Electricity Transmission

Framework for Risk Analysis and Modelling of Events

(FRAME)

Presenters

Aisha Ali
Innovation Engineer

Net Zero Innovation Team

NGET

nationalgrid

Contents

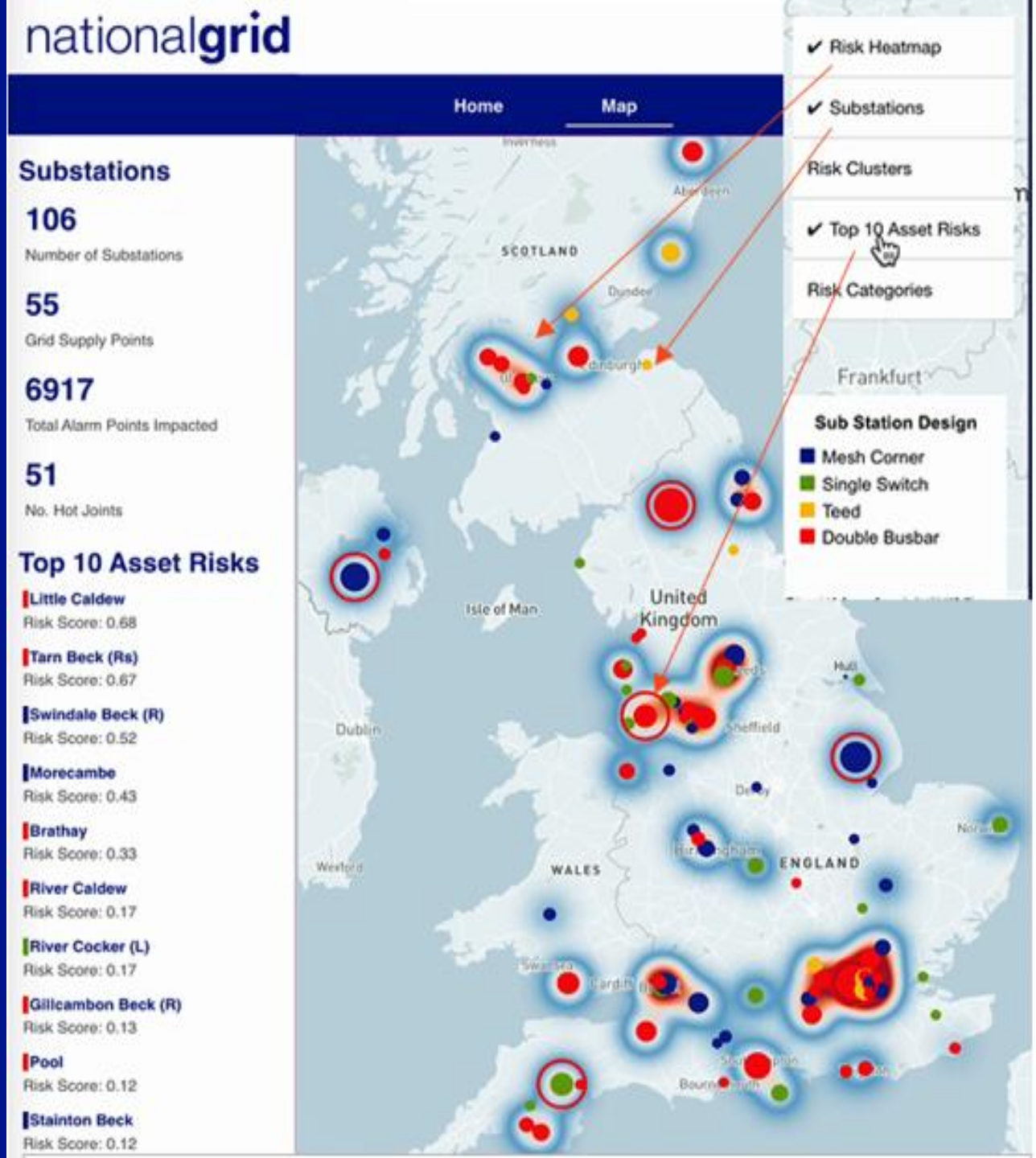
FRAME

- Electricity demand is rising, networks are more interconnected, and extreme weather is increasing.
- Ofgem's RIIO-3 framework pushes for proactive, data-driven asset risk management.
- NGET identified the need for a unified system to track events, asset health, and substation resilience.
- Current tools are fragmented across multiple data sources, limiting visibility of true network risk.
- This fragmentation slows decision-making during storms or major national events.
- Result: higher chance of missed risks, inefficient maintenance, and avoidable operational issues.

