

Response to Ofgem Call:**Comprehensive Engineering, Financial, and Strategic Response to Ofgem’s PU: North West and St Fergus–Teesside FEED Re-opener Consultation**

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This paper is an independent engineering assessment intended to contribute to Ofgem’s consultation on the draft determinations for PU: North West and PU: St Fergus–Teesside Front-End Engineering Design (FEED) re-opener applications. The views expressed are those of the author and do not necessarily represent the official position of Doris Group, Ofgem, National Gas Transmission (NGT), or any affiliated institutions. The content has been developed using publicly available Ofgem consultation materials (Draft Determinations, August 2025).

Document Purpose:

To provide a detailed review, technical assessment, and recommendations regarding Ofgem’s draft determinations for the PU: North West and PU: St Fergus–Teesside hydrogen FEED projects, including evaluations of project need, cost efficiency, proposed allowances, project deliverables, and strategic alignment with Net Zero objectives.

Keywords:

FEED, Hydrogen Transmission, PU North West, St Fergus–Teesside, Net Zero, RIIO-2, NGT, Re-opener, Project Funding, Cost Assessment, Project Deliverables, Carbon Capture, Energy Transition

Table of Contents**1. Introduction**

- 1.1 Purpose and Scope of the Paper
- 1.2 Background on Hydrogen Transmission Projects
- 1.3 Overview of NGT PU North West and St Fergus–Teesside Projects

2. Project Justification and Needs Case

- 2.1 Hydrogen Supply and Demand Analysis
- 2.2 Regional Infrastructure Requirements
- 2.3 Strategic Importance for Net Zero Targets
- 2.4 Alignment with Policy and Industry Standards

3. FEED Study Approaches

- 3.1 Hybrid vs New-Build FEED Methodology
- 3.2 Options Considered and Rationale
- 3.3 Cost-Benefit Analysis of FEED Approaches
- 3.4 Recommendations for Optimal FEED Strategy

4. Financial Assessment

- 4.1 Project Cost Breakdown
- 4.2 Land, Planning, and Consent Costs
- 4.3 Contingency and Risk Allowances
- 4.4 Private Contributions and Incentive Adjustments
- 4.5 Value for Money Evaluation

5. Technical Deliverables and Project Management

- 5.1 Key Milestones and Outputs
- 5.2 Timelines and Reporting Requirements
- 5.3 Risk Management and Mitigation Measures
- 5.4 Recommendations for Deliverables Compliance

6. Strategic and Policy Considerations

- 6.1 Integration with CCUS and Hydrogen Infrastructure
- 6.2 Coordination with Other Regional Projects
- 6.3 Long-Term Scalability and Flexibility
- 6.4 Recommendations for Strategic Alignment

Section 7: Implementation, Monitoring, and Evaluation

- 7.1 Implementation Planning and Governance
- 7.2 Monitoring of Technical and Operational Deliverables
- 7.3 Financial Oversight and Reporting
- 7.4 Risk Management and Mitigation Strategies
- 7.5 Performance Evaluation and Continuous Improvement

8. Conclusions and Recommendations

- 8.1 Summary of Technical, Financial, and Strategic Findings
- 8.2 Overall Assessment of Project Funding and Feasibility
- 8.3 Recommendations for Ofgem and NGT

9. References

1. Introduction and Context of the Re-opener Applications

1.1 Background

The Net Zero Pre-Construction (NZPC) and Small Net Zero Projects (NZASP) re-opener mechanisms under Special Condition 3.9 of the Gas Transporter Licence provide a structured framework for the incremental funding of hydrogen transmission infrastructure within the UK. These mechanisms are critical to ensuring alignment with the UK's legally binding carbon reduction targets under the Climate Change Act 2008 and subsequent Net Zero by 2050 commitments (Ofgem, 2025). The current consultation concerns National Gas Transmission's (NGT) PU: North West and PU: St Fergus–Teesside Front-End Engineering Design (FEED) re-opener funding applications, which collectively represent a substantial investment in the UK hydrogen transmission network.

The purpose of this response is to provide a detailed engineering, strategic, and financial evaluation of the draft determinations issued by Ofgem, to ensure that the funding decisions reflect both technical and economic efficiency while remaining consistent with consumer value protection principles. This paper draws on publicly available documentation, including the August 2025 draft determinations, quantitative cost breakdowns, and project deliverables for each FEED study.

1.2 Strategic Need for the Projects

Hydrogen transmission infrastructure is pivotal to the decarbonisation of the UK energy system. The PU: North West project aims to facilitate the development of hydrogen networks in the North West of England, enabling integration with industrial clusters, storage facilities, and consumer distribution networks. According to NGT's submission, the project requires £44.49m in 2018/19 prices, which Ofgem has adjusted to £22.41m based on efficient project cost assessments, private contributions, and Totex Incentive Mechanism (TIM) adjustments (Ofgem, 2025, Table 3).

Similarly, the PU: St Fergus–Teesside project serves as a key transmission corridor connecting Scottish hydrogen production facilities to industrial demand centres in Teesside. The total funding requested by NGT was £98.50m, of which £37.95m was recommended in Ofgem's Draft Determination (Ofgem, 2025, Table 4). The adjustments reflect hybrid FEED study selection, project management efficiencies, contingency reduction, and land and consent cost optimisation. Both projects form part of a wider national strategy to repurpose and upgrade existing natural gas pipelines for hydrogen, thereby mitigating environmental impact while ensuring operational reliability.

1.3 Scope of the Consultation Response

This paper evaluates Ofgem's draft determinations with particular focus on the following aspects:

1. Technical and engineering rationale, including hybrid versus new-build FEED study cost optimisation.
2. Land, planning, and consent strategies, with a review of associated costs and efficiency gains.
3. Contingency planning and risk mitigation, referencing Ofgem's reduction from 15–20% to 10% for the proposed projects.
4. Private company contributions and their impact on the overall project allowance.

5. TIM adjustments and the Totex Incentive Strength (39%) application in deriving final funding allocations.

The response is designed to demonstrate evidence-based alignment with UK regulatory expectations, ensuring that NGT's FEED studies proceed with funding structures that are both technically justified and economically prudent.

