SP Energy Networks

Energy Innovation Forum

Predict4Resilience

Creating a Trusted Fault Prediction Solution

09/2025

Contacts

SP Energy Networks

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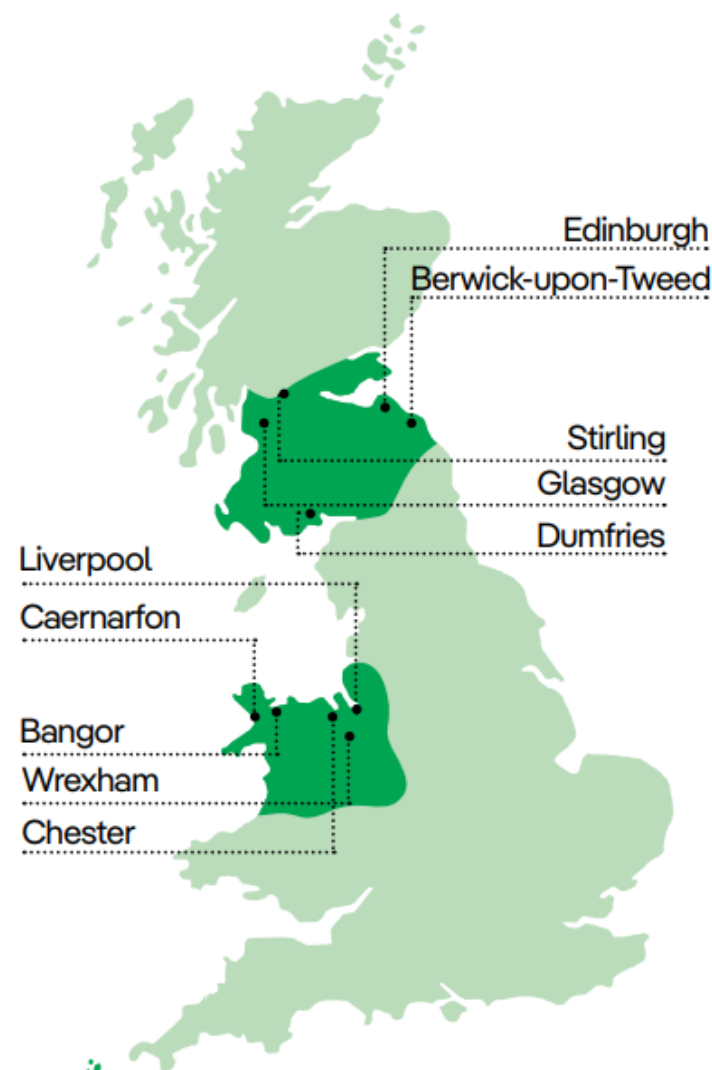pmomeni@spenergynetworks.co.uk

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About us

We are SP Energy Networks. As a Distribution and Transmission Network Operator we keep electricity flowing to homes and businesses throughout Central and Southern Scotland, North Wales, Merseyside, Cheshire and North Shropshire.

We do this through the network of Overhead Lines and Underground Cables which we own and maintain. No matter who you pay your bill to, we're the people to contact if you have a power cut, need a new or upgraded power connection or spot an issue with our equipment.

Our three regulated electricity businesses are:

•SP Transmission PLC (SPT)

•SP Distribution PLC (SPD)

•SP Manweb PLC (SPM)

Edinburgh
Berwick-upon-Tweed
Stirling
Glasgow
Dumfries
Liverpool
Caernarfon
Bangor
Wrexham
Chester

3.5 million
Our Distribution network serves 3.5 million business and domestic customers

105,000km
Our electricity network contains 40,000km of overhead lines and 65,000km of underground cables

30%
To date, we have connected 30% of all the wind power generated in the UK

Project Background

Background

Storm Arwen

On November 26-27, 2021, Storm Arwen brought severe weather with 98 mph winds to the UK, causing approximately 9,700 faults and leaving over 1 million customers without power.

Public Review

Due to the widespread disruption, Distribution Network Operators (DNOs) were reviewed by Ofgem and BEIS through the Energy Emergencies Executive Committee (E3C).

DNOs' Commitment

DNOs have committed to enhancing their preparedness, resilience, and customer support to respond even more effectively to severe weather events.

