Routing Automation & Planning with Intelligent Data (RAPID)

Pathways Report

Executive summary

Meeting the needs of the Electricity Network Commissioner's Report

Problem statement

Project RAPID (Routing Automation and Planning with Intelligent Data) is a strategic initiative aimed at transforming how electricity transmission infrastructure is developed and delivered across the UK.

In response to the Electricity Network Commissioner's Report, which highlights the need to overcome fragmented and slow planning processes among Transmission Operators (TOs), RAPID seeks to accelerate infrastructure deployment by leveraging advanced technologies like AI, enhancing data interoperability, and promoting cross-sector collaboration.

The project evaluates current routing practices to identify opportunities for improvement, with a particular focus on standardised automated corridor routing process led by landscape architects to ensure broader and more defensible route options, and the integration of Electricity Transmission Design Principles (ETDP) into route design, supported by tools that guide asset selection and placement within corridors.

Potential opportunities

Drawing on stakeholder engagement and internal expertise in planning, GIS, and data systems, three opportunities aimed at improving routing decisions and accelerating the delivery of a more efficient and future-ready electricity transmission network were defined. All three solutions included a foundational dependency, creation of a common data environment to support technology and data interoperability.

Opportunity one explored the use of AI through Route-Rationale GPT to help experts quickly articulate the rationale behind corridor or routing choices that were obtained through analysis and expert input.

Opportunity two explored automating the creation and updating of planning and land agreement documents, reducing the admirative burden, while allowing for flexibility to improve existing processes.

Opportunity three explored the use of modern portfolio theory to help with land negotiations, considering critical path, and overall budget.

Next steps

In response to the Electricity Network Commissioner's Report, this discovery report outlines three key opportunities to accelerate infrastructure deployment. Stakeholder feedback consistently highlighted the need for a more detailed definition of these opportunities, with a focus on quantifying their scale and benefits. To ensure viability, these benefits must also be validated by internal teams, such as land and consenting, and key external bodies like the Planning Inspectorate.

Our next steps will proceed in two phases.

Phase One will refine the proposed opportunities through user testing, cost-benefit analysis, technical feasibility assessments, and security reviews.

Following this, Phase Two will deliver a proof of concept (PoC) to validate the proposed technology. This includes creating a detailed design using TOGAF principles, building a common data environment, and training models with synthetic data and expert input to develop a robust, scalable solution.

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Project partners

Transmission Network Operators, System Operators, and industry

Lead project partner

Project partners

Industry partners

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Introduction

Setting the scene

Our approach to meeting the defined challenge & aim

Overview

Project RAPID, or Routing Automation and Planning with Intelligent Data, is a key initiative designed to modernise the UK's electricity transmission infrastructure development and build process.

As outlined in the **Electricity Network Commissioner's Report**, the United Kingdom (UK) must significantly accelerate the delivery of new transmission infrastructure by resolving the current fragmented, slow, and inconsistent planning and consenting processes across Transmission Operators (TOs), contributing to delays and rising constraint costs.

This project is assessing ways to modernise the infrastructure development process by outlining the opportunities to reduce and standardise the delivery of new transmission infrastructure by leveraging advanced technologies, such as AI, and by improving data, its interoperability and fostering cross-sector collaboration.

Aim

This report provides an overview of current routing practices across UK Transmission Owners (TOs). It seeks to identify opportunities for improvement in the route design process.

Central to this initiative is evaluation of the ways the two key recommendations from the Winser Report can be adopted in the overall process:

- **AR1**: The standardisation of an automated corridor routing process, overseen by landscape architects, to enable broader and more defensible route options.
- **AR2**: The integration of **Electricity Transmission Design Principles (ETDP)** into route design, supported by new tools that guide asset selection and location within corridors.

Approach

Definition of the challenge
Reviewed and analysed existing policy & process documents to outline the current needs and challenges

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Stakeholder engagement
Conducted ~12 stakeholders' interviews to review and define the routing process, challenges, and potential opportunities

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Brainstorming potential opportunities
Through stakeholder-led engagement sessions, outlined seven potential opportunities to meet the stated challenge

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Evaluated the opportunities
Assessed the opportunities against their ability to meet the challenge, user need, feasibility, and for any duplication in thinking.

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Outlined the short list of opportunities
Outlined the three potential solutions that can address the challenges, and ensure a lasting impact in the routing process

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Outlined delivery routes
Recommeded a potential that can be taken for further development by aligning the opportunity across all stakeholders

Continuous stakeholder engagement

Stakeholder engagement

Outlining the engagements completed to support the challenge & opportunities

Overview

As part of the engagement phase for the Routing Automation and Planning with Intelligent Data, we conducted dedicated workshops with three UK Transmission Operators (TOs) - Scottish & Southern Electricity Networks (**SSEN**), SP Energy Networks (**SPEN**), and National Grid Electricity Transmission (**NGET**).

These interactive sessions brought together engineering, and planning representatives from each TOs to walk us through their current end-to-end routing processes, from early optioneering through to alignment selection and consent submission.

This information formed the basis for our consolidated view of existing practices across the three TOs, highlighting areas of commonality and divergence to inform future standardisation opportunities.

Alongside the TOs, representatives from the National Energy System Operator (**NESO**) were involved to gain insight into forthcoming modifications to the routing process.

Workshop guide

The workshops provided detailed insight into:

- **Process steps** followed at each stage of route development
- **Data sources, tools, and technology** used in decision-making
- **Stakeholder engagement** and consultation practices
- **Challenges and opportunities** faced during routing and consenting

Key challenges

Defined through multiple stakeholder engagements

Overview

These challenges are categorized into four main areas:

Strategic Optioneering: involves the early-stage decision-making process where geographic constraints and schematic network needs must be balanced.

Route Corridor: focuses on the selection and management of the physical pathways for transmission lines.

Route Options: pertain to the iterative process of refining and selecting the best-possible routes.

Planning & Consenting: encompasses the legal, regulatory and administrative processes required to gain approval for the proposed routes.

Strategic Optioneering

- Limited integration of geographic constraints at this early-stage
- Disconnect between schematic network need and spatial feasibility
- Lack of standardised assumptions across TOs

Route Corridor

- Balancing environmental, technical, and social constraints
- Early-stage data gaps (e.g. Land ownership, access)
- Inconsistent corridor widths and selection criteria

Route Options

- Iterative redesign due to late-stage constraints or consultation feedback
- Poor integration between engineering and environmental data
- Manual processes for alignment refinement

Planning & Consenting

- Land access negotiations and legal processes (e.g. Wayleaves, easements) are often bottlenecks
- High administrative effort to complete the required tasks to get the plan approved

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Long list of opportunities

Long list of opportunities

An initial list of ideas

Overview

Bringing together insights from stakeholder engagement and internal expertise across planning, GIS, and data systems, the team defined a long list of potential solutions.

These options aim to improve routing decisions, accelerate delivery, and support a more flexible, efficient, and future-ready transmission network.

Opportunity long list

- **Common data model:** Definition of a common data model, taxonomy, data sets, and environment to enable technology and data interoperability.
- **Route-Rationale GPT:** Leverages AI to help subject matter experts answer, “Why this corridor?” rationale at pace and scale.
- **Planning-Pack Generator:** Builds and updates DCO/EIA document packs based on team notes, meeting transcripts, and other data sources - incorporating relevant permissions, appeals and information from statutory consultations.
- **Land consenting tool:** Extraction of land access agreements and tracking.
- **Common network assessment tool for strategic route optioneering:** A shared platform to support early-stage corridor identification using a common methodology agreed between TOs.
- **ETDP route scoring tool:** A multi-criteria assessment tool to help narrow down to numerous route options.
- **Stakeholder evaluation tool:** To evaluate and understand concerns based on historic applications.

Opportunity long list (1 of 2)

Outlining the opportunity, and its association with key challenges and how it can address it

Innovation opportunity	Description	Key challenges addressed	How it could work
Common data model	A common data model that would enable data interoperability across multiple technology platforms that can support in corridor routing understanding by reducing the burden in data integration.	• Need for transparent, defensible scoring frameworks • Need to integrate multiple digital platforms	Aligning on agreed data sets for route corridor selection and a common set of criteria weightings based on those datasets. This could be implemented by any routing software, allowing space for platform competition but ensuring the methodology is shared.
Route-Rationale GPT	Large Language Model (LLM) assisted process and tool that evaluates each predefined candidate polyline against weighted GIS constraints (SSSI, habitats, ownership, visual impact, cost) and justifies every geospatial decision line-by-line with citations. Output: ranked routes plus an auto-written “Why this corridor?” rationale.	• Inconsistent, route scoring methods across TOs. • Need for regulator-ready reasoning. • Manual narrative drafting slows projects. • Shrinks a 9–12-month corridor-study cycle significantly, while giving regulators a traceable audit trail.	Planners upload routes digitally; the platform taps the shared vector store of constraint layers and policy PDFs, the LLM scores every segment with reasoning, explains trade-offs, and exports a scored heat-map plus a narrative ready for NESO/PI submission.
Planning-Pack Generator	A tool which supports the generation of documents for the DCO process and creates an auditable trail for planning documents. A push-button creation (auto-differentiation and then regeneration) of elements of DCO/EIA chapters, Section 42 letters, consultation logs and other statutory documents, once a preferred alignment is chosen.	• Need for defensible, policy-aligned wording. • Saves time in generation of documents and give efficiencies in spend. • Gives discipline experts a core and controlled baseline for their assessments. • Assists in re-drafting thousands of pages at design fixes. • Supports the justification of why specific sites were identified for development	Feed the chosen corridor and project parameters into the AI platform. The LLM stitches past DCO templates, NPS EN-5 clauses and local-plan text into new chapters, with inline citations, which form core sections of reporting, as a baseline for discipline experts. Any geometry or parameter change triggers a smart difference that regenerates only affected sections, keeping a versioned audit trail. Human review will be required.

Opportunity long list (2 of 2)

Outlining the opportunity, and its association with key challenges and how it can address it

Innovation opportunity	Description	Key challenges addressed	How it could work
Land consenting tool	LLM assistant that parses HM Land Registry deeds, auto-drafts option agreements & follow-up emails, tracks landowner responses and suggests next-best negotiation terms. Human review will be required.	• Manual extraction of deed particulars. • Fragmented email/document workflow for hundreds of parcels. • Delays securing access, causing schedule slips. • Cuts legal drafting hours significantly and secures earlier site access, preventing downstream schedule slips.	Land registry deeds are OCR-parsed to JSON; the platform auto-drafts option agreements and emails, tracks parcel status with suggested counter-offers, and syncs everything to the common network assessment tool or CRM.
Common network assessment tool for strategic route optioneering	A shared platform to support early-stage corridor identification across TOs, integrating geospatial, environmental, and technical data to define strategic route options. This would enable a common methodology between TOs when submitting strategic options to NESO.	• Inconsistent corridor identification methods. • Fragmented data sources and lack of interoperability. • Reduces effort of strategic optioneering phase.	This tool could be similar to NESO's CSNP Options Optimiser but designed for the TOs. This tool would iterate between network, economic and geospatial models to suggest reinforcements that TO's would submit to NESO.
ETDP route scoring tool	A scoring tool designed to evaluate route options against the ETDP, ensuring alignment with national policy and regulatory expectations.	• Difficulty in justifying route decisions during statutory consultation. • Need for transparent, defensible scoring frameworks.	TO's would submit their route options to a common tool that would score the options against the ETDP. This would provide a common, impartial score that allows the different options to be compared.
Stakeholder evaluation tool	Utilising historic planning applications to understand stakeholder concerns and blockers earlier in the route planning process.	• Delays in processes due to stakeholder push-back	LLM based tool that can provide an early view of stakeholder concerns based on historic engagements for other planning applications for specific parts of the route.

2.1

Assessment of the opportunities

Assessment of the opportunities

Prioritisation & further definition

Approach

The assessment of the identified opportunities is divided into two main stages:

Prioritisation: Developing a short list through a systematic evaluation of each opportunity.

In this step, prioritization also involves reviewing each solution to identify any overlapping ideas.

Definition: Expanding the short-listed concepts into comprehensive product briefs.

Prioritisation

Each of the opportunities were evaluated against the below five criteria, further defined on the next page.

