



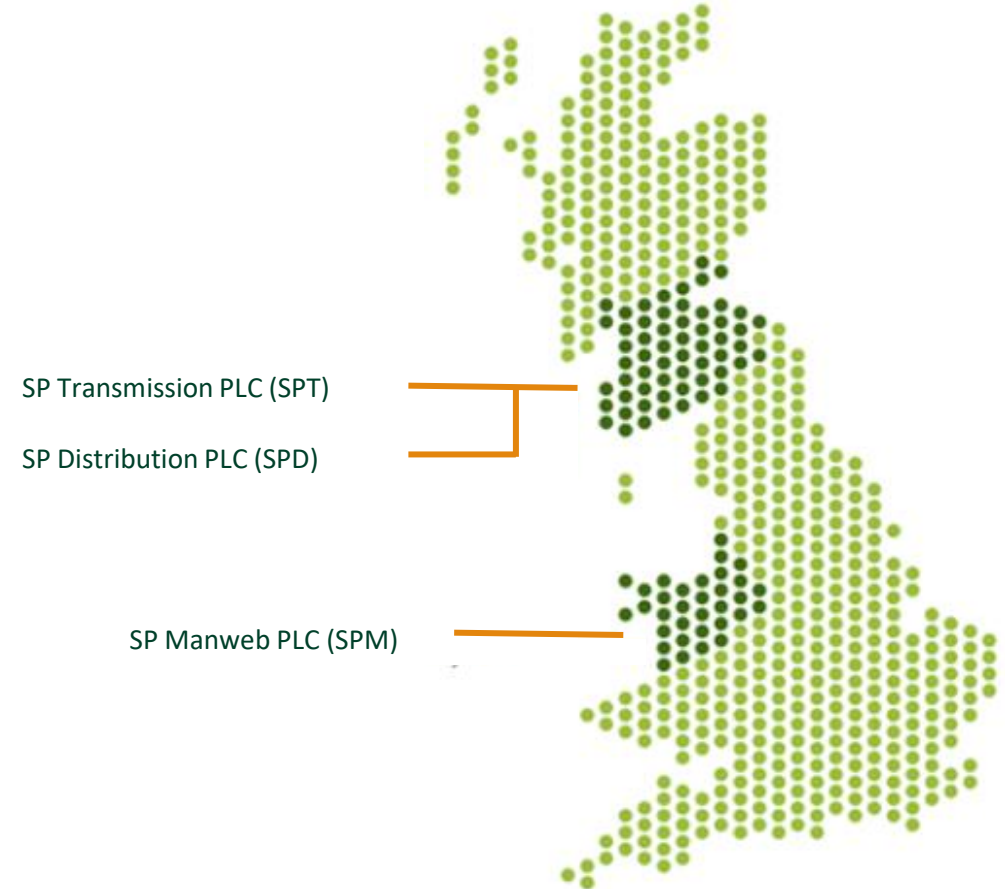
# Resilient and Flexible Multi-Energy Hub Networks for Integrated Green Mobility

Ross Davison – Senior Innovation Engineer

Future Networks



- TNO and DNO for Southern and Central Scotland
- DNO for Merseyside and North Wales
- 44,000km Overhead Lines
- 65,000km Underground Cables
- Over 3000 substations
- A Total of 3.5 Million Customers



## The Future Networks team are delivering our innovation strategy through;

- Industry leading expertise
- Concentrating on creating a positive and lasting impact on the future of distribution and transmission
- Two major fields of focus – black start and power electronics

### **Black Start**

Black Start since 2015

Range of partners

Built expertise and capabilities

### **Power Electronics**

Implementation across voltages on transmission and distribution networks

## VISOR

Greater visibility of network state and assets

## FITNESS

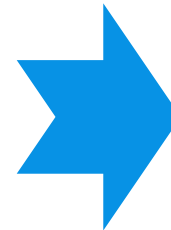
Efficient and effective digital substation

## Distributed Restart

DERs supporting the network and restoring power

## Synthesis

Advanced analytics and real-time control enabling rapid response to system disturbances



**£13.59m** further investment for SPT, estimated **£40m** for other GB Transmission business

**£54m investment** in RII0-2 Business plan - digital substations - Westfield and Hunterston

**£5m Green Recovery Fund: Synergy 2023-SIF:** Black-start from the offshore

## Phoenix

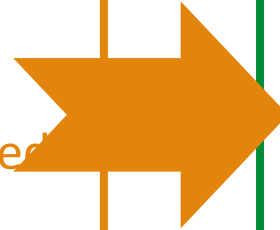
**Synchronous condensers + static compensator technologies - manage reduced inertia and voltage control on Transmission Network.**

## Angle-DC

Medium Voltage DC (MVDC) link to **Anglesey**, increased **renewable generation** integration.