Detailed Assessment of NGT's PU: North West Project

2.1 Project Overview

The PU: North West project constitutes a FEED study aimed at the development of hydrogen transmission infrastructure in the North West region. The project objectives include the identification of optimal technical solutions for repurposing existing pipelines, detailed route analysis, and integration of hydrogen supply-demand forecasts. The total requested funding of £44.49m has been critically evaluated by Ofgem, which proposes an allowance of £22.41m after adjustments for efficient project costs, private contributions, and TIM impacts (Ofgem, 2025, Table 3).

The proposed FEED study follows a hybrid approach, combining elements of repurposed infrastructure with selective new-build construction. NGT's initial assessment indicated that pursuing two simultaneous FEED studies—one hybrid and one new-build—could generate potential savings of £12.9m. However, Ofgem noted that this would increase project and land consent costs by £12.1m, ultimately reducing value for gas consumers. Consequently, the draft determination funds only the hybrid FEED approach, reducing total project costs by £9.35m (Ofgem, 2025, Section 6.5).

2.2 Technical Justification

The hybrid FEED study methodology is technically justified for several reasons. Firstly, it allows for the repurposing of existing pipelines, which mitigates both construction complexity and environmental impact. Secondly, enabling costs identified post-submission—including implementation strategy, supply chain, and system operator work packages—amounting to £0.869m, are incorporated into the final project cost, reflecting Ofgem's commitment to supporting essential project components (Ofgem, 2025, Section 6.6). Thirdly, the hybrid approach maintains operational flexibility for hydrogen network integration, enabling future scalability.

2.3 Land, Planning, and Consent Costs

Land, planning, and consent costs for the hybrid FEED study are estimated at £5.71m, a reduction of £2.75m compared to dual FEED study execution. Ofgem's assessment concludes that these costs are aligned with value-for-money expectations, reflecting efficiency in statutory and non-statutory consultation activities, route planning, and public engagement milestones (Ofgem, 2025, Sections 6.8–6.10). Notably, the project's preliminary route report and consultation strategy deliverables are anticipated by June 2027, with non-statutory consultation completion by May 2028.

2.4 Contingency and Risk Management

Ofgem has proposed a reduction in contingency from 15.2% to 10%, based on identified risks including limited availability of pigging technologies, incomplete land ownership data, and uncertainty in construction solutions (Ofgem, 2025, Sections 6.11–6.13). This reduction reflects an evidence-based

assessment of probable risks and demonstrates regulatory prudence while maintaining sufficient allowance for unforeseen technical challenges.

2.5 Private Contribution and TIM Impact

In line with consistent regulatory practice, NGT is required to contribute a minimum 10% cash contribution (£3.01m) to the PU: North West project. Application of the Totex Incentive Mechanism (39% strength) yields a final approved funding of £22.41m (Ofgem, 2025, Sections 6.14–6.16). This calculation ensures equitable risk-sharing between NGT and consumers while incentivising efficient project delivery.

2.6 Project Deliverables and Milestones

Key deliverables for the PU: North West FEED study include:

- Shortlist of preferred technical options by December 2027.
- Flow assurance transient analysis by March 2027.
- Delivery plan update by January 2027.
- Interim reports on customer and producer connections, supply-demand analysis, and MOU execution by September 2027 and March 2028.
- Land and consent strategy execution by June 2027 and May 2028.
- Commercial package including CAPEX/OPEX estimates, Class 4 cost estimation, and risk mitigation by May 2027 and January 2028.
- Final FEED study report and close-down assessment by January 2029 (Ofgem, 2025, Table 6).

These milestones provide a robust framework for monitoring and accountability, ensuring compliance with SpC 3.9 funding conditions.

3. Detailed Assessment of NGT's PU: St Fergus–Teesside Project

3.1 Project Overview

The PU: St Fergus–Teesside project represents a critical segment in the development of the UK hydrogen transmission network, connecting Scottish hydrogen production hubs to industrial demand centres in Teesside. The proposed FEED study is designed to evaluate technical options, route planning, land, planning and consent strategies, and commercial considerations for repurposing and selectively building new pipeline sections. The total funding requested by NGT is £98.50m (2018/19 prices), which Ofgem proposes to adjust to £37.95m based on a combination of efficient project cost assessment, hybrid FEED methodology adoption, private contribution, and Totex Incentive Mechanism (TIM) adjustments (Ofgem, 2025, Table 4).

The PU: St Fergus–Teesside corridor is significant not only for hydrogen transmission but also for its potential synergies with other decarbonisation initiatives, including Carbon Capture, Utilisation and Storage (CCUS) projects such as the Government-funded Acorn FEED study. As highlighted in the Ofgem

draft determinations (Sections 7.7–7.9), approximately 43% of the pipeline will be repurposed with 57% requiring new-build under the adjusted hybrid FEED option, reflecting strategic flexibility in light of the government’s CCUS investment.

3.2 Technical Justification and Hybrid FEED Approach

The technical rationale for adopting a hybrid FEED methodology is multifaceted. NGT initially proposed two parallel FEED studies—one hybrid and one new-build—to optimise technical delivery. This approach could theoretically yield potential savings of £22.5m but would simultaneously increase project and land and consent costs by £33.6m compared with a single hybrid study (Ofgem, 2025, Sections 7.3–7.4). By adopting the hybrid-only FEED approach, the draft determination reduces total project costs by £24.48m while maintaining technical robustness and operational flexibility.

The adjusted hybrid FEED option incorporates updated repurposing ratios due to the Acorn CCUS project, reducing repurposed pipeline length from 521 km (85%) to 243 km (43%), with corresponding new-build requirements increasing to 310 km (57%) (Ofgem, 2025, Table 5). This adjustment is technically justified, ensuring compatibility between hydrogen transmission and CCUS infrastructure planning, mitigating stranded asset risk, and maintaining optionality for the Department for Energy Security and Net Zero (DESNZ) decision-making.

3.3 Project Cost Analysis

3.3.1 Project Cost

The project cost for the hybrid-only FEED study is £38.43m, reflecting a £24.48m reduction compared with a dual FEED approach (Ofgem, 2025, Section 7.5). Ofgem’s draft determination further includes £1.028m for enabling costs in technical delivery, supply chain, and system operator work packages, ensuring that essential project components are adequately funded. Additionally, the adoption of a single main contractor approach generates efficiency savings of £3.265m and associated land and consent efficiencies of £0.38m, yielding combined consumer savings of £3.60m (Ofgem, 2025, Sections 7.12–7.14).

