Predict4Resilience

SIF Beta Phase – Annual Report
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01.

Executive Summary

Section 1. Executive Summary

Predict4Resilience (P4R) is a cutting-edge software platform designed to enhance the resilience of electricity networks during severe weather events by providing accurate fault predictions and actionable insights.

> Leveraging historic weather and fault data, and ensemble weather forecasts, P4R forecasts potential network faults up to five days in advance. This empowers network operators to proactively deploy resources, minimising outages and improving response times, especially for vulnerable customers.

Rationale

P4R was conceived in response to severe weather events like Storm Arwen in 2021, which exposed the limitations of reactive fault management approaches. The platform enables data-driven, proactive responses that reduce downtime, operational costs, and customer impact. It aligns with UKRI and Ofgem's Innovation Challenge 2 on Data and Digitalisation (SIF Round 1) by advancing planning, forecasting, and coordination across energy networks.

Projected Impact and Benefits

P4R aims to deliver tangible benefits, including cost savings for consumers, reduced operational costs for networks, and minimised carbon emissions through more efficient fault response. By providing advanced fault predictions, the platform will help operators restore power faster, reducing downtime and mitigating the impact of severe weather events on vulnerable customers.

Project Foundations (Discovery and Alpha Phases)

During the Discovery Phase, the potential benefits of the proposed solution and an initial relationship between wind and fault were effectively demonstrated. In the Alpha Phase, the project team leveraged data science, design expertise, and software development to design and develop a first prototype, resulting in a Fault Forecast Engine that utilises advanced statistical methods and the future user-centric interface wireframes. The statistical models achieved high accuracy in forecasts for days 1-7, a critical timescale for operational planning in the Control Room. Additionally, the model effectively predicted severe weather events leading to significant fault occurrences. User engagement and collaboration with UX experts were at the heart of the project's strategy to co-design an interface that met user needs, including displaying the entire fault probability distribution alongside the RAG status for improved decision-making.

First Year of the Beta Phase (2023-2024)

During the first year of the Beta Phase, the project focused on transforming the early-stage prototype developed in the Discovery and Alpha Phases into a fully functional solution ready for live trials.

Throughout this initial year, the project team successfully established and industrialised the technical infrastructure, including repository management processes, CI/CD pipelines and AWS environments. The platform was strengthened through the integration of live weather data and the development and enhancement of production-grade fault models capable of generating live forecasts and incorporating weather-driven impacts. The Alpha Phase models were migrated into production, where they underwent extensive rounds of training, testing and evaluation. Weather forecast bias-correction was also implemented, improving prediction accuracy.

The user interface was significantly expanded during this period, introducing key components such as licence-area and district dashboards with forecast pop-ups, the event library, the event simulator, and tools for tracking and assessing forecast quality. User preference management and platform configuration features were also added to ensure the solution aligned with operational needs.

Several important insights emerged during this first year — particularly around user engagement approaches, workflow validation and forecast output design — which directly informed planning for future Beta Phase development and trial activities.

Figure 1-1: P4R User Interface 2025

Achievements in the Past 12 Months

During the second year of the Beta Phase, the focus moved from establishing core foundations to validating the platform in live operational settings and expanding its use across participating organisations.

Over the past 12 months, the team scaled training and onboarding, equipping over 50 new users from SPD and SPM before Winter 2025through 4 full-days of training and providing a half-day refresher for the users already using P4R. The Project also brought SSEN teams into the platform ahead of the Summer 2025 trials with 2 full-days of training and provided 2 refresher sessions ahead of Winter 2025.

As familiarity increased, many users began to rely on P4R as a trusted source of operational insight.Users consistently reported gaining at least one additional day of foresight into potential network disruptions.

The platform continued to mature, with 10 new releases delivering major enhancements, including a new map infrastructure, redesigned weather tables and plots, an expanded alerting system and improved fault forecasting features such as licence-area and sub-district views. These developments were accelerated through reinvestment of project underspend.

Overall, the second year strengthened the platform's usability, demonstrated its operational value across different seasonal contexts and solidified the foundations needed for the transition toward Business-as-Usual integration in the coming phases.

Key Achievements

- **Successful Winter 1 and Summer 1 Trials:** Completed live testing between November 2024 and November 2025, validating workflows and operational use
- **Expanded Operational Adoption:** Trained new user groups across SPD, SPM and SSEN.
- **Major Platform Enhancements:** Delivered **10 new releases**, introducing improved mapping, alerting, weather visualisation and enhanced forecasting features.
- **Progress Toward BAU:** Reinvestment of underspend accelerated development and strengthened readiness for Winter 2 and eventual BAU integration.

Next Steps

The P4R project has now entered the Winter 2 trial phase, with trials continuing until Summer 2026. With SPEN and SSEN users now fully engaged, the focus for the remainder of the Beta Phase will be on refining the tool, validating its performance, and preparing for integration into BAU.

02.
Project Summary

Section 2. Project Summary

2.1. Addressing the Challenges of Weather-Driven Network Disruptions

Predict4Resilience (P4R) is a software platform that provides accurate fault insights and forecasts for electricity networks during adverse weather events.

By utilising hourly data from state-of-the-art weather forecasts and overlaying this onto historic network fault data and land cover data, P4R provides Control Room operatives short-term predictions regarding the expected number of faults and range of uncertainty in each district across the licence area, up to 5 days in advance. Using hourly data available enables P4R to provide the most accurate 6-hourly weather forecasting possible as well as providing the platform with the most granular weather imagery for the map.

This capability allows for the proactive placement of resources—such as engineers, mobile generation units, welfare provisions, and customer liaison staff—in areas most likely to be affected. This can be especially important in remote locations where travel distances are significant, and the proactive response will enable power supply to be restored sooner than is currently possible, creating a more resilient network and minimising disruption and stress for customers, particularly for the vulnerable.

The P4R project was developed in response to the electricity network sector's vulnerability to severe weather events, which can cause widespread outages and significant economic losses. Events like Storm Arwen in November 2021 highlighted the need for a more proactive approach to network fault management. With over a million customers affected and many losing power for over a week, the storm exposed gaps in preparation and resource management.

Until now, Distribution Network Operators (DNOs) have primarily relied on experience-based risk assessments which, while valuable, can be constrained by limited data-driven insights. This approach can result in reactive fault management and longer outage durations. The P4R system leverages real-time weather data and predictive analytics to forecast faults, helping to shift DNOs from reactive management to a more proactive strategy. This approach minimises downtime and reduce operational costs.

Aligned with UKRI and Ofgem's Innovation Challenge 2 on Data and Digitalisation (SIF Round 1), P4R enhances network planning, modelling, and forecasting through the innovative use of data. It improves resilience by integrating real-time analytics with weather insights, enabling faults to be predicted well in advance. This not only enhances operational planning and resource allocation but also fosters better communication across energy networks and key stakeholders, promoting coordination as outlined in the Innovation Challenge.

2.2. Milestones Achieved in the Year 2

The second year of P4R project marked a significant transition from foundational development to real-world validation. Building on the robust platform established in Year 1, the focus shifted towards trial execution and model refinement to ensure operational readiness and enhanced predictive capabilities.

A major achievement was the successful completion of Trial Phase Winter 1 (M3.1), and Trial Phase Summer 1 (M3.2) during the last year. Alongside these milestones the project also delivered the Trial Phase Winter 1 report (D3.1) and Trial Phase Summer 1 report (D3.2). These milestones provided critical insights into how P4R would be utilised in live environments, revealing practical considerations for outage prediction and response during severe weather conditions. These phases have been instrumental in validating the platform's performance across seasonal extremes, enabling the team to fine-tune operational workflows and improve user experience.

To strengthen forecasting accuracy, the project delivered several key technical milestones. The New Fault Types Model (M4.3) was introduced to capture outages caused by snow, ice, and lightning, expanding the platform's to diverse weather hazards. Additionally, the Spatial/Temporal Model (M4.4) enhanced reliability by incorporating location-specific and time-sensitive variables, significantly improving outage prediction.

The year also saw the implementation of New Interfaces (M4.5), enabling secure and seamless integration with additional systems. This advancement not only improved connectivity but also reinforced the platform's reliability and scalability, ensuring P4R can operate effectively within broader organisational ecosystems.

Collectively, these milestones represent a pivotal step towards operational maturity, demonstrating P4R's capability to provide accurate insights and robust performance under real-world conditions.