## LV Engine

Trial of innovative **Smart Transformers** for the connection of **LCTs**



**£120m investment in RIIO-2 Business plan - implementation of synchronous condensers at Eccles**

**3 further sites planned to roll out LV Engine Technology within RIIO-ED2**

## Project Overview

### Motivation

- **Rail** decarbonization – single largest electricity user
- **60%** of unelectrified routes: 3TWh demand increase

### Opportunities

- **Imposing large demand without flexibility** - significant costs and disruption

## Learning to date

### Identified benefits

Reduce constraint payments to curtailed renewables

Improve power quality to electricity customers

### Expanding from Rail

Consultation groups with transport users

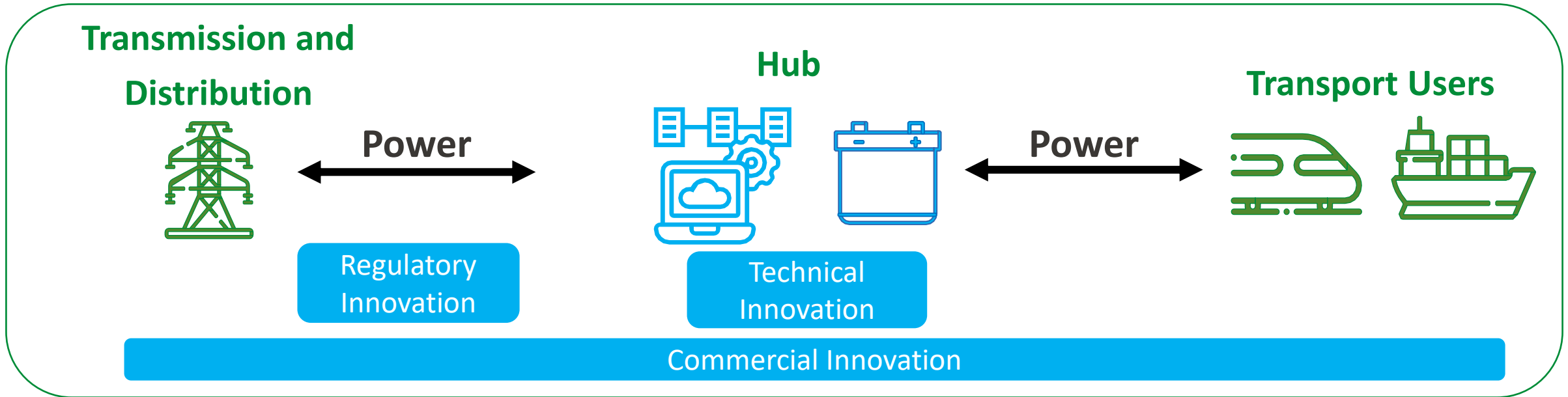
Expanding use cases for multi transport Hubs

### Focus on Energy Users

Partnered with NGENSO for flexibility expertise.