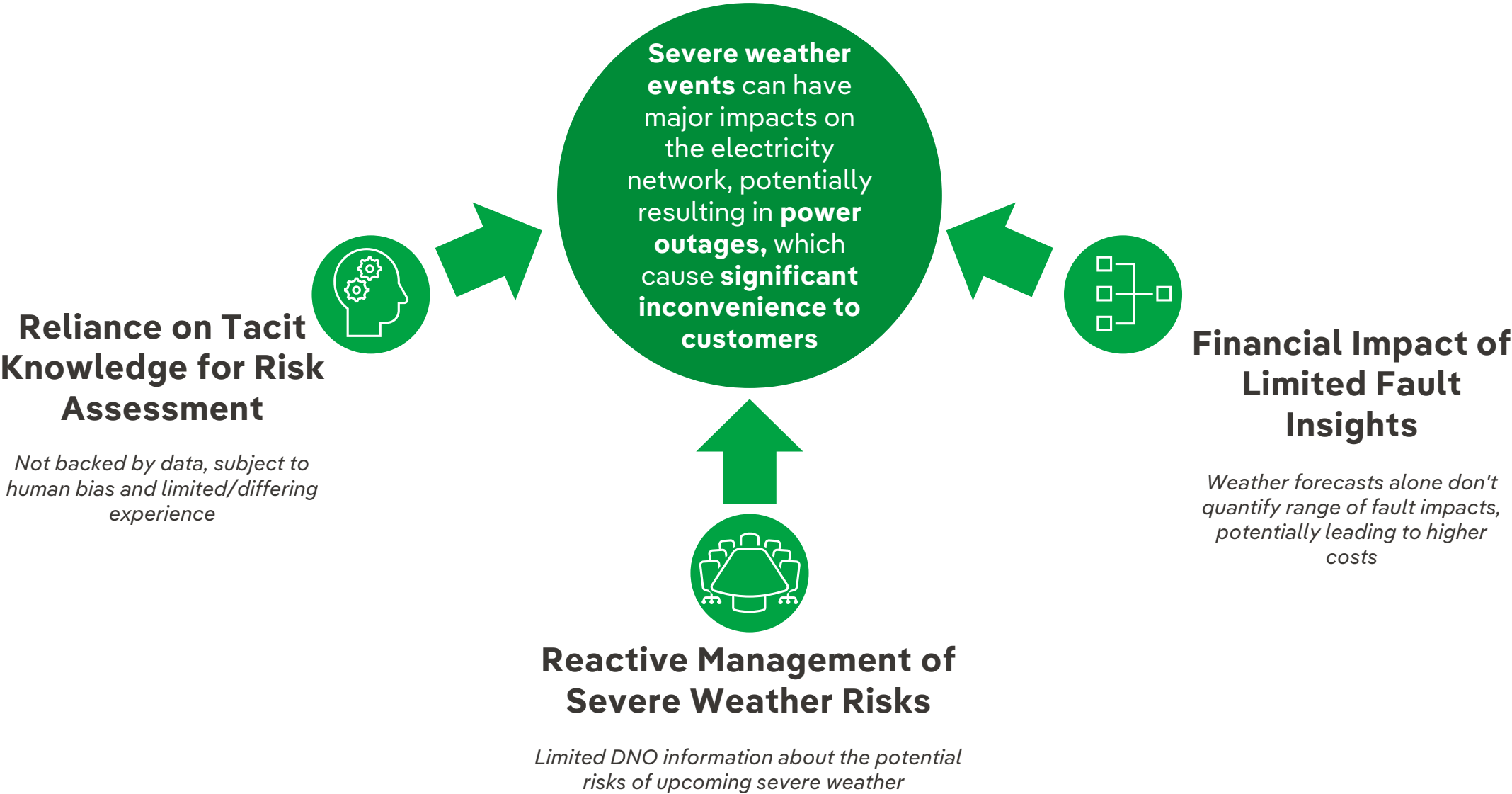## Predict-4-Resilience

2022: Discovery

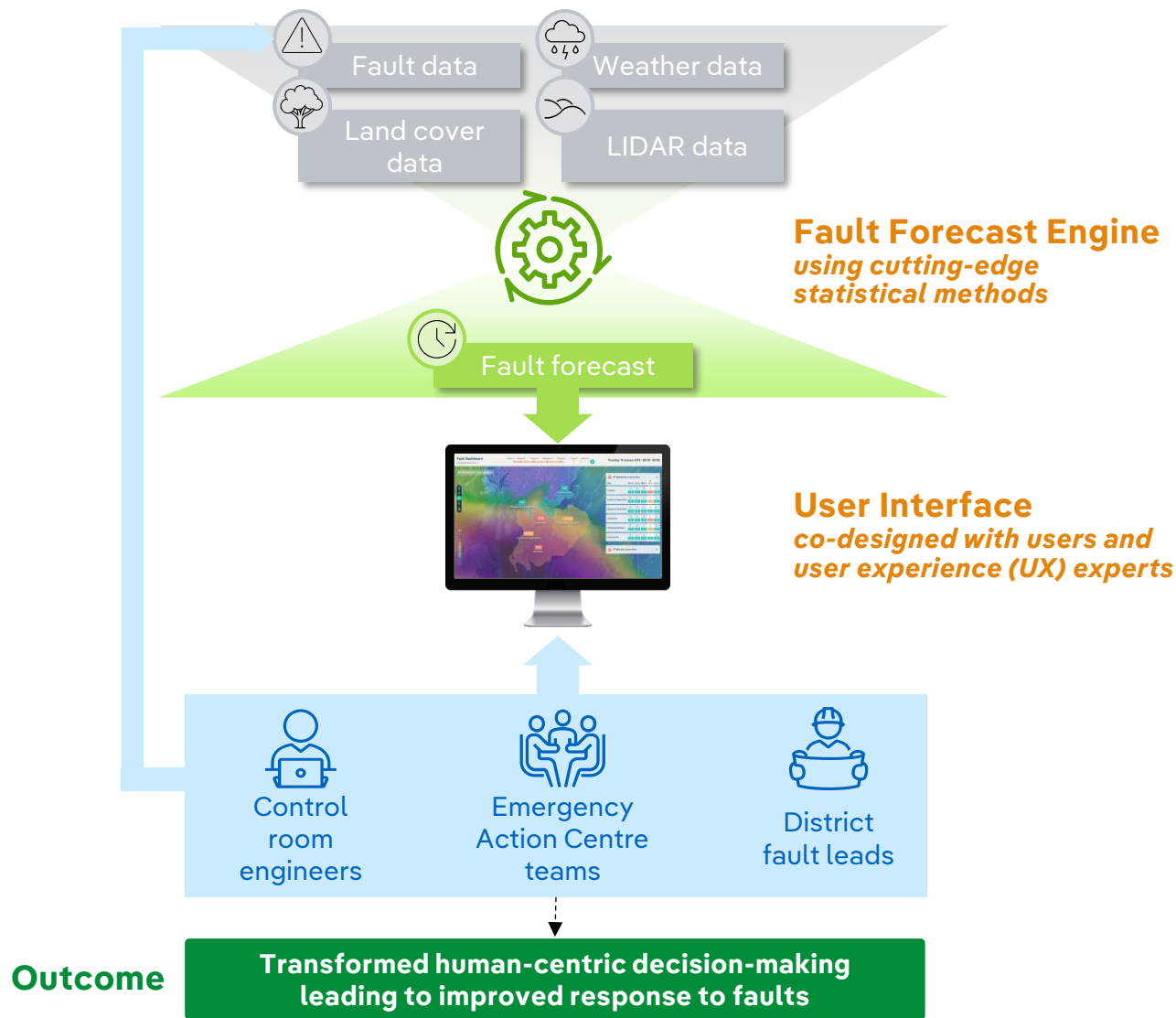Initial analysis and survey of existing practice and available tools. Potential benefits identified.

