PROJECT BRITANNIA

Repurposing North Sea Platforms for Offshore Hydrogen Production

A Just Transition for Coastal Communities

White Paper – Version 1.0

Executive Summary

Project Britannia proposes to repurpose end-of-life North Sea oil and gas platforms—currently facing expensive decommissioning—into offshore hydrogen production hubs powered by UK-designed small modular nuclear reactors (SMRs). This approach simultaneously addresses three critical national challenges:

1. **Decommissioning Costs:** The NSTA estimates £44–82 billion in total decommissioning costs for North Sea infrastructure, with UK taxpayers exposed to approximately £24 billion in tax relief. Repurposing platforms into productive assets reduces this burden.
2. **Energy Security & Climate:** Domestic hydrogen production powered by low-carbon nuclear energy (5–15 g CO_2-eq/kWh) reduces reliance on imports and delivers reliable baseload clean energy independent of weather.
3. **Just Transition:** Preserves thousands of skilled offshore jobs in Aberdeen, Teesside, and Humberside, avoiding the social devastation of the 1980s coal mine closures.

The proposal was conceived by David Waugh, a retired gas engineer who witnessed first-hand the industrial collapse of the 1980s. Unlike consultant-driven schemes, Project Britannia is grounded in decades of offshore operational experience and reflects a community-driven vision for the energy transition.

Core Architecture: A distributed 1+4 layout places one reactor platform (300–350 MWe Rolls-Royce SMR) 2–5 km from four hydrogen production platforms, ensuring safety through physical separation. Each cluster produces 40,000–50,000 tonnes of hydrogen annually. Full circular economy principles apply: oxygen sold to industry, brine valorised into de-icing agents and chemical feedstocks, waste heat utilised, and potential lithium extraction as technology matures.

Scale: Approximately 1,500 offshore installations exist across the North Sea, including around 470 end-of-life platforms in UK waters. Not all are suitable for repurposing, but even a fraction represents significant opportunity.

Timeline: Phase 1 (2025–2027) establishes regulatory pathways and conducts feasibility studies. Phase 2 (2028–2032) delivers the first demonstration platform. Phase 3 (2032+) enables fleet-scale deployment.

Contents

1. Introduction & Problem Statement

The North Sea at a Crossroads

The UK North Sea oil and gas sector, which has powered Britain for over five decades, is in decline. Production has fallen by more than 70% since peak output in 1999. As fields are exhausted and platforms reach end-of-life, the industry faces a costly reckoning: decommissioning.

The North Sea Transition Authority (NSTA) estimates total decommissioning costs at **£44–82 billion** for offshore infrastructure across the UK Continental Shelf. Under current tax arrangements, UK taxpayers are exposed to approximately **£24 billion** in decommissioning tax relief—essentially subsidising the removal of assets that still have structural integrity and strategic value.

The Human Cost: Lessons from the 1980s

Beyond financial costs lies a human story. As platforms close, thousands of skilled workers in Aberdeen, Teesside, and Humberside face unemployment. These are communities that have powered Britain for generations—riggers, engineers, technicians with decades of experience in operating complex offshore infrastructure in harsh environments.

David Waugh, the originator of Project Britannia, lived through the 1980s coal mine closures. "I watched my friends lose everything when the pits closed," he recalls. "Entire communities were destroyed. I won't stand by and watch the same thing happen to offshore workers."

Project Britannia is born from that determination: to learn from past mistakes and deliver a **just transition** that preserves livelihoods while addressing the climate crisis.

The Opportunity: Repurposing, Not Removal

What if, instead of tearing down platforms at great expense, we repurposed them into clean energy infrastructure? What if the same workforce that built and maintained these installations could operate the next generation of offshore energy systems?

Project Britannia proposes exactly that: converting end-of-life platforms into **offshore hydrogen production hubs** powered by UK-designed Rolls-Royce small modular reactors (SMRs). This approach delivers:

- **Cost savings:** Reduces decommissioning burden and taxpayer exposure.
- **Energy security:** Domestic hydrogen production independent of global supply chains.
- **Climate action:** Low-carbon hydrogen (5–15 g CO_2-eq/kWh) comparable to renewables.
- **Job preservation:** Thousands of skilled offshore jobs maintained and expanded.
- **Circular economy:** Zero-to-minimum routine discharge with full valorisation of all outputs (oxygen, brine, heat).