1. Ability to solve the challenges, referring to page 07
2. Feasibility
3. User value
4. Adoption viability
5. Duplication in thinking

Definition

Section 3 offers an in-depth examination of the short-listed solutions.

Each solution is described under the following categories:

- Overview of the solution
- Main features and characteristics
- Value offered
- Data requirements
- Essential interfaces

Prioritisation criteria

Evaluating the seven opportunities to reach a short list

Overview

Each opportunity is thoroughly examined against these five criteria:

- **Ability to Solve the Stated Challenge**: potential of the solution to meet the specific needs and requirements outlined in the report.
- **Feasibility**: the practicality of implementing the opportunity.
- **User Value**: measures of the tangible benefits that the opportunity can provide to business teams.
- **Adoption Viability**: the complexity of integrating the opportunity into existing processes.
- **Duplication in Thinking**: checks for any overlap with other opportunities or existing external tools and innovation projects.

By applying these criteria, opportunities prioritisation offer the greatest potential for improving the routing and planning processes while ensuring that they are practical, valuable, and unique.

Ability to solve the stated challenge

- Will it support solving the stated challenges?
- Can it meet the stated needs of the Winser report?

User value

- Is there a quantifiable time or cost savings compared to as-is process?
- Can it support business teams across NGET, SPEN, and SSEN-T make better decisions?

Adoption viability

- How complex is it to integrate this technology into current processes?
- To what extent is this solution scalable?

Feasibility

- Is the opportunity 'innovative’, requiring a submission to SiF Alpha?
- What is the confidence level of this tool achieving the stated benefits?

Duplication in thinking

- Does this opportunity have similar functionality as other long list of opportunities?
- Does this opportunity have similar functionality as other external tools and innovation projects?

Evaluation of each opportunity (1 of 2)

RAG rating of each opportunity against the five assessment criteria

Innovation opportunity	Description	Ability to meet the challenge	Feasibility	User value	Viability	Duplication in thinking
Common data model	A shared data repository, and models that would support data interoperability across multiple technology platforms.	Green	Green	Green	Green	Green
Route-Rationale GPT	Large Language Model (LLM) powered tool that reduces time & effort for answering "Why this corridor?".	Green	Green	Green	Green	Amber
Planning-Pack Generator	A tool which supports the generation of documents for the DCO process.	Green	Green	Green	Amber	Amber
Land consenting tool	LLM assistant for generation of agreements & follow-up responses with landowner responses and suggests next-best negotiation terms.	Green	Amber	Green	Amber	Amber
Common network assessment tool	A shared platform to support early-stage corridor identification across TOs to ensure optimal value for all customers.	Green	Green	Green	Green	Red
ETDP route scoring tool	A scoring tool designed to evaluate route options against the ETDP.	Green	Amber	Amber	Amber	Green
Stakeholder evaluation tool	Utilising historic planning applications to understand stakeholder concerns and blockers earlier in the route planning process.	Amber	Amber	Amber	Green	Red

Evaluation of each opportunity (2 of 2)

Explaining the reasoning behind the RAG rating

Innovation opportunity	Prioritisation	Rationale
Common data environment	Foundational requirement; Previously named as – Common data model	A shared dataset environment across all TOs, allowing for shared responsibility for data quality, assurance, and integrity. This functionality will be designed/developed as a foundational dependency across the other three short-listed solutions.
Route-Rationale GPT	Short-listed;	Supporting the detailed design stage by incorporating expert input into a highly analytical process. This LLM will work with the user to reduce the burden on pulling out documents, drawings, data, while providing a means for the Route-Rationale GPT to support future interactions. It would be able to generate a list explaining why a specific route was chosen over others, which will help with challenges in planning later down the line. This tool will be a bridge between the routing software, and the reporting/planning/engagement software.
Consenting Platform Integrator	Short-listed; Previously named as – Planning-Pack Generator	Supporting activities associated with creation of reports, based on templates. This tool will be fine-tuned to specific reports and support a LLM augmented editions. *Functionality of this opportunity is expanded to include reports and documents part of the 'Land Consenting Tool', leaving that opportunity to include only the outstanding aspects centred around negotiation.*
Land negotiating tool	Short-listed; Previously named as – Land Consenting Tool.	An innovative/trial solution using multi-agent model to support land negotiations. Underpinned by an optimisation model and a predefined framework based on negotiating principles such as cap & floor positions for each land parcel, costs for acquisition, optimisation of the overall portfolio, and future links to document generator opportunity.
Common network assessment tool	Not short-listed	Noted similarities to existing NESO initiative, CSNP Options Optimiser. In addition, existing optimisers can provide this functionality, and suggest TOs, and SMEs, work with suppliers to improve performance/output. This can be achieved through debt, equity, and BAU expenditure, and implementation of the common data model.
ETDP route scoring tool	Not short-listed	ETDP has not been released, and only limited details are available; as a result, any evaluation of its application for RAPID is constrained, presenting difficulties for its incorporation in next step proposals or solution development.
Stakeholder evaluation tool	Not short-listed	Similar initiatives are currently being completed by DSIT.

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Short list of opportunities

Setting the scene

Narrowing down the list of opportunities

Overview

Following a comprehensive assessment, three short-listed opportunities and one foundational dependency have been selected.

The foundational dependency refers to the fact this solution will be developed, in a limited context, to enable the three short-listed opportunities.

In the subsequent sections, each solution will be explored in detail, outlining its key features, and the advantages it offers.

Foundational dependency

Common Data Environment: This foundational dependency ensures data interoperability across multiple technology platforms, enabling consistent and accurate data integration for route planning and decision-making.

Short-listed opportunities

The three short-listed solutions are:

Route-Rationale GPT: This tool provides post-analysis reasoning for corridor and route options. It leverages AI to support SMEs throughout the reasoning process, significantly reducing the time required for corridor and route studies and enhancing the defensibility of route decisions.

Consenting Platform Integrator: Designed to support the generation of templated documents, this tool leverages AI in the drafting and regeneration of essential statutory and land access documents, saving time and reducing costs.

Land Negotiation Tool: This research/innovation opportunity leverages multi-agent systems & modern portfolio theory to help land teams negotiate with landowners.

3.1

Common Data Environment

Common Data Environment (1 of 2)

A foundational dependency for all short-listed opportunities

Overview

Data is the foundation of innovation needed to address the challenges associated with corridor and route-finding lifecycle. Without consistent and accurate data, even the most promising innovations cannot succeed. Effective route optioneering relies on timely, accurate, and interoperable data, making a Common Data Environment (CDE) an essential foundation.

CDE enables seamless integration of geospatial data, environmental constraints, land ownership, engineering parameters, and other data products. It can allow all stakeholders, from planners and engineers to environmental consultants, are working from a trusted and assured data set, reducing errors and duplication.

With real-time access to validated datasets and modelling outputs, operators can confidently assess trade-offs, identify risks, and optimise routes for cost, resilience, and environmental impact, transforming route optioneering from a fragmented process into a collaborative, data-driven strategy through a well-structured CDE.

Key characteristics & features

A common data environment facilitates the integration of diverse data sets, including geospatial, engineering, land, stakeholder engagement, and non-technical information such as project plans, meeting minutes, decision records, voice transcripts, and multiple boards.

This integration relies on a common data model that specifies the required data types, formats, assurance protocols, validations, and certifications. The model ensures data interoperability by clearly defining the structure that each data set must adhere to.

Supporting this model is a knowledge graph or ontology, which enables schematic interoperability by establishing the contextual relationships between multiple disparate data sets.

The design of the data environment, model, and ontology will be tailored to the selected short list opportunity, serving as an initial framework to demonstrate its value for future development.

Value proposition

CDE can play a pivotal role in streamlining collaboration and ensuring regulatory alignment and consistency.

Few noted benefits include:

- **Integrated decision-making**: Links geospatial, environmental, engineering, and land data to enable a shared schematic understanding of data.
- **Real-time collaboration**: Enables concurrent analysis across multiple teams, across different domains.
- **Shared ownership**: Fosters a culture of collaboration by allowing all TOs to share the responsibility for data quality, and assurance.
- **Trusted & assured data**: Ensures source of data is credible, trustworthy, and up-to-date.

Common Data Environment (2 of 2)

Interfaces, governance, and future-proofing

Required interfaces

Drawing on Ordnance Survey's expertise in geospatial data and national infrastructure mapping, the following outlines initial considerations, but not limited too, for developing a Common Data Environment (CDE).

- **Adoption of open data standards** (e.g. IFC, GeoJSON, NetCDF) to ensure interoperability across systems and organisations.
- **Implementation of robust metadata protocols** to maintain data provenance, versioning, and audit trails.
- **Establish a shared governance framework** defining roles, responsibilities, data ownership and access across multiple users, especially how these users will interact across organisations.
- **Facilitate cross-organisation working groups** to align on data models, workflows, and environmental assessment methodologies.
- **Ensure compliance with data protection regulations and best practices** (e.g. GDPR, UK EIR) and industry-specific standards.
- **Maintain audit logs** for all data interactions to support regulatory reporting and accountability.
- **Support real-time data sharing and updates** to enable concurrent analysis and reduce duplication.
- **Include visualisation tools** (e.g. Dashboards, map layers, impact overlays) to support decision-making.
- **Design for scalability** to accommodate new data sources, technologies, and regulatory requirements.
- **Incorporate AI/ML capabilities** for automated data classification, anomaly detection, and predictive analytics.
- **Plan for long-term data stewardship** to ensure continuity across asset lifecycles and regulatory cycles.

Risks

From stakeholder research, below list outlines several key risks that could impact the effectiveness and reliability of the common data environment (CDE).

- **Inconsistency of data across Wales, Scotland, and England, and associated councils**: arise from variations in data collection methods, standards, and regulations. As a result, integrating data from multiple countries can lead to discrepancies and inaccuracies, making it difficult to create a unified and reliable data environment.
- **Consistency of data**: Within TOs, there can be inconsistencies in the data used across different departments and teams. When data is not consistent within among the TOs, it can lead to miscommunication, errors, and inefficiencies.
- **The age, and source of data**: The age and source of data are critical factors that can impact its relevance and accuracy. Additionally, the source of the data must be credible and trustworthy. It is also important to consider which data is being used and how it is being interpreted.

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Route-Rationale GPT

Route-Rationale GPT (1 of 2)

Leveraging AI to help subject matter experts answer, “Why this corridor/route?” rationale at pace and scale

Overview

Route-Rationale GPT is designed to rapidly generate regulator-ready reasoning for corridor & route options once spatial analysis has been undertaken and candidate routes have been uploaded into the system.

Instead of manually drafting narratives or reconciling conflicting scoring methods, planners import 2–3 polylines and the tool gathers the relevant context against GIS- and policy-defined constraints, such as SSSI boundaries, habitats, land ownership parcels, and visual impact grids.

The system then surfaces constraint conflicts and auto-drafts the “Why this corridor?” rationale with full citations.

By shifting the effort from manual drafting to AI leveraged reasoning, Route-Rationale GPT allows project teams to respond quickly to stakeholder and regulator questions with clear, evidence-based justifications, while embedding expert input into a highly analytical process.

Key characteristics & features

The platform is structured around three integrated components:

Common Data Environment (CDE): consolidates GIS layers, parcel ownership data, cost models, and statutory policy documents into a single, indexed environment, ensuring evaluations are based on the most current information.

AI Reasoning Layer: applies domain-tuned models to abridge each uploaded corridor, outlining possible trade-offs and generating line-by-line justifications with citations.

First point assistant: a chat-bot interface for planners, engineers, and leaders to gather information and evaluating one route vs another, when answering “why this corridor/route?”. The chatbot will also navigate technical language between the different disciplines, leading to easier communication between teams.

Expert designed rational framework: agreed criteria by planners, routing experts, and consenting specialists. This framework will form a benchmark for trade-off reasoning, standardised where possible with all TOs, allowing for the model to continuously improve from expert training & feedback.

Value proposition

Route-Rationale GPT delivers impact across corridor studies by providing rapid, defensible reasoning for predefined routes.

Faster regulatory submissions: It could cut 9–12-month corridor optioneering cycles with automated rationale generation.

Auditable: Produces line-by-line reasoning with citations from statutory policy and GIS layers, creating a traceable audit trail.

Stronger stakeholder engagement: Provides clear, defensible narratives early to support faster, evidence-backed consultations.