Fund : Network Innovation Allowance (NIA)
Duration : 12 Months

Partners

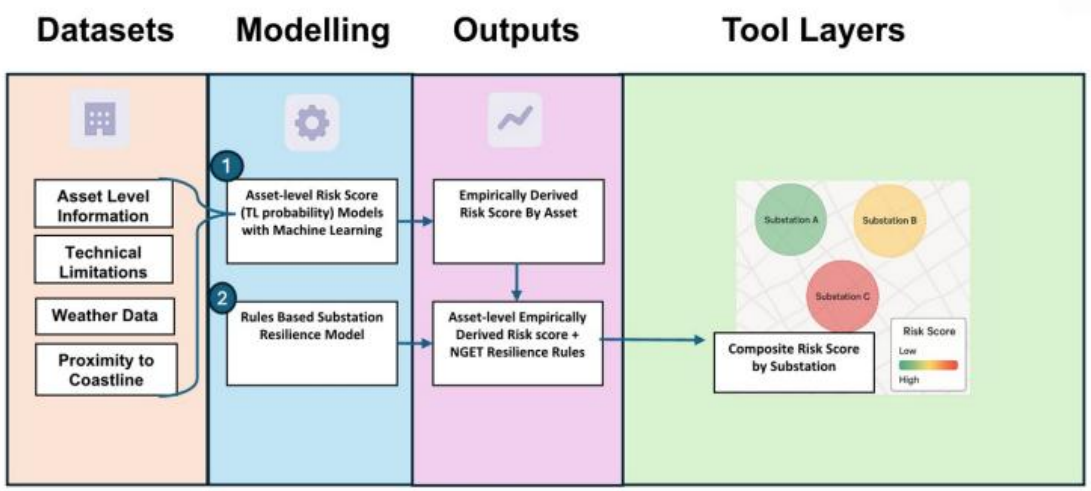
Baringa

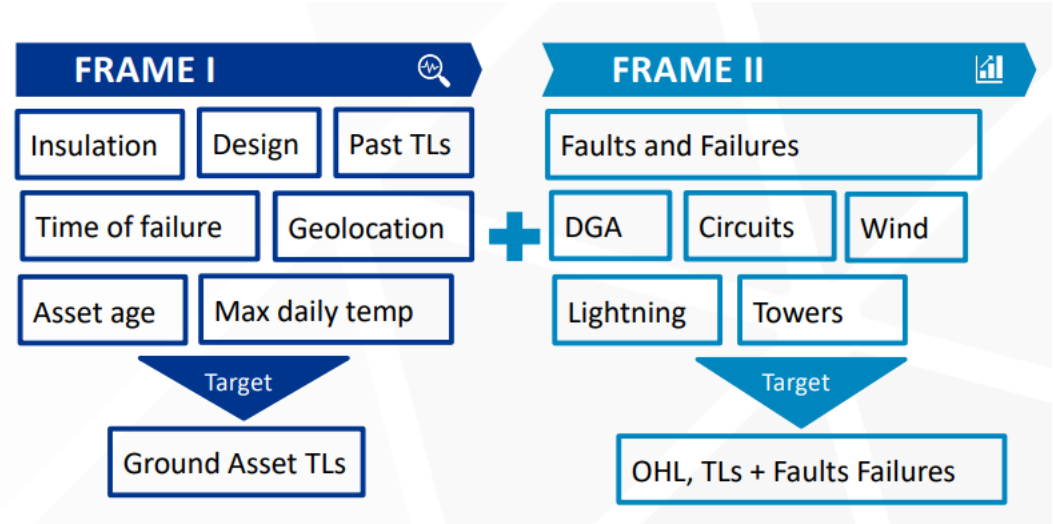


Summary

A mathematical risk modelling and visualisation tool (Proof of Concept) which is capable of interpreting and assessing multiple operational data sources to identify intrinsic risks/issues to operability of the transmission network based on proven systems engineering techniques.

