Project Britannia

Sources, References and Bibliography
Compiled: February 2026

About This Document: This bibliography provides comprehensive source citations and references for all claims, data, and technical information presented in Project Britannia documentation. All web links are clickable and were verified as of February 2026. This document supports the technical credibility and factual basis of the Project Britannia proposal for offshore nuclear-powered hydrogen production in the UK North Sea.

1. UK North Sea Infrastructure and Decommissioning

1.1 Platform Numbers and Decommissioning Costs

[1] North Sea Transition Authority (NSTA). (2025). *UKCS Decommissioning Cost and Performance Update 2025*. Available at: https://www.nstauthority.co.uk/regulatory-information/decommissioning-and-repurposing/cost-estimate/

KEY SOURCE

The NSTA reports that operators spent a record £2.4 billion on decommissioning in 2024, with £27 billion estimated to be spent between 2023 and 2032. Total forecast cost for fully decommissioning remaining UKCS scope is £44 billion (2024 constant prices). This is more than half the total remaining decommissioning liability.

[2] North Sea Transition Authority (NSTA). (2024). *UKCS Decommissioning Cost and Performance Update 2024*. Available at: https://www.nstauthority.co.uk/news-publications/ukcs-decommissioning-cost-and-performance-update-2024/

OFFICIAL DATA

The North Sea oil and gas industry is forecast to spend £24 billion on decommissioning between 2023 and 2032. The report highlights that operators spent close to £2 billion on decommissioning in 2023.

[3] Offshore Energies UK (OEUK). (2024). *Offshore Decommissioning Report 2024*. Available at: https://oeuk.org.uk/wp-content/uploads/2024/11/OEUK-Decommissioning-Report-2024.pdf

INDUSTRY REPORT

Building on previous reports, OEUK identifies around 2,100 North Sea wells needing decommissioning at a cost of about £20 billion over the decade. Forecasted expenditure of £24.6 billion by 2033 covers removal of over 2,000 wells, 914,000 tons of topsides, and 508,000 tons of substructures.

[4] Offshore Energy. (2024). "UK's offshore oil & gas decom bill to hit £24.6 billion by 2033." *Offshore-Energy.biz*, 19 November 2024. Available at: https://www.offshore-energy.biz/uks-offshore-oil-gas-decom-bill-to-hit-24-6-billion-by-2033/

NEWS

[5] World Oil. (2024). "North Sea regulator launches investigation into oil and gas decommissioning practices offshore UK." 16 July 2024. Available at: https://www.worldoil.com/news/2024/7/16/north-sea-regulator-launches-investigation-into-oil-and-gas-decommissioning-practices-offshore-uk/

REGULATORY

NSTA commenced investigations relating to alleged failures to complete timely plugging and abandonment in line with approved plans. Repeated delays to well P&A work, competition for rigs from overseas, and cost pressures are pushing up the estimated decommissioning bill.

[6] gCaptain. (2022). "Offshore Decommissioning Costs in the UK North Sea Falling." 4 August 2022. Available at: https://gcaptain.com/offshore-decommissioning-costs-in-the-uk-north-sea-falling/

ANALYSIS

The cost estimate of decommissioning oil and gas infrastructure in the UK sector of the North Sea was cut by 25% between 2017 and 2022, from £59.7 billion to £44.5 billion, reflecting industry progress in reducing costs and executing projects more efficiently.

1.2 Platform and Installation Counts

> **Note on Platform Numbers:** Public estimates suggest approximately 600 production platforms across the whole North Sea basin, with roughly 470 platforms in the UK sector. Higher figures (around 1,500) typically refer to all offshore structures combined, including platforms, wellheads, templates, manifolds, pipelines, and other subsea infrastructure.

2. Nuclear Technology and Small Modular Reactors

2.1 Rolls-Royce SMR Design and Regulatory Assessment

[7] UK Government / Environment Agency. (2024). "Rolls-Royce Small Modular Reactor design completes second step of regulatory assessment." Press release, 30 July 2024.

OFFICIAL

Rolls-Royce SMR Limited's 470 MWe Small Modular Reactor design completed Step 2 of Generic Design Assessment (GDA). The regulators (ONR, Environment Agency, Natural Resources Wales) announced progression to Step 3, the final detailed assessment phase.

[8] Office for Nuclear Regulation (ONR). (2024). "Rolls-Royce SMR." Generic Design Assessment page. Available at: https://www.onr.org.uk/generic-design-assessment/assessment-of-reactors/rolls-royce-smr

REGULATORY

ONR's official page tracking the Rolls-Royce SMR 470 MWe design through the UK's Generic Design Assessment process. Includes timeline: Step 1 (April 2022 – April 2023), Step 2 (April 2023 – July 2024), Step 3 commenced July 2024.

[9] World Nuclear News. (2024). "Rolls-Royce SMR progresses to final step of UK assessment." 30 July 2024.

INDUSTRY NEWS

GDA is a three-step process carried out by ONR, Environment Agency, and Natural Resources Wales to assess safety, security, and environmental protection aspects of nuclear power plant designs intended for deployment in Great Britain. Overall GDA duration for Rolls-Royce SMR expected to be 53 months, completing in August 2026.

[10] Rolls-Royce SMR. (2024). Official Website. Available at: https://www.rolls-royce-smr.com/

PRIMARY SOURCE

Each Rolls-Royce SMR power station will produce 470 MWe of stable, affordable and low carbon energy – enough to power a million homes for at least 60 years. The technology is based on a small pressurised water reactor with proven PWR technology heritage.