Summary of Milestones					
Ref	**Milestone Title**	**Success Criteria**	**Partner Responsible**	**Due Date (dd/mm/yyyy)**	**Status**
M3.1	Trial Phase Winter 1	Champions team engaged and captured bugs and lessons	University of Glasgow & Sia Partners	30/04/2025	
M3.2	Trial Phase Summer 1	New DNO onboarded and cross DNO lessons shared	Sia Partners	30/09/2025	
M4.3	New Fault Types Model	New models developed to capture new types of faults	University of Glasgow & Sia Partners	31/12/2025	
M4.4	Spatial/Temporal Model	New model developed at license area level	University of Glasgow & Sia partners	30/09/2025	
M4.5	New Interfaces	Report on capability to connect to other systems securely	Sia Partners	31/03/2025	
M3.3	Trial Phase Winter 2	Solution supporting decision in fault response during the winter	SPEN, Sia Partners & University of Glasgow	30/04/2026	
M3.4	Trial Phase Summer 2	Solution supporting decision in fault response during the summer and ready to be deployed	SPEN, Sia Partners & University of Glasgow	30/09/2026	
M3.5	Sage Gate – Summer 2	Decision to undertake Summer 2 trials	SPEN, Sia Partners & University of Glasgow	30/04/2026	
M5.2	Commercial Readiness	Commercialisation strategy agreed amongst partners	Sia Partners	31/12/2026	

Milestones were met.

Milestones not on the critical path have been pushed back to ensure the Business Live trials could start properly in Autumn 2024

Milestones are on track

Figure 2-1: Summary of Milestones up to January 2025

2.3. Key Technical Advancements to Date

P4R has undergone a major technical evolution across both its modelling capabilities and its functional/foundational features.

Modelling enhancements include:

- Substantially improved Machine Learning (ML) fault models that now incorporate a broader suite of environmental risk signals, such as wind speed and direction, seasonal vegetation state, lightning and lightning-risk proxies, and atmospheric energy indicators.
- Strengthened worst-case awareness through right-tail and extreme-event distribution modelling, including the use of Extreme Value Theory.
- Introduction of licence-area–level fault forecasts, enabling more spatially targeted prediction of network risk.

Functional improvements include:

- A significant UI and workflow redesign, with updated maps and dashboard pages that enhance overall user experience.
- Expanded network asset intelligence with substation visibility structured by voltage tiers (HV, 33 kV, 132 kV) and displayed across core dashboard views.
- A replay capability that allows users to review up to three months of past events to analyse recent faults and weather behaviours.
- Direct integration of weather alerts into P4R, improving situational awareness and operational readiness.

For more information, please refer to Sections 3 and 8 of this report.

2.4. Project Governance & Partner Collaboration

The governance framework established during the Beta Phase emphasises collaboration and transparency among the Funding Party, project partners, and stakeholders. Regular meetings—including quarterly Monitoring Office and Steering Committee sessions, along with monthly Partner meetings—facilitate effective communication and enable comprehensive reviews of financials, risk assessments, and technical progress. The Steering Committee plays a vital role in providing high-level oversight and strategic guidance.

The integration of insights from project partners — Sia Partners, University of Glasgow, SPEN, and SSEN — has been essential in shaping P4R's development with several teams from within SPEN offering inputs to the project including the Innovation, Control Room, Asset Management and Network Planning & Regulation teams. The partnership between Sia Partners and the University of Glasgow enhances technical capabilities by leveraging diverse expertise. Ongoing consultations with representatives from partner organisations ensure that strategies benefit from a comprehensive array of knowledge and experience.

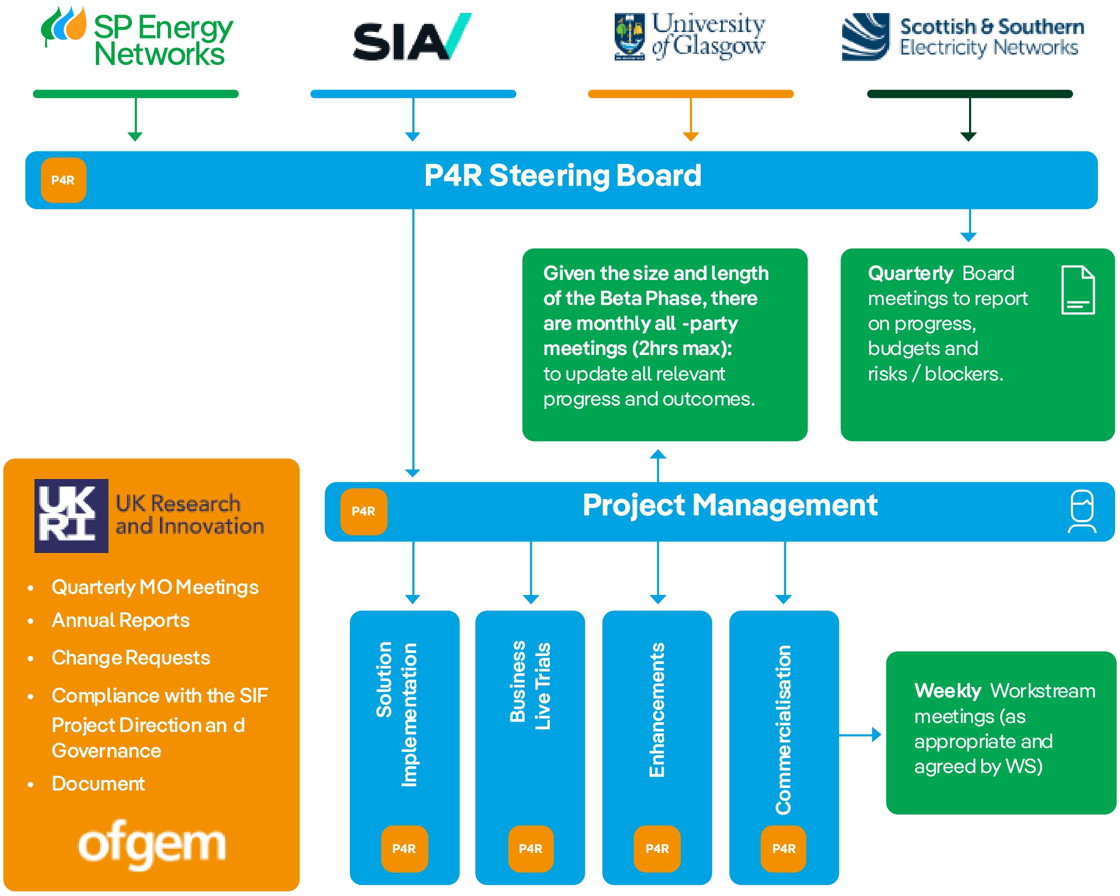


Figure 2-1: Predict4Resilience Project Governance

This iterative approach to collaboration drives continuous enhancements to the P4R solution, particularly in areas such as fault data processing and algorithm development. Insights gained from technical partnerships lay the groundwork for transparency and shared learning.

03.

Knowledge Creation & Dissemination

Section 3. Knowledge Creation and Dissemination

3.1. User Engagement

User engagement was positioned as a central pillar of the P4R trials, with a strong emphasis on aligning the platform to the operational workflows of end-users. At the outset, the engagement strategy consisted of three core mechanisms. First, users could submit live feedback, report bugs, or raise queries directly via the platform interface, creating a direct line of communication with the Development Team. Second, dedicated feedback forms were to be completed during storm events, capturing operational insights in real time. These forms aimed to inform enhancements to forecasting, the user interface, and broader resource planning. Third, monthly feedback forms were introduced to gather input on the platform's performance during periods of business-as-usual. Responses were to be reviewed by Sia and discussed during regular feedback meetings, contributing to a continuous improvement loop.

This comprehensive engagement structure was designed not only to gather insights, but also to assess the effectiveness of different feedback mechanisms and inform the organisation of future trial phases. However, as the trials progressed, it became clear to the P4R Team that actual user engagement deviated significantly from this initial plan. In practice, the volume and frequency of feedback mechanisms proved overly ambitious. Live comments submitted through the platform interface were limited, and engagement with the feedback forms—particularly during storm events—was significantly lower than expected. The number of forms to be completed placed a heavier burden on users than anticipated, which in turn reduced participation. Due to the irregularity of weather events, storm review meetings were occasionally combined with monthly meetings. These adjustments highlighted that written forms and passive feedback channels were insufficient to sustain active engagement.

One of the most important learnings was the value of direct, face-to-face interaction. It became evident to the Team that in-person workshops were far more effective in fostering engagement and meaningful dialogue. As a result, feedback workshops were scheduled at the end of the trial period to re-engage users and capture richer, more actionable feedback.

In response to these lessons, the engagement strategy was revised. Feedback forms — both weather-specific and monthly — were discontinued. Instead, monthly meetings served as the primary channel for collecting user feedback and addressing any issues. To ensure deeper engagement, two in-person workshops were planned: one at the midpoint and one at the end of the trial period. Anonymised notes were taken during the session and then circulated after to all attendees for their reference. The outputs were collated by the Product Owner and fed into a Product Roadmap.