- Geospatial **Resilience Risk Score**.
- AI - identify trends and patterns.
- Different zone/site/national level holistic view.
- Quick identification of a worry list
- Improved decision-making to support CR.

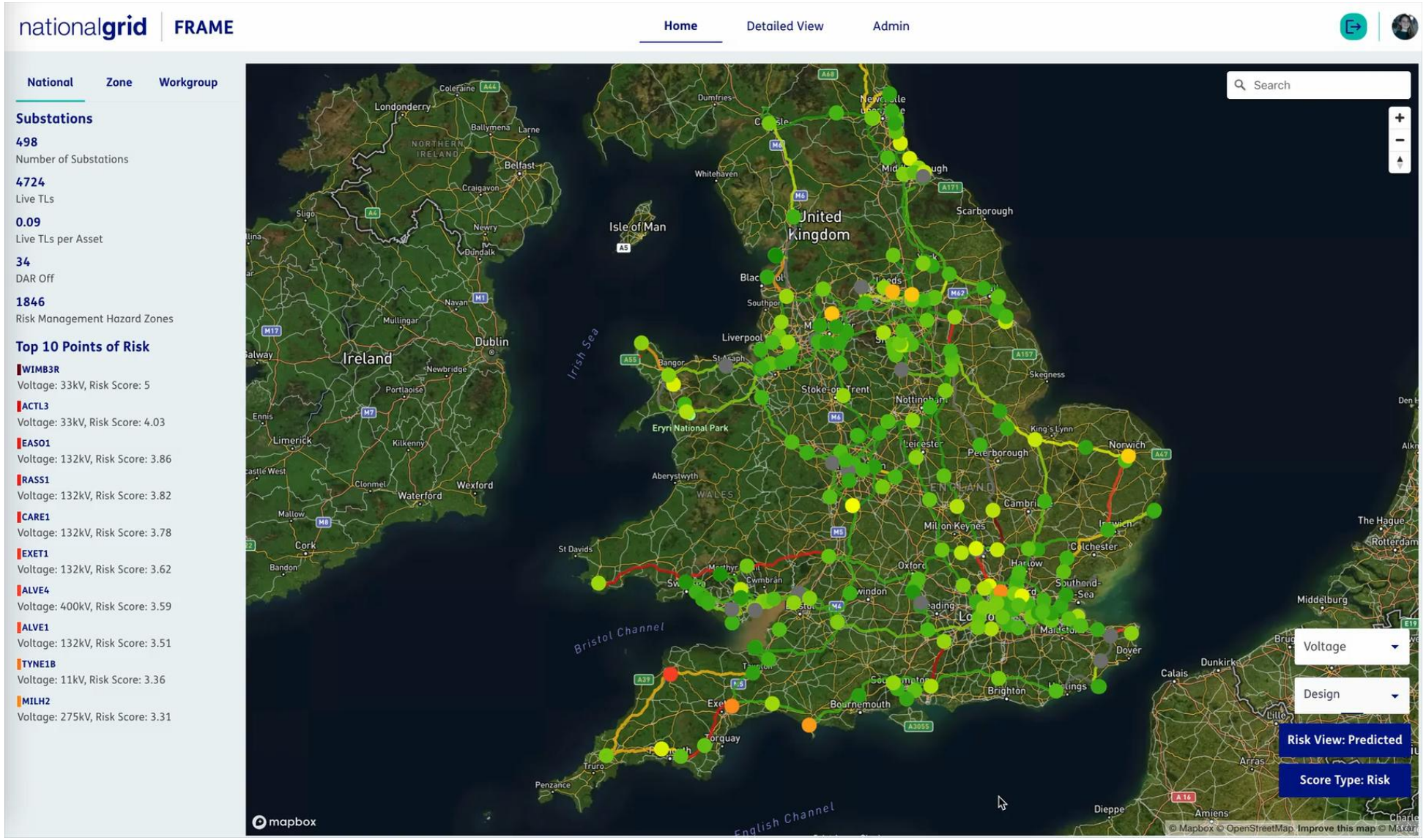




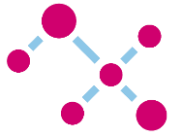
Benefits

Network Resilience (Resilience and Policy Team) and TNCC (Control Room)	AO (Planning & Performance managers, lead ACEs, operational managers):	NOI and AO management
Unified Map View & Real-Time Risk Visualization		
Trend Identification	Issue Identification	Comprehensive Data Source
Resilience Risk Scoring	Justification for Investment	Proactive Storm Response
Collaboration	Optimized Resource Allocation / planned work	Cost Reduction