2. Project Architecture & Technical Basis

The 1+4 Distributed Layout

Safety and operational resilience are central to Project Britannia's design. The proposal uses a **distributed 1+4 configuration**:

- **One reactor platform:** Hosts a 300–350 MWe Rolls-Royce SMR providing baseload electricity.
- **Four hydrogen production platforms:** House electrolysers, desalination units, and gas separation systems, located 2–5 km from the reactor platform.

This physical separation ensures that:

- No single incident can cascade across the entire cluster.
- Routine maintenance and operations can proceed independently.
- Safety zones and exclusion radii are manageable.
- Emergency response resources are distributed.

Hydrogen Production Process

1. **Seawater desalination:** Intake water is desalinated using reverse osmosis or thermal processes, producing fresh water and brine.
2. **Electrolysis:** Fresh water is split into hydrogen and oxygen using electricity from the SMR. Pink hydrogen (nuclear-powered electrolysis) has lifecycle emissions of 5–15 g CO_2-eq/kWh, comparable to wind and solar.
3. **Gas separation & compression:** Hydrogen is purified, compressed, and prepared for pipeline export. Oxygen is captured for sale.
4. **Brine valorisation:** Brine is processed into valuable products (see Section 6).

Order-of-Magnitude Output

A single 1+4 cluster is estimated to produce:

- **Hydrogen:** 40,000–50,000 tonnes per year (sufficient for heavy industry, transport, heating).
- **Oxygen:** ~350,000 tonnes per year (industrial/medical use).
- **Brine products:** Variable depending on processing route (de-icing salts, chemical feedstocks, aquaculture nutrients).

Technology Readiness

Component	Technology Readiness Level (TRL)	Notes
Small Modular Reactors (Rolls-Royce)	TRL 6–7	Design approval process underway; first units expected late 2020s
	TRL 8–9	

Component	Technology Readiness Level (TRL)	Notes
Electrolysis (PEM/ Alkaline)		Commercially available; offshore adaptation required
Desalination (RO/thermal)	TRL 9	Mature technology; widely deployed offshore
Platform repurposing	TRL 5–6	Precedents exist (Neart na Gaoithe, oil-to-CCS); detailed engineering required

3. Target Regions & Industrial Integration

Teesside

Assets: Existing hydrogen infrastructure, Net Zero Teesside project, industrial demand from chemicals and steelmaking.

Opportunity: Offshore platforms in the Southern North Sea could feed hydrogen directly into the H2Teesside network, supporting decarbonisation of heavy industry.

Humberside

Assets: Major industrial cluster (refineries, chemicals, power generation), offshore wind integration potential, strong port infrastructure.

Opportunity: Hydrogen from repurposed platforms could support Zero Carbon Humber and displace natural gas in industrial heating.

Aberdeen

Assets: Offshore supply chain hub, world-leading engineering expertise, existing workforce with North Sea experience.

Opportunity: Platforms in the Central and Northern North Sea provide hydrogen for local use, export, or blending into gas networks.

Pipeline & Export Infrastructure

Many end-of-life platforms are already connected to existing pipeline networks. Where pipelines are decommissioned or unsuitable for hydrogen, options include:

- **Repurposing gas pipelines:** Subject to integrity assessments and embrittlement risk mitigation.
- **New hydrogen pipelines:** Direct tie-ins to coastal terminals.
- **Shipping (liquid hydrogen or ammonia):** For platforms without pipeline access.

4. Safety & Risk Management

Safety by Design

Project Britannia incorporates multiple layers of safety:

- **Passive Safety SMRs:** Rolls-Royce designs use inherent safety features (natural circulation, low power density) requiring no active intervention for safe shutdown.
- **Offshore Isolation:** Natural separation from population centres; established maritime safety and emergency response protocols.
- **Distributed Layout:** Physical separation (2–5 km) between reactor and hydrogen platforms minimises cascading risks.
- **Proven Naval Heritage:** Builds on thousands of reactor-years of safe Royal Navy submarine operations.

