

# North of Scotland Grid Expansion on Steroids

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For power system expertise

# Overview

- The humble beginnings: Power from the Glens
  - ✓ Up to early 2010s
- North of Scotland network development
  - ✓ By 2021
  - ✓ Rapid and continued expansion
- Exciting challenges ahead



# The Humble Beginnings

Power from the Glens

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# North of Scotland Hydro-Electric Board

## NOSHEB

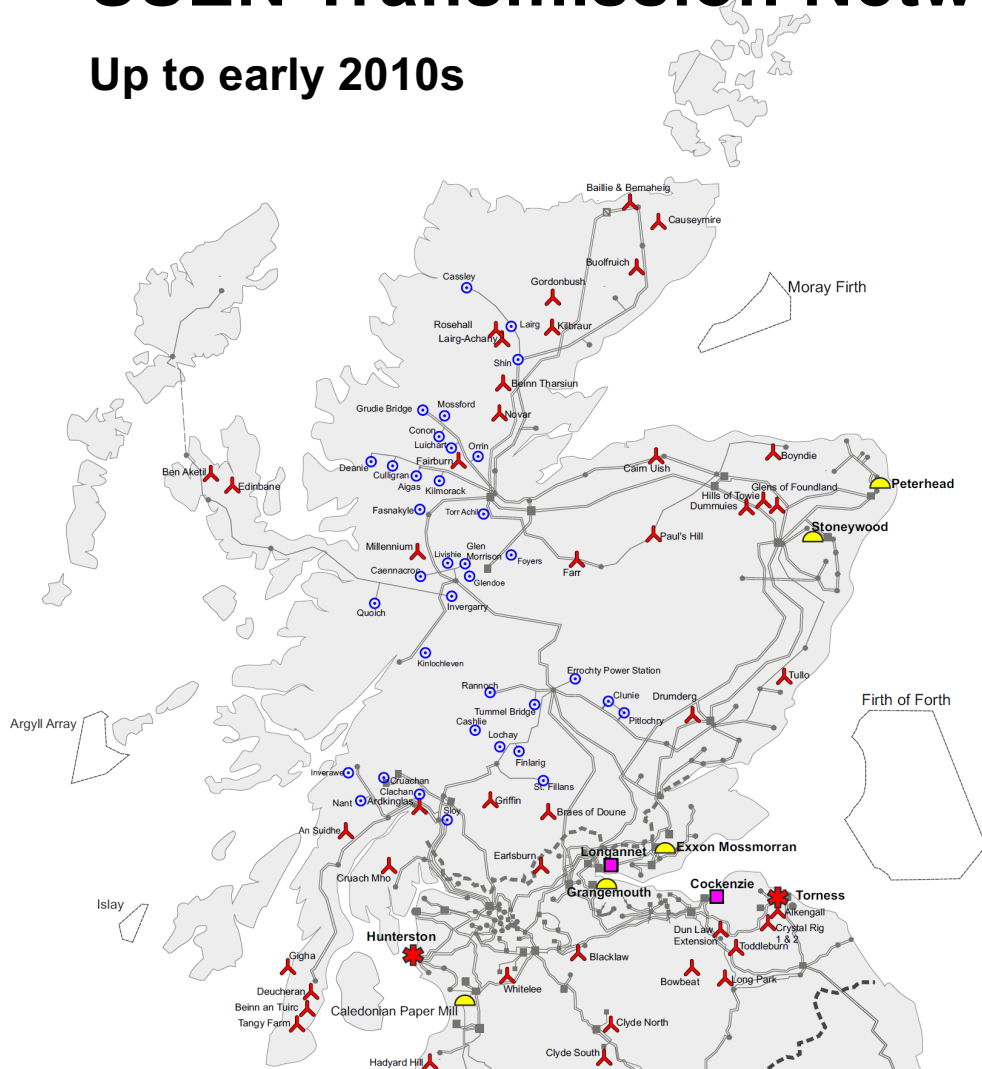
- Founded in 1943
- Design, construct and operate hydro-electric power stations in the north of Scotland
- Covers 25% of land area of the UK, with 3% population
- Also required the construction of power lines (transmission and distribution)
- Main construction phase post-WWII to 1970s
- Privatised in 1991





# SSEN Transmission Network

Up to early 2010s



- Strong 132kV and 275kV circuits along the east coast (Perth, Dundee and Aberdeen), along the Moray coast to Inverness – served **population centres**
- Weak radial 132kV circuits to the north of Scotland (Caithness), west (Fort William) and southwest (Argyll) – served **small population centres and small hydro schemes**
- Of the Scottish islands, only Skye and the Western Isles were served by a long radial 132kV circuit