Demonstration

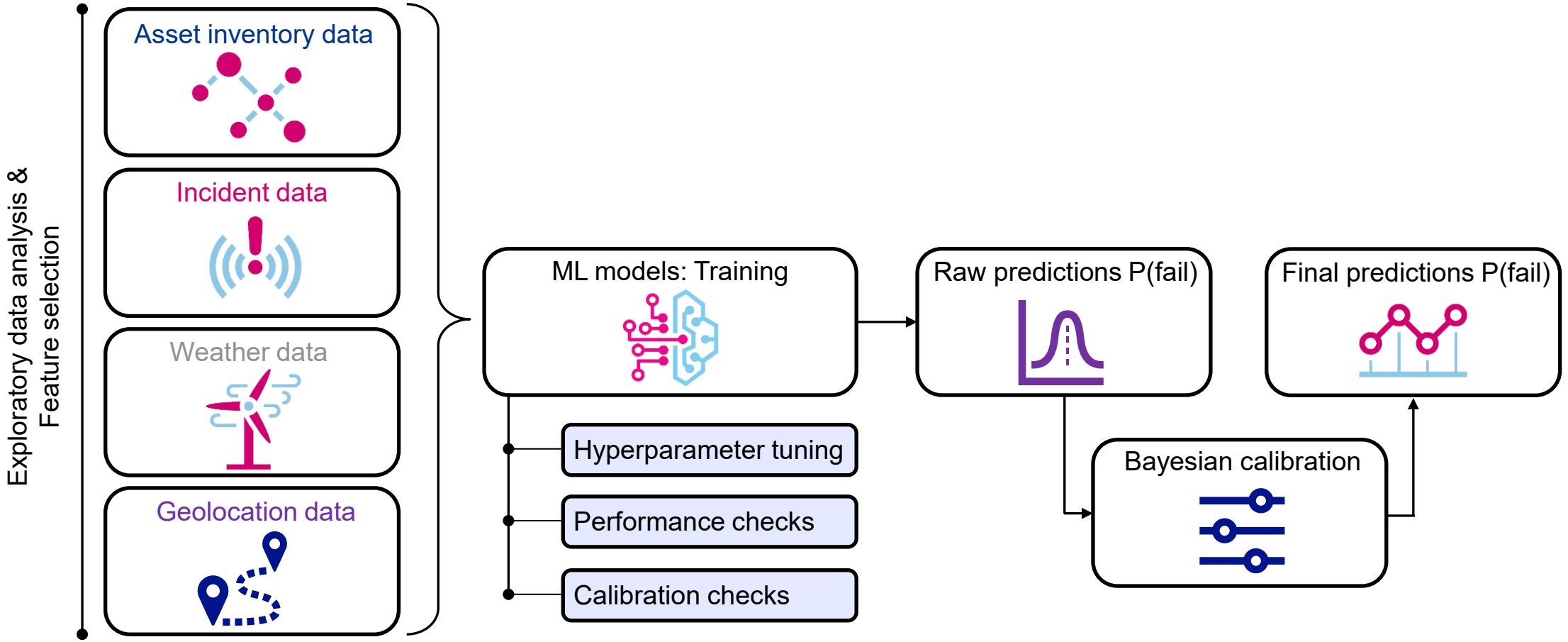


Methodology – Datasets and features explored

Data Type	Ground assets	OHL assets
Asset inventory data 	• Asset type • Age • Manufacturer • Insulation, design	• Conductor type • Age • Length • Line greasing, operating voltage
Incident data 	• Technical limitations, seasonality • Faults & Failures, seasonality • Frequency of historical incidents • Maintenance events	• Faults & Failures, seasonality
Weather data 	• Wind speeds • Rainfall, Snowfall • Temperature • Lightning (CAPE, K-index)	
Geolocation data 	• Latitude, Longitude • Proximity to industrial sites • Level of emissions • Distance to coastline	