Reduced cost and rework: Lowers reliance on consultancy hours while ensuring consistent outputs across projects.

Route-Rationale GPT enables project teams to explain why a corridor was chosen in a way that is transparent, consistent, and regulator-ready, transforming justification into a strength that accelerates the consenting process and builds stakeholder confidence. This transparency helps make the decisions that were made defensible at submission stage.

Route-Rationale GPT (2 of 2)

Dependencies, interfaces, and risks

Data dependencies

Route-Rationale GPT relies on accurate, current datasets to generate defensible outputs. This is enabled through the establishment of the Common Data Environment.

Core spatial data includes corridor alignments, buffer zones, and constraint layers such as SSSI boundaries, habitats, flood zones, and visual impact grids, all provided in GIS-ready formats. Land and ownership information is essential, comprising parcel boundaries, registered titles, deeds, easements, and access rights.

Policy and regulatory content includes National Policy Statements, local-plan text, and precedent from inspectorate determinations. Cost and design parameter data, such as construction footprints and indicative engineering limits, provide the economic and technical context for assessments.

Regular updates, structured formats, and version-controlled metadata ensure the rationale remains accurate, and audit-ready. In addition, data on historical precedents will assist in showing where route optioneering was undertaken before and why certain routes made more sense than others.

Technology interfaces

The system is designed to connect seamlessly with existing enterprise tools and external data services. GIS platforms provide spatial visualisation and allow import/export of files.

Land registry services can be linked for deed and title retrieval, with structured parsing into machine-readable formats.

Document management platforms such as SharePoint or ProjectWise serve as repositories for both inputs and generated outputs, ensuring alignment with existing project information environments.

Policy libraries and statutory guidance are indexed to allow inline citation within generated reports.

Security and compliance are maintained through audit logs and role-based access controls, ensuring confidence in both the process and the outputs.

Risks

Route-Rationale GPT introduces powerful automation for route planning, but its deployment carries key risks around constructability, data integration, stakeholder traceability, and role-based workflows.

1. **Constructability & segment mixing:** Multiple route segments can be combined, disjointed, and revised during the routing process, which can challenge for labelling & tagging data to pull out relevant considerations around constructability, linkages, cost estimates, and landowners.
2. **Tool Integration:** Engineers use tools like ArcGIS and Pathfinder. The integration of Route-Rationale GPT with other tools can be a challenge for optimal user experience; therefore, multiple testing of different interfaces should be considered.
3. **Design change control:** Lack of unified tracking for document dependencies causes rework. Early identification of underpinning data is critical.
4. **Data access:** Clear workflows are needed for different roles (GIS analysts, engineers, planners) to ensure accountability and data clarity.

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Consenting Platform Integrator

Consenting Platform Integrator (1 of 2)

Reducing administrative time & effort through data and technology integration

Overview

This opportunity brings together Planning-Pack Generator, and certain functionality from Land Consenting Tool because the underlying technology and training will be similar across both opportunities.

In addition, it allows for an integration of two separate workflows, Statutory Planning & Land Consenting.

- **Statutory Planning** focusing on generating documents such as Environmental Impact Assessments, Development Consent Orders, and consultation records.
- **Land Consenting** focusing on deeds agreements and stakeholder negotiations, access and survey.

This division often creates duplication, inconsistencies, and delays. The proposed tool would bring these two strands together into an integrated digital system, enabling projects to progress from environmental assessment through planning submissions and into land access and agreements within a single workflow.

Key characteristics & features

The platform integrates two core elements:

Digital EIA that structures environmental data for visual analysis and LLM enabled generation of statutory documents.

Land parcel database that records ownership, correspondence, and negotiation progress.

Both are underpinned by a **Common Data Environment** (CDE) holding geometry, constraints, parcel data, and policy libraries.

An AI layer reinforced by learning from historic DCO/EIA documents would supplement statutory text, parse deeds, and suggest agreement terms, improving continuously with user feedback.

Smart change detection would regenerate affected sections when data changes, while a unified dashboard would integrate maps, planning tools, land records, and audit trails.

Value proposition

The platform delivers value across multiple areas:

Efficiency is improved by reducing the time and effort required for drafting, cutting reliance on external consultancy hours, and streamlining document generation to accelerate statutory submissions.

Consistency is ensured with outputs aligned to national policy statements and local plans, providing a reliable baseline for discipline experts to refine without repeated re-drafting.

Risk is reduced by dynamically updating all associated planning documentation to reflect design or parcel changes, avoiding inconsistencies across submissions.

Transparency and control is enhanced through a built-in audit trail that underpins statutory compliance and a shared environment that removes silos and ensures all stakeholders work from the same, up-to-date information.

Consenting Platform Integrator (2 of 2)

Interfaces, dependencies, and risks

Data dependencies

Core spatial data includes project footprints, corridor alignments, buffers, and constraint such as protected sites, flood zones, topography, all in GIS-ready formats.

Land and ownership information comprises parcel boundaries, registered titles, deeds, easements, access rights, and negotiation records, including correspondence and stakeholder engagement logs.

Policy and regulatory content includes National Policy Statements, local plans, statutory guidance, and precedent from past DCO decisions.

Project and design data covers construction footprints, engineering limits, and cost assumptions.

Document and knowledge bases include historic EIAs, planning applications, statutory submissions, and template agreements, supporting automated drafting and change detection.

All datasets are would be managed within a **Common Data Environment (CDE)**, ensuring structured formats, version-controlled metadata, and a single source of truth for transparency, consistency, and audit readiness.

Technology interfaces

GIS and mapping through tool such as ArcGIS Enterprise (Atlas), which provides spatial visualisation, analysis, and map-based dashboards.

Integration systems through tools such as Fuse, combining maps, dashboards, SharePoint, and other enterprise tools into a single interface.

AI and automation can be integrated through Fuse, applying paid or open large language models to learning to draft statutory text, parse deeds, suggest agreement terms, and automate workflows.

Land management, underpinned by databases like Parcel, capturing ownership, correspondence, negotiation progress, and access rights to support the land consenting workflow.

Common Data Environment (CDE) through project WISE, SharePoint, Fuse would integrate spatial, policy, and project data into a connected web of data, with version control, structured formats, and audit trails to ensure transparency, consistency, and compliance across workflows.

Risks

Data integration and standardisation: With no single taxonomy for land use or planning data in the UK, the platform relies on a harmonisation layer to align disparate datasets into consistent formats.

Stakeholder trust and adoption: Land access and compulsory purchase are sensitive and often contested.

Regulatory alignment: Planning law and policy shift frequently. Without automated monitoring, outputs risk becoming outdated or non-compliant, exposing projects to rejection or legal challenge.

AI reliability: Large Language Models may "hallucinate" and produce authoritative but incorrect text. Human-in-the-loop review and validation are essential to maintain accuracy in statutory and legal outputs.

Data security and governance: Ownership records, negotiation histories, and environmental assessments are sensitive. Any breach or misuse could have legal consequences and erode trust.

3.4

Land Negotiation Tool

Land Negotiation Tool (1 of 2)

A multi-agent negotiation model for UK land assembly

Overview

This is a research opportunity to evaluate the use of multi-agent system with modern portfolio theory to accelerate land negotiation. This tool now only encompasses the functionality to support negotiations; features associated with agreement generation has moved to Consenting Platform Integrator.

This tool will let land team(s) game out negotiation pathways, quantifying trade-offs across the whole portfolio. It will work as an optimisation model, proposing a terms that balances the needs of System Operators, and the individual landowners.

Why use strategic portfolio thinking?

Land negotiations are not a single optimisation, local trades and concessions propagate system-wide (e.g., shift a compound 200m to satisfy one owner, and haul road lengths and costs change elsewhere), adding to the time taken and complexity to reach an agreement.

A dynamic simulation lets local strategies (offers, counter-offers, mitigation bundles) **co-evolve** under global portfolio objectives.

What are the optimisations?

Utilising multi-agent system with optimisation algorithms will help land teams quantify negotiation terms at scale, reducing # of negotiation cycles.

This tool will have two primary agents:

System operator agent (SOA): The aim of this agent will be to utilise strategic portfolio thinking to reach the best-possible portfolio of agreements, focusing on dozens of deals as one entity, while weighting locational and constructability concerns, especially as they affect the value of the land parcel.

Landowner agents (LA): They are work on behalf of the landowner, trained based on the land area, cap and floor prices, and value of future payments.

- This agent can be further augmented with external datasets such as, housing valuation trends, risks evaluations for flood zones, restricted land rights, previous planning issues, and other to be defined external and locational specific datasets.

Value proposition

This tool begins by identifying an optimal baseline to engage early adopters of the project. The resulting optimisation model equips land teams with data-driven insights to initiate informed conversations, helping to minimise surprises later on.

The true value of this approach is realised overtime with the ability of the tool to support the arduous process of ‘haggling’ with landowners.

This research will experiment the ability to use finance theory to help expedite land consenting.

For example,

1. Adjust the value of parcel A, based on the perceived chances of acquiring parcel B.
2. Highlight areas of risks as stakeholder engagements are completed, and designs finalised.
3. Outline areas that are correlated through technical design, social connections, cultural norms.

Land Negotiation Tool (2 of 2)

Interfaces, dependencies, and risks

Data dependencies

Negotiation price range: cap and floor negotiation positions for each parcel, provided by the valuation agent or financial organisations.

Property data: provides the basic facts about each land parcel, including its physical characteristics, ownership, market value, historical transactions, community attributes, and legal status.

Valuation data: Valuation Office Agency (VOA) holds detailed data on property attributes like age, size, and type for tax purposes. Access to this granular data is crucial for the Valuation Agent to build accurate automated valuation models.

Local planning data: Sourced from individual Local Planning Authorities, this includes local development plans, planning application histories, conservation area boundaries, and brownfield land registers.

Property interface data: Information that links various land parcels, and design decisions to outline interdependencies when undertaking routing decisions.

Technology interfaces

This tool cannot interact without other supporting interfaces, to provide dynamic information about the constantly changing circumstances of the development. These interfaces include:

Land tools, such as Parcel & Tracktivity: Tools that provide the underlying data regarding the landowners' interaction across the project lifecycle.

GIS platforms such as ArcGIS Enterprise (Atlas) & authoritative datasets like the OS National Geographic Database (NGD): Will provide the spatial foundation, visualising environmental and planning constraints, highlighting risks across multiple parcels, and mapping potential routes.

Routing tools such as pathfinder: Tools will provide the route options, cost estimates, and support dynamic change control of smaller segments.

Common data environment tools, such as Fuse: technology integrator platforms enable the unification of data and technology interfaces within a single, cohesive work environment.

Risks

Data Integration and standardisation: There is no single, agreed-upon taxonomy for land use in the UK. Therefore, the system is dependent on a sophisticated "Data Harmonisation Layer" capable of ingesting data from disparate sources and transforming it into a consistent, analysis-ready format.

Stakeholder trust and adoption: process of compulsory purchase is already deeply contentious and can be an emotional and stressful experience for affected individuals. Introducing an automated negotiator could be perceived as a dehumanising, opaque "black box" designed to unfairly minimise compensation.

4

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Next steps

Next steps

Further developing the three opportunities

Overview

A clear feedback from stakeholder engagement was the need for further definition of the opportunities, as summarised below:

1. **Quantifying the opportunities**: to understand the scale, quantifying the impact (e.g., financial waste due to lack of geospatial consideration) and the potential benefits of proposed innovations is needed.
2. **Centralising planning data**: There is currently no single repository for all planning constraints and local plan layers. Common Data Environment as a cross-cutting capability can look at a creation of a centralised solution for planning data, learning from initiatives like the HM Land Registry's Local Land Charges migration and PropTech Innovation Fund projects.
3. **Further stakeholder engagement**: Engaging with the Planning Inspectorate, and relevant teams in TOs is advised to understand the potential for automation in significant project determinations and to anticipate legal or procedural challenges.

Phase one

This phase will focus on further developing the three opportunities defined in the discovery phase. It will include:

User testing: Engage stakeholders and end-users to validate usability and feasibility and refine use cases based on feedback. This can include building user journey's, wireframes and mock-ups to support user testing.

Business case: create a CBA for prototype development costs against expected financial, environmental, and strategic benefits to justify moving to phase 2.

Technical feasibility Assess integration with existing systems and explore technology options and architecture for phase 2.