Key Risks

Risk 1: Regulatory Uncertainty
There is no existing regulatory framework for offshore nuclear-hydrogen integration in the UK. Approval pathways are unclear.

Mitigation: Early engagement with ONR, HSE, and DESNZ to co-develop regulations. Commission independent safety assessments. Phased approach with demonstration platform before fleet-scale deployment.

Risk 2: Public & Political Acceptance
Offshore nuclear may face opposition due to perceived safety concerns and historical nuclear incidents (Fukushima, Chernobyl).

Mitigation: Transparent public engagement emphasising passive safety features, offshore isolation, and job preservation. Highlight decades of safe naval nuclear operations. Position as just transition alternative to mass unemployment.

Risk 3: Structural Integrity
Not all platforms are suitable for repurposing. Corrosion, fatigue, and structural degradation may limit candidates.

Mitigation: Detailed structural surveys and integrity assessments. Focus initial efforts on newer, well-maintained platforms. Factor retrofit costs into economic analysis.

Risk 4: Timeline Optimism
SMR deployment timelines are uncertain. First Rolls-Royce units may not be available until late 2020s or early 2030s.

Mitigation: Conservative timeline (first platform 2030–2032). Use regulatory and feasibility phases (2025–2027) productively. Coordinate closely with Rolls-Royce on deployment schedules.

5. Hydrogen Export & Market Integration

Domestic Demand

UK government projections estimate hydrogen demand of **250–460 TWh annually by 2050** (equivalent to 7–13 million tonnes), driven by:

- Heavy industry (steel, chemicals, refineries)
- Heavy transport (shipping, aviation, HGVs)
- Heating (blending into gas networks or pure hydrogen boilers)
- Power generation (backup for renewables)

Project Britannia could supply a meaningful fraction of this demand from domestic, low-carbon sources.

Export Potential

European hydrogen demand is projected at **~2,000 TWh annually by 2050**. The UK is well-positioned to export hydrogen via:

- Pipelines to mainland Europe (North Sea interconnectors)
- Shipping (liquid hydrogen or ammonia conversion)

Pricing & Economics

Levelised cost of hydrogen (LCOH) for pink hydrogen is estimated at **£5–7 per kg**, competitive with blue hydrogen (natural gas + CCS) and increasingly competitive with green hydrogen (renewables + electrolysis) as renewable costs fall. Final economics depend on SMR capital costs, platform conversion expenses, and carbon pricing.

6. Circular Economy & Waste Valorisation

Project Britannia is designed for **zero-to-minimum routine discharge**. Every output stream has economic value:

Oxygen

- **Volume:** ~350,000 tonnes per year per cluster
- **Markets:** Industrial (steelmaking, chemicals), medical (hospitals), aquaculture (fish farming)

- **Value:** £100–300 per tonne (market-dependent)

Brine

Rather than discharging brine back to sea, it is processed into valuable products:

- **De-icing agents:** Road salt for winter maintenance (existing UK market ~2 million tonnes/year)
- **Chemical feedstocks:** Chlor-alkali production (chlorine, caustic soda)
- **Concrete additives:** Magnesium-based binders
- **Sustainable aquaculture:** Nutrient-rich brine supports fish farming with 12-month nutrient cycles, avoiding harmful algal blooms

Lithium Extraction

Lithium extraction from seawater brine is an **emerging technology** (TRL 4–5). As methods mature, Project Britannia platforms could extract lithium for battery production. This is considered **conceptual upside**, not a core assumption.

Waste Heat

SMRs produce significant waste heat. Project Britannia utilises this for:

- Thermal desalination (reducing electricity demand)
- Brine concentration and processing
- Platform heating and operations

7. Workforce & Just Transition

The Skills Passport

Project Britannia proposes a **Skills Passport** framework to recognise existing offshore expertise and facilitate upskilling for the energy transition. Key elements:

- **Core Competencies:** Offshore survival, rigging, mechanical/electrical maintenance, safety protocols—skills already held by North Sea workers.
- **Upskilling Modules:** Hydrogen safety, electrolyser operation, nuclear safety culture, circular economy processes.
- **Portability:** Passport credentials recognised across offshore wind, hydrogen, CCS, and nuclear sectors.
- **Delivery Partners:** Collaboration with trade unions, Offshore Energies UK, regional colleges, and industry training bodies.

