Probabilistic Pathways for Energy System Planning

Whole system planning for faster and cheaper network transformation

Show and Tell

5th June 2024

ESO

Problem Statement: Increasing complexity, growing uncertainty

'One of National Grid ESO's key responsibilities is planning the UK's future grid infrastructure to assure security, sustainability, and affordability of supply. As the energy transition accelerates, complexity and uncertainty associated with long-term planning and decision-making grows'

- **Increasing complexity** - driven by the transition NESO, which adds the need to co-optimise planning decisions across multiple energy vectors.
- **Growing uncertainty** - driven by the need to make high value decisions based on a range of possible system scenarios.

There is a need to deliver the future **whole energy system** quickly, at **lowest cost** with **risk-based** decision making.

Project Overview

ROUND 3

Challenge 1
Whole system network planning and utilisation to facilitate faster and cheaper network transformation and asset rollout

Theme 1
Digital simulation and advanced modelling techniques to facilitate whole system network planning and development

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- Explore opportunities to develop an enhanced **end-to-end network planning methodology** for the **whole energy system**.
- Identify novel applications of advanced computational techniques to **capture uncertainty** within future energy pathways, enable **rapid iterative** network needs analyses, **risk-based** network options assessments, and deliver **optimised planning decisions**.

User Needs

Scenario Development			Outline Requirements		Generate Solutions	Options Assessment		
Agree pathway framework & assumptions	Demand pathway outputs	Supply pathway outputs	Dispatch model for peak demand	Generate system capability requirements	TO's generate and return proposed solutions	Day ahead dispatch model	Day ahead constrained re-dispatch model	Cost Benefit Analysis

PRIMARY USER

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Soon to be 'NESO'

Responsible for whole energy system planning

- Capture uncertainty in planning process
- Analyse a greater number of scenarios and 'what ifs'
- Optimise decision making across multiple vectors
- Allow for the quantification of risk associated with decisions

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PRIMARY USER

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Soon to be NESO

SECONDARY USERS

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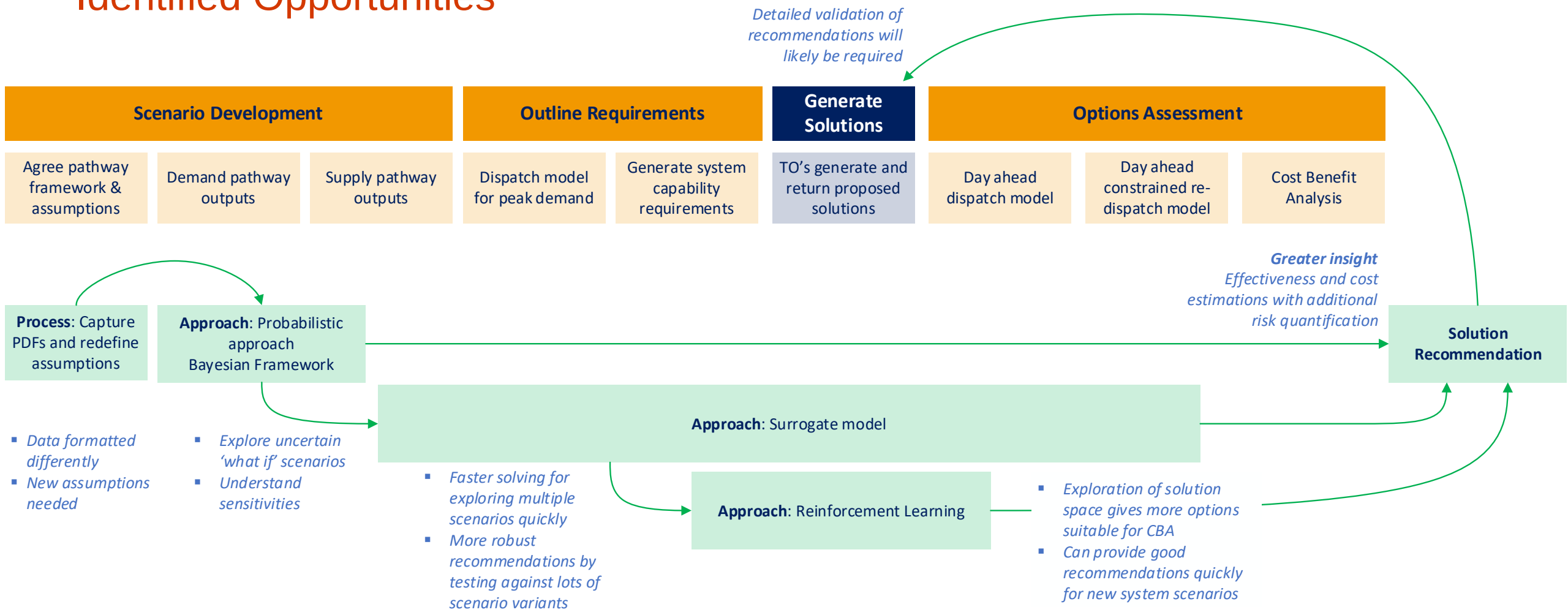
national gas