3.2. Worst Case Scenario

P4R quantifies forecast uncertainty by estimating the number of faults that are expected with a given probability. Separate models are used for a range of probability levels from 5% to 95%, however, this approach cannot be applied to the most extreme probability levels where, by definition, data is sparse. Therefore, to estimate the number of faults associated with extreme probabilities, up to 99.95%.

To address this, new modelling approaches were introduced under the name "Worst Case Scenario" enhancement that estimates a parametric distribution using methods from Extreme Value Theory, illustrated in Figure 3-1. The parameters of the tail distribution depend on covariates, such as wind speed, which are selected for each district based on cross-validation and back testing. These verified the performance of the full density forecasts and yielded modest improvement in categorical forecasts (Amber and Red alerts).

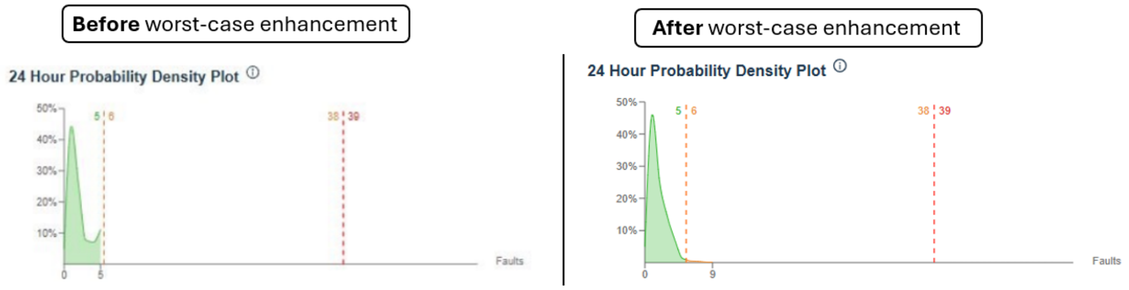


Figure 3-1: Worts Case Enhancement. The right tail of the predictive probability distribution has been completed with a parametric distribution

[For more information, please see Addendum A - Lessons Learned in the Appendix at the end of the report.]

Lessons learned

Face-to-face workshops unlock better insights

- Direct interaction proved most effective for accessing deep, operational user knowledge.

Feedback channels support a user-centric approach—but must respect user schedules

- Mechanisms should align to real workflows and time constraints to sustain engagement.

Trial-driven model adjustment is essential

- Adapting models during trials—such as strengthening lightning-risk detection and worst-case fault awareness—showed the importance of evolving forecasts through evidence-led learning.

04.

Intellectual Property Rights

Section 4. Intellectual Property Rights Generation

P4R maintains an IP Register listing background and foreground IP generated by and used within the project. Foreground IP falls into three categories: knowhow, database rights, and computer software, which will be addressed separately below.

Knowhow developed to date relates to fault modelling and forecasting methodology. Fault modelling involves processes for preparing fault data analysis (cleaning, correcting, aggregating etc.) as well as model selection and evaluation. The fault forecasting models currently used are quantile generalised additive models estimated using the Bayesian framework of Fasiolo et al 2020 and implementation in the R package "qgam", and conditional Generalised Pareto Distributions for the right-tail.

Fault forecasting knowhow comprises the combination of methods for post-processing ensemble numerical weather predictions and combining these with fault prediction models to produce the final fault forecast. This represents a combination of existing methods, but details of their integration and implementation comprise this IP.

Foreground IP relating to statistical methods developed for fault forecasting will be shared with network licensees and more broadly though an academic publication that has been submitted to a peer-reviewed academic journal. Knowhow will also be disseminated via reports as required by the SIF, at industry events such as the Energy Innovation Summit, and other media as appropriate.

4.1. Database rights

P4R has produced multiple databases that are used in fault modelling and forecasting by processing and combining a combination of open datasets (with Licence Terms that allow commercial and non-commercial use), paid-for datasets, and data assets owned by network licensees.

Open datasets include weather re-analysis (ERA5), land use maps, topographic maps and so on. Access to historic weather forecasts from ECMWF is paid-for, but data may be shared under the CC-BY licence. This data can either be shared on request with licensees or can be accessed directly from source by licensees themselves. Operational (live) weather forecast data is procured on a commercial basis by Sia Partners to produce fault forecasts based on the latest weather forecast; the terms of this data restrict sharing until it is no longer valid (the time of the forecast has passed).

Fault and network data owned by a given network licensee is used in the fault forecasting process for that licensee's network and is considered sensitive for commercial and security reasons and can therefore not be shared with other licensees. For the same reason, databases created within P4R that link fault, network and other data (e.g. weather), are potentially sensitive and will undergo a triage process to establish their level of sensitivity. These databases include linked weather and fault data, parameters of statistical models, network/user preferences for forecast display, and model and forecast evaluation metrics. For example, processed fault data linked with weather data for the purpose of fault modelling is considered sensitive; however, fault forecast evaluation metrics from the P4R Alpha Phase were deemed safe and shared in end of project reporting.

4.2. Computer Software

Computer Software has been developed to implement the P4R fault forecasting methodology and manage the multiple data pipelines required to set-up P4R models for a given licence area/district, produce operational forecasts, and provide a user interface to those forecasts and additional related features. This software combined with necessary database comprises the “P4R solution” which is accessible to users via a web browser. All computer software is hosted and stored by Sia Partners and is considered commercially sensitive. How this software and service will be made available to network licensees will be determined by activities in the Commercialisation work package of P4R. The full range of options will be explored; however, it should be noted that there is a significant cost associated with setting-up and running this Computer Software and required databases. Costs include cloud computing infrastructure, data storage, weather forecast subscriptions, and human resources to operate and maintain the system. Therefore, it is anticipated that the preferred route for network licensees to access this IP with be to procure “P4R-as-a-service".

05.

Data Access Details

Section 5. Data Access Details

5.1. Data Access

The data generated from the project is published on the P4R platform, which is hosted by Heka, part of the Sia Partners' ecosystem of artificial intelligence solutions. All partners involved in the project have access to the platform's user interface, which allows for seamless interaction with the data and insights.

The primary output of the P4R platform is fault forecasts, which are generated using fault bands and forecast probabilities. These forecasts are updated every 6-hours over a 5-day horizon and are available for each district and licence area of the DNO. Additionally, the platform provides weather forecasts for the same locations and time periods, to help understand the fault predictions.

Other functionalities of the P4R platform include:

- Calculating the resources needed to address forecasted faults.
- Replaying past weather events and associated fault bands for any selected date.
- Displaying DNO substations across the network.
- Displaying Weather Alerts from the Met Office and SEPA
- Replaying any past P4R forecast to support retrospective análisis.

Users are only able to access pages and data relevant to their own DNO and are not able to see any content belonging to a different DNO.

5.2. Published Insights

The University of Glasgow presented work in progress of P4R at the EPSRC Risk Day, a meeting of the UK Chapter of the International Institute of Forecasters, and the Royal Statistical Society Conference in 2026. An academic paper describing the P4R methodology has been submitted to an academic journal and is under review at the time of writing. This paper will expand upon earlier technical reports describing the current P4R production models and results.

06.

Route to Business-as-Usual

Section 6. Section 6: Route to Market/ Business as Usual

6.1. P4R Implementation Progress and Next Steps

The implementation of P4R continues to follow a phased approach. Having completed Winter 2024 and Summer 2025 trial, we have gathered valuable feedback that has driven substantial improvements to the platform. These enhancements have strengthened functionality and user experience, positioning P4R for broader integration.

Two trials remain: the Winter 2025, which is already in progress, and the Summer 2026 trial. As we move forward, additional new users are being trained at the start of each trial phase to ensure smooth onboarding and adoption. The team is actively tracking usage to assess benefits and identify opportunities for further optimisation. Feedback from ongoing trials remains central to our strategy, enabling continuous improvement and the addition of new features to support daily operations. This iterative process ensures P4R is well-prepared for business-as-usual (BAU) operations and future commercial deployment.

6.2. Deployment at Large Scale

In the Beta Phase, P4R will initially be deployed at SPEN and SSEN, marking the beginning of its rollout. The complete implementation at these two DNOs is scheduled for Q4 2026, after which the focus will shift towards expanding to the remaining four DNOs in Great Britain. All of them were engaged with during the Alpha Phase, to understand their current storm impact prediction systems, assess their interest in P4R, and explore the feasibility of a broader rollout. Both Electricity North West and UK Power Networks responded positively, entering detailed discussions that are ongoing. This nationwide deployment is projected to take place between Q4 2026 and Q4 2028.

In addition, international expansion is being explored, with targeted regions identified based on the presence of Iberdrola Group subsidiaries and utilising Sia Partners' established footprint in the Energy and Utilities sector. These include Western Europe and North America as a priority, followed by South America and Asia Pacific. These international discussions will continue until Q4 2026, laying the groundwork for broader global adoption of P4R.