Security considerations: Review security standards and compliance requirements (e.g., trust frameworks, metadata standards).

Requirements: Prepare for transition to phase 2 by defining functional and non-functional requirements,

Phase two

Phase two will focus on developing a PoC for one selected solution:

Detailed Design: Use TOGAF principles to define the solution architecture that connects data, technology, people, and processes.

Data & Framework: Build a common data environment, collect and clean required data, and engage stakeholders to outline the needs of the model framework.

Model Training: Incorporate and refine the framework using expert input and synthetic projects. Train the model using previous transmission network projects and expert feedback.

Appendix

A

Literature review

Literature review

Brief that kicked off the start to the challenge definition

Overview

Policy review aimed to understand how existing UK energy and planning policies may support or constrain the aims of the RAPID SIF project, specifically the potential for more automated corridor routing (AR1) and standardised route design practices (AR2). To do this, 13 relevant documents published between 2021 and 2025 were selected and reviewed.

All documents came from official sources such as government departments, regulators, or system operators.

Methodology

Step 1: Document Selection and Categorisation

Each document was grouped into four categories:

- **Strategic Roadmaps**: Long-term planning documents setting out high-level goals for system development (e.g. CP2030). These were reviewed to assess how broader system objectives align with automation and standardisation themes.
- **Policy Reforms**: Documents outlining changes to planning procedures, consenting processes, or design requirements (e.g. EN-5, TAAP). These were analysed for how they shape or limit changes to route planning practices.
- **Regulatory Statements**: Formal guidance or clarifications from authorities like Ofgem or DESNZ. These were reviewed to understand current regulatory positions and expectations.
- **Technical Supplements**: Detailed annexes or implementation guides (e.g. CP2030 Annex, Environmental Assessments). These provided granular input on existing methodologies and data use.

Step 2: Review Process

Each document was reviewed in three stages:

- **Support Assessment**: Identified any clear references that support or align with RAPID’s AR1/AR2 goals.
- **Constraint Identification**: Noted any barriers to change, including legal, procedural, or technical limitations.
- **Actionable Content Extraction**: Highlighted specific methods, data points, or practices that could be relevant to future tool development or policy alignment.

Step 3: Observed Themes and Synergies

- Strategic documents tend to support AR1 more strongly, due to their focus on system-wide spatial planning.
- Policy reforms are more relevant to AR2, as they shape how design practices are formalised and regulated.

Cross-policy analysis

Overview

The comparative analysis of the 13 UK policy documents reveals both alignment and divergences in their approaches to energy transmission infrastructure, alongside notable gaps that hinder the integration of emerging technological solutions such as automated routing (AR1) and standardised design principles (AR2).

Common themes across policies

1. **Planning Acceleration and Streamlining.**

All documents emphasise the urgency of delivering transmission infrastructure at an accelerated pace to meet decarbonisation targets. Key recommendations include:

- **Fast-track planning reforms:** Multiple sources, including the Transmission Acceleration Action Plan, suggest expedited planning routes through mechanisms like pre-application engagement and streamlined National Policy Statements (NPS).
- **Updates to regulatory frameworks.**
- **Spatial planning integration:** Strategic spatial planning is consistently highlighted as critical in reducing inefficiencies, improving geographic clarity for infrastructure siting, and optimising transmission costs for generators and consumers.

2. **Data-Driven Policy and Strategic Network Planning.**

- **Strategic Spatial Energy Plan (SSEP) and Centralised Strategic Network Plan (CSNP)**: Endorsed in multiple documents as essential frameworks to bridge the gap between government policy and infrastructure execution. NESO's draft CSNP methodology explicitly details a structured multi-criteria evaluation process that incorporates stakeholder collaboration, environmental assessments, and whole-system scenario analysis.
- **Marine Environmental Assessments (MEA):** Highlighted for informing spatial planning decisions, particularly for offshore transmission infrastructure.

3. **Environmental and Community Impacts.**

Environmental sustainability and community engagement are recurring priorities. Established industry guidelines, specifically the Horlock Rules (focusing on proactive environmental assessment and practical mitigation) and the Holford Rules (prioritising landscape protection and visual minimisation)

Contradictions

Policy and regulatory contradictions affecting RAPID

Overview

Fast-Track Planning vs. Comprehensive Consultations

While fast-track approval mechanisms are championed in several documents (e.g., Getting Great Britain Building Again), other policies stress the importance of extensive environmental and stakeholder consultations (e.g., National Policy Statements). This tension raises concerns about whether expedited planning compromises thorough assessments and public trust. This contradiction becomes particularly evident when considering the qualitative assessments historically required by the **Horlock and Holford Rules**, which emphasise thorough environmental appraisal and community sensitivity, complicating expedited approvals.

Strategic Planning vs. Flexibility

The push for rigid strategic frameworks, such as the SSEP and CSNP, contrasts with requirements for flexibility in regulatory updates (e.g., periodic NPS revisions). Over-reliance on static strategic plans could hinder adaptability to unforeseen changes in technology or policy landscapes.

Land Access and Compensation Frameworks

Documents advocating for uniform compensation rules (e.g., Recommendation LA2) conflict with calls for further analysis on land acquisition processes (e.g., Recommendation LA3), underscoring discrepancies in the approach to balancing landowner rights and infrastructure demands.

Gaps

Policy and regulatory gaps affecting RAPID

Gaps

Integration of AI and Machine Learning in Planning Processes

None of the reviewed documents provide explicit guidance on how AI-driven tools or machine learning algorithms should be utilised within Development Consent Order (DCO) applications or infrastructure planning frameworks. While integrating legacy qualitative principles from Horlock and Holford Rules alongside the structured approach outlined in the CSNP methodology provides partial guidance, there remains a notable lack of explicit frameworks for embedding these qualitative assessments into automated or AI-driven route planning processes.

The recent Linear Infrastructure Planning Panel report similarly notes gaps in regulation and standards around AI and automated planning tools, highlighting the need for clear governance structures and assurance mechanisms tailored specifically for infrastructure planning.

Clear Data Governance Framework

While data-driven approaches are emphasised, there is no comprehensive strategy for managing, sharing, and securing data across stakeholders. This gap complicates the establishment of interoperable systems for GIS-based routing optimisation and predictive analytics. Moreover, despite structured methodologies from CSNP clearly defining strategic versus non-strategic planning components, there remains an absence of clear data governance frameworks that specifically address data sharing and interoperability across these two planning levels

Resource Allocation for Advisory Bodies

Though several policies mention the need for increased pre-application engagement, there is a lack of clarity on funding mechanisms or resource allocation for statutory advisory bodies tasked with facilitating consultations and environmental reviews.

Cross-Border Coordination

The absence of explicit mechanisms for harmonising policies across England, Scotland, and Wales risks fragmentation in planning and consenting processes. This is particularly problematic for projects requiring interregional transmission routes.

Supply Chain and Skills Development

While the importance of long-term supply chain relationships is recognised (e.g., Recommendation SC1), no document adequately addresses the skills gap in the workforce required to implement advanced technologies like automated routing systems or AI-driven planning tools.

Quantified Metrics for Success

Most policies lack predefined metrics or benchmarks to evaluate the success of planning reforms or infrastructure acceleration measures. This lack of quantification impedes objective assessment of their impact on national decarbonisation goals.

Implications for RAPID

Key areas that require innovation according to the 13 policy documents

Overview

1. **Real-Time Data Integration**: Ensure compatibility with data platforms for real-time updates on land use, ecological constraints, and infrastructure availability.
2. **Conflict Resolution Mechanism**: Include functionality to flag and resolve potential conflicts with existing land use, community objections, and environmental restrictions.
3. **Standardised Design Templates**: Integrate pre-defined templates based on ETDP guidelines for asset design in various environmental conditions (urban, rural, coastal).
4. **Stakeholder Collaboration Module**: Include interactive tools for stakeholders to provide input on design choices within permissible influence areas.
5. **Lifecycle Cost Analysis**: Embed functionality to evaluate long-term costs, carbon impacts, and societal benefits of selected designs.
6. **Compliance Verification System**: Develop automated checks to ensure designs meet equipment standards and regulatory requirements.
7. **Interoperability Across Platforms**: Ensure tools can seamlessly integrate with existing Geographic Information Systems (GIS) and other planning platforms used by TOs and statutory consultees.
8. **Environmental Impact Assessment Integration**: Incorporate modules to quantify ecological impacts of proposed routes and designs.
9. **Community Engagement Optimisation**: Add visual tools for community stakeholders to understand proposed routes and designs.
10. **Training and Skill Development Integration**: Develop training modules within the tools to enhance user competency in automated routing and standardised design principles.
11. **Cross-Border Collaboration Features**: Incorporate functionality to harmonise routing and design processes across regional boundaries.

Documents reviewed

1. Clean Power 2030 (CP2030) Action Plan
2. Electricity Networks Commissioner’s Report (Nick Winser)
3. Electricity Networks Commissioner: Letter to Secretary of State
4. Secretary of State’s Response to the Electricity Networks Commissioner
5. Transmission Acceleration Action Plan (TAAP)
6. National Policy Statement for Electricity Networks Infrastructure (EN-5)
7. Strategic Spatial Energy Plan (SSEP)
8. National Infrastructure Commission (NIC) Reports
9. Strategic Energy Planning Environmental Assessments
10. Clean Power 2030 (CP2030) Technical Annex
11. Horlock Rules
12. Holford Rules
13. Centralised Strategic Network Plan (CSNP) Methodology

B

Assessment of current routing practices

VOLTQUANT ARUP

SPEN Routing Process Overview

4-steps

Overview

SPEN (Scottish Power Energy Networks) manage the electricity transmission system for southern Scotland.

SPEN is focusing on connecting renewable generation and reducing visual impact in sensitive landscapes. Its flagship VIEW Project seeks to tap a £500 million Ofgem fund to mitigate the visual impact of existing transmission infrastructure in Scotland's National Parks and National Scenic Areas .

Also, SPEN is co-leading the £2.5 billion Eastern Green Link 1 subsea transmission project (2 GW from Torness to Hawthorn Pit), in partnership with NGET, which began onshore construction in February 2025 and aims for completion by 2029 to channel North Sea wind power south

SP Energy Networks

Current Route Alignment Stages

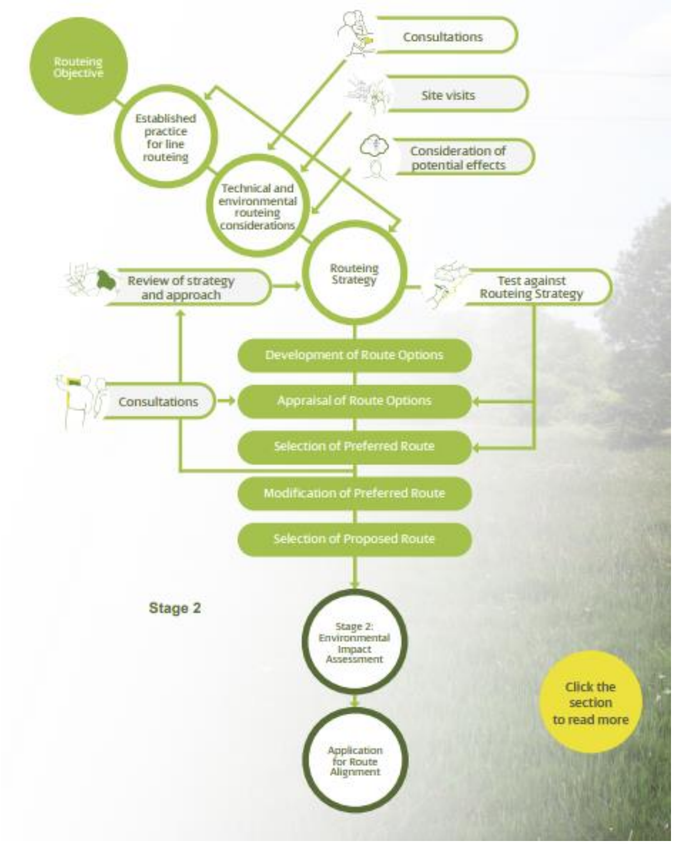
1. Development of route options
Considerations identified in the routing strategy are applied to the study area to establish possible 'route options'.

2. Appraisal of Route options
Each route option is appraised against the agreed environmental and technical routing considerations, which have supporting objectives.