2022-23: Alpha

Proof-of-concept developed, and desk-based studies verify potential skill of fault forecasts. Business case developed.
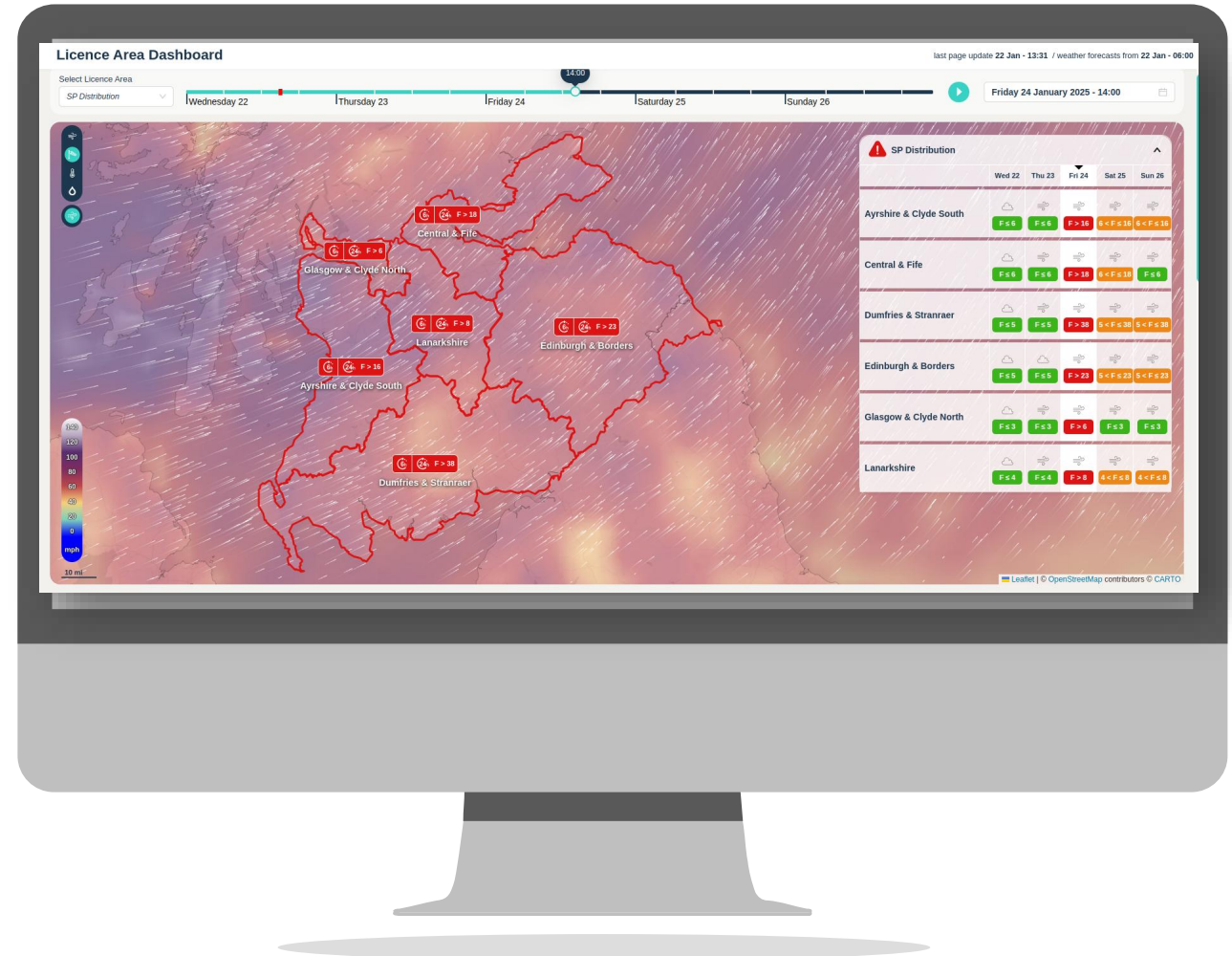
2023-27: Beta