Moreover, P4R demonstrates potential applicability across other UK sectors with weather-sensitive assets, such as transport (e.g., Network Rail, National Highways, Local Government Association), telecoms (e.g., Openreach, CityFibre, Virgin Media), and water utilities (e.g., Yorkshire Water, Northumbrian Water, South West Water), requiring minimal modifications for adaptation. This broad applicability suggests a strong potential for widespread deployment of P4R, both domestically and internationally, across multiple sectors. Engagements with these sectors are anticipated at the end of the Beta Phase, with discussions set to commence in Q1 2027 and continue through 2029.

Figure 6-1: Go-To-Market Target Audience

To understand the likelihood that P4R will be deployed in a large scale, a comprehensive competitor analysis was conducted, examining a range of global tech offerings, weather-focused offerings, GB DNO-specific offerings, and research-led offerings. By comparing the advantages and disadvantages of these offerings with those of P4R, it was determined that no direct competitors exist, particularly in the UK. The analysis also highlighted three key differentiators for P4R. First, P4R's strong emphasis on user engagement makes it a user interface tailored to meet specific needs. Second, it's standalone nature means it operates independently without requiring additional software. Finally, P4R benefits from being developed by a team of experts with extensive industry knowledge, including Control Room experts, developers, UX designers and weather data specialists. Given these factors, and the potential for adaptability across various sectors, P4R is well-positioned for extensive deployment both domestically and internationally.

6.3. Exploiting the Outcomes of the Project

To fully capitalise on the potential of P4R, both the fault forecast engine, and the weather data can be applied in the adjacent sectors previously mentioned. This will allow for the identification of additional use cases where P4R's predictive capabilities can enhance operational efficiency and infrastructure resilience. In the transport sector, for instance, P4R could support proactive maintenance and improve response strategies by forecasting weather-related disruptions. Similarly, in the telecom sector, the solution can assist in predicting infrastructure impacts from adverse conditions, aiding in service continuity and infrastructure protection. In the water sector, P4R's data could be used to foresee risks, helping prevent disruptions and maintain service quality. By expanding the application of P4R's predictive analytics across these sectors, its deployment can maximise impact, enabling organisations to better anticipate and address weather-related challenges while improving reliability and resilience.

6.4. Innovation and Commercial Readiness Levels

At the time the Beta Phase application was written, the Commercial Readiness Level (CRL) of P4R was assessed at 6 (Product Optimisation), with an expected progression to CRL 8 (Market Introduction) by the end of the Beta Phase (see appendix). Currently, the CRL remains at 6. Although the user interface has been developed and is undergoing testing—with further improvements planned based on user feedback—the product design is not yet fully finalised, and some agreements are still pending. It is anticipated that CRL 8 will be achieved by the end of the Beta Phase, with P4R expected to be fully deployed at both SPEN and SSEN.

Regarding the Innovation Readiness Level (IRL), the initial assessment set it at 4 (Quality and Assurance of Integration), with a target of reaching IRL 7 (Verified and Validated) by the end of the Beta Phase (see appendix). Following the development of the solution and a year-long trial at SPEN, the IRL has now successfully progressed to 7, meeting the project's original target. P4R is currently operational at SPEN and SSEN, and the tool has been verified and validated in real operational conditions. Further product enhancements will be required to support international deployment and adaptation to other sectors

6.5. Enabling Commercialisation

There have been no changes to the plans for enabling the procurement and utilisation of P4R across Great Britain and internationally, except for SSEN requesting to bring their trial forward to Summer Trial 2025. The roles of other partners in maintenance, ongoing development, and royalties/licensing are still being defined. Intellectual property (IP) matters are currently being addressed, with the commercial agreement expected to be finalised in 2025.

Following trials with SPEN and SSEN, no additional capital investment is anticipated for the commercialisation of the innovation. All partners, both network and non-network, have sufficient expertise and do not require further support as they move toward commercialisation.

07.

Policy, Regulation & Standards Barriers

Section 7. Policy, Regulatory, and Standard Barriers

Following further investigation during the second year of the project, no new regulatory barriers or uncertainties have been identified by SPEN, SSEN, or project partners, or expert assessors. This continues to confirm that the project remains fully compliant with existing regulatory frameworks.

Additionally, there are still no derogations, licence exemptions or regulatory sandboxes which would be required to progress towards project completion. Likewise, there are no ongoing conversations with the Government, Ofgem, or other relevant bodies that would impact the current phase of delivery.

From a long-term perspective, no policy considerations have emerged that would necessitate changes to the Business-as-Usual rollout of P4R.

SPEN and SSEN will continue monitoring the regulatory landscape to assure a successful delivery of P4R.

08.
User needs

Section 8. User Needs

During the Beta Phase of P4R, the platform's design has been shaped directly by user feedback gathered through interviews and workshops. While the extensive user workshops during Alpha led to initial designs, the Beta Phase has been pivotal in refining the platform based on detailed codesign and collaboration as the solution was developing. Specifically, multiple interviews were conducted with Control Room Leads, District Fault Leads, and other key stakeholders at SPEN.

Alongside SPEN, workshops were also held with SSEN, which helped compare expectations and processes between two different Distribution Network Operators and evaluate key themes such as the plausibility of user flows and the differences between BAU and extreme weather scenarios. These interviews provided actionable feedback that influenced the definition of User Types, clarified user journeys, and informed the implementation of key platform updates. They also led to the identification of weather conditions particularly pertinent for SSEN's network (e.g. line icing and lightning). 8.1 User Profiles is a comprehensive summary of how these interviews impacted the system's development and functionality.

8.1. User Profiles

During the Beta Phase of P4R, the Project's prioritised users (established in Alpha) have been confirmed as Control Room Engineers, Emergency Action Centres (EACs), District Fault Leads, Data Scientists, and IT/System Administrators. Each of these user types plays a crucial role in the overall resilience of the energy network, and their specific needs have shaped the design of the P4R platform.

- **Control Room Engineers (CREs):** CREs are responsible for monitoring and managing real-time network operations. During normal business hours, they do not have direct control over district resources and must rely on contacting the Fault Lead in the affected district to request resources. The P4R platform enhances their visibility, especially outside business hours, by providing comprehensive data and predictive insights. This allows them not only to request resources more efficiently but also to anticipate fault occurrences and coordinate responses proactively, significantly reducing the manual effort involved and streamlining the overall fault management process.

- **Emergency Action Centres (EACs):** EACs are responsible for managing resources and coordinating responses during extreme weather or critical events. The P4R platform provides EACs at both district and head office levels with a real-time strategic overview of network faults and resource distribution. By centralising this information and allowing access to a tactical overview, P4R enables EACs to quickly mobilise resources across districts. This streamlines communication and reduces the response time to fault events. The platform also includes an event comparison function to assess current faults against similar past events, assisting in rapid decision-making.

- **District Fault Leads (DFLs):** DFLs serve as the primary coordinators for dispatching resources in response to fault indications. They utilise the platform to access a wide range of functionalities, including maps, forecasts, and updates relevant to their district. Their interaction with the platform includes but is not limited to assessing fault details, planning resource allocation, and leveraging tools like the resource calculator to determine response needs. The Beta Phase has improved the P4R team's understanding of their operational requirements by providing more granular forecasts and enabling comparisons of forecast quality with historical event data. This ensures DFLs can make informed decisions with greater confidence and adaptability.

- **Data Scientists:** Data scientists support predictive modelling and data analysis for the P4R platform. Their role requires access to vast amounts of system data to refine models and recalibrate predictions. P4R has been designed to provide enhanced access to raw data and the ability to interact with real-time system analytics, ensuring that data-driven insights are incorporated into the platform's predictions.

- **IT and System Administrators:** System admins ensure the platform's functionality and configuration, managing access, system updates, and configuration to align with user requirements. P4R has integrated user-friendly admin features to allow seamless updates and configuration, minimising downtime and enhancing overall system efficiency.

8.2.1. Objectives of the Live Trials:

The Live Trials, running from Winter 2024 to Summer 2026, are essential for refining and validating the P4R platform. Designed to test the system's performance during both extreme weather events and BAU operations, the trials aim to ensure the platform aligns with the real-world needs of its key users.

These trials allowed the P4R Team to simulate real-world user journeys and gather critical feedback to refine platform features and enhance operational workflows. They are designed to meet several key objectives:

- **Validating User Journeys and Product Design:** The trials observe how users, including CREs, EACs, and DFLs, navigate through the platform in real-time scenarios. By tracking their workflows in both routine and emergency situations, the trials ensure that the platform is designed around the specific needs of its users. This hands-on approach helps refine user journeys, ensuring solution features are optimised for efficiency and ease of use.

- **Translating User Feedback into Continuous Improvement:** The trials act as a feedback loop, allowing the Team to adjust platform features like dashboards, weather forecasts, and resource allocation tools. This direct engagement with users ensures that the platform evolves continuously based on real-time user experiences.