3. Selection of Preferred Route
After the comparative appraisal of route options, an emerging preferred option is subjected to a further technical check prior to SPEN confirming the preferred option.

4. Modification of Preferred Route
The preferred route is subjected to further consideration in response to public consultation, and may be modified further in the light of these consultations

5. Selection of Proposed Route
The preferred route, with post-consultation modifications, becomes the proposed route.



SPEN Routing Process

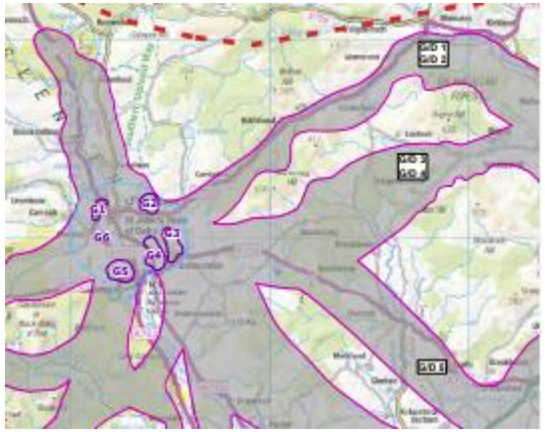
Current routing process

Step 1: Development of route options

In this initial step, SPEN identifies and defines potential routes for new transmission infrastructure. The goal is to develop a continuous and feasible set of routing options between defined connection points, considering technical, environmental, and social constraints.

This activity is carried out by SPEN's internal routing and environment teams, supported by engineering consultants and environmental specialists.

These activities includes defining broad search areas between connection points, developing continuous route corridors, identifying both overhead line (OHL) and underground cable options, applying routing principles (e.g. Holford Rules) and considering local sensitivities



Identified challenges & opportunities

Maintaining route continuity requires managing conflicting environmental and technical factors while also improving early stakeholder involvement to prevent later rejection of the route.

Additionally, there is an absence of clear guidelines for underground cable routing, presenting an opportunity to create shared criteria and guidance for cable routes among TOs.

Step 2: Appraisal of Route options

At this stage, route options are assessed using environmental, technical, and economic criteria to short list and identify the route that best balances all considerations. This is a comparative evaluation phase.

This activity is carried out by SPEN's environmental assessment and engineering teams, supported by planning and consultation leads.

These activities include applying appraisal criteria across all route options, reviewing constraints such as flood risk, visual impact, land use, technical conflict, constructability, refining, re-appraising or discarding options as more data becomes available and assessing cable route viability where applicable.

Identified challenges & opportunities

There is subjectivity involved in assigning weights to route criteria (such as visual appeal, cost, and impact), leading to an opportunity to create common scoring frameworks among TOs for evaluating routes. Early-stage design input into appraisals is limited, leading to an opportunity to incorporate engineering feasibility assessments earlier in the route scoring process.

SPEN Routing Process

Current routing process

Step 3: Selection of preferred route

Following appraisal, a single preferred route is technically validated and shared for public and stakeholder consultation. Adjustments are made post-consultation before proceeding to the environmental impact assessment (EIA) and detailed design. This activity is carried out by SPEN's routing team, planners, and technical leads, with sign-off from project leadership and stakeholder engagement teams.

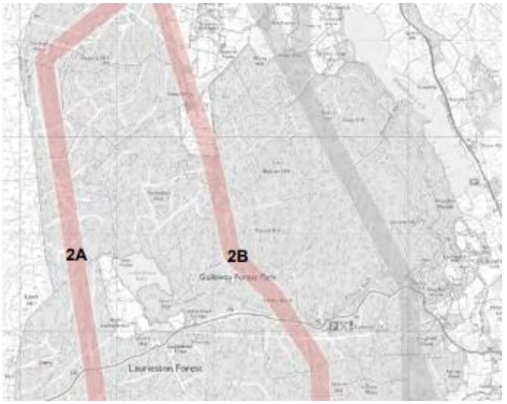
These activities include confirming stakeholder acceptability and alignment with design principles, documenting rationale for route selection in consultation materials, and defining the final 'proposed route' to be progressed through EIA and consent.

Identified challenges & opportunities

Lengthy public consultations can delay the finalisation of routes; however, there is potential to standardise routing documentation templates to make the consultation process more efficient. It is important to ensure transparency and justify the selection process, with the option to incorporate visual aids such as heat maps and 3D models to enhance consultation explanations.

Step 4: Modification of the preferred route

In this step, the preferred route is reviewed and potentially adjusted based on concerns or suggestions raised during consultations. This ensures the route is socially acceptable and environmentally sensitive.



Identified challenges & opportunities

Limited visibility into constructability and land access, outlining the need for a land access intelligence tool to better anticipate and manage these constraints.

SPEN Routing Process

Current routing process

Step 5: Selection of Proposed Route

The preferred route, with any post consultation modifications, becomes the proposed route. This is then progressed to the EIA and detailed design stage to establish a final alignment, including locations for towers/poles and for any ancillary development required such as temporary construction access tracks, laydown areas and construction compounds.

Identified challenges & opportunities

Weak integration between GIS and PLS-CADD highlights the potential for a platform that connects BIM and GIS systems.

SSEN Routing Overview

Four stage approach

Overview

Scottish & Southern Electricity Networks (SSEN) manage the electricity distribution and transmission networks that carry electricity to over 3.9 million homes and businesses across the North of Scotland and Central Southern England. SSEN is currently delivering a range of major infrastructure projects across its distribution and transmission networks to support the UK's net zero goals, improve resilience, and unlock capacity for low-carbon technologies. Key initiatives include a £450 million upgrade across Northern Scotland's distribution network, a £155 million enhancement programme in Southampton, and the ongoing 7 GW Connections Reform Programme aimed at accelerating grid access for renewables. On the transmission side, SSEN is investing over £10 billion through its "Pathway to 2030" plan, including subsea HVDC links like Eastern Green Link 2 and the Western Isles connection, to enable large-scale offshore wind integration.

Scottish & Southern Electricity Networks
TRANSMISSION

Current Route Alignment Stages

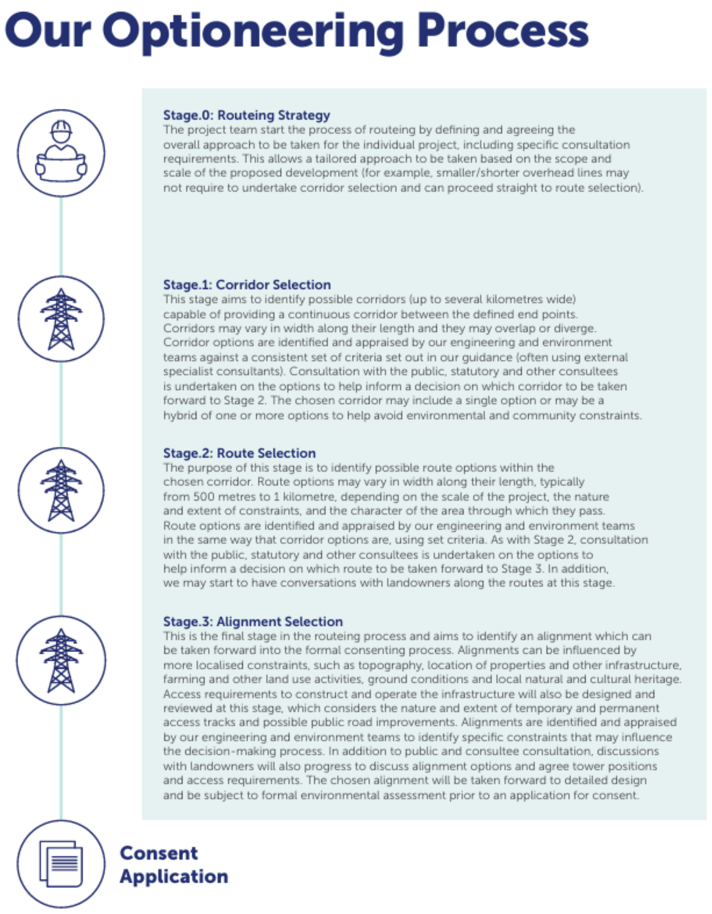
Projects follow a defined route development lifecycle:

Stage 0 - Routing strategy: The routing process begins with defining and agreeing on the project's scope and scale, including consultation requirements.

Stage 1 - Corridor selection: This stage identifies and appraises multiple potential corridors between defined endpoints, using consistent criteria and stakeholder consultation to select a preferred or hybrid corridor that best avoids environmental and community constraints.

Stage 2 - Route selection: This stage involves identifying and appraising route options within the selected corridor typically 500m to 1km wide based on environmental and technical criteria, with public and stakeholder consultation helping to inform the selection of a preferred route for further development.

Stage 3 - Alignment selection: Final stage defines the detailed alignment to be taken into the consenting process, considering localised constraints, with engineering and environmental appraisal, landowner discussions, and public consultation informing the final alignment ahead of detailed design and environmental assessment.



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SSEN Routing Process

Current routing process

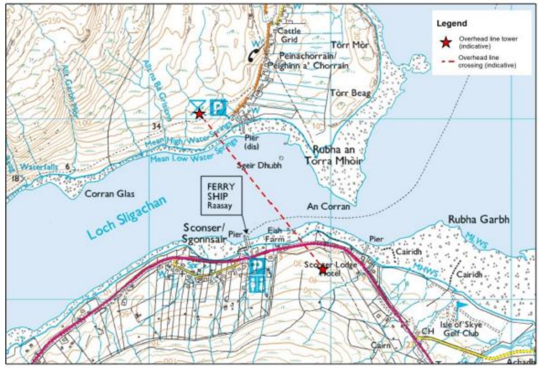
Step 1: Routing strategy

This phase defines the tailored approach to be taken for each infrastructure project, including the consultation plan, based on its scope and scale.

The key activities include:

- Establish project-specific routing methodology.
- Define which stages of routing apply (e.g. Some smaller projects may skip corridor selection)
- Identify early consultation requirements.

This activity is carried out by SSEN's Project team, statutory consultees (e.g. ECU, SEPA), and project planners.



Identified challenges & opportunities

Addressing environmental sensitivity and constructability in confined corridors presents a chance to utilise LIDAR and remote sensing technologies for early terrain analysis.

There is also a risk of insufficient consultation on smaller projects, alongside the possibility to customise engagement and design processes accordingly.

Stage 2: Corridor selection

Once route options are established, SSEN undertakes a detailed appraisal to identify wide corridor options (several kilometres in width) that could feasibly support a transmission route between defined connection points and assess environmental, technical, and cost-related performance. This activity is carried out by SSEN's engineering & environment teams, external consultants, statutory consultees, landowners & the public.

These activities include defining and mapping multiple corridor options using engineering and environmental analysis, appraising corridors against consistent criteria, consulting public, landowners, and statutory stakeholders to inform corridor selection, selecting a single or hybrid corridor to take forward.

Performance	Comparative Appraisal
Most Preferred	Low potential for the development to be constrained
	Intermediate potential for the development to be constrained
Least Preferred	High potential for the development to be constrained

Identified challenges & opportunities

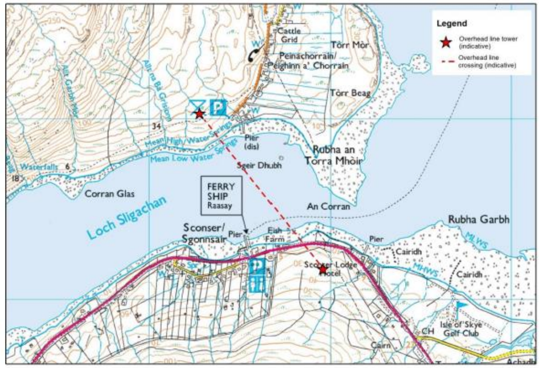
Public scrutiny and the need to justify route rejection and selection decisions provides a challenge. There is the opportunity to standardise appraisal documentation to enhance transparency and dependability. There is a need to balance constructability, ecological sensitivity, and cost with the opportunity to improve use of digital multi-criteria decision-making tools.

