The UK Industrial Decarbonisation Research and Innovation Centre (IDRIC)

IDRIC Project 58: An Integrated Energy System Planning Tool for Net-Zero Industrial Clusters

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Background

Assessing the wave of green technologies requires modelling and simulation of energy system configurations and capabilities to optimise and control novel system/process topologies and their holistic impact on the energy network infrastructure and carbon emissions.

Aim: Support local efforts to decarbonise all industrial clusters, starting with Teeside industrial cluster.

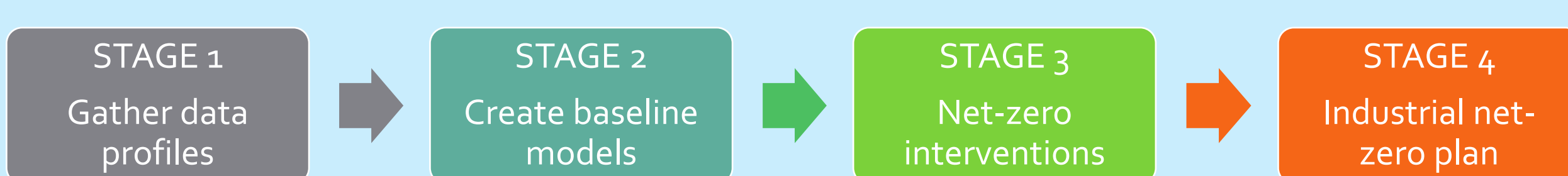https://www.netzeroteesside.co.uk/project/

Four key sites:

☐ Seal Sands
☐ Teesworks
☐ Billingham
☐ Wilton International

Multi-Vector Energy System

❖ Integrated networks
❖ Generators
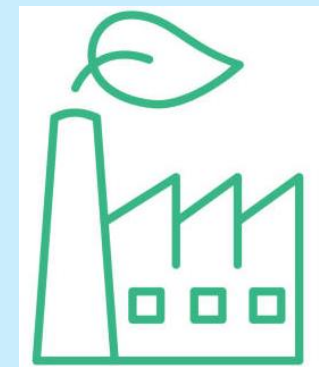❖ Storage units
❖ Consumers

Project Plan

Objective: Tool development for high-level planning scenarios to explore and analyse against strategic energy services investments and decarbonisation plans.
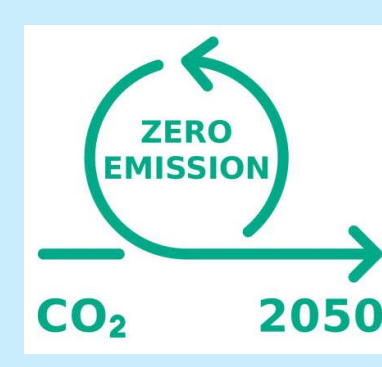
STAGE 1 Gather data profiles	STAGE 2 Create baseline models	STAGE 3 Net-zero interventions	STAGE 4 Industrial net-zero plan

➤ Gas demand	○ Integrated heat and power networks	☐ Fuel/feedstock switch	▪ Net-zero pathways
➤ Electricity demand		☐ Carbon capture	▪ Investment costs
➤ Heat/steam demand	○ Generators	☐ Electrification of heat	
➤ Temperature setpoints	○ Storage units	☐ Integrated renewables	▪ Operating cost savings
➤ Feed stock supply	○ Consumers	☐ Heat recovery	▪ Carbon savings
		☐ Energy storage	
		☐ Energy efficiency	▪ Carbon abatement

Case Study: Wilton International

Wilton International in Teeside Industrial Cluster offer the UK's largest private wire network with plug-in and play utility supply capabilities and import/export energy to the National Grid. Four energy generation units utilising three fuel types are located in the Wilton cluster.
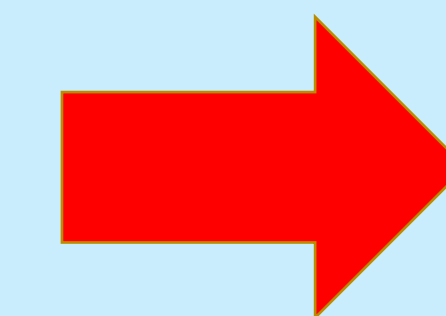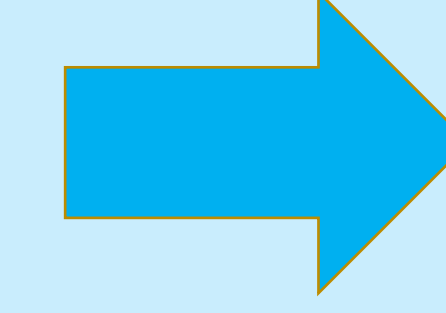

https://www.wiltoninternational.com/

Wilton Site Energy Supplies

- Gas Turbine GT1 (Combined Cycle)
- Steam Turbine ST11 (Combined Cycle)
- Gas Turbine GT2 (Open Cycle)
- Biomass W10
- Energy from Waste W11
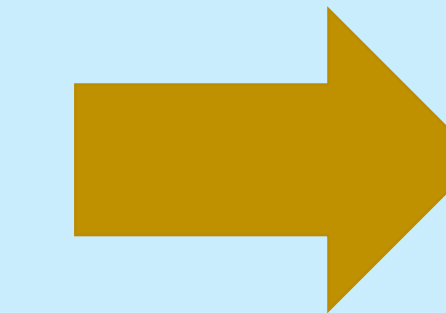- Package Boilers (Steam)
- Existing Utility Pipelines

Heat (Steam) →
Electricity →
Hydrogen / Natural Gas →

Wilton Site Consumers (Processing Plants)

- Olefins Cracker
- Low Density Poly Ethelene Plant
- Polyurethane Plant
- Biofuels
- Others

Planned Developments

- 2 x 850 MW Tees Combined Cycle Power Plant
- 300 MW Whitetail Clean Energy with carbon capture technology plus carbon capture for existing Biomass and Energy from Waste Power Plants as part of Net Zero Teesside (NZT)
- Tees Green Hydrogen: Wind farm (1.5 GW) and solar farm (50 MW) by EDF Renewables and Hynamics to power the hydrogen electrolyser for green hydrogen production
- Energy Storage Systems
  - Europe's largest battery, 360 MW
  - Nitrogen storage, 2.4 MNm^3 underground salt caverns on Wilton International site

Tool capabilities

The tool will model and simulate the multi-vector energy system networks on the Wilton site as described above and assess the impact of the planned interventions for achieving net-zero. The key tool features are listed below:

- Energy systems operation and control using hybrid power and steam generation (gas/steam turbine, biomass, energy from waste etc.) and heat networks (gas & electric) to match supply and demand
- Assessing the impact of additional developments of electrical/gas supply and storage with Industry based renewables (PV, wind, hydrogen etc.)
- Integration with other energy networks in the cluster, local energy demand (domestic/non-domestic), Distribution Network Operators (DNO), and the National Grid
- Techno-Economic-Carbon (TEC) analysis to assess the impact of decarbonisation measures
- Reconfiguration of various energy systems network topologies to model and simulate other industrial sites