Job Preservation & Creation

Each converted platform cluster (1+4 layout) requires:

- **Operations:** 30–50 personnel (reactor operations, electrolyser maintenance, logistics)
- **Maintenance:** Rotating crews for inspections, repairs, and upgrades

- **Onshore support:** Engineering, planning, supply chain management

Scaling to 10–20 clusters preserves **thousands of direct jobs** and supports tens of thousands more in the supply chain.

Regional Impact

Aberdeen, Teesside, and Humberside—communities that powered Britain for generations—face precipitous job losses as oil and gas declines. Project Britannia offers an alternative: a **just transition** that honours their contribution and secures their future.

8. Delivery Roadmap & Regulatory Pathway

Phase 1: Regulatory Framework & Feasibility (2025–2027)

Objectives:

- Establish regulatory pathway for offshore nuclear-hydrogen production (ONR, HSE, DESNZ).
- Commission independent feasibility and safety studies.
- Conduct structural surveys of candidate platforms.
- Engage stakeholders (Rolls-Royce, Offshore Energies UK, trade unions, local authorities).
- Develop Skills Passport framework.

Deliverables:

- Regulatory framework draft
- Feasibility study report
- Shortlist of 5–10 suitable platforms
- Skills Passport pilot program

Phase 2: First Demonstration Platform (2028–2032)

Objectives:

- Detailed engineering and design for first 1+4 cluster.
- SMR installation and commissioning.
- Platform conversion (electrolysers, desalination, brine processing).
- Hydrogen production trials and safety validation.

Deliverables:

- Operational 1+4 cluster producing 40,000–50,000 tonnes H_2/year
- Safety case and operational data for regulatory review
- Proof of concept for circular economy integration

Phase 3: Fleet-Scale Deployment (2032+)

Objectives:

- Roll out across suitable platforms in UK sector.
- Expand pipeline and export infrastructure.
- Scale workforce and supply chain.
- Integrate with national hydrogen strategy and industrial clusters.

Target: 10–20 clusters operational by 2040, supplying 400,000–1,000,000 tonnes of hydrogen annually (equivalent to 15–35 TWh).

9. Annex: Terminology & Data Sources

Platform vs. Installation vs. Rig

Platforms: Fixed or floating structures supporting production, processing, or accommodation. Typically large, permanent installations.

Installations: Broader term including platforms plus subsea infrastructure (manifolds, wellheads, pipelines, etc.).

Rigs: Mobile drilling units (jack-ups, semi-submersibles, drillships). Not production infrastructure; not candidates for repurposing.

North Sea Counts: Public data suggests ~600 oil and gas production platforms across the whole North Sea basin, with ~470 in the UK sector. The total of ~1,500 installations includes subsea structures and smaller facilities. Not all platforms are suitable for repurposing; suitability depends on age, structural integrity, location, and configuration.

Data Sources & Assumptions

- **Decommissioning costs:** NSTA estimates (£44–82 billion total, £24 billion taxpayer exposure).
- **Hydrogen production:** Based on 300–350 MWe SMR output, electrolyser efficiency (~60–70%), and capacity factors (~85%).
- **Lifecycle emissions:** Pink hydrogen (nuclear electrolysis) literature values: 5–15 g CO_2-eq/kWh.
- **Platform counts:** Derived from Offshore Energies UK data, NSTA decommissioning reports, and academic literature. Precise public counts are not available; figures are indicative.

Author's Disclaimer

This white paper is based on publicly available data, independent research, and technical estimates. While every effort has been made to ensure accuracy, all figures should be regarded as indicative and subject to detailed engineering review, regulatory assessment, and stakeholder consultation. Project Britannia originates from David Waugh, a retired offshore professional with decades of North Sea experience. It is not affiliated with any government body, commercial *entity, or industry consortium. The proposal reflects a community-driven perspective on the energy transition and is offered in the spirit of constructive dialogue.*