SSEN Routing Process

Current routing process

Step 3: routing selection

This phase defines a potential *route options* within a previously selected corridor, and to appraise their feasibility and potential impacts before narrowing down to a preferred route. This activity is carried out by SSEN Transmission’s engineering and environmental teams, supported by planning consultants, land agents, and specialist stakeholders. These activities include identifying multiple route options (typically 500m–1km wide) within the corridor impact, applying consistent technical, environmental, and cost-based criteria to appraise each route and Running further consultation with the public, statutory bodies, and consenting authorities to gather feedback on route options.



Identified challenges & opportunities

Navigating several constraints—such as residential proximity, protected habitats, and terrain—while addressing initial landowner concerns and clearly communicating that options are not final can be difficult. However, employing digital mapping and data can speed up appraisal and visualisation processes, and involving stakeholders early on can help minimise delays during formal consent phases.

Step 4: Alignment selection

Once route selection is established, SSEN undertakes a detailed appraisal to refine the preferred route into a *detailed alignment* suitable for submission into the formal consenting process under *Section 37 of the Electricity Act 1989*. This activity is carried out by SSEN’s Engineering, planning, and environmental specialists within SSEN, in collaboration with land agents and legal advisors.

These activities include identifying specific alignments within the preferred route corridor, down to the level of individual tower locations. Assessing detailed constraints such as topography, existing infrastructure, land use, and landowner input. Conducting final public and landowner consultations to validate decisions and agree mitigations.

Performance	Comparative Appraisal
Most Preferred	Low potential for the development to be constrained
	Intermediate potential for the development to be constrained
Least Preferred	High potential for the development to be constrained

Identified challenges & opportunities

Securing landowner permission and access rights, addressing local opposition, and incorporating updated environmental information are essential.

Reaching early consensus on tower locations and access paths helps minimise construction risks; insights from environmental impact assessments can enhance design and lower long-term effects.

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NGET Routing Overview

Six stage approach

Overview

National Grid Electricity Transmission plc (NGET) own, build and maintain the high-voltage electricity transmission network in England and Wales.

NGET is investing roughly £1.3 billion annually rising to a proposed £35 billion between 2026 and 2031to transform England and Wales's transmission network.

It is delivering multiple Accelerated Strategic Transmission Investment (ASTI) projects, including subsea HVDC links like Eastern Green Link 1 (2 GW from Torness to County Durham) and Eastern Green Link 2 (2 GW from Peterhead to Drax), both targeting 2029 completion to relieve Scotland–England transmission bottlenecks.

nationalgrid
Electricity Transmission

Current Route Alignment Stages

Projects follow a defined route development lifecycle:

- **Stage 1: Strategic Proposal**
  Identify network options to meet need case
- **Stage 2: Options Identification & Selection**
  Identify and appraise project options
- **Stage 3: Defined Proposal and Statutory Consultation**
  Develop project design in response to feedback
- **Stage 4: Assessment & Land Rights**
  Refine project design in response to feedback and prepare application documents
- **Stage 5: Application, Examination & Decision**
  Submit application and respond to questions through examination hearings
- **Stage 6: Construction**
  Deliver project, discharge requirements and post construction monitoring

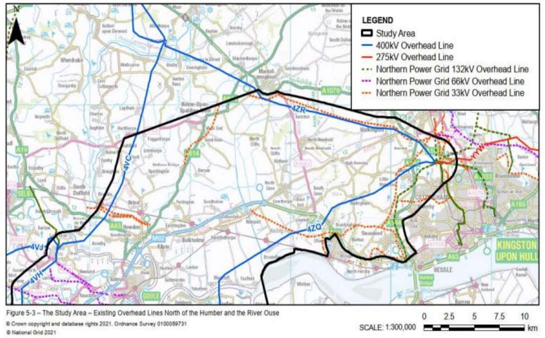
NGET Routing Process

Current routing process

Stage 1: Strategic Proposal

The strategic proposal phase aims to identify the need for network reinforcement based on system-wide assessments such as the SSEP and the CSNP, define the geographical and spatial scope of potential infrastructure, including the identification of broad study areas and establish early options for how the network might be configured to meet future energy demands.

This phase involves defining broad study areas and identifying preliminary routing corridors using constraint mapping and expert judgement, ensuring alignment with environmental, technical, and socio-economic considerations. Strategic options are then appraised against national policy objectives and the Electricity Transmission Design Principles (ETDP) to inform cost-effective, policy-compliant infrastructure planning.



Identified challenges & opportunities

Data Quality: The effectiveness of this phase depends heavily on the availability and accuracy of spatial and land ownership data.

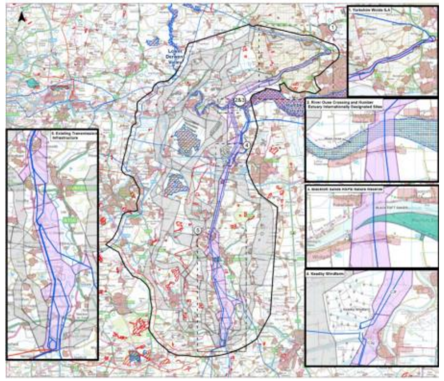
Project Interdependencies: Early identification of interdependencies with other infrastructure projects is essential to avoid costly redesigns later.

Regulatory Complexity: Even at this early-stage, the process must anticipate the requirements of the consenting phase, which can be lengthy and involve multiple stakeholders.

Stage 2: Options Identification & Selection Phase

This phase builds upon the strategic proposal by developing, refining, and assessing route corridor options for the proposed transmission infrastructure. It aims to identify an emerging preferred corridor that offers a balanced solution considering technical, environmental, and socio-economic constraints.

In this phase, broad geographical study areas are defined and informed by spatial, environmental, and socio-economic data, which are visualised using heat mapping to highlight constraint sensitivity. Multiple corridor options are developed and iteratively appraised using technical, environmental, and planning criteria, resulting in a graduated swathe that highlights likely alignment zones within the preferred corridor.



Identified challenges & opportunities

Managing the trade-offs between environmental, technical, and financial limitations is complicated, while maintaining uniformity throughout corridor segments during a comprehensive review.

Conveying uncertainty during the creation of the graduated swathe.

NGET Routing Process

VOLTQUANT ARUP

Current routing process

Stage 3: Defined Proposal and Statutory Consultation Phase

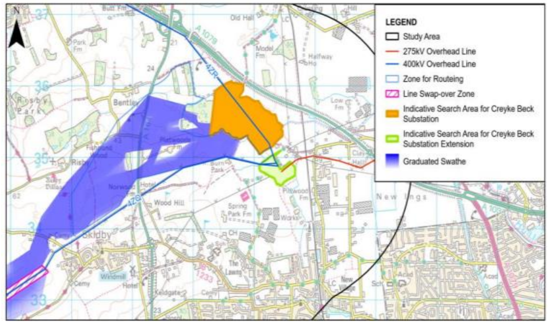
To refine the emerging preferred corridor into a defined route alignment and initiate statutory consultation with stakeholders and the public under the Planning Act 2008 framework. Some of the key activities and outputs of these phase are

Design Refinement: Further environmental surveys, engineering studies and stakeholder feedback shape a defined alignment within the graduated swathe.

Statutory Consultation: Conducted under Section 42 and 47 of the Planning Act 2008, targeting prescribed consultees, landowners and the public.

Preliminary Environmental Information Report (PEIR): Issued to support consultation and provide a transparent account of anticipated impacts and mitigation strategies.

Consultation Reporting: Feedback is documented in a Consultation Report which informs design changes and future consent applications.



Identified challenges & opportunities

Effectively addressing varied feedback from different route segments.

Showing the progression of design and explaining the reasoning behind decisions.

Handling public opinion and setting realistic expectations for impact reduction.

Stage 4: Assessment & Land Rights Phase

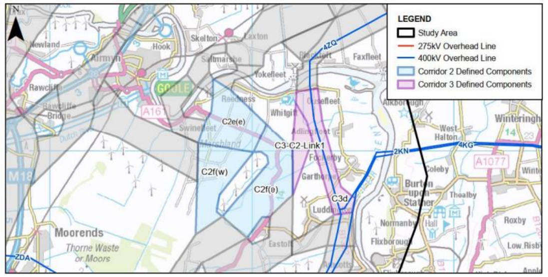
To secure access to land and complete detailed assessments needed to support the Development Consent Order (DCO) application and construction planning. Some of the key activities and outputs of these phase are:

Environmental Impact Assessment (EIA): Full statutory EIA is conducted, supported by extensive survey work.

Land Referencing: Identification of all affected landowners and rights holders for legal notices and consultation.

Access Negotiations: Engagement with landowners to secure voluntary agreements or identify need for compulsory acquisition.

Mitigation Planning: Refinement of construction techniques, compound locations, and ecological measures based on land and environmental constraints.



Identified challenges & opportunities

Challenges in negotiating land access involving multiple parties.

Managing sensitive environmental features revealed through surveys.

Ensuring project schedule reliability while considering landowner issues.

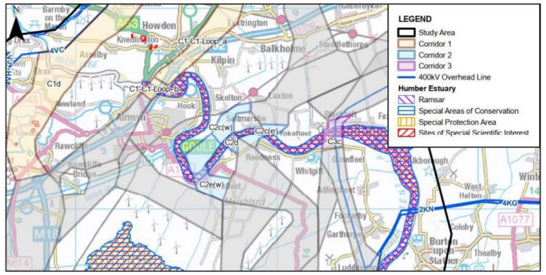
NGET Routing Process

Current routing process

Step 5: Application, Examination & Decision Phase

This phase aims to submit, examine, and receive a decision on the DCO application for the proposed development.

Application Submission: Full DCO application submitted to the Planning Inspectorate, including environmental, planning, and land rights documentation.
Examination Process: A formal examination by a panel of inspectors, typically over a 6-month period, involving written questions, hearings, and site visits.
Stakeholder Engagement: Continued engagement with statutory consultees and stakeholders to resolve objections and clarify application details.
Decision: Following examination, a recommendation is made to the Secretary of State who makes the final decision.



Identified challenges & opportunities

Ensuring documentation is comprehensive and withstands scrutiny.

Managing objections and Representations from landowners, stakeholders, and the public.

Aligning with emerging policy and legal precedent during the decision period.

Common Routing Steps

	Strategic optioneering	Route corridor	Route options	Design & planning
Purpose	*Identify high-level network reinforcement needs and broad spatial options for infrastructure.*	*Define a study area and identify feasible corridors between connection points.*	*Define a centreline within the selected corridor and refine it based on detailed constraints.*	*Translate the route alignment into a detailed engineering design, including tower siting and access.*
Common activities	• Identify strategic network reinforcement needs following SSEP. • Engage with NESO and CSNP processes. • Develop schematic network proposals. • Define broad spatial options for infrastructure.	• Define study areas between connection points. • Identify feasible corridors using constraint mapping. • Apply Holford Rules and internal guidelines. • Engage with stakeholders on corridor options.	• Define centreline within selected corridor. • Refine alignment based on detailed constraints. • Conduct site-specific surveys (ecology, archaeology). • Incorporate stakeholder feedback.	• Translate route alignment into detailed engineering design. • Site towers/poles and define access tracks, laydown areas, and compounds. • Conduct ground investigations and structural assessments. • Finalise asset specifications and prepare for construction.
Digital tools	**Power Analysis**: PowerFactory **Routing software**: Pathfinder, Optioneer, Quantum **GIS Platforms:** ArcGIS, Smallworld	**Routing software**: Pathfinder, Optioneer, Quantum **GIS Platforms:** ArcGIS, Smallworld	**GIS Platforms:** 3D modelling in GIS **Consultation:** Consultation websites and visualisation tools	**BIM/CAD:** PLS-CADD & Autodesk **Consultation:** Consultation websites and visualisation tools
Data	• Demand and generation data from SSEP • GB Transmission Network Schematics • Broad geographic and topographic data (i.e. National parks, AONB, onshore/offshore etc.)	• Satellite imagery and maps • Social & environmental constraint layers from open datasets (Population centres, land classifications e.g. AONB, SSSI,) • Built & planned infrastructure	• LIDAR & satellite data following the route options • Local site survey data (environmental, topographic, visual impact etc.) • Consultation feedback	• Local site survey data (Ground investigations, archaeological)

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Upcoming changes to the routing process

Overview

Current changes to the transmission planning approach

A new approach to planning

The Strategic Spatial Energy Plan (SSEP), Regional Energy Strategic Plans (RESPs), and Centralised Strategic Network Plan (CSNP) together define NESO's evolving framework for system-wide transmission planning.