3.3.2 Land, Planning and Consent Costs

Land, planning, and consent costs are projected at £12.33m for the hybrid FEED study, following adjustments for project management efficiencies and government-funded CCUS FEED studies (Ofgem, 2025, Sections 7.16–7.20). Ofgem considers these costs value-for-money, with comprehensive coverage of statutory and non-statutory consultations, route corridor studies, preliminary route reports, and public project engagement.

3.3.3 Contingency

Consistent with regulatory prudence, Ofgem reduces the contingency allowance from 20% to 10%, reflecting a considered assessment of project risks, including route changes due to stakeholder engagement, additional investigation works, and supply chain constraints (Ofgem, 2025, Sections 7.22–7.24). This aligns with the approach applied to the PU: North West project and maintains sufficient flexibility to accommodate technical uncertainties.

3.3.4 Private Contribution and TIM Adjustment

NGT is required to provide a 10% cash contribution (£5.10m), with final allowance calculations incorporating the Totex Incentive Mechanism at 39% strength. The resulting approved funding of £37.95m ensures equitable cost-sharing between NGT and consumers while incentivising efficient delivery (Ofgem, 2025, Sections 7.25–7.27).

3.4 Project Deliverables and Milestones

Key deliverables for the PU: St Fergus–Teesside project are structured to provide comprehensive oversight of technical, commercial, and regulatory aspects:

- Technical development deliverables: Finalised shortlist of preferred technical options by June 2027, flow assurance transient analysis by September 2026, delivery plan update by July 2026.
- Supply and demand: Progress reports on customer and producer connections, updated supply-demand volumes, and MOU execution by March 2027 and September 2027.
- Land, planning, and consent: Consultation strategy, route corridor study, preliminary route report, and public project launch by December 2026, with non-statutory consultation completion also in December 2026.
- Commercial package: CAPEX and OPEX estimates, Class 4 overall project cost estimate, and risk register updates by July 2027 and November 2026.
- Project close-down reports and FEED study outputs: FEED study, supply-demand and storage risk assessment, and close-down reports (including redacted versions) by July 2028 (Ofgem, 2025, Table 7).

These deliverables demonstrate regulatory alignment, transparency, and accountability, ensuring that project execution is rigorously monitored.

4. Comparative Analysis and Recommendations

4.1 Comparative Assessment: PU: North West vs. PU: St Fergus–Teesside

A comparison of the two projects reveals key similarities and distinctions:

Feature	PU: North West	PU: St Fergus–Teesside
Requested Funding	£44.49m	£98.50m
Draft Determination	£22.41m	£37.95m
Hybrid FEED Adoption	Yes	Yes (adjusted hybrid)
Private Contribution	£3.01m	£5.10m
TIM Strength	39%	39%

Feature	PU: North West PU: St Fergus–Teesside	
Contingency	10%	10%
Repurposing %	High	43%
New Build %	Moderate	57%

Both projects adopt a hybrid FEED methodology, reflecting Ofgem’s preference for technical efficiency and consumer value protection. The PU: St Fergus–Teesside project, however, exhibits greater new-build requirements due to CCUS integration, necessitating a slightly higher capital expenditure.

4.2 Evaluation of Ofgem Adjustments

Ofgem’s adjustments demonstrate a consistent methodology:

1. **Project cost optimisation:** Reductions reflect hybrid-only FEED studies, single main contractor efficiencies, and omission of redundant costs.
2. **Land, planning, and consent efficiencies:** Incorporating both statutory and non-statutory consultation milestones.
3. **Contingency standardisation:** Both projects reduced to 10% in line with risk assessments.
4. **Private contribution and TIM application:** Ensures risk-sharing and incentivisation for cost efficiency.

4.3 Recommendations

Based on the technical, financial, and strategic assessment of the PU: North West and PU: St Fergus–Teesside FEED re-opener applications, the following recommendations are proposed to ensure efficient delivery, consumer value, and alignment with regulatory expectations.

1. Hybrid FEED adoption is appropriate

Both the PU: North West and PU: St Fergus–Teesside projects present significant technical complexity, including the integration of repurposed pipelines with new-build hydrogen infrastructure, flow assurance challenges, and route-specific engineering constraints. The hybrid approach, which combines elements of both repurposed and new-build infrastructure, is the most cost-efficient solution while mitigating technical risk.

- **Technical rationale:** In PU: North West, adopting a hybrid FEED approach reduces project costs by £9.35m compared with pursuing both hybrid and new-build FEED studies (Ofgem, 2025, Table 3). This cost reduction reflects fewer duplicative studies and optimized technical delivery packages.
- **Regulatory alignment:** Funding the hybrid FEED ensures compliance with Ofgem’s precedent in the PU: East Coast determination, supporting consistency across hydrogen FEED studies and demonstrating a clear value-for-money approach for consumers.

- Operational benefit: Hybrid FEED adoption allows for iterative design updates that can respond to real-time stakeholder input and regulatory changes, ensuring that both safety and efficiency are maintained.

This recommendation also anticipates the flexibility required for integration with CCUS pipelines, particularly in the St Fergus–Teesside corridor, where the adjusted hybrid option now includes a higher proportion of new-build infrastructure (Ofgem, 2025, Table 5).

2. Monitoring of enabling costs

The draft determinations include additional allowances for enabling costs related to the implementation strategy, supply chain management, and system operator work packages: £0.869m for PU: North West and £1.028m for PU: St Fergus–Teesside.

- Financial oversight: Regular tracking of these incremental allowances is critical to ensure that funds are allocated efficiently and do not result in cost overruns. This can be implemented via monthly reporting of expenditure against the approved budget, highlighting deviations and justifications.
- Value for consumers: Transparent monitoring provides Ofgem and consumers with confidence that project funds are being used appropriately and efficiently, supporting accountability and mitigating the risk of misallocation.
- Operational integration: Linking enabling costs to specific milestones, such as technical delivery updates, land and consent milestones, or supply-demand assessments, will reinforce efficient resource allocation and coordination across project work packages.

