation while staff are actively working. Following completion of the work the locks can be released and the segments can be safely re-energised.



The prime reason for installing this system are the safety benefits, especially in regard to shared knowledge of the current network status between field teams and control engineers. There will be some financial benefits, but these are difficult to estimate.

## 8. RIIO-T2 OPERATIONAL TECHNOLOGY CONTROL SYSTEMS

### 8.1 Operational Technology Control Systems Project Summary

Internal Cost Estimate Project Ref.	Project Title and Brief	Cost £'M
8.2	Deployment of new DR Site [REDACTED]	[REDACTED]
8.3.1	FEP Replacement Project	[REDACTED]
8.3.2	Corporate PI Historian	[REDACTED]
8.4	ICCP Implementation to NG and SP	[REDACTED]
8.5	Alarm Prioritisation and Rationalisation	[REDACTED]
	<b>Total</b>	[REDACTED]

The recent highly public cyber-attacks on energy companies in other areas of the world have focused the company to make changes in the provision of operational systems during RIIO-T1 to ensure the security of the Transmission energy network it controls.

During the RIIO-T1 period we have started a business and systems separation programme of work to separate the company's central control systems from those systems operated by Scottish Hydro Electric Power Distribution, also owned by SSE Plc and operated under the trading name SSE Networks.

Our Stakeholders have told us that they would prefer to see investment in the network and the control systems to ensure the longevity and security of the supply.

To ensure the network security of supply; in RIIO-T2 we will continue this separation programme by creating a new Transmission Control Centre (T2BP-EJP-0003) and relocating the disaster recovery facility from [REDACTED] to [REDACTED]. There will be several other control rooms, operational technology activities that will also need to be considered to ensure the security and independence of the Transmission Control Systems in the future.

In addition to the business and systems separation work we are also planning to undertake activities relating to evaluating and implementing change resulting from the National Institute of Standard and Technology (NIST) 800-82, 800-53 guidance during the RIIO-T2 period.

This approach is in line with the guidance set out within the RIIO-T2 Sector Specific Methodology Decision paragraph 6.96 which states

'...network companies must demonstrate how companies will take appropriate and proportionate technical and organisational cyber security measures to manage risks posed to the security of the network and information systems on which their essential services depend, and to prevent and minimise the impact of incidents on these essential services.'



**PowerOn Advantage**

## SHE Transmission RIIO-T2 IT Investment Plan

Further improvements will be made into the RIIO-T2 period as threats are identified.

### 8.2 Deployment of a New Transmission DR Centre

Name of Scheme	Deployment of a New Transmission DR Centre
Strategic Theme(s)	Safe and Secure Network Operations
Cost	
Benefit Analysis	
Planned Delivery Year	2022/23

The business has evaluated the physical Transmission Control Centre strategy during the RIIO-T1 period. During the period the network being managed has increase substantially in scale and complexity. Capital programmes stated in the RIIO-T2 plan will only continue to increase the size of the network being managed and the complexity.

This evaluation has led to the conclusion that the company has outgrown the current shared physical Transmission Control Centre (TCC) and Distribution Control Centre (DCC) facilities in Perth and the shared Distribution Disaster Recovery (DDR), Transmission Disaster Recovery (TDR) and Renewable Operations Disaster Recovery (ROC DR) facilities also located within Perth. These control and DR centres were implemented when the Transmission network was less complex and smaller.

In addition to the DR centres mentioned above, other business units have been allocated DR space at these locations due to its proximity to the main SSE Perth campus. Put simply Transmission is unable to expand on this site without significant investment in the fabric of the build to provide more space. Also given the geographical separation of this site to the Perth campus this option is not optimal for network operation and security going forward.

The new TCC represents a major investment in new buildings, communications and equipment during RIIO-T2 and has been discussed elsewhere in the RIIO-T2 plan.

The new Transmission Disaster Recovery centre will re-purpose space at the Inverness Depot. The facilities are capable of being expanded to host the communications, server infrastructure, physical workstations, working environments and welfare facilities to operate as the TDR going forward.

The site provides the company with a good geographical separation from the proposed locations for the new TCC in Perth and is permanently manned by Transmission staff unlike the current DR provision which requires staff to re-locate from the main TCC in the event of an issue.

The scope of this project will be to implement the communications, IT, office and welfare infrastructure to support the TDR.



### 8.3 Additional Operational Systems Separation

At the start of the RIIO-T1 period, we shared our Transmission Control System with the Distribution Control System used by SHE Power Distribution. We are currently migrating from this shared environment to a new Transmission Control System running on separate operational technology platform dedicated to operating the Transmission Control Centre. This work is scheduled to complete before the completion of the RIIO-T1 period, however there will be several additional subsystems that are also shared with SHEPD that will be separated during the RIIO-T2 period.