SSEP provides a national spatial blueprint, identifying zones where transmission capacity will likely be needed. By establishing these areas ahead of individual project proposals, the SSEP aligns infrastructure planning with system demand and net zero goals.

RESPs, developed regionally, embed local constraints, planning factors, and stakeholder priorities into the national picture. They support regional needs while promoting cross-border policy alignment across England, Scotland, and Wales.

The CSNP turns strategy into delivery. Through a structured multi-criteria assessment, scoring corridor options on cost, environmental impact, and community acceptance, it enables NESO to guide investment sequencing and support Transmission Operators (TO) in identifying viable, locally appropriate routes.

What this means for TOs

The transition to a nationally coordinated planning framework brings increased visibility, and additional scrutiny for TO.

TO must reorient their internal planning functions to engage earlier and more collaboratively with NESO and regional RESP processes. This includes co-developing transmission corridors and shifting from reactive connection-based planning to proactive, strategic coordination.

To meet expectations around transparency and interoperability, TO will be expected to contribute asset, land use, and constraint data to shared national tools. This will require adopting standardised data governance practices aligned with NESO's digital infrastructure strategy.

Workforce capability must also evolve. The integration of geospatial modelling, AI-based routing tools, and scenario planning will demand upskilling in areas historically outside core engineering competencies.

Finally, TO must coordinate more closely across borders—England, Scotland, and Wales, ensuring consistency in corridor design and reducing friction in interregional infrastructure development.

New tools

CSNP Options Optimiser – NESO tool that brings the routing options across all the TO, to holistically assess the options together.

Electricity Transmission Design Principles

What are the ETDP?

Electricity Transmission Design Principles (ETDP)

ETDP, highlighted in the Nick Winser report, aims to expedite the development of key electricity transmission infrastructure throughout Great Britain.

These principles represent a proposed set of publicly accessible, standardised guidelines for designing electricity transmission systems. Their purpose is to:

- Establish the framework for transmission system design
- Inform decisions regarding asset placement—whether infrastructure should be located onshore or offshore, and whether it should be overhead or underground
- Clarify the balance between environmental, technical, and community factors in design choices

NESO are currently defining these principles and are expected to go out to consultation on the draft principles in Q3 of 2025. NESO have engaged TO's through this process and will be required to seek approval of the principles from Ofgem. Once agreed they will be regularly reviewed and formally incorporated into the National Policy Statements (NPS).

Purpose and Strategic Role

The ETDP are intended to:

- Streamline the planning and consenting process by offering a clear, consistent framework for route and asset design
- Reduce project delays by removing the need to justify design decisions from scratch for each project
- Support public understanding and trust by making design decisions more transparent and defensible
- Enable innovation and best practice sharing across the sector
- Anchor regulatory and planning approvals in a shared, system-level design logic

By embedding the ETDP into national policy and regulatory frameworks, the goal is to cut the delivery time for strategic transmission projects from 14 years to 7 years, aligning infrastructure deployment with the UK's clean energy targets.

D

Market research on current tooling

Setting the scene

Informed & holistic review of existing solutions

Overview

This section explores a diverse range of current electricity network route finding solutions, highlighting the technological advancements and methodologies shaping infrastructure planning internationally.

A comparative review of leading digital platforms and decision-support tools is presented, including solutions as Optioneer, Pathfinder and Quantm, each offering unique capabilities in geospatial analysis, multi-objective optimisation, stakeholder engagement, and regulatory compliance.

These tools collectively demonstrate a shift towards AI-powered, GIS-integrated, and cloud-based systems that streamline route selection, enhance transparency, and reduce planning timelines.

By automating complex evaluations and integrating environmental, technical, and social constraints, these platforms are enabling Transmission Operators (TOs) to make more informed, defensible, and efficient routing decisions in alignment with national policy goals.

In addition, OpenUtilities and ArcGIS Utility Network were included as related toolkits.

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Optioneer

Continuum Industries

Overview

Optioneer by Continuum Industries is an AI-powered 'Software as a Service' platform designed to enhance infrastructure project planning through automated and intelligent route optimisation. Optioneer uses evolutionary AI and multi-objective optimisation to evaluate millions of potential routing scenarios, balancing engineering constraints, environmental impacts, community concerns, permitting challenges, and strategic project goals. Unlike traditional least-cost path analysis, Optioneer enables a broader, more nuanced analysis to support decision-making.

Key features include automated integration of open-source GIS data, real-time route iteration, seamless export to GIS/CAD software, and advanced reporting tools. Infrastructure developers are able to generate diverse, viable route options in hours, accelerating timelines and reducing project risk. Its interface and centralised communication tools also streamline collaboration across teams.

Key capabilities

Multi-objective optimisation: Applies AI to evaluate millions of route options based on cost, environmental impact, engineering feasibility, and social constraints.

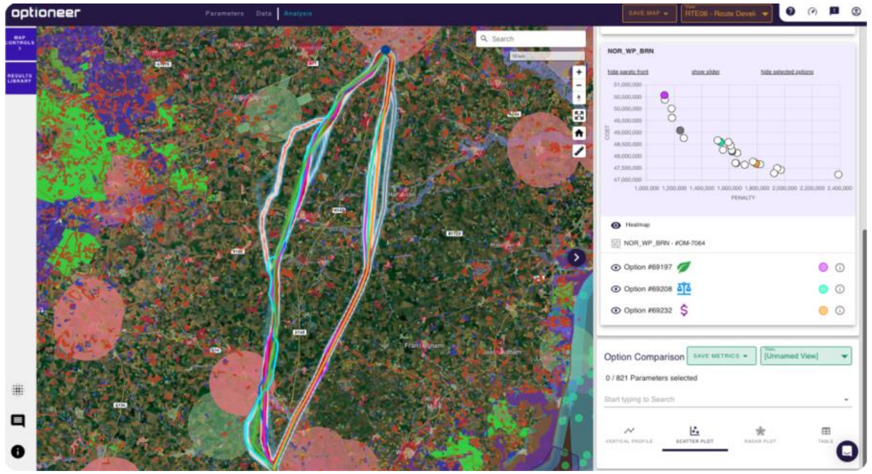
Real-time updates: Allows dynamic re-evaluation of routes as new data or stakeholder input becomes available.

Integrated GIS data: Combines spatial data layers (e.g., terrain, land use, protected areas) for accurate route planning.

3D visualisations: Assists stakeholders in visualising routes in a realistic terrain model, improving decision-making and communication.

Summary

Optioneer is an AI-powered multi-objective optimisation and collaborative platform for route optimisation and related stakeholder engagement.



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Pathfinder

Gilytics

Overview

Pathfinder is a cloud-based geospatial decision-support platform by Gilytics, designed to optimise the planning and routing of linear infrastructure projects such as power lines, railways, and renewable energy connections. Pathfinder uses a proprietary optimisation engine that integrates spatial and non-spatial data including environmental, technical, legal, and economic constraints to generate and compare multiple routing and siting scenarios in minutes rather than weeks.

Pathfinder's advantages lie in its ability to accelerate project timelines, reduce planning costs by over 50%, and enhance transparency and collaboration among stakeholders. Its intuitive interface and cloud-based architecture make it accessible for utilities, engineering firms, and public authorities aiming to streamline infrastructure development while meeting environmental and regulatory requirements.

Key capabilities

Automated scenario generation using customisable planning rules

2D and 3D visualisation tools for enhanced stakeholder communication

Integration with ArcGIS and CAD/GIS formats

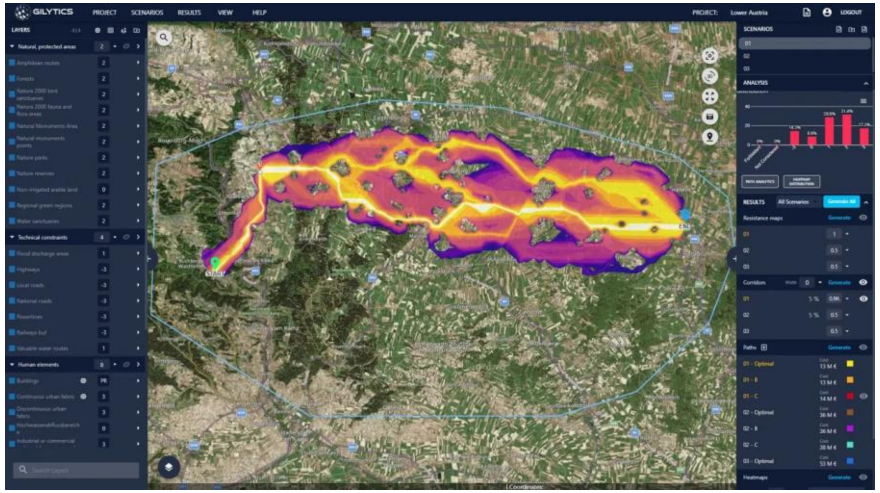
Support for overhead, underground, and hybrid routing

Cost modelling (CAPEX, OPEX, cost per km)

Advanced analytics for comparing alternatives based on KPIs

Summary

Pathfinder is a cloud-based, GIS-powered platform that automates and optimises infrastructure routing and siting by integrating spatial data, cost models, and stakeholder constraints into fast, collaborative scenario planning in 2D and 3D.



Quantm

Trimble

Overview

Quantm is an advanced alignment planning solution by Trimble, designed to optimise the conceptual design phase of road and rail infrastructure projects. It leverages algorithms and domain-specific knowledge to automatically evaluate millions of potential route alternatives, integrating data such as terrain, geology, hydrology, environmental constraints, property ownership, and construction costs. This enables planners and engineers to visualise and compare feasible alignments quickly, improving decision-making and accelerating project approvals.

Key features include automated corridor analysis, CO_2 emissions forecasting, noise impact modelling, and traffic flow simulations, all within a unified platform. Quantm also supports sustainability goals by helping users assess trade-offs between cost, environmental impact, and long-term operational efficiency. Its ability to reduce financial risk and streamline early-stage planning makes it especially valuable for both small-scale road projects and large, complex rail developments.

Key capabilities

GIS Data Integration: Supports terrain models, geological, hydrological, environmental, and property ownership data.

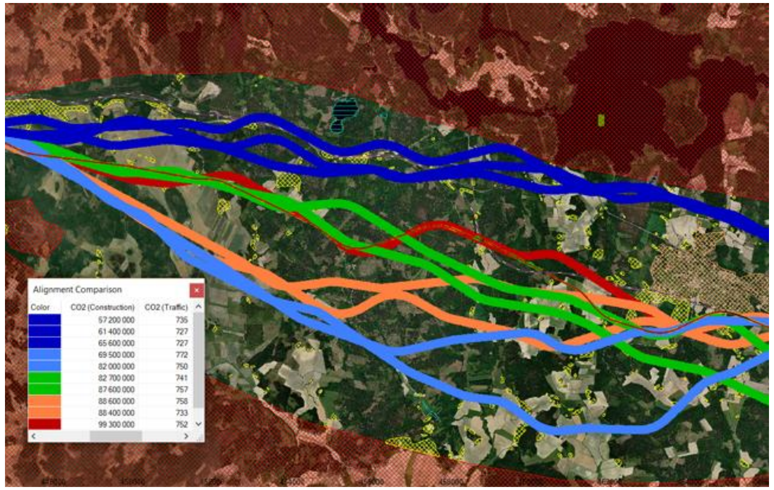
Automated Property Analysis: Identifies affected land parcels and owners for each alignment.

Visualisation Engine: Enables design reviews and stakeholder engagement.

Design Standards: Incorporates engineering constraints and standards into route generation,

Summary

Quantm is a corridor and alignment planning tool that uses algorithms to evaluate millions of route alternatives based on terrain, environmental constraints, property ownership, and construction costs. It supports early-stage infrastructure planning by enabling fast, data-driven decision-making and sustainability analysis.



Smallworld Electric Office

GE Digital

Overview

Smallworld Electric Office by GE Digital is a geospatial asset management solution tailored for electric utilities. It provides a comprehensive digital representation of electric transmission and distribution networks, supporting the full asset lifecycle—from planning and design to maintenance and refurbishment.