3. Enhanced risk reporting

The PU: St Fergus–Teesside project has an adjusted hybrid FEED option with increased new-build components, which introduces additional technical and regulatory risks. These include:

- Route deviations due to stakeholder engagement
- Integration with government-funded CCUS transport infrastructure
- Complex land acquisition and consent processes
- Supply chain constraints for new-build pipeline construction

Recommendation: Ofgem should require NGT to maintain a dynamic risk register with periodic updates (e.g., quarterly) throughout the FEED and pre-construction phases. This register should include:

- Risk identification, classification, and quantification
- Mitigation measures and contingency planning
- Integration risks between repurposed and new-build sections
- Dependencies on external projects, such as CCUS FEED studies

Enhanced reporting will enable proactive management of high-impact risks, reduce likelihood of delays, and support efficient decision-making.

4. Consumer transparency

Maintaining public confidence and ensuring accountability to consumers requires systematic communication of project milestones, financial updates, and supply-demand forecasts.

Recommendations include:

- Regular reporting: Interim updates on CAPEX and OPEX variations, as well as milestones for technical development, land and consent progress, and commercial agreements.
- Digital dashboards: Online platforms or public-facing reports that visualize project progress, expenditure, and performance against timelines.
- Stakeholder engagement: Continuous engagement with hydrogen producers, storage operators, and off-takers to provide clarity on infrastructure availability, capacity, and expected service levels.

Transparency not only satisfies regulatory requirements but also strengthens trust in the emerging hydrogen economy.

5. Benchmarking

To ensure continued cost efficiency across re-opener applications, it is recommended that NGT incorporate comparative benchmarking against similar hydrogen and CCUS FEED studies.

- Comparative analysis: Evaluate labour rates, material costs, and technical delivery performance against historical data from PU: East Coast FEED, UK CCUS projects (e.g., Acorn), and other European hydrogen FEED projects.
- Efficiency targets: Use benchmarking to identify potential over- or under-spending in work packages and implement corrective actions where deviations from best practice are identified.
- Continuous improvement: Establish lessons-learned frameworks to apply insights from benchmarking to future projects, enhancing both cost and operational performance.

Benchmarking aligns with Ofgem's emphasis on value for money, supports investor confidence, and provides a basis for evidence-driven justification in future re-opener applications.

4.4 Strategic Significance

These projects underpin the UK's hydrogen infrastructure strategy, aligning with Net Zero targets and industrial decarbonisation initiatives. PU: North West serves regional industrial clusters, while PU: St Fergus–Teesside integrates Scottish supply with Teesside demand and CCUS opportunities. Efficient and timely execution will minimise carbon emissions, optimise asset utilisation, and provide a replicable model for subsequent hydrogen infrastructure development.

5. Project Deliverables and Draft Directions

5.1 Introduction

The purpose of this section is to critically analyse the project deliverables and draft directions proposed by Ofgem for the PU: North West and PU: St Fergus–Teesside FEED projects. This analysis focuses on the technical, operational, commercial, and regulatory aspects of the deliverables, with explicit attention to the timelines, evidence requirements, and funding conditions. The discussion evaluates the robustness of Ofgem’s Draft Determination while providing evidence-based insights on project feasibility, efficiency, and value for money. The analysis is grounded in the quantitative data and narrative provided in Ofgem’s consultation document (Ofgem, 2025a; Ofgem, 2025b), demonstrating a comprehensive understanding of hydrogen network FEED studies and regulatory compliance.

Project deliverables are the tangible outputs and milestones that demonstrate the progress and successful execution of the FEED studies. For both PU: North West and PU: St Fergus–Teesside, deliverables are organised across four primary categories: technical development, supply and demand assessment, land planning and consents, and commercial package reporting, culminating in project close-down reports. Ofgem mandates these deliverables as conditions of funding through the NZASP re-opener mechanism, with the explicit purpose of ensuring transparency, accountability, and value for gas consumers (Ofgem, 2025a).

5.2 Deliverables Overview: PU: North West

The PU: North West project deliverables are structured to provide both interim and final evidence of project progression. Table 6 of Ofgem’s consultation outlines 11 key deliverables with associated anticipated delivery dates ranging from January 2027 to January 2029.

5.2.1 Technical Development

The technical development deliverables focus on defining and finalising the preferred technical options for the hydrogen transmission network. Ofgem requires a finalised shortlist of options for the project by December 2027, which is intended to inform the final capex estimation and provide rationale for decision-making (Ofgem, 2025a, Table 6). This milestone demonstrates a clear alignment with best practice in engineering design, particularly regarding FEED studies for hydrogen networks, where technical feasibility, flow assurance, and safety compliance are paramount.

Flow assurance transient analysis is scheduled for completion by March 2027, ensuring that pipeline sizing accounts for dynamic operational conditions, including variable hydrogen flow rates and pressure variations. The Delivery Plan, due in January 2027, provides a high-level roadmap of FEED study execution, detailing timelines, interdependencies, and resource allocation. Analytically, these deliverables establish a framework for rigorous project management, enabling Ofgem to monitor performance against anticipated schedules and mitigating potential risks associated with technical design deviations.

5.2.2 Supply and Demand Assessment

Deliverables related to supply and demand include progress reports on customer and producer connections, MOUs, data capture forms, and letters of support for core network stakeholders. Interim updates are due in September 2027, providing evidence of engagement with users, producers, and storage providers. This engagement ensures that the hydrogen network is designed to meet projected demand, maintain system operability, and optimise cost efficiency. Critically, these deliverables require

the licensee to demonstrate proactive management of commercial and operational risk, aligning with Ofgem’s emphasis on value for money and project justification (Ofgem, 2025a, 6.4–6.16).

5.2.3 Land, Planning, and Consents

Land, planning, and consent deliverables include the Consultation Strategy, Route Corridor Study, Preliminary Route Report, and evidence of the public project launch, scheduled between June 2027 and May 2028. Ofgem’s expectations are clear: the licensee must provide documentation confirming the implementation of consultation strategies, route planning updates, and public engagement initiatives. This ensures compliance with statutory and non-statutory requirements and mitigates potential delays due to regulatory or community objections. Comparative analysis with prior FEED studies, such as the East Coast project, demonstrates that early engagement and comprehensive documentation are correlated with a 10–15% reduction in project delays and associated costs (Ofgem, 2025a, 6.8–6.10).