- **Confirming and Refining Understanding of User Needs:** As the trials progress, feedback provide deeper insights into user needs that may not have been identified in earlier development phases. This iterative approach enables ongoing adjustments to features like fault prediction and resource mobilisation, ensuring the platform adapts to operational realities.

- **Assessing Forecasting Models**: The trials evaluate how well the forecasting models perform operationally and highlight areas for improvement to continuously enhance the model's accuracy.

- **Leveraging Forecasts for Decision-Making**: The trials assess how users utilise these forecasts to inform and support operational decisions, ensuring the platform optimally supports proactive management.

- **Minimising User Burden and Avoiding Duplication of Effort:** A key objective is to reduce user workload by automating processes and offering an intuitive interface. The trials test how well the platform simplifies workflows, streamlines decision-making, and prevents redundant efforts. The goal is to ensure P4R serves as an all-in-one tool for fault management, offering clear, practical insights without overburdening users.

8.2.2. Training for Trials

In 2025, before the Summer trial 1 the primary training focus shifted to SSEN onboarding and the P4R team conducted, two full-day training sessions one in the north and one in the south for SSEN. Meanwhile, active support was provided to SPEN for any ad-hoc sessions to help users as needed.

Ahead of the Winter 2 trial, two refresher sessions were conducted for SSEN where previously trained users were brought up to date with the changes to the platform. For SPEN the team delivered four full-day training sessions for new users and one-half day refresher session for previously trained users.

Additional training sessions are planned during the Winter 2 trial to further drive user adoption and embed the platform within business operation across both SSEN and SPEN.

8.2.3. Feedback Mechanisms

The trials are fundamentally user centric. By focusing on the operational workflows of users, they ensure that the platform seamlessly fits into their day-to-day operations. This approach is designed to improve decision-making, fault management, and resource allocation during both normal and extreme weather conditions.

1. **Live Feedback via UI:** Users can submit real-time feedback, report bugs, or ask questions directly through the user interface. This allows for immediate reporting of issues and suggestions, creating a direct communication line with the development team. It ensures that feedback related to usability, or any technical issues can be swiftly addressed.

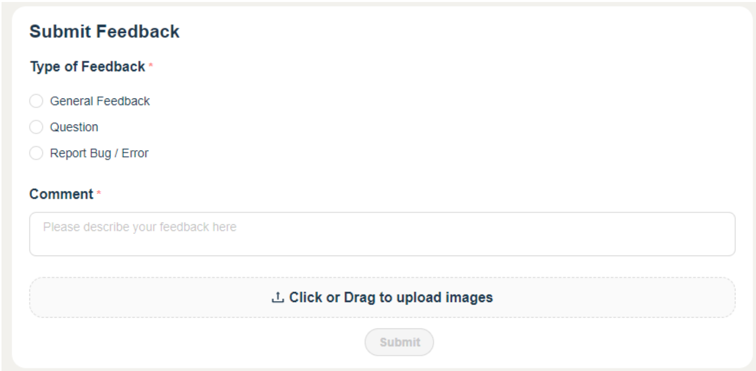


Figure 8-1: Feedback Form via User Interface

2. Monthly Meetings: recurring meetings to discuss general feedback, address any major issues and agree on changes to the user interface.
3. Midpoint/ End of Trial Review Workshops: organised meetings to review the use of P4R, accuracy of forecasts and discuss each feature of the User Interface.

8.2.4. Implemented Feedback from the First Winter and Summer Trials

User feedback collected during the live first Winter and Summer Trials identified some key areas for improvements which the P4R team implemented.

Map and Weather Forecasts

Discussion

- Users are using the map to understand the weather forecast and where the weather front is coming from. They are very rarely, however, going all the way to the bottom of the district dashboard page to view detailed weather forecasts for the district.
- They expressed the need to visualize network assets on map and show directly on the map the wind gusts & direction at those assets. Users said it would also be "really good to have line plots for the GSPs", which is more useful than the line plot for an entire district.
- Users also expressed that it would be useful to see Lightning risk on the map. Alerts around heavy rain and floods were suggested, specifically, information from SEPA around rainfall.

Actions Taken:

- Implemented a new technical infrastructure for the map, displaying network assets, and overlaying key KPIs (wind gusts, direction) at those assets directly on the map.
- Redesigned the district weather tables & plots to provide more relevant information on weather at specific locations, especially assets.
- Built a flexible alerting system that can be customed to include different alert sources, including MetOffice & Sepa.

Fault Forecasts

Discussion:

- Users confirmed that it would be useful to have a view of the fault forecast at the licence area level and make it easier to have a view of what is going on in the other districts & the other licence area as well.
- Some districts are exceptionally large, so it would be useful to know where the faults are likely to occur within the district.
- Some users said it was challenging to get a specific idea of the number of faults that are going to occur based on the density plots & probabilities, and when faults are going to happen within a day.

Actions Taken:

- Developed a licence area fault forecast, displayed in a new design that makes it easy to compare the forecast for both licence areas.
- Planning to launch a Proof of Concept to explore the feasibility and performance of sub-district fault forecast, before considering industrialisation

- Explored a way of accompanying the forecasted fault band with information about the fault forecast, including a better indication of the time that they will occur.

Replay Recent Forecast Feature

Discussion:

- Users expressed interest in a "look back" function to help them reflect on what P4R said 'post-event', helping them to review its performance (during storm reviews for example) and better interpret results in the future.
- Users confirmed this functionality would be useful to build trust for the solution, but needs to be scoped more (number of days for which to replay the forecast, map view of forecasts as well as summary view of forecasts…)

Actions Taken:

- Implemented a replay function in the User Interface, allowing to replay events up to 3 months in the past.

The Beta phase of the P4R platform has been pivotal in its development, emphasising direct user engagement and iterative improvement. By prioritising a user-centric approach, the P4R team has effectively incorporated critical feedback from key stakeholders, ensuring the platform aligns with the specific needs of its core users. These enhancements have strengthened the platform's functionality.

Lessons learned

5. Continuous User-Centric Development

One of the primary takeaways from the Beta Phase has been the importance of a continuous, iterative user-centric approach. The feedback loop established through direct engagements has been crucial in ensuring that the platform meets the specific operational needs of all user types.

09.

Impacts and benefits

Section 9. Impacts and Benefits

9.1. Expected Benefits of P4R

By accurately predicting how many and where network faults are likely to occur up to 5 days in advance, P4R will enable teams of engineers to be proactively placed in those areas most likely to be impacted. This is expected to lead to a reduction in travel time for those faults where an onsite presence is required and enable power supply to be restored sooner than is currently possible, minimising disruption for customers to bring about financial, social and environmental benefits.

These benefits were assessed and calculated as part of the Alpha Phase as part of the Benefits Case as well as for the Beta Application for funding. Since the Beta Phase began, the priority has been the development of the platform, and the fault forecast engine that sits behind it. Part of this process has involved in-depth user engagement during the design phase as well as detailed conversations with a broader audience of end users during the Training Sessions held prior to the start of the Live Trials in SPM and SPD.

The outcome of these various interactions with the end users within the businesses have validated the assumptions that were made during the benefits assessment previously and no new benefits have been identified.

9.2. Cost savings to consumers (£m)

A loss of power supply increasingly inconveniences individuals and businesses, especially the vulnerable and with working from home becoming more prevalent. Living without modern conveniences can cause anxiety, with appliances' battery life diminishing, particularly for the medically dependent. Places of work may be closed, causing lower-income families further stress because of lost wages. P4R's social benefits were calculated by multiplying the expected CML savings from P4R by the societal CML value in the CBA provided by Ofgem/UKRI.

9.3. Cost reductions in operating the networks and wider energy system (£m)

CML Savings: DNOs are set targets for the number of unplanned CMLs on their networks (the outage duration multiplied by the number of customers affected). Performance against these targets is linked to financial rewards and penalties. Having resources strategically positioned ahead of time in those areas most likely to be impacted will lead to a reduction in outages which in turn creates a financial CML payment saving to the DNO. It is worth noting that these figures do not include extreme weather events which are excluded from the incentive mechanism.

Guaranteed Standards of Performance (GSP) savings: GSP sets out how quickly DNOs must restore power following an interruption in supply. Should DNOs not meet these standards, customers are entitled to statutory compensation. With quicker restoration, some customers' outage duration will therefore be brought under a GSP time threshold, creating a financial saving to DNOs.

Storm Support: As part of DNO's Storm Support, they may provide meal vouchers, alternative accommodation (e.g. hotels) and warm packs (e.g. hats, gloves, blankets, torches etc.) to customers who are off supply for extended periods. P4R will drive a reduction in the need to provide Storm Support to affected customers, creating another financial saving to DNOs.