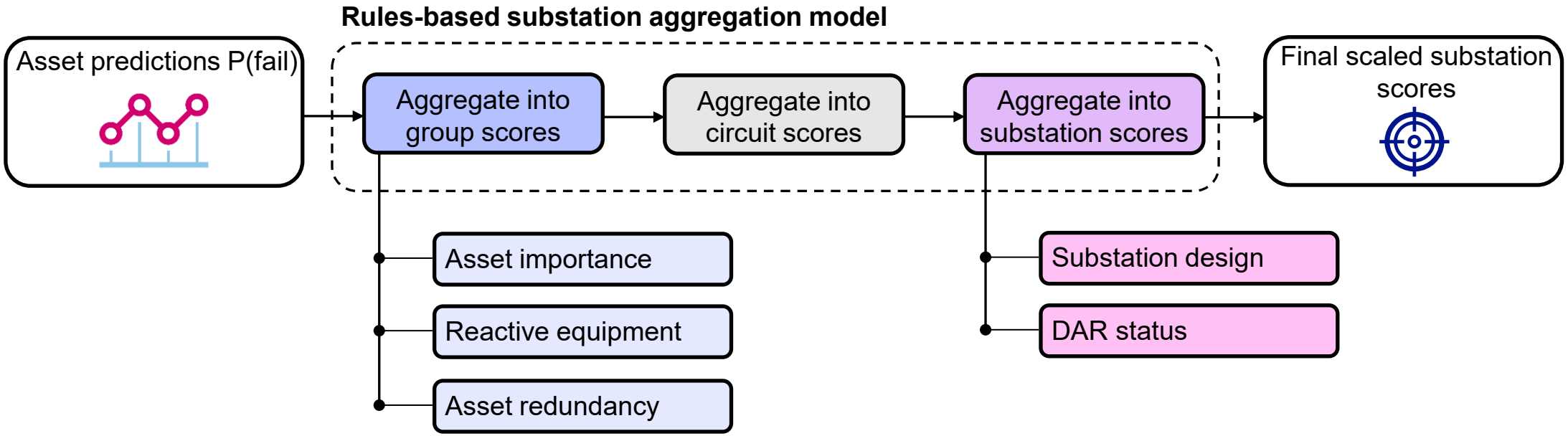
Methodology – Asset risk modelling

***Asset P(fail)*:** ML models (supervised learning) are trained to predict probability of TLs/Faults & Failures across assets. Ground assets and OHL are modelled separately, using distinct binary classifier models. Predictions are generated at monthly granularity for ground assets and at weekly granularity for OHL (more exposure to weather hazards).



Methodology – Substation risk modelling

***Substation risk score*:** Ground assets P(fail) predictions from ML models are aggregated into substation risk scores using a rules-based model, incorporating SME knowledge. The final scaled substation risk scores are bounded between 1-5 (1 corresponding to low risk, and 5 to high risk).



Methodology – Key observations

Notable risk drivers:

- Frequency of past incidents (historic TLs or faults/failures) and asset age for ground assets.
- Lightning risk (CAPE, K-index), wind gust speed, precipitation, conductor length and age for OHL.

