

Decarbonised Maritime Transport: Research, Test and Demonstration

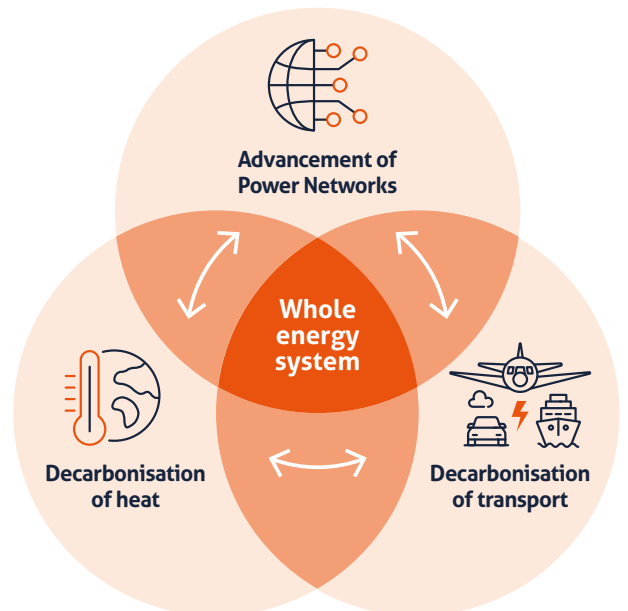
Transforming the future of transport and energy

PNDC is developing and de-risking the technologies, planning and operational processes, and finance models required to enable the transition to zero emission vessels and required infrastructure at the lowest cost to operators and vessel owners in a timescale compatible with net zero targets.

We do this through:

- ▶ Coordinating energy network and transport industry stakeholders to collaborate on innovation and infrastructure deployment.
- ▶ Physical and virtual test environment for industry partners to create integrated systems for electric and other alternative fuel vessels.
- ▶ Providing academia-industry collaboration and knowledge exchange of best practice and state-of-the-art.
- ▶ Coordinate energy network forward investment and infrastructure coordination.
- ▶ Digitalisation, data and tools to enable flexibility, grid services and digital twins for simulating different operational scenarios for decarbonised energy.

A Whole Systems Approach



Decarbonisation of Transport



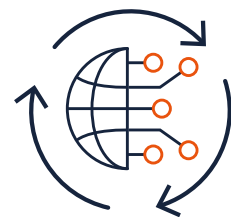
- ▶ Marine, HGV, aviation and rail-enabling cross sector benefit
- ▶ Power electronics converters
- ▶ LVAC and LVDC systems
- ▶ Drive train
- ▶ Electrification infrastructure

Decarbonisation of Heat



- ▶ Heat sources (e.g. heat pumps)
- ▶ Heat storage
- ▶ Heat networks
- ▶ Cooling systems
- ▶ Hydrogen for heat

Advancement of Power Networks



- ▶ Asset management
- ▶ Digitisation
- ▶ Informatics
- ▶ Communications and cyber security
- ▶ Power hardware in the loop (PHiL)
- ▶ LV and 11kv network validation

Test Assets and Capabilities

A Whole Systems Innovation Environment

- ▶ 50kW rapid charger (DC: CCS & CHAdeMO Mode 4 outlets, and AC: Type 2/Mode 3 outlets)
- ▶ 22kW rapid charger (DC: CCS & CHAdeMO Mode 4 outlets, and AC: Type 2/Mode 3 outlets)
- ▶ 7kw fast charger post (2x AC: Type 2/ Mode 3 outlets)
- ▶ Wireless electric vehicle charger bay (Inductive: 100kW, 20kHz)
- ▶ Indoor vehicle bay (for passenger and lightduty vehicles)
- ▶ Operation of PNDC HV/LV network in gridconnected or off-grid modes (45Hz – 62Hz and 9.5kV - 13kV)
- ▶ Motor-Generator set (1MW/5MVA) with a 24MVA fault level
- ▶ 11KV configurable overhead (60km equivalent) distribution network
- ▶ 11kV configurable underground cable (3.4km equivalent) distribution network
- ▶ 400V configurable underground cable secondary distribution network
- ▶ 10 x 11kV/400V secondary substations (capacity ranging 50 to 500kVA)
- ▶ AC and DC compatible electrical network test buses for integration and operation of EV-hub designs with collocated EV charging, storage and on-site generation
- ▶ Indoor 400V LV test bays to integrate and test renewable, energy conversion, and storage
- ▶ Outdoor 400V LV test bays to integrate and test large sized energy resources
- ▶ Real-time digital simulator (RTDS) capable of modelling national and facility scale energy networks with energy resource device models
- ▶ 540kVA bi-directional power converter capable of high-fidelity emulation of AC and DC voltage and current supplies – compatible with real-time digital simulator for power hardware-in-the-loop (PHIL) applications
- ▶ Energy storage and energy conversion systems emulation, e.g. grid scale and distributed li-ion, fuel-cells, flow-batteries
- ▶ Renewable generation emulation and profiles, e.g. distributed solar, wind, hydro
- ▶ 600kVA of low voltage load banks with load profile control (resistive & inductive)
- ▶ Solar PV array emulators (2x DC controllable supplies: 600V, 8.5A up to 5kW)
- ▶ Array of 5 controllable solar PV inverters (ranging 3 to 10kW) to test co-location of renewables with charge points
- ▶ HV and LV phase-to-phase and phase-to-earth fault capability to test protection and contingency schemes
- ▶ Smart grid monitoring and control systems, including full supervisory control and data acquisition (SCADA) system
- ▶ Smart grid communication networks: e.g. Ethernet, fibre, GSM, satellite, LoRaWAN
- ▶ Smart grid communication protocol test harnesses: E.g. Modbus, DNP 3.0, IEC61850
- ▶ High-fidelity data acquisition system(s) capable of sampling and logging electrical network parameters at rates up to 100kHz
- ▶ Electronics fabrication and machine shop