Fuel Savings: When power supply restoration is anticipated to be longer than usual, DNOs will provide onsite diesel generators to supply back-up power to its customers while that fault is repaired. P4R will result in both a reduction in the need to provide a generator as well as shortening any time they are required. A reduction fuel consumption creates a financial saving to DNOs.

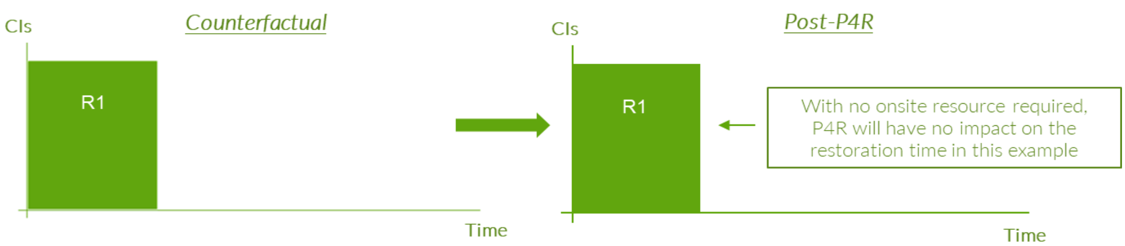
Carbon reductions -- direct or indirect (MTCO2e)

Renewable generators need a reliant connection to the network to operate and sell their electricity. Long network outages therefore prevent renewable generation accessing the grid with potential carbon impacts. Additionally, as part the Storm Support, when any power restoration is anticipated to be longer than usual, DNOs aim to provide onsite diesel generators to supply back-up power to its customers while that fault is being repaired. Given P4R is expected to deliver a potential improvement to those restoration times, it was expected that this should result in both a reduction in the need to provide a generator as well as shortening any time they are required. This reduction diesel has an associated carbon emission reduction benefit.

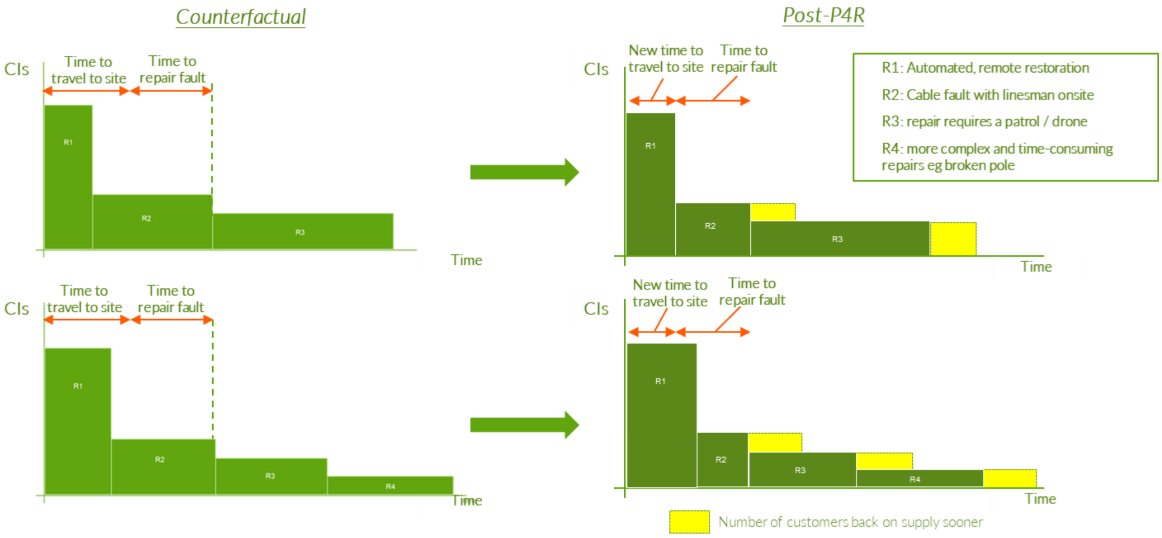
9.4. Assessment of the benefits

During previous phases of the project, the Benefits Case for P4R was calculated and refined at several junctures.

The benefits were modelled using actual SPEN fault data from the last 5 years and only weather-related faults included within the assessment. Additionally, given different network faults could result in a range of different restoration profiles (depending on the type of fault and network architecture), only those faults where an individual is required onsite before restoration can be completed were assessed (any faults where switching is performed offsite were excluded as P4R is not expected to provide any benefits in these use cases).



- **Figure 9-1: Example of a Fault Restoration Profile Where P4R Would Have No Impact Due to the Ability to Restore Power Remotely**



- **Figure 9-2: Two Examples of Fault Restoration Profiles Where an Onsite Presence is Required**

The calculation of the potential benefits of P4R focused on the premise that the platform will enable teams of engineers to be proactively placed in those areas most likely to be impacted and therefore lead to a reduction in travel time for those faults.

Having established those faults where P4R would enable an earlier restoration time, the size / scale of that time saving was applied to potential benefits. The impact of the new restoration time was modelled for the relevant faults and the new value compared against the counterfactual.

9.5. Changes Since the Beta Submission

As developed earlier in this section, the bulk of the work carried out over the first 12 months of the project has been to develop the P4R solution, in line with refined user needs, and its fault forecast engine in preparation for the start of the Live Trials in Autumn 2024. Additionally, given the solution is not yet in production nor generating any benefits to its users, there has been limited focus on recalculating the benefits as tracking them is not yet possible.

The one significant change from the Beta submission is the likelihood that the project will not be able to capture any benefits during the first trial phases. During the submission, it was estimated that the benefits for SPEN Trial Phase 1 would be 25% of those generated during Business as Usual and SPEN Trial Phase 2 would be 75%. However, after further discussion with the Control Room and other related business functions at SPEN, the decision has been taken that given P4R will not actively drive decision-making for how the network responds to potential inclement weather. Instead, during the first Winter Trial session, the Control Room will continue to utilise existing sources of information while also monitoring the outputs of the platform, providing feedback to the project team around the UX and suitability of the fault bands, as well as the model performance. The performance of P4R will be assessed at the end of the first Winter trial and inform the strategy to the next Business Live Trial session. The benefits associated with the Summer trial session and further trial sessions will be reevaluated in time. Those will be highly linked with P4R demonstrating its performance over a sustained period and give the network the confidence to move away from more traditional methods of estimating the fault impact.

While not a benefit per se, it is worth noting how positive the response to the solution has been from staff within the business who were previously unaware of P4R and who had not been involved in prior stages. The engagement during the training sessions and the early feedback from future users has been encouraging and provides us with confidence that the tool will be utilised by the Control Room in the future, displacing previous methodologies and thereby generating the proposed benefits outlined in the Beta Submission.

9.6. Benefits Arising from the Trials

From the results and feedback of the first two trials, we have identified a wider set of benefits arising from the use of P4R. These benefits have been assessed across three scenarios in which P4R delivers measurable value:

- **Scenario 1:** During severe named storms, P4R predicts the location of faults earlier and with greater precision than alternative tools. This enables optimised crew deployment, fewer emergency contractor callouts, shorter restoration times, and improved customer service.

- **Scenario 2:** During an active weather warning, P4R accurately predicts "green" conditions (i.e., no faults expected). As a result, DNOs avoid mobilising crews or placing unnecessary standby resources, preventing avoidable operational costs.

- **Scenario 3:** During amber or red weather events, P4R again predicts fault locations earlier than alternative tools. This supports more efficient crew deployment, reduces contractor call-outs, shortens restoration times, and enhances customer service.

9.6.1. Benefits Claimed Across All Scenarios:

- **Contractor Emergency Call-out Savings** P4R forecasts enable earlier, planned deployment using internal crews (including those from neighboring licence areas), avoiding the need for emergency contractor callouts.

9.6.2. Additional Benefits Claimed in Scenarios 2 and 3:

- **Better Welfare Planning:** Because P4R predicts where and how severely the network will be impacted, networks can pre-position welfare teams and resources—such as food trucks—in the right locations ahead of the storm. This leads to avoided costs in emergency meal provision and reduced travel distances required to serve customers.

- **Earlier Communication with Customers:** With earlier visibility of affected areas, networks can alert customers sooner about potential outages. This gives them more time to prepare—buying food, arranging blankets, charging devices, and making household plans—at lower personal cost.

- **More Realistic Restoration Times:** By predicting both the volume and type of faults, P4R helps networks estimate reconnection times with greater accuracy. This results in more reliable restoration windows, enabling customers to plan more effectively and reducing unnecessary travel or disruption.

- **Staff Wellbeing:** P4R provides advance visibility of storms and expected network impacts, allowing field staff to organise and prepare resources ahead of time. This reduces the reactive, unpredictable nature of storm response. With fewer last-minute pressures, staff experience less disruption to sleep patterns and lower fatigue. By shortening storm duration and reducing the number of consecutive high-stress days, P4R helps mitigate the exhaustion typically associated with prolonged restoration work.