These systems have not been separated at the same time as the main TCC to ensure security of supply.

#### 8.3.1 Front End Processors (FEP's)

Name of Scheme	Front End Processors (FEP's)
Strategic Theme(s)	Safe and Secure Network Operations
Cost	██████
Benefit Analysis	████
Planned Delivery Year	2022/23

Front End Processors are distributed throughout the operational technology environment, principally to process the signals to and from the Remote Terminal Units (RTU's) and converting these into the protocols used by the TCC.

Because historically the TCC and the DCC operated on a shared system, the FEP's were deployed to the control network as shared resources. These units will now need to be separated by deploying new FEP units specifically for the TCC leaving the existing legacy equipment attached to the DCC.



### 8.3.2 Operational Corporate PI Historian Deployment

Name of Scheme	Operational Corporate PI Historian Deployment
Strategic Theme(s)	Safe and Secure Network Operations
Cost	██████
Benefit Analysis	████
Planned Delivery Year	2021/22

The Cyber Engineering programme of work undertaken during RIIO-T1 identified that one of the key access threats to the operational technology environment related to how the corporate teams accessed the real time data being generated by the TCC. The data was at this point being written to a PI Historian shared between us and SHEPD hosted in the operational technology environment.

This access risk was mitigated by deploying a networks corporate PI solution. Data required by the business is pushed from the operational PI solution to the Network Corporate PI solution using an encrypted one-way PI link. Business users access to the operational PI Historian and operational networks were then revoked.

With changes being implemented within the energy distribution business, especially to Whole System working, it is clear that operational data about the operation of the Transmission network needs to be formally exchanged between the Transmission and Distribution businesses as opposed to being accessed from shared resources.

The new TCC deployment will deploy a new Transmission PI Historian, which will only contain Transmission data and will satisfy the separation of Transmission and Distribution data in the operational environment. This activity will replicate this separation in the corporate environment by the creation of a new corporate Transmission environment.

Following completion of this exercise no historian data relating to Distribution and Transmission will be stored on shared systems.





#### 8.4 Inter-Control Centre Protocol (ICCP) Implementation to National Grid and Scottish Power

Name of Scheme	Inter-Control Centre Protocol (ICCP) Implementation to National Grid and Scottish Power
Strategic Theme(s)	Safe and Secure Network Operations
Cost	██████
Benefit Analysis	████
Planned Delivery Year	2024/25

Inter-Control Centre Protocol (ICCP) is an industry standard protocol used throughout the world for the exchange of data between the control centres used by utility companies. The System Operator (SO) and other Transmission Operators (TO's) have been operating this protocol for some time.

Historically the Transmission business has exchanged data with the SO and TO's using a solution based on PI Historian protocols. However, the assessment of the current solution against the changes within the UK energy industry has shown that this system will need to be replaced.

The implementation of Whole System working into the energy market will require more operational data to be exchanged between the SO and TO's and also change the format / type of the data being moved between the entities.

In order to ensure that Transmission is able to facilitate this data exchange the company will move these links to use the ICCP protocol. The use of this protocol will allow legacy connections to be retired in favour of the more secure ICCP connection and ensure bi-directional data exchange is capable of efficiently handling the increased future data flow.

## 8.5 Alarm Prioritisation and Rationalisation

Name of Scheme	Alarm Prioritisation and Rationalisation
Strategic Theme(s)	Safe and Secure Network Operations
Cost	██████
Benefit Analysis	██████
Planned Delivery Year	2022/23

Following a fault on the network, Control Engineers working in the TCC can be bombarded by alarms. These can be generated by multiple sensors on the network simultaneously recording the faults back through the SCADA system to the control engineer.

The control engineer is then required to sift through the generated alarm messages (circa 5 pages) to work out the root cause of the alarm before they can issue corrective actions to network devices, issue field instructions or reset alarm conditions. This manual sifting process distracts the control engineer from instigating these corrective actions.

This whole process is inefficient, highly manual and can result in an extended time period before the rectification instructions can be issued.

This activity is focused on improving the control engineer's situation awareness by being able to take control of the situation quickly.

Implementing a solution either within the TCC, or to run real time alongside the TCC, will enable the control engineers to filter out the noise generated as part of fault scenarios and home in on the alarms that inform them as to what is generating the alarm. The application of sorting and filtering technology to the alarm generation process will reduce the 'noise' and allow sifter action to be taken to rectify the fault.

## 9. RIIO-T2 IT INVESTMENT PLAN CONCLUSION

Our RIIO-T2 IT Investment Plan has been prepared based on SHE Transmission's strategic themes. The plan proposes 27 major projects during the next price period with a combined capital investment of £53.29M. Our plan has been reviewed and validated by independent assessment (Gartner Consulting) and is in line with the Energy Data Taskforce 'A Strategy for a Modern Digitalised Energy System'.