# North of Scotland Network Development

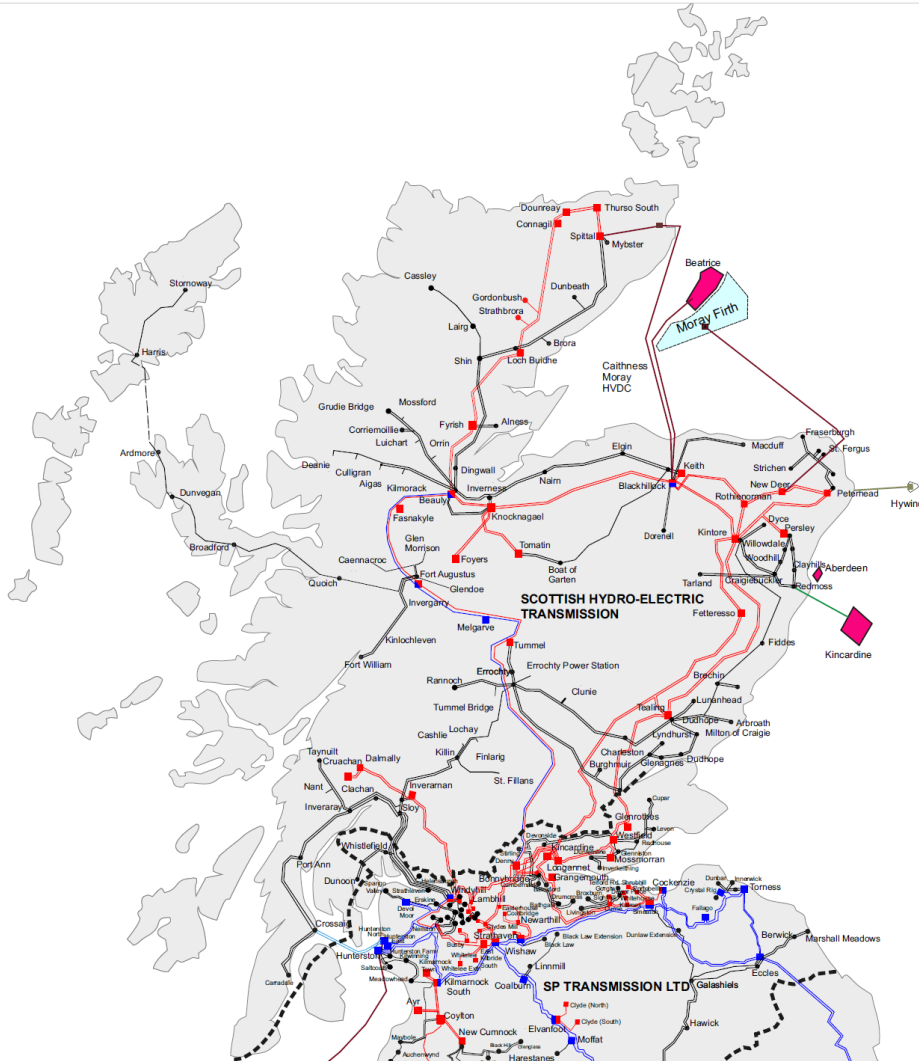
Rapid and Continued Expansion

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# Notable Developments in the last decade



- First 400kV assets (Beauly – Denny line: 2015)
- First STATCOMs (Melgarve: 2017)
- First embedded VSC HVDC link (Caithness – Moray: 2018)
- In southern Scotland the Western HVDC link was also commissioned in the same decade
- Closure of Longannet, Cockenzie and Hunterston power station in southern Scotland
- Continued growth in onshore wind generation and introduction of offshore wind generation



# Main north of Scotland Electricity Transmission Network in 2030

Investments currently in discussion with Ofgem

1. Argyll 275kV strategy
2. Fort Augustus to Skye 132kV upgrade
3. Orkney 220kV AC subsea link




Pathway to 2030 Investments

- 1a. Beaulieu to Loch Buidhe 400kV reinforcement
- 1b. Loch Buidhe to Spittal 400kV reinforcement
- 2a. Beaulieu to Blackhillock 400kV double circuit
- 2b. Blackhillock and Peterhead 400kV double circuit
3. Beaulieu to Denny 275kV circuit to 400kV
4. East Coast Onshore 400kV Phase 2 reinforcement
5. Spittal to Peterhead 2GW HVDC subsea link (EGL2)
6. Peterhead to Drax 2GW HVDC subsea link (EGL4)
7. Peterhead to South Humber 2GW HVDC subsea link (EGL4)
8. Arnish to Beaulieu 1.8GW HVDC Western Isle link
9. Aquila Pathfinder - Peterhead DC switching substation

