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

Ross Davison – Senior Innovation Engineer

Future Networks
SP Energy 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
Innovation Strategy

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
Transmission Network Reliability/Security

**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 RIIO-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 NGESO for flexibility expertise.
Developed, CBA to focus on benefits for Energy users and stakeholders
• 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:

- **Grid** Energy Hub
- **Station** Energy Hub
- **Project** Trial Sites
- **Future WCML roll-out?**
- **M74 Service Stations**

**Rail Network**
- 400kV
- 275kV
- 132kV
- 33kV
- 275kV

**Existing Rail 25kV Supply**
- **Future Rail 25kV Supply**

**Existing Rail 25kV Supply**
- Saltcoats 15GWh
- Ecclefechan 8.2GWh
- Harker 22.2GWh
- Maybole ~5GWh
- Cummertrees ~20GWh
- Glenluce ~2GWh

**Future Rail 25kV Supply**
- Elvanfoot 18.8GWh
- Glenmuckloch ~20GWh
- Gretna 22.2GWh
- Cummertrees ~20GWh

**Rail Network**
- 400kV
- 132kV
- 33kV

**Gretna service station**
- Total installed EV charger capacity of 4 MW

**Abington service station**
- Total installed EV charger capacity of 2 MW

**Flexibility Services tenders**

**Integrating the grid and transport for flexible demand:**
**Project Partners**

**Experienced team**

- **SP Energy Networks**
  - Transmission Owner, Proposal leading licensee

- **enTrust microgrid**
  - Smart grid expertise

- **Network Rail**
  - Determining rail route for hub network design

- **Costain**
  - Rail construction expertise

- **University of Leeds**
  - Engineering design of individual hub and microgrid

- **National Grid ESO**
  - Expertise on network flexibility

- **Ricardo**
  - 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 ktCO2e (3% less OHL)