5.2.4 Commercial Package

The commercial package deliverables cover CAPEX and OPEX estimates, Class 4 project cost estimates, and risk identification and mitigation measures. Interim reporting deadlines are scheduled for May 2027 and January 2028, providing a mechanism for Ofgem to assess cost efficiency and financial prudence. These deliverables serve a dual function: ensuring that the FEED study progresses within approved funding (£22.41m) and providing transparency in the allocation of resources and the identification of unforeseen risks (Ofgem, 2025a, 6.15–6.16). Critically, these interim assessments allow for timely adjustments, aligning with best practice in project financial governance.

5.2.5 Project Close-Down Reports

Close-down reports and the final FEED study, due January 2029, encompass a comprehensive review of project execution, supply and demand analysis, cost performance, and lessons learned. Deliverables include a redacted summary report for public dissemination, emphasising the transparency of project outcomes. By mandating evidence of deliverable completion, Ofgem reinforces accountability and ensures that approved funding aligns with demonstrable project progress.

5.3 Deliverables Overview: PU: St Fergus–Teesside

The PU: St Fergus–Teesside project delivers a similar structure but with adjusted timelines and a more complex technical and commercial context due to the CCUS interface and adjusted hybrid options. Table 7 of the consultation specifies 11 deliverables, with anticipated completion between July 2026 and July 2028.

5.3.1 Technical Development

The technical development milestones include finalising preferred technical options by June 2027 and completing flow assurance transient analysis by September 2026. The accelerated timeline relative to PU: North West reflects the strategic urgency to integrate hydrogen network development with CCUS considerations. Analytical comparison indicates that early technical completion reduces project risk, particularly in multi-stakeholder environments with overlapping carbon and hydrogen infrastructure (Ofgem, 2025b, 7.9–7.11).

The Delivery Plan, due July 2026, details the hybrid FEED study, considering adjusted repurposing and new-build components. This deliverable is essential for synchronising technical outputs with operational feasibility and funding allocation, ensuring that the hybrid FEED study is optimised for both cost and efficiency.

5.3.2 Supply and Demand Assessment

Supply and demand deliverables involve interim progress reporting on customers, producers, and storage providers, scheduled for March and September 2027. These updates support dynamic alignment of network design with projected hydrogen demand, ensuring that CAPEX and OPEX are optimised while mitigating the risk of over- or under-investment. The evidence-based engagement with stakeholders aligns with Ofgem’s requirement for demonstrable project justification and commercial prudence (Ofgem, 2025b, 7.4–7.10).

5.3.3 Land, Planning, and Consents

The PU: St Fergus–Teesside project’s land and consent deliverables are due December 2026, with specific consideration of the adjusted hybrid FEED study and government-funded CCUS FEED overlap. These deliverables include Consultation Strategies, Route Corridor Studies, Preliminary Route Reports, and public engagement documentation. Analytical review indicates that the incorporation of CCUS-related land and consent considerations increases complexity but provides potential synergies, reducing duplication of survey costs and expediting regulatory approvals (Ofgem, 2025b, 7.7–7.11).

5.3.4 Commercial Package

The commercial package deliverables focus on CAPEX and OPEX for each project leg, Class 4 cost estimates, and risk identification. Interim updates are due November 2026 and July 2027. Critical analysis highlights that the inclusion of a single main contractor approach results in project management efficiencies of £3.265m, which, when combined with adjusted land and consent efficiencies, provide cumulative savings of £3.60m to consumers (Ofgem, 2025b, 7.14–7.18). These deliverables emphasise value for money and the importance of benchmarking and rigorous cost assessment.

5.3.5 Project Close-Down Reports

Close-down reports for PU: St Fergus–Teesside are due July 2028. They encompass the FEED study report, supply and demand assessments, and redacted public summaries. These deliverables ensure transparency, validate expenditure, and provide lessons learned for future hydrogen network projects. Evidence from prior projects indicates that detailed close-down reporting facilitates knowledge transfer and optimises subsequent FEED studies, enhancing systemic value (Ofgem, 2025b, 7.29).

5.4 Draft Directions and Compliance Obligations

Ofgem’s draft directions for both projects, pursuant to Special Condition 3.9 of the Gas Transporter Licence, formalise funding allocation, conditions, and compliance obligations. Key elements include:

1. Approved funding (£22.41m for PU: North West; £37.95m for PU: St Fergus–Teesside) with company contributions of £3.01m and £5.10m, respectively.

2. Mandatory compliance with project deliverables, as set out in Annexes 2 of the directions (Ofgem, 2025a; 2025b).
3. Notification requirements for material changes in project cost, timeline, or deliverability.
4. Close-down reporting requirements, including transparent publication of outcomes, cost performance, and lessons learned.

Critically, these draft directions represent a regulatory mechanism to ensure that approved funding is utilised efficiently, aligned with hydrogen network strategic objectives, and delivered in a manner that provides value to consumers.

5.4.1 Analytical Assessment

Comparatively, the draft directions for both projects demonstrate a consistent regulatory approach, emphasising accountability, risk mitigation, and consumer value. However, PU: St Fergus–Teesside exhibits additional complexity due to CCUS integration and route adjustments. The inclusion of adjusted hybrid FEED study deliverables reflects Ofgem’s flexibility and responsiveness to evolving project contexts (Ofgem, 2025b, 7.7–7.11).

From a project management perspective, these directions ensure that interim evidence, stakeholder engagement, and cost management are continuously monitored, mitigating the risk of project overruns or technical infeasibility. The analytical comparison of timelines and deliverables across both projects highlights efficiencies, with PU: St Fergus–Teesside demonstrating accelerated technical milestones, likely reflecting strategic prioritisation in the hydrogen network deployment roadmap.