Department for Energy Security & Net Zero

Identified Opportunities



Our thinking has evolved to realise that while there are many individual challenges and opportunities, there is also a holistic end-to-end solution

Project Activities

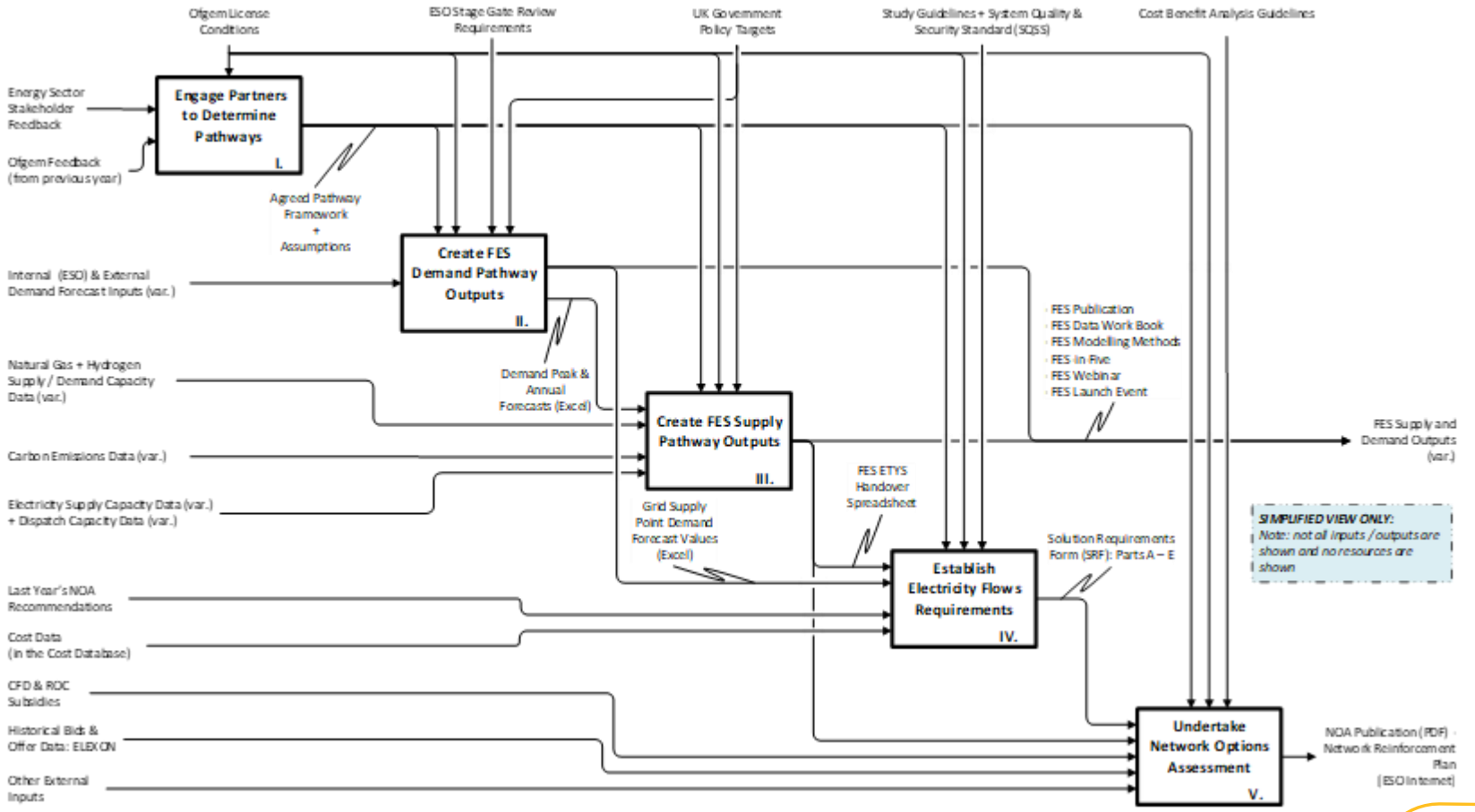
Business Process Modelling

Technique Optioneering

Roadmapping