10.

Risks, Issues and Constraints

Section 10. Risks, Issues and Constraints

Risk management continued to be a central pillar of the P4R project throughout 2025, underpinning the transition from development to live business trials and the early stages of business-as-usual planning. The project team maintained its structured approach to risk logging, with risks systematically reviewed and updated in monthly partner meetings and shared with the SteerCo and UKRI quarterly. This ensured that all partners remained aligned and responsive to emerging challenges.

As the project moved into business trials and BAU transition phases, the nature of risks evolved. While earlier concerns around development delays and resource allocation had been largely mitigated, the focus in 2025 shifted to operational, commercial, and transition risks, such as:

Project Resource from Lead Partner (SPEN): Ensuring continued resource commitment from SPEN remained a priority. Written confirmations, strong sponsor support, and contingency planning helped reduce this risk from a high inherent score to a moderate residual risk. Ongoing monitoring and engagement with business units ensured that resource gaps did not impact delivery.

User Engagement and Buy-in: The risk of insufficient user engagement in SPEN/SSEN was actively managed through the selection of business champions and frequent communication. Leveraging lessons from the Alpha phase, the team maintained strong relationships with business units, reducing the likelihood of disengagement impacting trial success.

Weather Data Availability: The business trial's success was partly dependent on the occurrence of significant weather events. While the probability of two consecutive years without such events is low, the team maintained close contact with Control Room staff to capture lessons and ensure readiness for variable trial lengths.

Automated Data Integration: Access to live internal data from SSEN/SPEN was identified as a moderate risk. Early anticipation, a fallback manual integration plan, and close collaboration with both DNOs ensured that data workflows remained robust.

BAU Transition: The risk of unforeseen internal procedures or governance changes delaying BAU transition was mitigated by aligning the project plan with SPEN's digitalisation strategy and maintaining early and ongoing consultation with IT and business stakeholders.

Commercial Strategy: The risk of an inadequate or delayed commercial strategy affecting rollout was addressed by updating the strategy and scheduling commercial discussions following the first winter trial's performance review.

Training and User Competence: Ensuring effective user training remained a focus, with business champions leading training and refresher sessions planned. The risk of misinterpretation or untrained use was mitigated through ongoing support and clear communication, with BAU support budgeted for further training if required.

Contingency Fund: With the majority of the £150k contingency fund activated and £28k remaining, financial flexibility was limited. However, with most development work complete and the project currently underspending, the risk of future overspend was considered low.

Change Requests: New high-value improvements identified by users posed a risk if not approved. The project team engaged all partners to build consensus, with fallback plans ensuring continued platform value even if changes were not implemented.

All ongoing risks are now classified as low likelihood, with none assessed as high impact. The PMO team continues to monitor these risks regularly, ensuring that any emerging issues are addressed promptly. This proactive and transparent approach has enabled the project to maintain momentum, adapt to changing circumstances, and prepare for a successful transition to BAU.

The experience of 2025 reinforced the value of systematic risk management in innovation projects. By anticipating and addressing operational, commercial, and transition risks, the P4R team safeguarded project outcomes and provided a strong foundation for future innovation initiatives.

11.

Working in the Open

Section 11. Working in the Open

The Beta Phase of the P4R project has focused on transparency, clear public communication, active stakeholder collaboration, and the integration of external input. These efforts have ensured the project meets both public interests and the technical requirements of all involved parties. In this phase, P4R has concentrated on technical improvements and strategic partnerships to prepare the platform for broader implementation.

This section outlines the methods used to ensure transparency, engage stakeholders, and apply external insights to refine the solution and guide its future rollout.

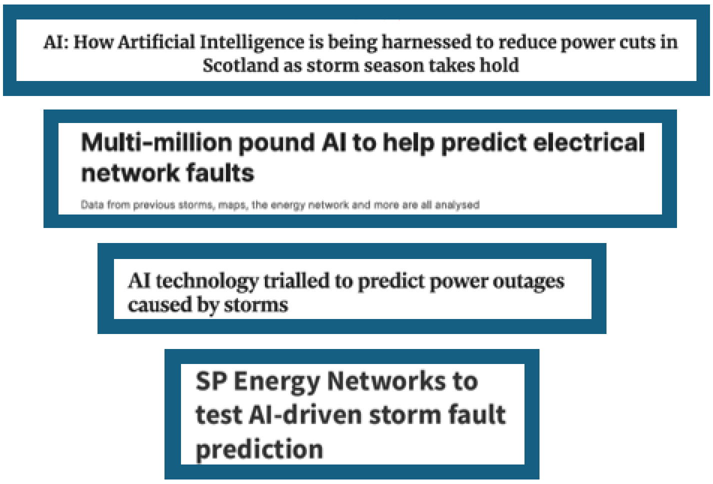
Public Communication

Ensuring that the P4R project's progress is communicated effectively to the public has been a priority throughout the Beta Phase. A multi-channel approach has been used to provide regular updates, ensuring that the project remains accessible and transparent.

Media Outreach and Traditional Channels

Throughout the first year of the Beta Phase, press releases and media appearances played a crucial role in keeping the public and stakeholders well informed about the P4R project. Major outlets, including *The Independent*, *The Scotsman*, *Evening Standard*, and STV News, provided prominent platforms for communicating key milestones and sharing updates on the project's progress. This ensured that both the technical community and the public remained aware of P4R's developments, objectives, and wider implications.

During the second year, communication efforts shifted toward operational readiness and industry engagement, with a strong presence on LinkedIn. A series of posts was published in the lead-up to the 2025/2026 storm season, highlighting progress, showcasing new capabilities, and maintaining stakeholder visibility as the tool moved into sustained use.


AI: How Artificial Intelligence is being harnessed to reduce power cuts in Scotland as storm season takes hold

Multi-million pound AI to help predict electrical network faults

Data from previous storms, maps, the energy network and more are all analysed

AI technology trialled to predict power outages caused by storms

SP Energy Networks to test AI-driven storm fault prediction

Figure 11-1: Selected Media Coverage of the P4R Solution

In addition to traditional press engagement, as part of the Project Specific Conditions stipulated within the SIF process, the P4R project team produced a 60-second promotional video designed to simplify and communicate the project's goals to a wider audience. This video ensures that the technical aspects of the project are accessible and understandable for non-specialist audiences, while still conveying the project's significance and impact.

For more information, please see Addendum B - P4R Video in the Appendix Attachments Folder.

Industry Conferences

In 2025, P4R's dissemination efforts were marked by a series of high-profile events and sustained stakeholder engagement. This year the project team was at the Energy Innovation Forum held in Glasgow on 17th of September, where the P4R team delivered a presentation to a diverse audience of network operators, innovators, and policy makers. This session showcased the latest advancements in the platform, highlighting improvements made in response to feedback from previous winter and summer trials. The event facilitated new connections with other network operators and industry experts, supporting P4R's roadmap towards national and international adoption.

P4R's visibility was further improved at the Energy Innovation Summit this year, where SPEN organised, a dedicated demonstration stand for the platform. An expert user provided live demonstrations, engaging directly with industry stakeholders. This demonstration allowed for hands-on exploration of P4R's features and benefits, generating valuable feedback and increasing the industry's interest in the platform.

Sharing Learnings and Preventing Duplication

One of the key goals of the P4R project is to ensure that lessons learned are effectively shared across the industry to avoid duplicative efforts and streamline progress on related initiatives. P4R has focused on sharing its findings widely. This approach allows the energy sector to innovate more rapidly and efficiently.

One of the key future collaborations being developed is with CReDo+, another SIF-funded project that focuses on mitigating risks of electricity supply disruption due to climate change. CReDo+ is particularly interested in how P4R's use of weather data and fault prediction models can support its mission. Preliminary discussions have already taken place, and the collaboration will begin in2026. This partnership will allow both projects to share insights on climate impacts, ensuring that they build upon each other's findings and avoid repeating efforts in predictive modelling and fault management.

Similarly, P4R is also partnering with the Predictive Safety Interventions (PSI) project, which aims to improve safety in the utilities sector by leveraging advanced AI technology for real-time safety assessments. PSI has already seen significant success, achieving a 20% reduction in safety events through AI-driven video risk assessments. The two projects had joint "Lessons Learned" knowledge-sharing sessions. These focused on fostering continuous improvement by sharing insights on AI-driven data analysis, ensuring both projects can evolve without duplicating past work. The collaboration between P4R and PSI provided valuable cross-sector learnings, particularly around the safe deployment of AI technologies in field operations.