Fault forecasting methodology has been productionised and live trials are under way. Enhancements continue to be developed and rolled out to trial participants. Commercialisation strategy under development.
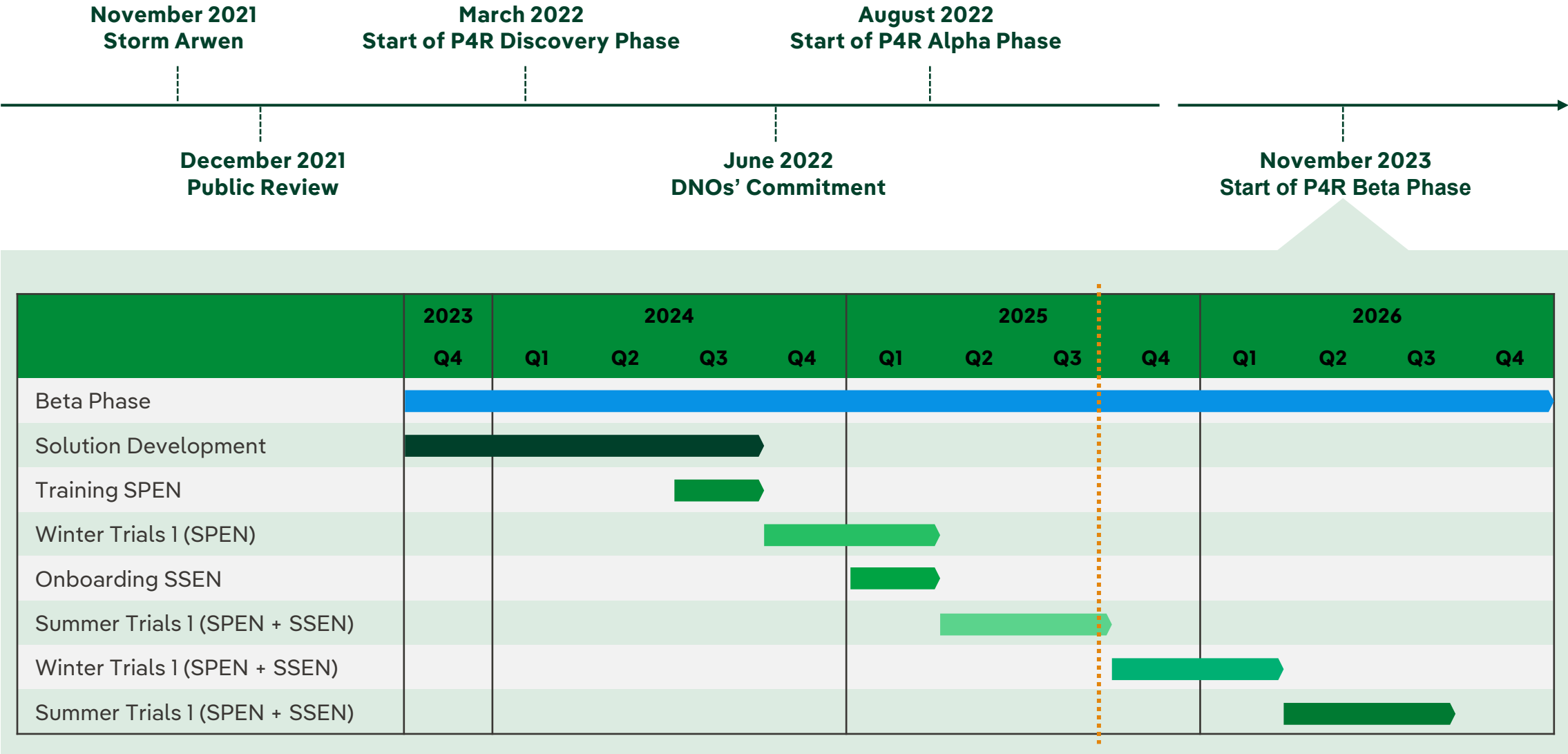
Problem Statement

Severe weather events can have major impacts on the electricity network, potentially resulting in **power outages,** which cause **significant inconvenience to customers**

Reliance on Tacit Knowledge for Risk Assessment

Not backed by data, subject to human bias and limited/differing experience

Financial Impact of Limited Fault Insights

Weather forecasts alone don't quantify range of fault impacts, potentially leading to higher costs

Reactive Management of Severe Weather Risks

Limited DNO information about the potential risks of upcoming severe weather

P4R as a Solution

Fault Forecast Engine
using cutting-edge statistical methods

Fault data
Weather data
Land cover data
LIDAR data

Fault forecast

User Interface
co-designed with users and user experience (UX) experts

Control room engineers

Emergency Action Centre teams

District fault leads

Outcome

Transformed human-centric decision-making leading to improved response to faults

The User Interface

Interactive user interface with features designed for ease-of-use and options to deep-dive into forecast information:

- Map view displaying five-day weather and fault forecast for all districts in a licence area (right)

- District dashboard displaying detailed forecast at 24h and 6h resolution

- Event library and matching to compare and "replay" historic events

- Resource calculator to support allocation of staff and equipment

Project Progress & Results

Project Progress

November 2021
Storm Arwen

March 2022
Start of P4R Discovery Phase

August 2022
Start of P4R Alpha Phase

December 2021
Public Review

June 2022
DNOs' Commitment

November 2023
Start of P4R Beta Phase

	2023	2024				2025				2026			
	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Beta Phase													
Solution Development													
Training SPEN													
Winter Trials 1 (SPEN)													
Onboarding SSEN													
Summer Trials 1 (SPEN + SSEN)													
Winter Trials 1 (SPEN + SSEN)													
Summer Trials 1 (SPEN + SSEN)													