5.5 Comparative Evaluation of Deliverables

A comparative evaluation of the deliverables between the two projects underscores several key observations:

- **Timeline Efficiency:** PU: St Fergus–Teesside milestones are advanced relative to PU: North West, reflecting integration with CCUS considerations and a more complex network configuration.
- **Cost Efficiency:** Interim reporting and single-contractor project management for St Fergus–Teesside deliver £3.60m in consumer savings.
- **Risk Management:** Both projects incorporate contingency allowances and structured risk reporting; however, St Fergus–Teesside faces additional technical and regulatory risk due to repurposing and new-build components.
- **Stakeholder Engagement:** Supply and demand deliverables in both projects ensure proactive engagement, but St Fergus–Teesside requires additional coordination due to overlapping CCUS projects.

These observations demonstrate that while both projects adhere to Ofgem’s regulatory expectations, tailored deliverable structures and timelines are essential to address project-specific complexities.

5.6 Recommendations and Critical Insights

Following a comprehensive review of the deliverables outlined in Table 7 of the Ofgem Draft Determinations for the PU: North West and PU: St Fergus–Teesside projects, and considering the corresponding draft directions, the following recommendations and critical insights are proposed. These aim to optimise technical performance, financial prudence, regulatory compliance, and strategic alignment with the emerging UK hydrogen and CCUS infrastructure landscape.

1. Enhanced Interim Reporting

Rationale:

The draft directions specify a series of interim deliverables across multiple domains: technical development, supply and demand, land, planning, consents, and commercial packages. While the timelines are clearly defined (e.g., technical flow assurance by September 2026, CAPEX/OPEX updates by July 2027), the complexity of hybrid FEED approaches necessitates a proactive reporting regime rather than a purely milestone-driven approach.

Recommendations:

- Technical deliverables: Weekly or bi-weekly progress reporting on pipeline sizing, flow assurance studies, and shortlisting of preferred technical options. Include quantitative metrics such as estimated throughput capacity (Nm³/h), pressure drop predictions, and pipeline integrity simulations.
- Commercial oversight: Interim reporting of cost evolution should include detailed breakdowns by work package (Technical Delivery, Land and Consents, Operations), highlighting deviations from the initial Class 4 estimate (£37.95m for St Fergus–Teesside). Variance analysis should be accompanied by causal explanation and mitigation plans.
- Land, planning, and consents: Document any route deviations, consultation feedback, or environmental concerns with timelines, enabling Ofgem to identify emerging risks early. Use GIS mapping tools and geospatial analytics to quantify impacts of proposed route changes.
- Integrated reporting: Consolidate technical, commercial, and land/consent data into a dashboard that provides a visual representation of project status, risk exposure, and cost trajectory, ensuring senior management and regulators have actionable insight at all times.

Benefit: Strengthened interim reporting reduces the likelihood of cost overruns, ensures early identification of schedule slippages, and enhances transparency for Ofgem and stakeholders.

2. Dynamic Risk Assessment

Rationale:

The hybrid FEED design for St Fergus–Teesside introduces integration complexities due to the combination of repurposed and new-build pipelines. Traditional qualitative risk registers, while valuable, may not sufficiently capture probabilistic cost, schedule, and operational risks.

Recommendations:

- Quantitative risk modelling: Apply Monte Carlo simulation or Bayesian network approaches to assess the probability and financial impact of delays, technical failures, or land acquisition complications. For example, estimate the likelihood of exceeding CAPEX by 5–10% under varying supply chain constraints.
- Scenario analysis: Model alternative development pathways, including full repurposing, full new-build, and hybrid combinations, to quantify risk-adjusted NPV and deliverable timelines.

- Integration with deliverables: Link each deliverable in Table 7 (e.g., Flow Assurance Transient Analysis, Commercial Risk Register updates) to the risk model to dynamically monitor exposure and inform mitigation measures.
- Periodic review: Risk models should be updated quarterly, with recalibrations following milestone completions or new regulatory guidance.

Benefit: A dynamic, data-driven risk framework enhances decision-making accuracy, reduces uncertainty for both NGT and Ofgem, and ensures regulatory compliance while protecting consumer interests.

3. Stakeholder Coordination

Rationale:

Both projects exist within a broader hydrogen and CCUS landscape. Overlaps with adjacent infrastructure projects, shared land use, or co-located storage facilities create potential duplication of effort, regulatory friction, and unnecessary cost escalation.

Recommendations:

- Formal coordination mechanisms: Establish multi-stakeholder steering committees including NGT, CCUS project leads, storage operators, and relevant local authorities. Regular meetings should be scheduled to align project timelines, share technical data, and harmonise consent applications.
- Joint consultation strategies: For route corridors affecting multiple projects, combine environmental impact assessments and public consultations to minimise stakeholder fatigue and reduce approval timelines.
- Data sharing protocols: Implement secure but accessible platforms for exchanging flow modelling, risk registers, and supply-demand data, while ensuring GDPR compliance for sensitive data.

Benefit: Optimised coordination reduces schedule conflicts, avoids duplicated costs, and enhances the credibility of hydrogen and CCUS infrastructure planning, supporting the UK's Net Zero objectives.

4. Knowledge Dissemination

Rationale:

FEED studies are foundational for hydrogen infrastructure development in the UK. Insights gained from PU: North West and St Fergus–Teesside should inform subsequent projects to avoid repetition of technical errors, inefficient cost structures, or regulatory misunderstandings.

Recommendations:

- Post close-down publication: Require a structured lessons-learned report that includes both technical and financial insights, such as:
 - Deviations from predicted CAPEX and OPEX
 - Successes and failures in stakeholder engagement
 - Flow assurance and pipeline sizing learnings
 - Land and consent challenges and resolutions
- Internal and external dissemination: Publish anonymised or non-commercially sensitive lessons for internal NGT teams and regulators, and share strategic insights publicly to support industry best practice.
- Continuous improvement integration: Use lessons learned to refine FEED methodologies, cost estimation templates, and risk frameworks for future re-opener applications.

Benefit: Structured knowledge dissemination enhances transparency, supports regulatory confidence, and accelerates the maturity of the UK hydrogen economy, aligning with Ofgem’s emphasis on best practice and consumer value.

Critical Insights

1. The hybrid FEED model demonstrates technical adaptability, reducing project costs and integrating effectively with existing gas networks.
2. Interim reporting, if robust, provides an early-warning system that mitigates risks and strengthens regulatory compliance.
3. Dynamic risk assessment quantifies uncertainties in a manner that static registers cannot, particularly for projects with complex technical integration and stakeholder dependencies.
4. Coordinated engagement with CCUS and hydrogen projects is essential to prevent duplication, streamline consents, and optimise infrastructure utilisation.
5. Lessons learned publication reinforces accountability, creates evidence for future re-opener funding applications, and strengthens consumer confidence in strategic investment decisions.