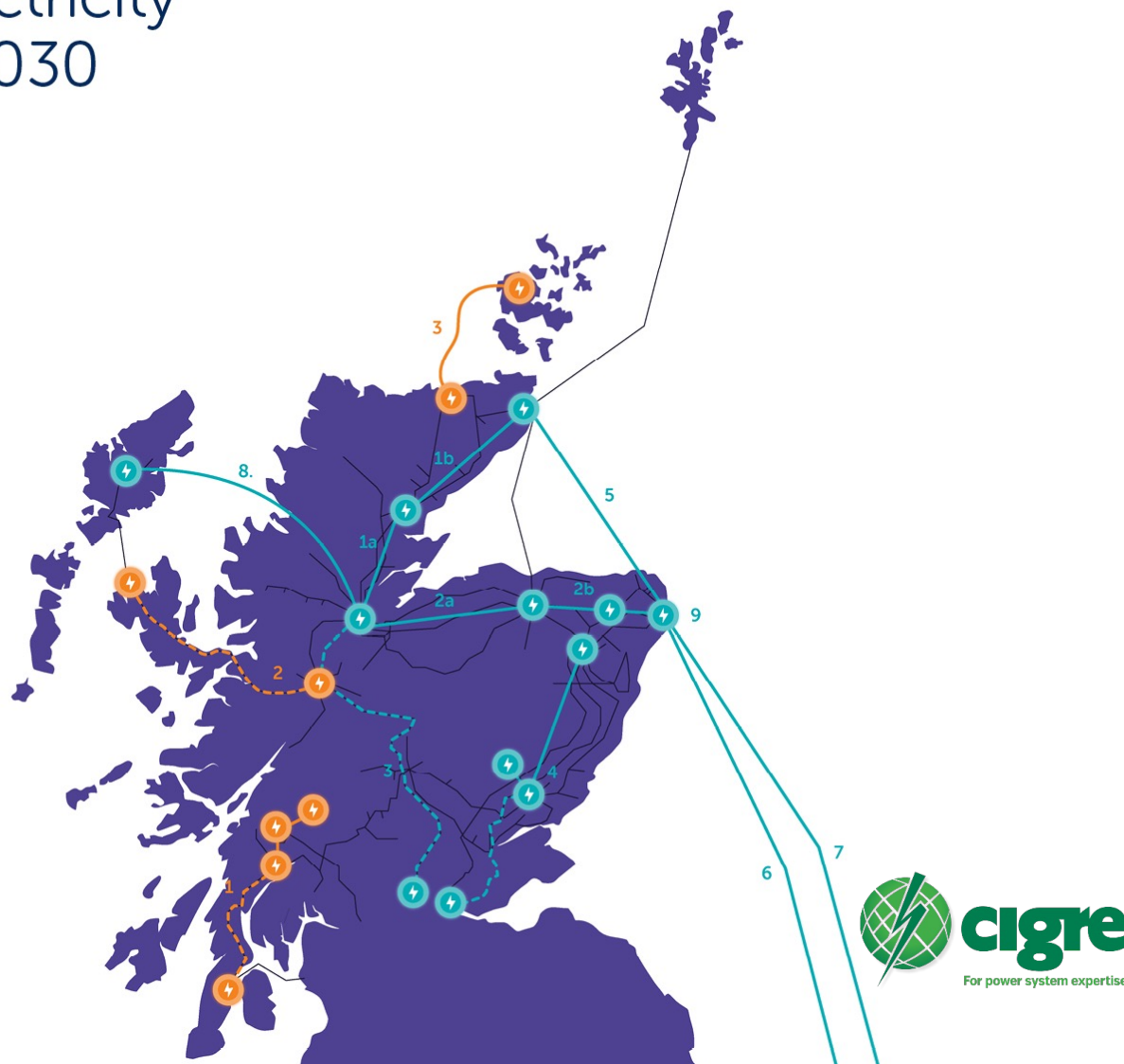
Public Consultation to Inform Project Development

All new reinforcements remain subject to detailed consultation and environmental assessments to help inform route and technology options

More detail on these projects, including how to sign up for updates, will be made available on SSEN Transmission's website, [www.ssen-transmission.co.uk](http://www.ssen-transmission.co.uk)

-  New Infrastructure (Routes shown here are for illustrative purposes)
-  Upgrade/Replacement of Existing Infrastructure
-  Existing Network

Forecast as at 16 Sept 2022



# Exciting Challenges Ahead

Technical, Economic, Community, Environmental

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# Developing at Pace – a programme approach

- Previous approach of project by project development does not work
- Limited time for detailed design
- Strategic stakeholder engagement is critical
- Innovation is key to success
  - ✓ Development of offshore grid by multiple parties
  - ✓ Advancements in HVDC technology capabilities
  - ✓ Constrained supply chain
  - ✓ Commercial, technical and regulatory frameworks
  - ✓ System modelling

# A New Era of System Modelling

- With the changing characteristics of the system, we need to adapt our system modelling techniques
  - ✓ Low system strength definition and solutions
  - ✓ Active network technologies (FACTS devices) and Inverter based resources require detailed modelling of controller interactions
  - ✓ Multi-vendor, multi-terminal HVDC links critical to unlock offshore grids – development interoperability standards
- These are no longer textbook and exam challenges
  - ✓ More skills and Engineers needed!

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