Business Process Modelling

- Model the end-to-end planning process
- Identify challenges and opportunities



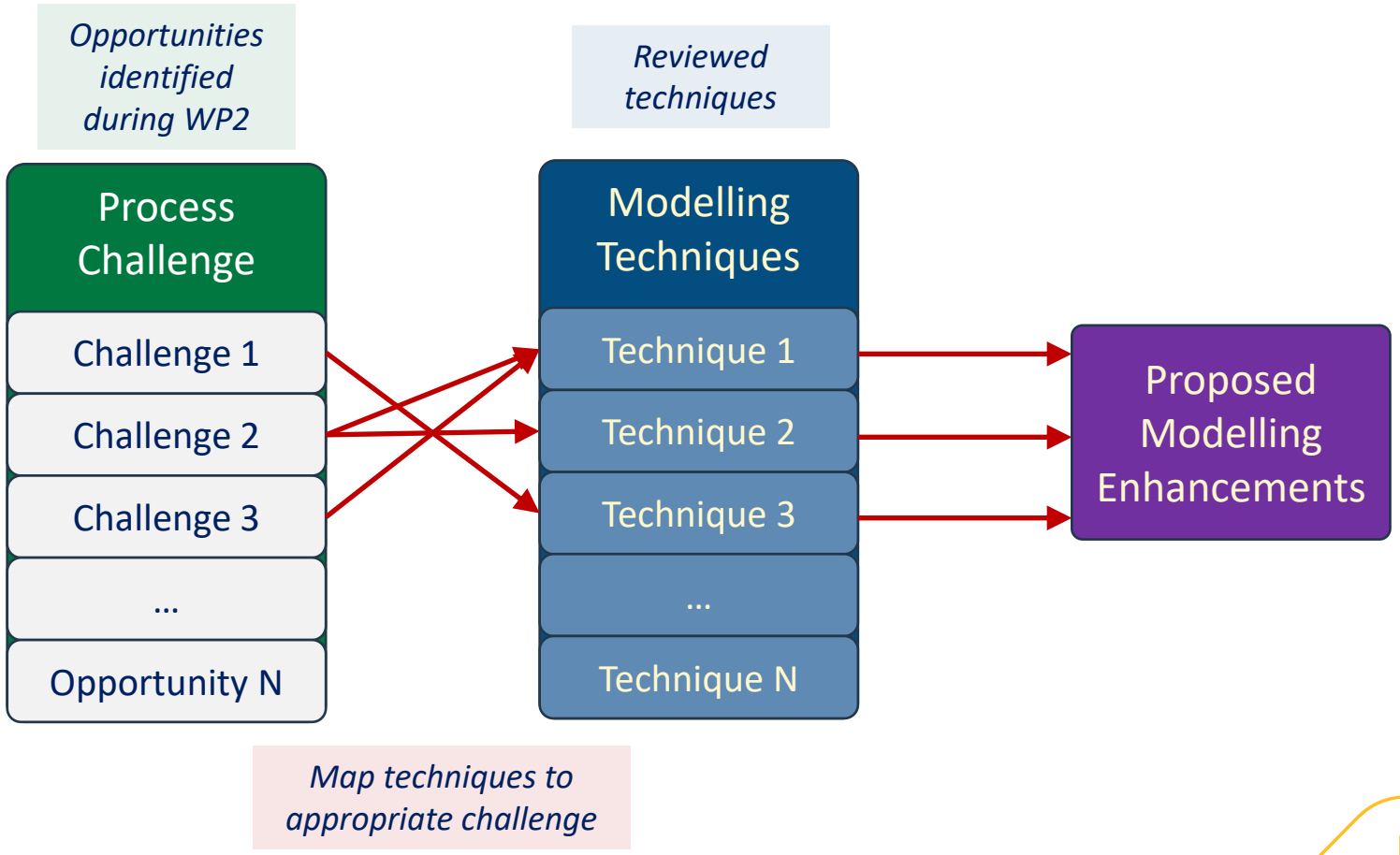
Project Activities

Technique Appraisal
- Review a range of different modelling approaches
- Assess their potential to solve the identified challenges

Business Process Modelling