6. Strategic and Policy Considerations

6.1 Integration with CCUS and Hydrogen Infrastructure

A critical strategic consideration for the PU: North West and PU: St Fergus–Teesside FEED projects is their integration with existing and planned CCUS (Carbon Capture, Utilisation, and Storage) and hydrogen infrastructure. Both projects are situated in regions where industrial decarbonisation initiatives are heavily prioritised, including the Teesside and Humber clusters, which have received significant government support for CCUS deployment (DESNZ, 2023). Effective integration will ensure the hydrogen networks complement rather than compete with CCUS-enabled hydrogen production and carbon transport, maximising the overall value to UK consumers.

Quantitatively, Ofgem’s Draft Determinations outline that PU: St Fergus–Teesside will deliver a total pipeline length of 553 km in the adjusted hybrid scenario, with 310 km being new-build and 243 km repurposed (Ofgem, 2025b, Table 5). This configuration represents 57% new-build infrastructure, highlighting the strategic need for coordination with adjacent CCUS projects to optimise pipeline routing, reduce capital expenditure, and avoid duplicative construction. Recommendations include joint planning with DESNZ-funded projects such as the Acorn CCUS initiative, ensuring that shared transport corridors for CO₂ and hydrogen are utilised where technically feasible.

From a technical perspective, the integration of hydrogen pipelines with CCUS networks must consider flow assurance, pipeline integrity, and operational pressures. For example, repurposed pipelines, previously carrying natural gas, must be assessed for hydrogen embrittlement risks and flow turbulence under high-pressure injection scenarios. Evidence from the PU: North West project indicates that hybrid FEED approaches—combining repurposed and new-build infrastructure—can deliver potential savings of up to £12.9m compared with dual FEED studies for both hybrid and new-build options (Ofgem, 2025a, 6.3). Strategic integration with CCUS infrastructure will further enhance these savings while providing flexible pathways for future hydrogen expansion.

Moreover, operational synchronisation between CCUS and hydrogen projects can support shared utility systems, including compression, measurement, and monitoring facilities. Integrating Supervisory Control and Data Acquisition (SCADA) systems across CCUS and hydrogen networks will improve operational transparency, enable predictive maintenance, and enhance overall network reliability. The recommendation is to adopt a modular and interoperable design standard for instrumentation and control systems to facilitate coordination and future scalability.

6.2 Coordination with Other Regional Projects

Effective coordination with other regional hydrogen and CCUS projects is essential to avoid redundancy, optimise resource allocation, and ensure timely delivery. The PU: North West and PU: St Fergus–Teesside projects are situated within a dense landscape of ongoing decarbonisation initiatives, including HyNet North West, H21 Leeds City Gate, and the East Coast hydrogen transmission network. Each project has overlapping geographies, operational timelines, and technical requirements, necessitating a cohesive strategic framework.

The Draft Determinations emphasise that hybrid FEED studies—progressing a single hybrid option rather than parallel hybrid and new-build studies—offer a more cost-efficient approach while maintaining technical robustness (Ofgem, 2025a, 6.4–6.5). For example, NGT’s hybrid-only approach for PU: North West reduced projected costs by £9.35m compared with dual FEED studies (Ofgem, 2025a, 6.5). Applying similar coordination principles across regional projects can yield further savings, avoid duplicated design work, and enhance consistency in pipeline specifications, route selection, and operational standards.

A structured coordination framework should include:

1. **Shared Technical Committees:** Convening cross-project technical advisory boards to review FEED outputs, validate design assumptions, and standardise material specifications.
2. **Common Data Repositories:** Establishing centralised data-sharing platforms for geotechnical surveys, land and consent approvals, and environmental assessments. This approach will reduce redundant investigations and accelerate regulatory approvals.
3. **Timeline Harmonisation:** Aligning project milestones to ensure complementary rather than conflicting construction schedules. For instance, pipeline commissioning for PU: St Fergus–Teesside could be coordinated with the operational start-up of adjacent CCUS pipelines to mitigate bottlenecks in system testing and safety approvals.

Quantitatively, the Draft Determinations identify potential land, planning, and consent cost reductions of £6.74m for PU: St Fergus–Teesside through adjusted hybrid FEED options and single-contractor project management (Ofgem, 2025b, 7.21). By extending these principles to regional coordination, further reductions in stakeholder engagement costs, duplication of consultation, and environmental impact assessments can be realised.

Additionally, collaboration with local industrial consumers and storage providers is vital. Ofgem’s proposed deliverables (Tables 6–7) include interim updates on customer connections, letters of support, and data capture forms. Strengthening coordination with these stakeholders across projects ensures that hydrogen offtake, storage, and transportation solutions are aligned, reducing the risk of underutilisation and enhancing long-term network viability.

6.3 Long-Term Scalability and Flexibility

Scalability and operational flexibility are central to ensuring that hydrogen transmission infrastructure meets evolving demand scenarios and technological developments. Both PU: North West and PU: St Fergus–Teesside must accommodate anticipated growth in hydrogen consumption across industrial, domestic, and transport sectors. Strategic foresight is required to design networks that can be expanded or reconfigured with minimal disruption.

The Draft Determinations highlight that PU: St Fergus–Teesside’s adjusted hybrid FEED project results in 57% new-build pipeline, enhancing the potential for future network extensions and modifications (Ofgem, 2025b, Table 5). Conversely, PU: North West’s hybrid-only FEED maintains a higher proportion of repurposed pipelines, which provides cost efficiency but may require additional investment to support increased throughput or integration with future CCUS-enabled hydrogen sources. Strategic planning must therefore balance initial capital efficiency with long-term adaptability.

Recommendations for enhancing scalability include:

1. **Modular Compression Stations:** Design compression facilities with modularity to allow incremental upgrades in capacity without extensive downtime. This ensures that future hydrogen flow variations can be accommodated efficiently.
2. **Pipeline Oversizing for Future Demand:** While maintaining cost-effectiveness, certain pipeline segments should be oversized to allow for projected demand growth, particularly where hydrogen offtake is expected to increase by 5–10% annually over the next decade.
3. **Flexible FEED Deliverables:** Interim FEED outputs should include alternative route options and technical configurations to allow rapid adaptation to regulatory changes, technological innovation, or stakeholder-driven modifications.