Developed, CBA to focus on benefits for Energy users and stakeholders

# Novel and ambitious innovation

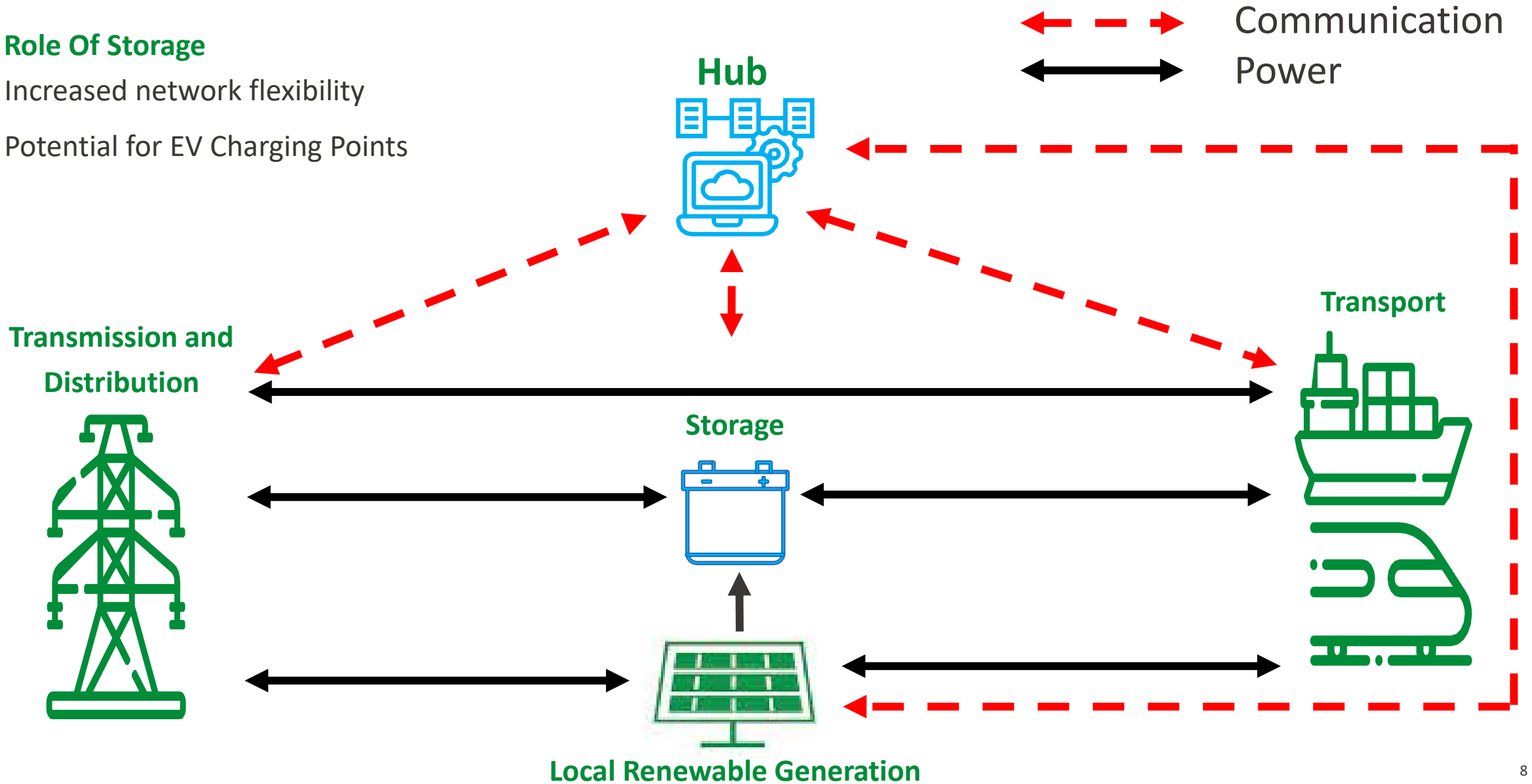


- Modular design and power-buffer technology
- Control scheme including cyber security
- Wide area planning and optimization
- Digital twin