It also integrates geospatial data with utility-specific applications, enabling accurate modelling of network assets and seamless integration with systems like SCADA and outage management. The platform also supports mobile field data collection, enhancing field-to-office collaboration. Advantages of Smallworld Electric Office include reduction in planning time, improved workforce productivity, faster outage response, and reduced capital and operational costs. Its scalability makes it suitable for utilities of all sizes, and its modular design allows for regional customisation, such as European-specific configurations

Key capabilities

Geospatial asset management: Maintains detailed spatial records of network assets.

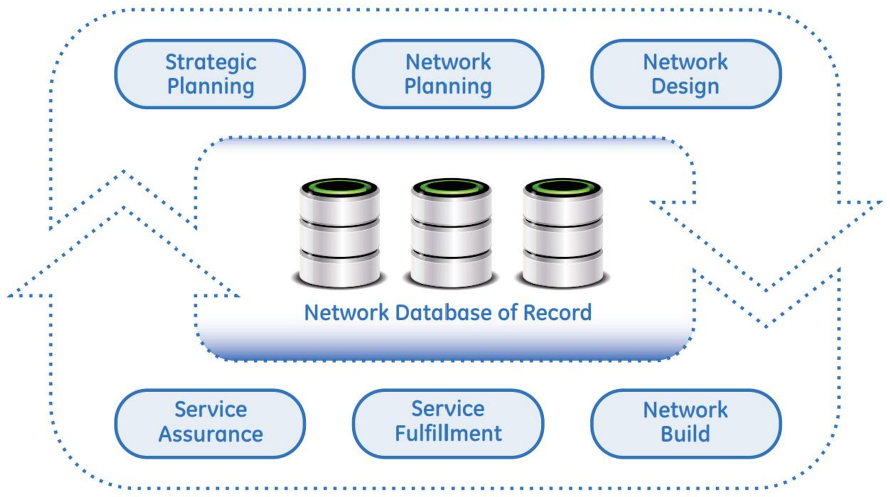
Network modelling: Simulates electrical behaviour across the network for planning and analysis.

Real-time analysis: Supports operational decisions with up-to-date network status.

Outage and grid analytics: Helps identify vulnerabilities and optimise restoration strategies.

Summary

Designed for electric utilities, Smallworld Electric Office offers detailed network modelling, real-time analytics, and outage management capabilities. It supports full lifecycle planning and operational decision-making, helping utilities reduce planning time, improve reliability, and optimise route planning for electric transmission and distribution.



Pivvot Platform

Pivvot/Terracon

Overview

Pivvot is a location intelligence platform tailored for energy infrastructure projects. It enables utilities, developers, and engineering firms to conduct virtual site analysis, generate preferred transmission routes, and produce regulatory and environmental reports within hours instead of weeks.

Pivvot uploads existing assets (e.g., transmission lines, substations) for integrated planning and compares multiple route options side-by-side, while accessing hundreds of datasets instantly, including environmental, societal, and engineering data. It also identifies optimal interconnection points and streamline grid integration.

Pivvot allows for regulatory reporting, generating Permit Reports outlining jurisdictional boundaries and required permits, while also creating Parcel Reports with critical development attributes. Automated reporting minimises time spent in the field and avoid costly delays.

Key capabilities

Routing Analysis: Generating point-to-point preferred routes using custom constraints (preferred, avoidance, exclusion).

Siting and Suitability Analysis: Evaluating constructability based on topography, access, proximity to load centres and nearby infrastructure.

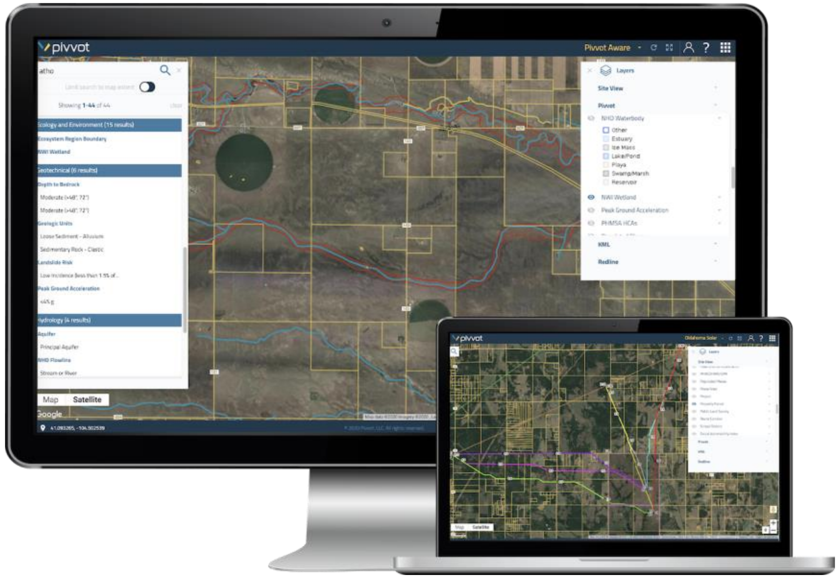
Environmental & Regulatory Reporting: Producing detailed Crossing & Impact Reports covering land ownership, endangered species, floodplains, and protected areas.

Project Acceleration: Reducing project schedules by up to 50% through virtual analysis and automated reporting.

Data Security & Collaboration: Secure cloud-based platform with SSL encryption and firewalls allowing for safe collaboration across teams using a web map interface.

Summary

Pivvot provides a location intelligence platform that compares multiple route alternatives side-by-side, making use of constraint data and a cost surface to identify the optimal path.



EPRI-GTC Methodology

NV5

Overview

EPRI-GTC is a methodology by NV5 for overhead transmission line siting and takes any transmission line construction project from initial planning through final route selection. A rigorous step-by-step process facilitates the selection of the most optimal route, considering the natural environment, built environment, and design and construction concerns. This improves analytical capabilities and productivity.

The standardised approach that the EPRI-CTG methodology follows results in siting decisions being quantifiable, consistent, transparent, and defensible. It reduces risk and shortens the planning and permitting cycle by addressing regulatory scrutiny and stakeholder issues early in the process.

Key capabilities

Macro corridor identification: Identifying the start and end points of a proposed transmission line and creating a digital study area map where values are assigned to map cells, before calculating optimal paths.

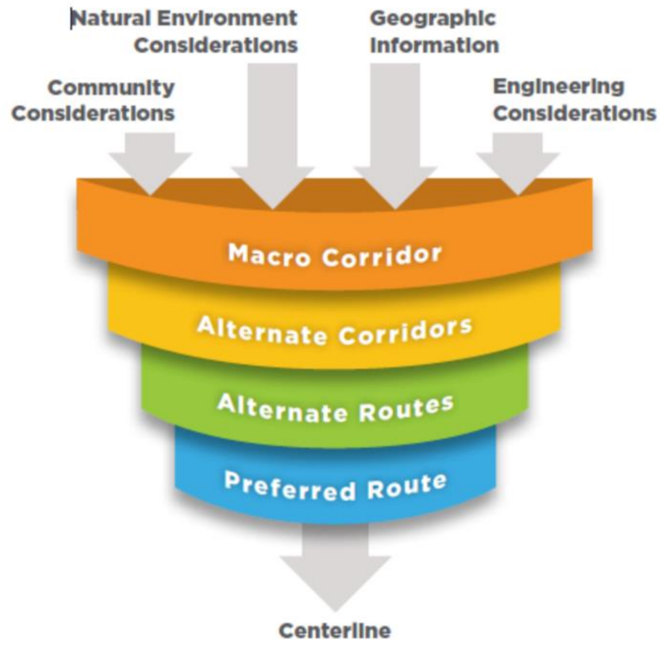
Alternate corridor identification: Collecting more detailed data within the macro corridors, creating suitability maps and defining different types of alternative corridors.

Alternate route identification: Identifying property boundaries and classifying building types within the alternate corridors to identify alternate routes.

Preferred route selection: Reviewing a standard list of metrics (cost, number of houses nearby, etc.) for the alternate routes and assigning relative weights to community concerns, visual concerns, special permit issues, scheduling risks, and accessibility for construction and maintenance. The top alternate routes are then ranked and the preferred route identified.

Summary

The EPRI-GTC Overhead Transmission Line Siting Methodology is a GIS-based, multi-phase decision-support system that integrates spatial data, stakeholder input, and algorithmic modelling to identify optimal transmission line routes.



OpenUtilities

Bentley Systems

Overview

OpenUtilities by Bentley Systems is a suite of software solutions designed to support the planning, design, and management of utility infrastructure networks, including electric, gas, water, wastewater, and district energy systems. OpenUtilities provides a robust GIS-enabled design environment that integrates seamlessly with enterprise systems.

Key features include intelligent network modelling, real-time cost estimation, and embedded workflow management tools that streamline project execution and reduce delays. The platform supports industry-standard data models and business rules, enabling accurate asset representation, connectivity, and operational insights.

Enhanced by Bentley's iTwins technology, it enables digital twin capabilities for advanced simulation, structural analysis, and grid optimisation to assist utilities in modernising infrastructure and reduce operational costs.

Key capabilities

Network design and optimisation: Automates the layout of utility networks, ensuring efficient and cost-effective designs.

SCADA and asset management integration: Links with operational systems to ensure designs are aligned with real-world constraints and asset conditions.

Scenario modelling: Supports planning for future demand, outages, or infrastructure upgrades.

Summary

OpenUtilities is a GIS-integrated platform that supports the planning, design, and optimisation of utility networks, including electricity, by combining intelligent network modelling with real-time cost estimation and workflow automation.

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ArcGIS Utility Network

ESRI

Overview

ArcGIS Utility Network by Esri is a GIS solution designed to modernise how utilities manage, model, and analyse their infrastructure networks. It introduces a unified network information model that supports both 2D and 3D visualisation, enabling utilities to represent complex systems with high fidelity.

ArcGIS Utility Network includes advanced connectivity modelling, topology validation, and real-time tracing and analytics, allowing users to simulate and understand network behaviour under various conditions.

The platform also supports containment and structural modelling, which helps represent dense asset clusters without cluttering maps. ArcGIS Utility Network enables improved data integrity, faster decision-making, and reduced operational costs.

Key capabilities

Advanced tracing: Identifies optimal paths for energy flow, fault isolation, and service restoration.

Real-time data integration: Incorporates live sensor and operational data for accurate modelling.

Visualisation and collaboration: Enables interactive maps and dashboards for planning and stakeholder engagement.

Summary

ArcGIS Utility Network is a GIS-based platform that modernises utility infrastructure management through advanced connectivity modelling, real-time tracing, and 2D/3D visualisation. It enables utilities to simulate network behaviour, optimise route planning, and enhance collaboration across departments using integrated spatial and operational data.

AENi

Developing Advanced Infrastructure Design Tools

Overview

AENi is an early-stage spin-out from the University of Sheffield, focused on developing a software-as-a-service (SaaS) platform for pre-FEED (Front-End Engineering Design) routing and network design.

The platform is tailored for sectors such as electricity transmission, hydrogen, and carbon capture and storage (CCS). Unlike traditional tools that focus on single least-cost paths, AENi enables network-level design and incorporates multi-objective optimisation as well as an agent-based social consent simulation.

In practical application, such as the Norwich-Tilbury Line case study, the tool achieved approximately 99% containment within the National Grid's reference corridor and demonstrated efficient routing within small-width corridors.

Key capabilities

AENi's platform stands out for its ability to deliver comprehensive network-level and multi-objective design, supporting planner-in-the-loop editing and future-proofing by considering technical, environmental, and social trade-offs.

The system generates and compares alternative routes across a wide range of metrics, including length, visual impact, environmental and technical feasibility, planning and consent, biodiversity net gain, climate resistance, operations and maintenance, social factors, and carbon or peat impact.

It extends its optimisation engine to full network configurations, ingesting existing assets and expanding to new connection points, while providing multiple options with detailed scorecards.

A distinctive feature is the agent-based social consent simulator, which models public behaviour, predicts objection distribution, and enables trade-off analysis between engineering cost and social acceptability, introducing the "Price of Acceptability" metric..

Summary

AENi presents a sophisticated, multi-objective infrastructure design tool that integrates technical optimisation with social consent modelling.

By offering planners robust and defensible options for early-stage infrastructure projects, the platform addresses both engineering and social challenges. Its ability to generate, compare, and justify alternative routes, while factoring in social, environmental, and technical risks positions.

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