Winter Trial Results

Forecast Performance Study

- Evaluated on a **six-month trial** (Oct 2024 - Mar 2025).
- **Fault forecasts and categorical prediction** (RAG) assessed for calibration and sharpness.
- Limitations:
  - Few critical events
  - Pre-upgrade version

Study Results

- **Satisfactory calibration** for the number of fault forecasts.
- **Satisfactory performance in the display of warnings** (RAG).
- **Some Red misses** (especially post-Eowyn) likely due to delayed fault reporting, not model error

Key Highlights

1. **Early and accurate event detection** – P4R provided earlier situational awareness than official forecasts.
2. **Better resource management and collaboration** – Enabled more effective allocation and cross-district coordination.
3. **From weather data to confident decisions** – Translated forecasts into actionable insights, reducing reliance on individual judgment.

Early and Accurate Event Detection

SIA / Scottish & Southern Electricity Networks / University of Glasgow / SP Energy Networks
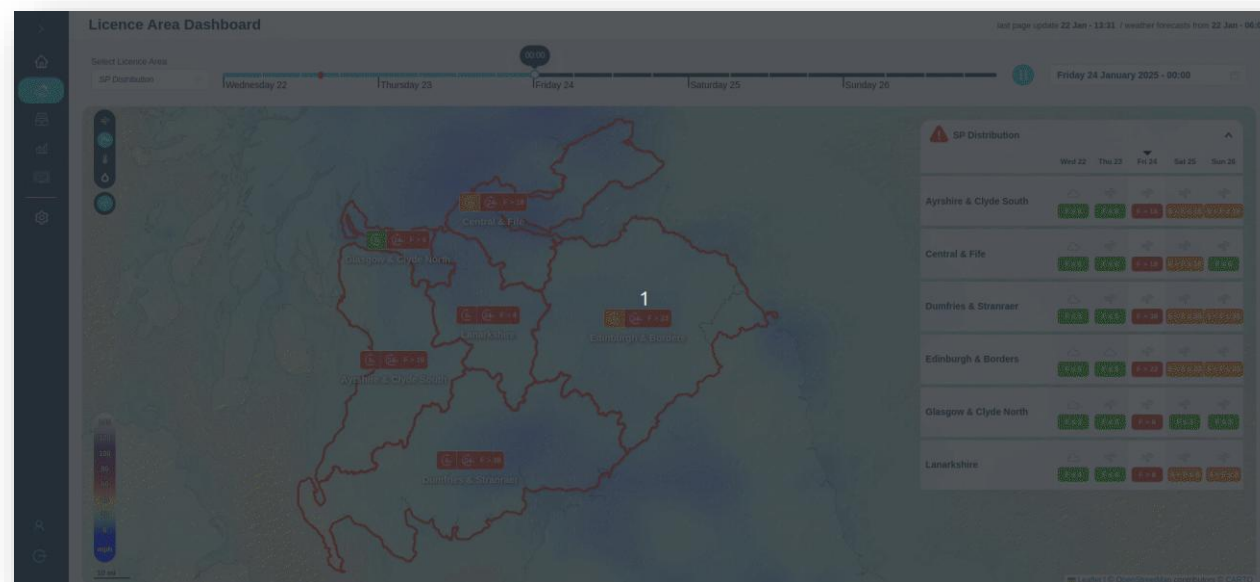
P4R provides insights on the scale of impact, sometimes earlier than weather warnings, providing earlier situational awareness.

Case Study: Storm Eowyn

Met Office

Timeline:

- January 20th — National Severe Weather Warning
- January 21st — Naming Storm Eowyn
- January 22nd — Amber Warning
- January 23rd — Red Warnings
- January 24th — Storm Eowyn Recorded
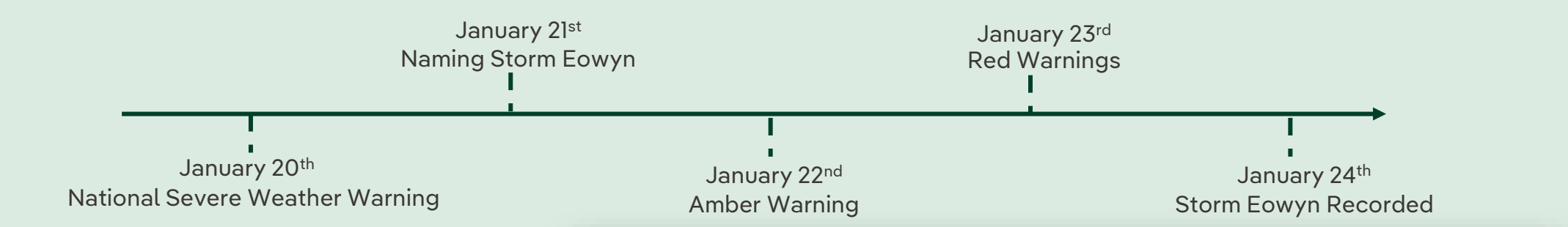
Predict-4-Resilience

Monday 20 January: P4R issued a forecast (four days before Storm Eowyn)
- Red warnings in five districts
- Amber warnings in all other districts
- 1 day earlier than Met Office's Initial Amber Warning

Tuesday 21 January: P4R forecasted: Red events with high probability in all districts except Merseyside

Outcome: All districts except Merseyside did indeed experience a Red event

Licence Area Dashboard

Better Resources Management
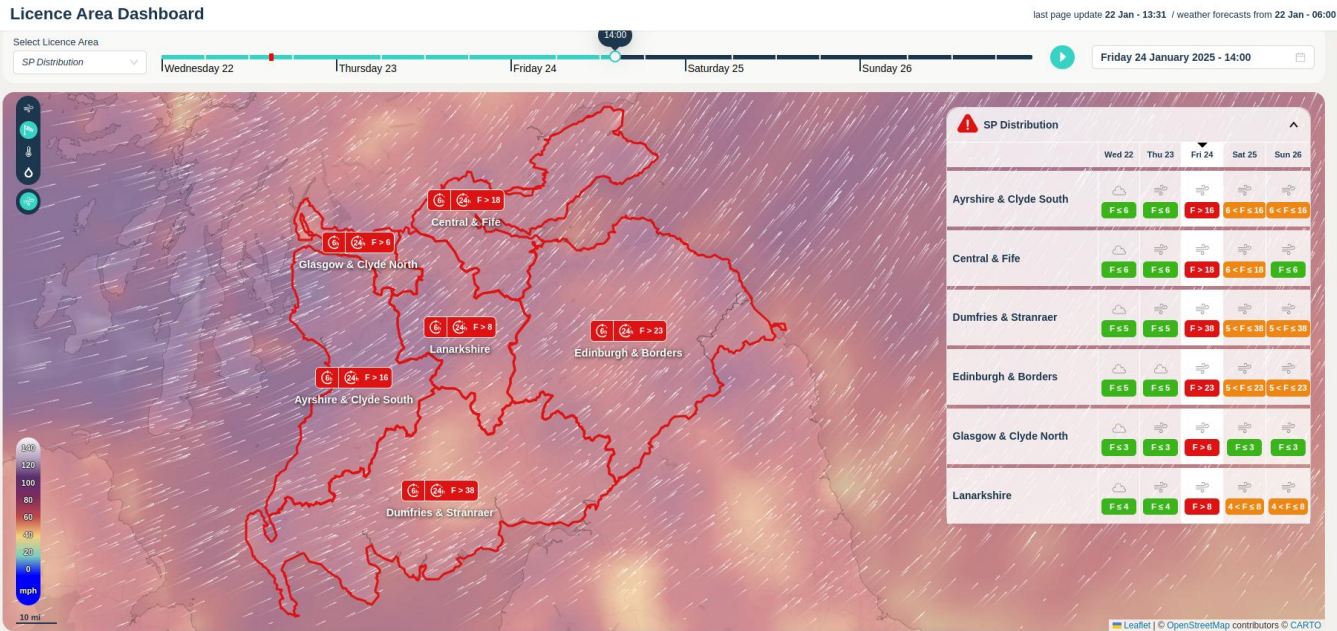
P4R enables smarter allocation of resources and strengthens cross-district collaboration, especially during amber situations.