The projects have been broken down into four main delivery workstreams:

**Stakeholders including customer connections** – The projects within this work stream are all focused at improving how our company interacts with both our external and internal Stakeholders. The goal is to move to more active interaction during the price control period.

**Asset projects** – The projects within this workstream are designed to digitalise our asset based, improve the static information we hold about our asset base, the information the assets generate during both normal and abnormal operations and improving how we appraise the assets when considering maintenance and network improvements.

**Work Management** – The projects in this workstream will improve the way we operate and maintain our assets, both in terms of managing work and how we interact with our environment. They will provide our workforce with better information about the tasks that they are undertaking.

**Operation Technology Control Systems** – The projects in this workstream are designed to ensure that our company continues to run a safe and secure network. Network control team have proposed building a new Transmission Control Centre and several the projects in this area support this new facility coming on stream during RIIO-T2.

SHE Transmission has demonstrated IT investment in RIIO-T1 significantly above the plans outlined in the RIIO-T1 business plan. The IT investment proposed during RIIO-T2 builds on this prior investment.

The RIIO-T2 IT Investment plan is bold and represents an investment level required to improve our IT systems to help us move to a fully digitised business as set out in our Digital Strategy, providing all Stakeholders the information they need through a contemporary user interface.



## 10. APPENDIX A – KEY ASSUMPTIONS

At this stage in the RIIO-T2 IT Investment Plan definition, several key assumptions have been made. These are listed as follows:

### 10.1 Project Cost

Project costs have been calculated on a project by project basis. At this point in the development of the RIIO-T2 IT Investment plan, no synergies have been applied through the operation of a programme of work as opposed to a group of individual projects.

### 10.2 Project Operational Costs Year 1

We have assumed that during project delivery any operational costs will be sunk by the project. Operational costs will normally be paid from 3 months after project delivery.

### 10.3 Tablets and Mobile Devices

Tablets and mobile devices required by work management will be covered by the corporate Mobile Device Management service and have not been capitalised into the project costs.

### 10.4 Benefit Calculations

In general, the benefits from implementing the solution have been calculated over the year of implementation and the following 4 years. This is in line with the SHE Transmission's standard investment and Net Present Value (NPV) investment appraisals.

At this stage in the development of the IT Investment Plan, the benefits that will be realised from projects that deliver in the last part of the RIIO-T2 period have not been profiled as benefits for RIIO-T3.

### 10.5 Business Cost

The projects have been costed based on the estimated level of resource to deliver the project that has been described. Business resources have been costed on a back-fill basis assuming that the business subject matter expert normal duties will need to be under taken by another resource.

The costs of a back-fill resource have been taken from the table of rates supplied by OfGEM.

### 10.6 Business Resources

It has been assumed that the business is able to supply the correct resource to service the programme through to completion. Unavailability of resources could see elements of the programme delayed or de-scoped to ensure other projects are correctly delivered.

### 10.7 IT Resources

The IT resource costs have been applied based on rate tables supplied by SSE IT. These rates in many cases assume a blended rate between internal and external resource.

### 10.8 IT Hardware

IT hardware has been costed on the basis of servers being supplied by SSE Group IT and installed in the corporate data centres. Synergies relating to alternative provisioning have not been factored into the IT Investment Plan costs at this stage of development.

## 10.9 Business Separation

There has been no consideration relating to separating systems that are currently implemented as shared between SHE Transmission, SHE Power Distribution or SE Power Distribution. There is currently no clear policy on this area and costs have been assigned on the basis that the status quo is maintained.

## 10.10 Programme Phasing

Programme phasing has been defined based on the knowledge and experience of the IT Investment Plan development team to provide SHE Transmission finance with reasonable phased expenditure over the RIIO-T2 period. The sequencing of projects in the programme and project interdependencies (data, resource, service) have yet to be applied to the sequence.

Business Stakeholders have not signed off the sequencing, which is liable to change as the programme mobilises during 2020.

## 10.11 Data Management

An estimated amount has been added to each proposed project to cover data management activities that may be required.

## 10.12 Contingency

## 10.13 Cyber Security Costs

Each project included in the programme bears its own costs of security by design. No costs have been included in the IT Investment Plan relating to general Cyber Security implementation. Threats will need to be assessed and mitigated on a threat by threat basis and are subject to work being undertaken elsewhere in SHE Transmission.

## 10.14 RIIO-T1 Investment Plan

The RIIO-T2 plan assumes that all projects current inflight or scheduled to be completed by 31 March 2021, will have done so. There is no allowance in the plan for completing these projects. Many of the projects have been costed on the basis that RIIO-T1 projects are there as a base for RIIO-T2 investment.