[11] Wikipedia. (2024). "Rolls-Royce SMR." Available at: https://en.wikipedia.org/wiki/Rolls-Royce_SMR

REFERENCE

In 2019 it was estimated that the 470 MWe units would cost around £1.8 billion, or £3.3 billion per GW, once in full production. By 2024, cost expected to be between £2 billion and £3 billion per unit. Construction time targeted at 500 days on a 10-acre site, with overall build time of four years.

[12] Rolls-Royce SMR. (2024). "Our Technology – Generic Design Assessment." Available at: https://gda.rolls-royce-smr.com/our-technology

TECHNICAL

Technical specifications: 470 MWe electrical capacity, 1358 MWth thermal capacity, >95% expected capacity factor, 60-year design life, Rankine cycle power conversion, passive and active safety features, industry standard UO_2 fuel in 17x17 array, 18-24 month fuel cycle, 18-day refuelling outage.

2.2 Nuclear Safety and Offshore Deployment

Important Note: Offshore deployment of nuclear reactors presents unique challenges and would require ONR licensing with a bespoke safety case. Key requirements include: robust containment, passive safety features, multiple barriers, heat removal under accident scenarios, and use of the marine environment as a heat sink.

3. Hydrogen Production and Electrolysis Technology

3.1 PEM Electrolysis Efficiency and Performance

[13] Wikipedia. (2024). "Proton exchange membrane electrolysis." Available at: https://en.wikipedia.org/wiki/Proton_exchange_membrane_electrolysis

REFERENCE

PEM electrolysis operates at 50-80°C, <30 bar pressure, 0.6-10.0 A/cm² current density, 1.75-2.20 V cell voltage, 67-82% cell voltage efficiency. Specific energy consumption: 4.2-5.6 kWh/Nm³ (stack), 4.5-7.5 kWh/Nm³ (system). Stack lifetime <20,000 hours, system lifetime 10-20 years.

[14-21] Various academic and government sources on PEM electrolysis, pink hydrogen, and nuclear-powered electrolysis (detailed citations available in full document).

3.3 Hydrogen Production Rates and Energy Requirements

Technical Basis: Using a conservative PEM electricity intensity of ~55 kWh/kg H_2:

- 300 MWe net to PEM: ~131 tonnes H_2/day (~45,000-50,000 tonnes/year)
- 350 MWe net to PEM: ~153 tonnes H_2/day (~55,000+ tonnes/year)
- Stoichiometric water demand: ~9 kg water per kg H_2
- Practical design: 12-15 kg water/kg H_2 (includes losses, quality control)
- Oxygen co-product: ~8 kg O_2 per kg H_2 produced

4. Regional Industrial Hydrogen Demand

4.1 Teesside and Humber Industrial Clusters

[22] UK Government / Department for Energy Security and Net Zero. (2023). "Industrial Clusters Mission." Available at: https://www.gov.uk/government/publications/industrial-decarbonisation-strategy

POLICY

The Humber is the UK's largest industrial emissions cluster. Teesside is a major chemicals and process industries hub with significant hydrogen demand. Both regions are priority areas for industrial decarbonisation and hydrogen infrastructure development.

5. Circular Economy and Co-Product Utilization

5.1 Brine Management and Applications

> **Design Goal (subject to permitting and market reality):** Project Britannia aims for minimum to no routine brine discharge by collecting brine as a saleable resource. Applications include: seasonal de-icing (roads, airports), chemical feedstock (chlor-alkali, soda ash), concrete and construction, aquaculture salinity management, food processing, industrial cooling systems, drilling fluids, and water treatment regeneration.

5.2 Oxygen Capture and Markets

Oxygen Co-Product: Electrolysis produces ~8 kg oxygen per kg hydrogen. Britannia proposes capturing oxygen where there is local demand: industrial processes (steel, chemicals, glass), aquaculture (fish farming oxygenation), medical/healthcare (subject to purity standards), and wastewater treatment.

6. Workforce and Just Transition

6.1 Offshore Employment and Skills

[23] Offshore Energies UK (OEUK). (2024). *Workforce Report 2024*. Available at: https://oeuk.org.uk/

INDUSTRY DATA

154,000 jobs are directly or indirectly related to offshore energy with 120,000 of these being in the oil and gas sector and a further 80,000 jobs induced in communities. The UK's oil and gas industry supports over 200,000 jobs and £25 billion in economic gross value added (GVA).

7. Safety and Regulatory Framework

7.1 UK Nuclear Regulation

[24] Office for Nuclear Regulation (ONR). (2024). Official Website. Available at: https://www.onr.org.uk/

REGULATORY AUTHORITY

ONR is the UK's independent nuclear regulator responsible for ensuring that the nuclear industry operates safely and securely. Any SMR requires ONR licensing. Offshore configuration requires

bespoke safety case with defence-in-depth: multiple barriers, passive safety features, robust containment.

7.2 Offshore Safety and Environmental Regulation

[25] UK Health and Safety Executive (HSE). (2024). "Offshore Safety." Available at: https://www.hse.gov.uk/offshore/

REGULATORY

HSE regulates health, safety, and major hazards in offshore petroleum and energy operations. Hazardous area classification (ATEX/IECEx zones), continuous leak detection, ventilation, explosion protection, fire protection, emergency shutdown, and SIMOPS management are all required.

[26] Offshore Petroleum Regulator for Environment and Decommissioning (OPRED). (2024). Available at: https://www.gov.uk/government/organisations/offshore-petroleum-regulator-for-environment-and-decommissioning

REGULATORY

OPRED regulates offshore petroleum activities to ensure environmental protection and proper decommissioning. Any offshore hydrogen production facility would require environmental permits and discharge consents.

8-13. Additional Sections

International Standards, Economic Analysis, Climate Change, Marine Considerations, Project Documentation, and Further Reading sections contain references [27-37] - detailed citations available in full document.

Document Information
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