Moreover, to avoid duplicating efforts across the DNO ecosystem, P4R has actively collaborated with key stakeholders and project partners, SPEN, SSEN, along with and other GB DNOs, to ensure that the solution is informed by real-world operational needs. The feedback loop established through live trials and stakeholder engagement has not only refined the P4R platform but also provided a framework for integrating new use cases and insights from across the sector. This approach mitigates the risk of redundancy by incorporating the lessons learned from other DNOs and adjacent sectors.

By fostering these collaborations and actively sharing findings, P4R ensures that new developments in fault prediction and network resilience are complementary rather than repetitive.

International Stakeholder Engagement

The project has also strengthened its international engagement, with presentations this year to EDF SEI (France), Hydro-Québec (Canada), PGE (United States), and Western Power (Australia). These demonstrations showcased the platform's capabilities to a broad global audience, reinforcing P4R's position as a leader in fault prediction and network resilience while fostering valuable collaboration across the international energy sector.

12.

Costs and value-for-money

Section 12. Costs and value-for-money

Section 12 Content has been omitted from the external issue due to confidentiality restrictions.

13. Special Conditions

Section 13. Special Conditions

In this section, a summary has been made on the fulfilment of the special conditions.

Condition 1

The funding party, Scottish Power Transmission PLC (SPT), did not spend any SIF funding rewarded for this project before the contract signing in November 2023.

Condition 2 – Financial contribution

SPT has reported the financial contributions made to the project as set out in the Beta application.

Condition 3 – Meeting arrangements

SPT and the project consortium have participated in all meetings related to the Project that they are invited to by Ofgem/UKRI/DESNZ during the Beta Phase.

Condition 4 – Stage gate scoping

SPT and the project partners, with the support from UKRI/Ofgem, has passed the project's first stage gate on 7th August 2024 with an unconditional pass which is the highest rating in the grading framework. For the next stage gate planned before Summer 2026, the project team will continue to work with UKRI/Ofgem to establish the success criteria to fulfil all the requirements to pass the final stage gate.

Condition 5 – Impact monitoring

SPT and project partners will produce a Project Impact Monitoring and Evaluation Plan, as part of the end of Project Phase report. The project team will put in place a plan for conducting this work once UKRI/Ofgem issues guidance on this.

Condition 6 – SIF Community Forums

SPT representatives and project partners attended the SIF Community Forum on 8th February 2024 in Newcastle. The project team will continue to participate in future community forums throughout the duration of the project.

Condition 7 – Policy, regulatory and standards barriers

SPT and the project partners haven't identified any policy, regulatory or standards barriers. The project team will update UKRI/Ofgem on any regulatory, policy and standards barriers and any change requirements which may impact delivery of the Beta Phase activities. Please refer Policy, Regulatory, and Standard Barriers in this report regarding this condition.

Condition 8 – Updated 60–seconds video

SPT, with the support of the project partners, have submitted an updated 60-seconds video at the beginning of Beta Phase of P4R in 2023. Because the project duration is longer than 24 months, the project team will provide another updated 60-seconds video at the project's mid-point meeting. As a part of the end of phase report, the project team will also provide the final updated 60-seconds video.

Condition 9 – Post – Beta Phase roadmap

SPT and the project partners have provided the Monitoring Officer a Post-Beta Phase roadmap within six months of the contract signing. SPT will provide an update on this to the Monitoring Officer every six months at the Quarterly Monitoring Meetings. A final updated version of this roadmap will be submitted as an attachment to the end of phase report.

Condition 10 – Commercialisation strategy

A draft Commercialisation Strategy has been submitted by the project team in July 2024. SPT and the project partners will update the Monitoring Officer on the Commercialisation Strategy every six months at the Quarterly Monitoring Meeting. SPT will include a final update of the Commercialisation Strategy as an attachment to the end of phase report.

Condition 11 - Data Best Practice and Digital Strategy and Action Plan Guidance alignment

SPT and the project partners have provided a response on Data Best Practice and Digital Strategy and Action Plan Guidance alignment in the slides presented at the second Quarterly Monitoring Meeting. Please refer to Section 5. Data Access Details of this report on the Data Access Details.

Condition 12

The 'WARN' Project was not selected to received SIF Funding at the Alpha Phase, therefore the P4R project team didn't engage with the team behind the 'Warn' Project.

14. Material Change Requests

Section 14. Material Changes

15.
Appendix

Section 15. Appendix

15.1. Addendum A - Lessons Learned

- Face-to-face workshops unlock better insights
  Direct interaction proved most effective for accessing deep, operational user knowledge.
- Feedback channels support a user-centric approach—but must respect user schedules
  Mechanisms should align to real workflows and time constraints to sustain engagement.
- Trial-driven model adjustment is essential
  Adapting models during trials—such as strengthening lightning-risk detection and worst-case fault awareness—showed the importance of evolving forecasts through evidence-led learning.
- Continuous User-Centric Development
  One of the primary takeaways from the Beta phase has been the importance of a continuous, iterative user-centric approach. The feedback loop established through direct engagements has been crucial in ensuring that the platform meets the specific operational needs of all user types.
- Complexity Management
  Sufficient time and resources should be allocated for complex components (e.g., Interactive Map) to prevent schedule overruns.
- Enhanced Collaboration
  Cross-functional teamwork can lead to better problem-solving and innovative solutions (e.g., Sia Partners' Data Scientist joining the Enhancement team).

See Appendix Attachments Folder.

15.3. Addendum C – Commercial Readiness Level (CRL) Scale

CRL	CRL Summary
1	Knowledge of applications, use-cases, & market constraints is limited and incidental, or has yet to be obtained at all.
2	A cursory familiarity with potential applications, markets, and existing competitive technologies/products exists
3	A more developed understanding of potential applications, technology use-cases, market requirements/constraints, and a familiarity with competitive technologies and products allows for initial consideration of the technology as product.
4	A primary product hypothesis is identified and refined through additional technology product-market analysis and discussions with potential customers and/or users. Potential suppliers, partners, and customers are identified and mapped in an initial value-chain analysis. Any certification or regulatory requirements for product or process are identified.
5	A deep understanding of the target application and market is achieved, and the product is defined. A comprehensive cost-performance model is created to further validate the value proposition and provide a detailed understanding of product design trade-offs. A basic financial model is built with initial projections for near- and long-term sales, costs, revenue, margins, etc.
6	Market/customer needs and how those translate to product needs are defined and documented (e.g., in market and product requirements documents). Product design optimization is conducted considering detailed market and product requirements, cost/performance trade-offs, manufacturing trade-offs, etc.
7	Product design is complete. Supply and customer agreements are in place, and all necessary certifications and/or regulatory compliance for product and production operations are accommodated. Comprehensive financial models and projections have been built and validated for early stage and late-stage production.
8	Customer qualifications are complete, and initial products are manufactured and sold.
9	Widespread deployment is achieved

15.4. Addendum D –Innovation Readiness Level (IRL) Scale

IRL	IRL Summary
1	Basic principles have been observed and/or formulated: Lowest level of technology readiness. Scientific research begins to be translated into applied research and development (R&D). Examples might include paper studies of a technology's basic properties.
2	Developing hypothesis and experimental designs: Invention begins. Once basic principles are observed, practical applications can be invented. Applications are speculative, and there may be no proof or detailed analysis to support the assumptions. Examples are limited to analytic studies.
3	Specifying and developing an experimental Proof of Concept (PoC): Active R&D is initiated. This includes analytical studies and laboratory studies to physically validate the analytical predictions of separate elements of the technology. Examples include components that are not yet integrated or representative
4	PoC demonstrated in test site/initial evaluation of costs and efficiency produced: Basic technological components are integrated to establish that they will work together. This is relatively “low fidelity” compared with the eventual system. Examples include integration of “ad hoc” hardware in the laboratory.
5	Technology/process validated in relevant environment: Fidelity of breadboard technology increases significantly. The basic technological components are integrated with reasonably realistic supporting elements so they can be tested in a simulated environment. Examples include “high-fidelity” laboratory integration of components.
6	Technology/process validated in operational environment: Representative model or prototype system, which is well beyond that of TRL 5, is tested in a relevant environment. Represents a major step up in a technology's demonstrated readiness. Examples include testing a prototype in a high-fidelity laboratory environment or in a simulated operational environment.
7	System complete and qualified: Prototype near or at planned operational system. Represents a major step up from TRL 6 by requiring demonstration of an actual system prototype in an operational environment (e.g., in an aircraft, in a vehicle, or in space).
8	Product/technology in manufacture/process being implemented: Technology has been proven to work in its final form and under expected conditions. In almost all cases, this TRL represents the end of true system development. Examples include developmental test and evaluation (DT&E) of the system in its intended weapon system to determine if it meets design specifications.
9	Product/service on commercial release/process deployed: Actual application of the technology in its final form and under mission conditions, such as those encountered in operational test and evaluation (OT&E). Examples include using the system under operational mission conditions.
10	Dead end and reached.