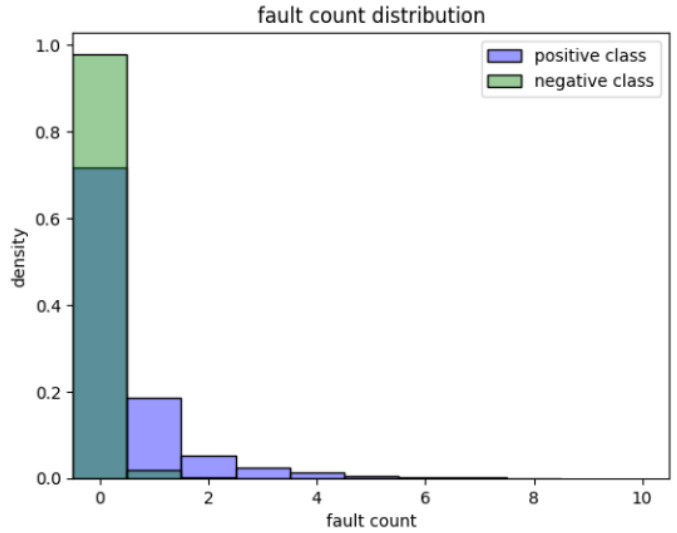


Fig 1 - Positive (fault) and negative (non-fault) histograms vs past number of faults

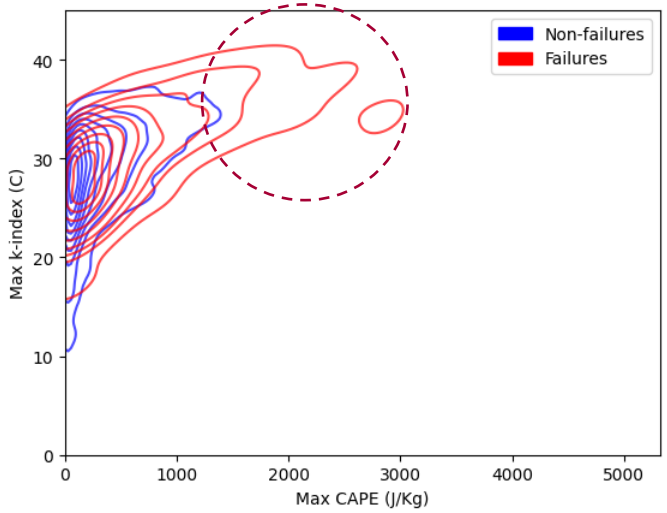


Fig 2 – Bivariate distributions of fault and non-fault OHL vs lightning metrics (CAPE and K-index)

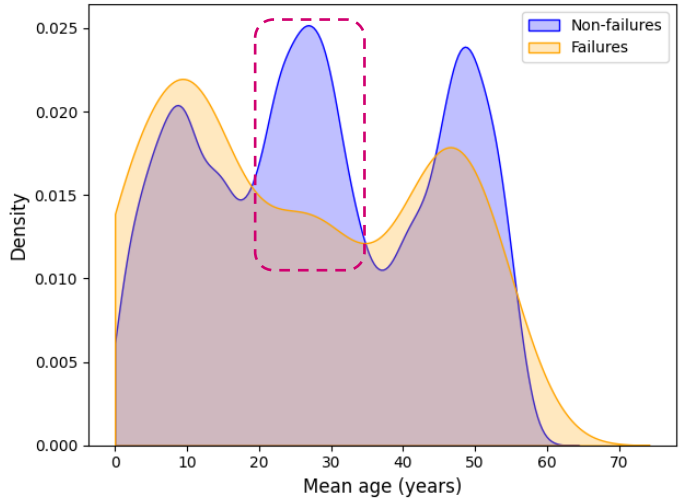


Fig 3 – Distributions of failure and non-failure of OHL vs conductor age (in years)

Modelling challenges/considerations:

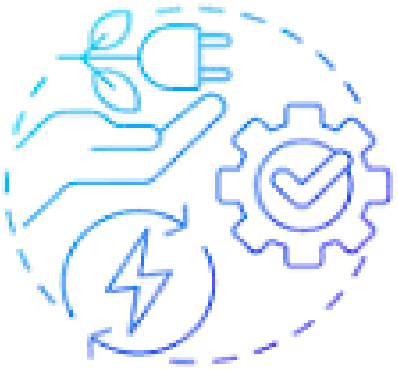
- Extreme class imbalance impacts model training. Re-balancing improves this but impacts precision and increases false-positive rates. Additional Bayesian calibration adjusts predicted P(fail)s to match operational conditions.
- Inclusion of additional asset health features, increased TLs/faults & failures data timespans and maintenance records could improve model performance.

Recap

FRAME

Innovative Solution

Benefits



nationalgrid

Contact : aisha.ali@nationalgrid.com