Technique Optioneering

Roadmapping



Project Activities

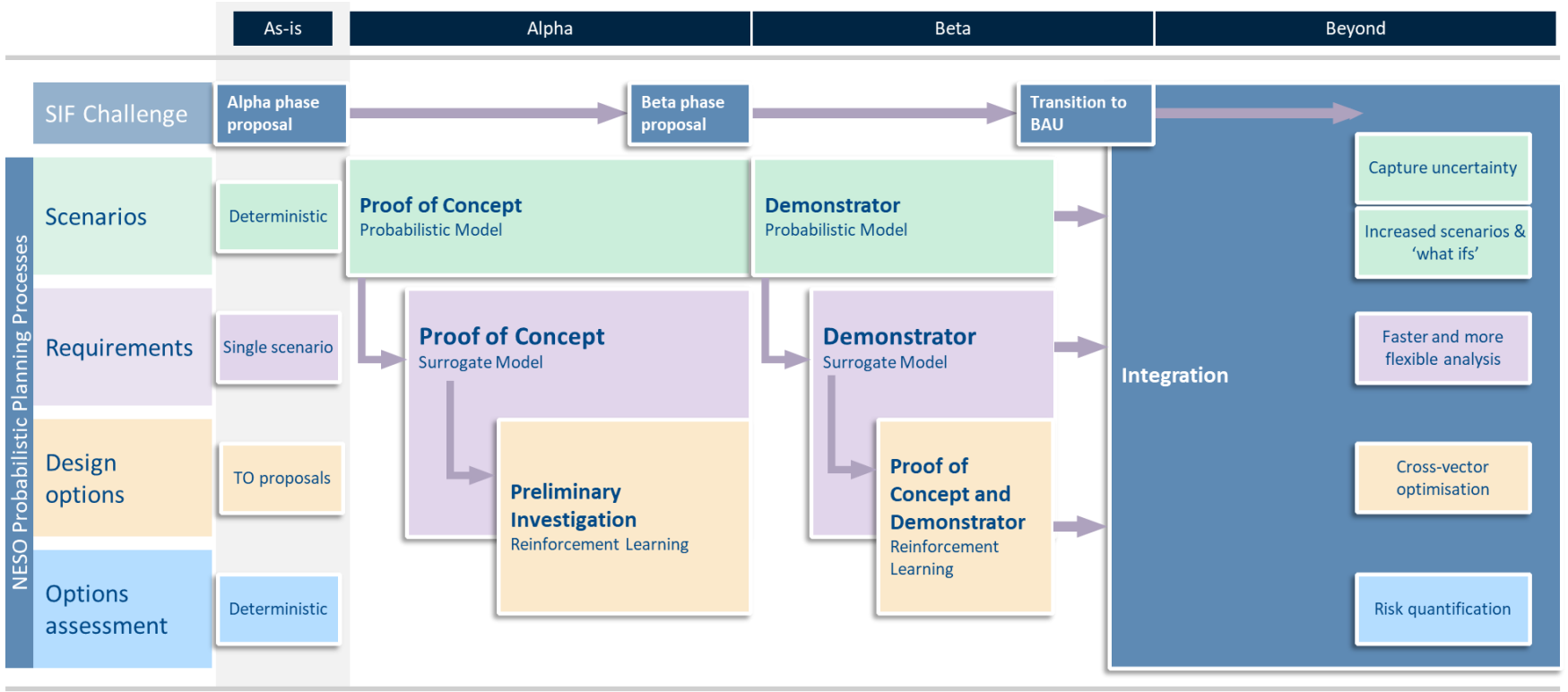
Business Process Modelling

Technique Optioneering

Roadmapping

Roadmapping

- Explore barriers and enabler to deployment of selected approach
- Assess benefits of selected approach
- Develop a roadmap for developing and integrating selected approach