# Project Overview: Hubs - Storage

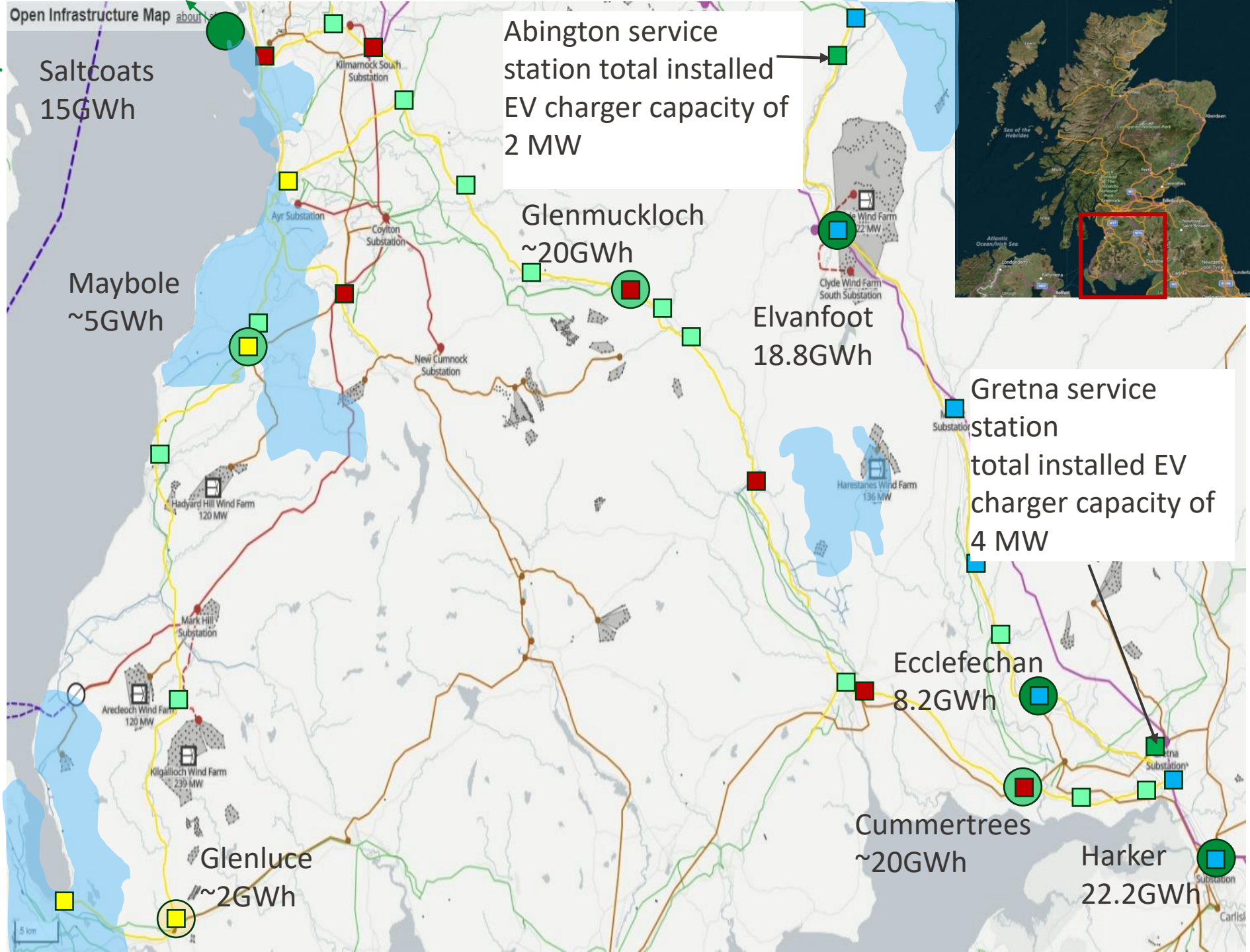
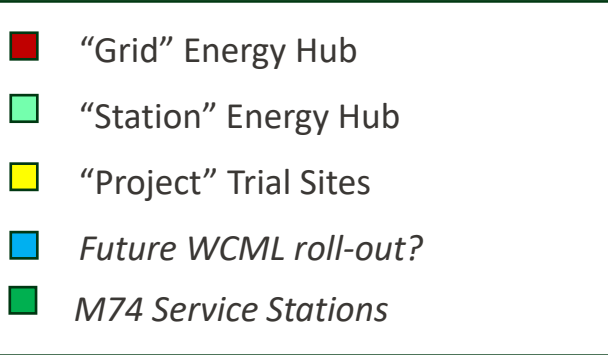
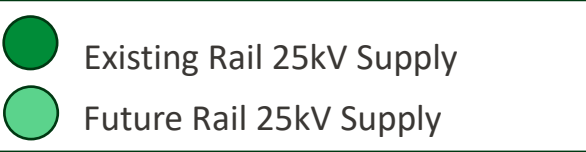
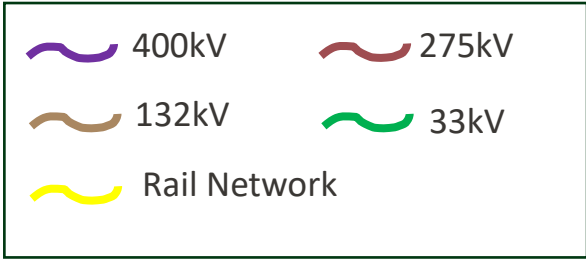
## Key Role Of Storage

- Increased network flexibility
- Potential for EV Charging Points





# Integrating the grid and transport for flexible demand:



## Project Partners

### Experienced team



Transmission Owner, Proposal leading licensee



Engineering design of individual hub and microgrid



Smart grid expertise



Expertise on network flexibility



Determining rail route for hub network design



Rail construction expertise



Electrical network expertise

# Benefits

Reduced Constraint Costs

Ancillary Service: Demand Response

Ancillary Service: Frequency Response

Reduced energy bills for customers

3% Reduced OHL (Over-Head Lines) Installation

Increase Resilience and Flexibility of Railway Infrastructure



**PBP per hub**

**< 1 year**

**NPV by 2040**

**£772m**

**Carbon Savings by 2040**

**94 ktCO<sub>2</sub>e (3% less OHL)**