Case Study: Unnamed Storm Feb 2025

Event
- Severe weather on Feb 21 & 23 (not a named storm)
- 81 network faults in SPD over three days

Forecast Performance
- Amber risks signaled **4 days ahead**
- Forecasts accurately showed:
  - Faults on **Feb 21 & 23**
  - No significant issues on **Feb 22**
- 6-hour forecasts pinpointed **timing of Sunday faults**

Impact
- Staff scheduling optimised (work Friday, rest Saturday, return mid-Sunday)
- Clear example of P4R's value in **busy but non-exceptional events**

From Weather Data to Fault Forecasts

By translating weather information into fault forecasts, P4R turns raw data into actionable insights, reducing reliance on individual judgment and enabling more confident decision-making.

Case Study: Unnamed Event Aug 2025

Event

- August 30/31st 2025 – routine weekend

- Potential weather risk flagged by weather operator

Forecast Performance

- Weather suggested risk in 4 districts

- P4R indicated **Green** with no sign of faults expected over the weekend

- No issues occurred in those districts

Impact

- Decision made not to put staff on call

- No issues occurred in those districts

- Multiple ££k saved by avoiding unnecessary standby costs

Benefits

1. Direct Financial Benefits

Savings to networks through improving performance against **Customer Minutes Lost** incentive scheme and reducing compensation payments to customers for failing to meet a **Guaranteed Standard of Service.**

2. Network Avoided Costs

Network savings through avoidance of costs that it would have otherwise incurred as part of **Storm Support**.

4. Social Benefits

A reduction in **stress** for vulnerable customers and minimising the **inconvenience** of a disruption in power supply to all customers.
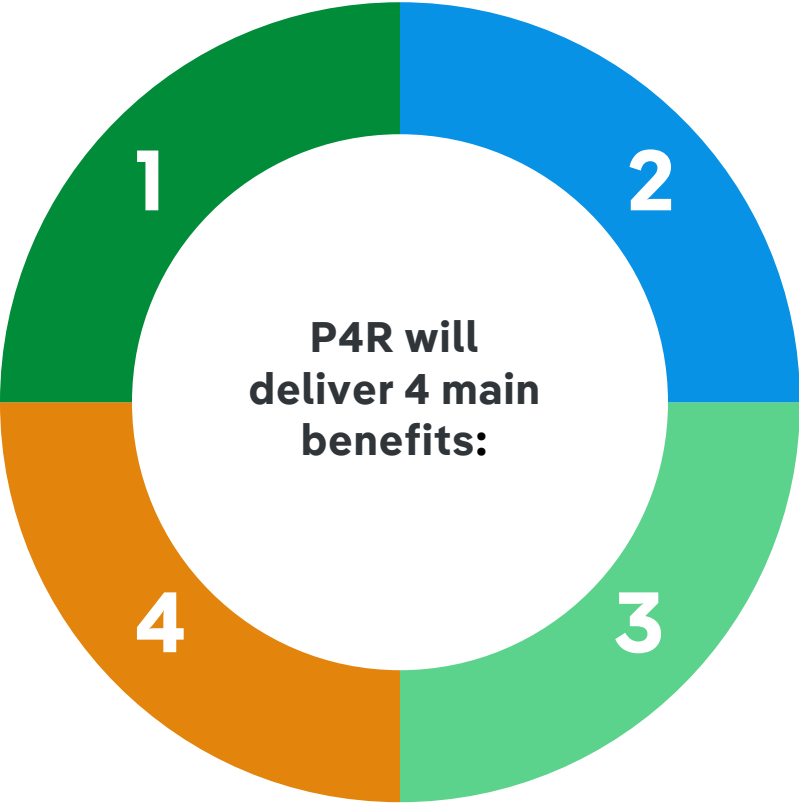
3. Environmental Benefits

A reduction in **CO_2 emissions** and an improvement in air quality.

P4R will deliver 4 main benefits:

1

2

3

4

15

Next Steps

Next Steps

1 | **Phase 1: Completion of Trials** | • Improving and finalising models and User Interface according to observations and feedback collected during the Trials
• Scheduled for Q3 2026

2 | **Phase 2: Full Deployment at SPEN and SSEN** | • P4R fully integrated (BAU) at SPEN and SSEN
• Solution embedded in the control room to inform decisions.
• Solution deployed to the rest of SPEN and SSEN
• Scheduled for Q4 2026

3 | **Phase 3: National and International Expansion** | • Expansion to GB DNOs first - scheduled Q4 2026 – Q4 2028
• Expansion to international DNOs to start in Q4 2024

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Questions?