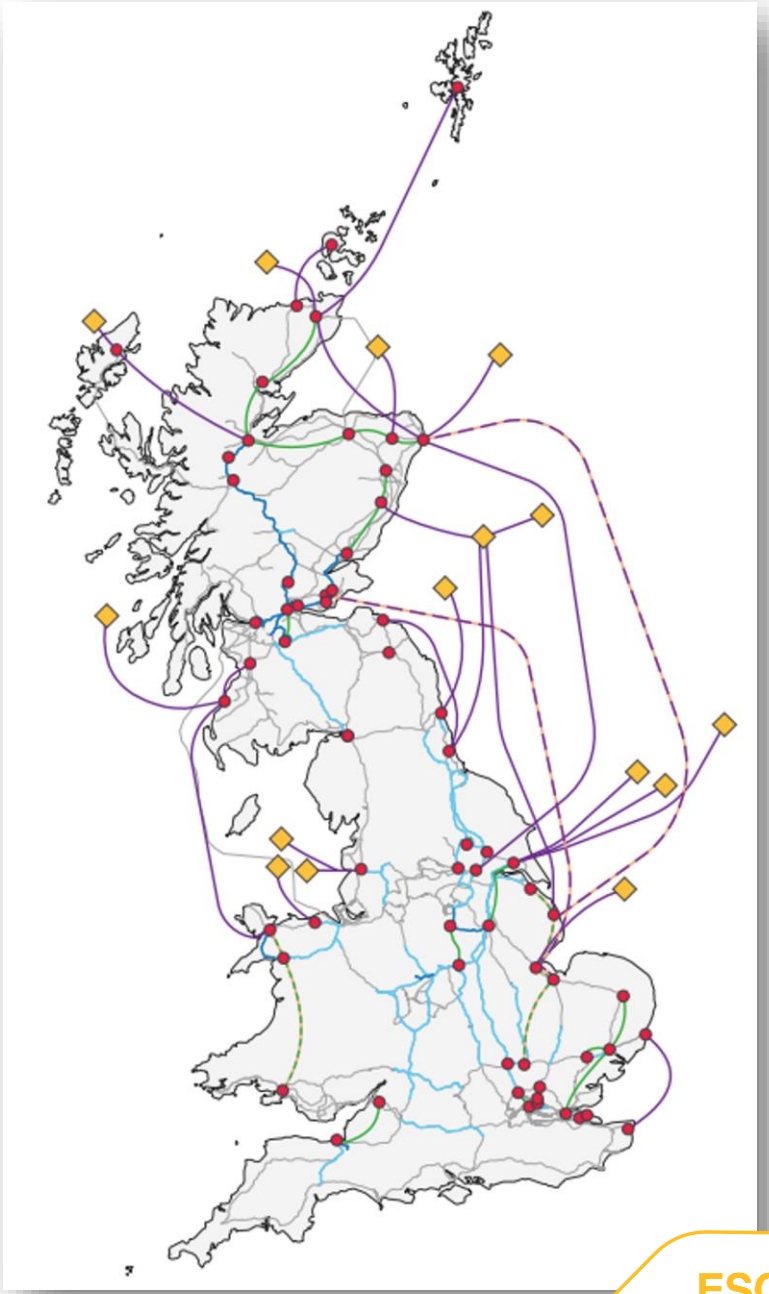
Potential Benefits

The project aims to:

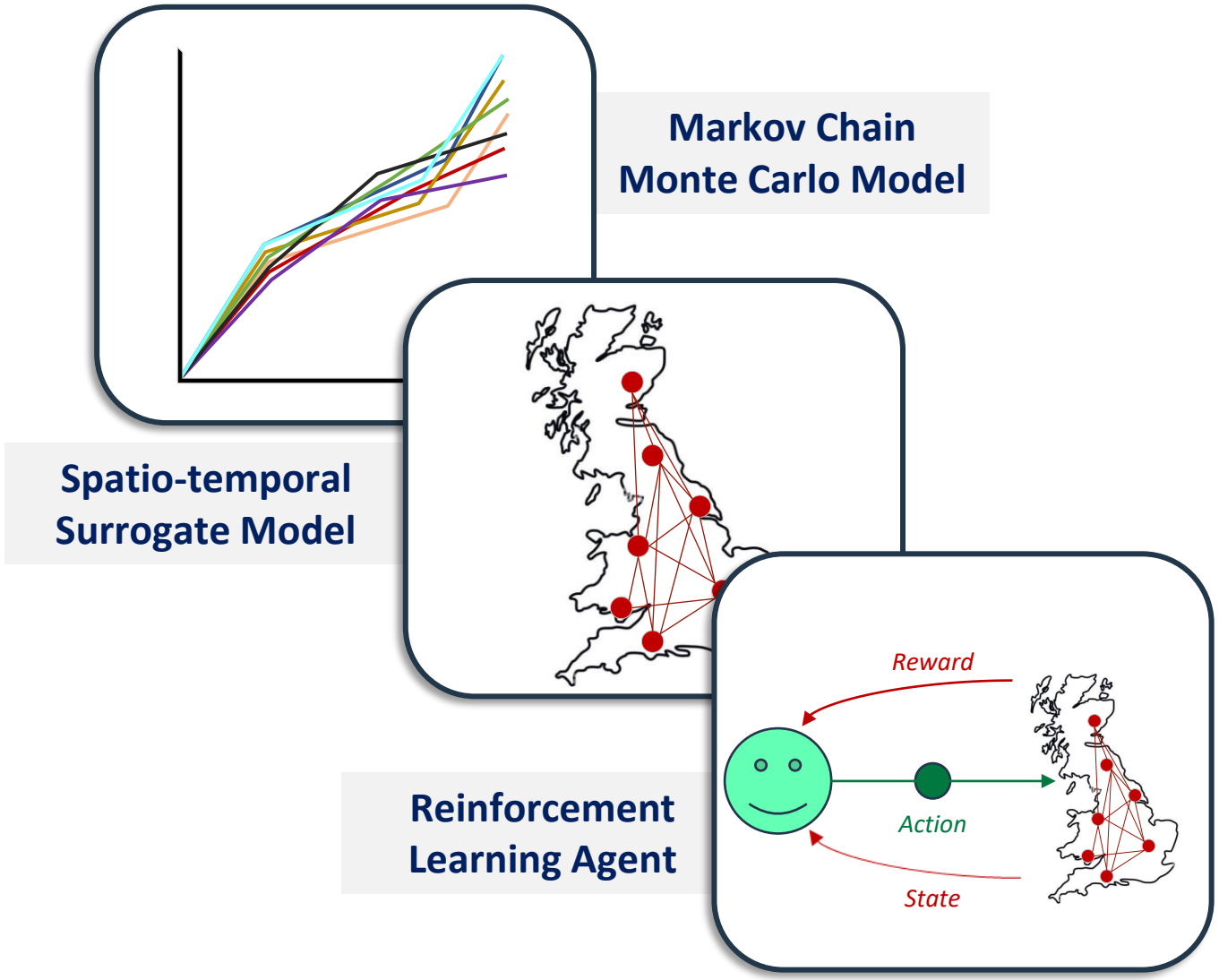
- Add a greater understanding of uncertainties and risk into the network planning process
- Greatly improve the speed of assessing different transition pathways
- Highlight new, cross-vector transformation options that are optimised for a variety of future scenarios

This will lead to:

- **Reduced whole energy system costs:** savings passed on to consumers.
- **Efficient investment decisions:** lower risk decision making to enable least-regret network enhancements.
- **Faster renewable connections:** accelerated transition to net zero energy system.
- **Optimisation across vectors:** enhanced system resilience and security of supply.



Look Ahead



ALPHA *Derisking a future Beta stage*

- Generate probabilistic framework for a single module, as proof of concept.
- Prototype surrogate model for a small region of network.
- Develop detailed requirements for Reinforcement Learning agent.

BETA

- Develop probabilistic capability for demand and supply capacity.
- Generate whole energy system surrogate model.
- Integrate Reinforcement Learning optimisation for decision making enhancement.