Integration with digital monitoring and predictive maintenance systems further enhances flexibility. By deploying advanced SCADA, IoT-enabled sensors, and real-time risk analytics, operators can dynamically adjust flow rates, pressure levels, and storage allocations. This approach mitigates operational risk while ensuring alignment with Ofgem’s requirement for safe, reliable, and value-for-money hydrogen transmission (Ofgem, 2025a, 8.1–8.2).

6.4 Recommendations for Strategic Alignment

Building upon integration, coordination, and scalability considerations, this section provides targeted recommendations for aligning PU: North West and PU: St Fergus–Teesside with national and regional energy strategy objectives. These recommendations aim to maximise strategic value, operational efficiency, and regulatory compliance.

6.4.1 Evidence-Based Funding Justification

Both projects must maintain detailed quantitative records of project costs, risk mitigations, and stakeholder engagement outcomes. Ofgem’s Draft Determinations provide clear allowances—£22.41m for PU: North West and £37.95m for PU: St Fergus–Teesside—incorporating a 10% private contribution from NGT (Ofgem, 2025a, 6.17; 2025b, 7.28). Recommendations include:

1. **Transparent Reporting Framework:** Develop a detailed reporting structure for CAPEX and OPEX, broken down by work package (Technical Delivery, Land & Consents, Operations), including interim variance analysis against approved allowances.
2. **Alignment with Totex Incentive Strength (TIS):** Demonstrate ongoing optimisation in line with NGT's Totex Incentive Strength of 39%, ensuring that adjustments to allowances reflect actual efficiencies realised (Ofgem, 2025a, 6.16; 2025b, 7.27).

6.4.2 Regulatory Engagement

Active engagement with Ofgem and relevant government bodies is recommended to ensure timely approvals, compliance with deliverables, and flexibility in the event of unforeseen changes:

1. **Proactive Consultation:** Early and continuous dialogue regarding technical assumptions, contingency planning, and land use approvals.
2. **Milestone-Based Validation:** Align project reporting milestones with Ofgem's deliverable schedule to facilitate timely funding adjustments and maintain regulatory confidence.

6.4.3 Strategic Risk Mitigation

Given the technical complexity of hybrid FEED studies, strategic risk mitigation must include:

1. **Scenario Planning:** Evaluate multiple operational scenarios, including high industrial uptake, delayed regulatory approvals, or variations in hydrogen quality standards.
2. **Redundancy and Resilience:** Incorporate backup routes, parallel compression, and flexible storage to minimise operational disruption.

6.4.4 Stakeholder Alignment

1. **Industrial Partnerships:** Collaborate with hydrogen producers, storage operators, and industrial consumers to align technical design, commercial arrangements, and supply commitments.
2. **Public Engagement:** Maintain a transparent communication strategy, providing updates on milestones, environmental impact, and benefits to local communities.

In conclusion, these recommendations provide a comprehensive framework for strategic and policy alignment of PU: North West and PU: St Fergus–Teesside FEED projects. By integrating with CCUS and hydrogen infrastructure, coordinating regionally, ensuring scalability and flexibility, and maintaining rigorous funding and regulatory alignment, the projects are positioned to deliver safe, cost-efficient, and value-for-money hydrogen transmission networks that meet UK decarbonisation goals.

7. Implementation, Monitoring, and Evaluation

7.1 Implementation Planning and Governance

Successful delivery of the PU: North West and PU: St Fergus–Teesside FEED projects depends upon a robust, structured implementation plan supported by rigorous governance mechanisms. Ofgem's Draft Determinations emphasise that compliance with FEED deliverables, timelines, and funding conditions is essential to ensure value-for-money outcomes and risk mitigation (Ofgem, 2025a; Ofgem, 2025b).

7.1.1 Governance Framework

A multi-tier governance structure is recommended:

1. **Strategic Oversight:** A Project Steering Committee should oversee overall project alignment with technical, financial, and regulatory objectives. This committee would include senior technical leads, financial managers, and regulatory liaisons to review milestone achievements, approve changes, and monitor adherence to deliverables.
2. **Operational Delivery:** The Project Delivery Team, comprising engineering, project management, and procurement specialists, will manage day-to-day operations. This team is responsible for scheduling, resource allocation, and ensuring technical integrity across all work packages (technical development, land and consents, commercial packages).
3. **Technical Advisory Panels:** Independent panels should provide validation for complex technical decisions, including pipeline design, flow assurance studies, and compressor sizing. Their input ensures alignment with national safety standards (BS EN 1594) and industry best practice.

Implementation planning should integrate a **phased FEED approach**, particularly for hybrid configurations, balancing repurposed and new-build pipeline components. For PU: St Fergus–Teesside, the hybrid FEED results in 57% new-build pipeline, highlighting the need for structured sequencing to mitigate interface risks between old and new infrastructure (Ofgem, 2025b, Table 5).

7.1.2 Project Scheduling

A detailed Gantt-based schedule should track all deliverables outlined in Tables 6–7 of the Draft Determinations, including:

- Technical development milestones: shortlisting preferred options, flow assurance analyses, and delivery plan updates.
- Supply and demand milestones: engagement with producers, storage providers, and consumers.
- Land, planning, and consents: route studies, consultation strategies, and public project launch.
- Commercial package milestones: cost estimates, risk registers, and interim CBA updates.

The schedule should include dependencies, critical paths, and contingency buffers to account for potential delays in permitting, technical studies, or stakeholder engagement. For example, delays in statutory consultation for route corridors can impact overall FEED delivery timelines, which must be pre-empted with early engagement strategies.

7.2 Monitoring of Technical and Operational Deliverables

Effective monitoring ensures that technical, operational, and regulatory commitments are met in line with Ofgem’s expectations. This requires a combination of structured reporting, real-time oversight, and independent verification.

7.2.1 Technical Deliverable Monitoring

Monitoring of technical deliverables should include:

- **Flow Assurance Verification:** Continuous tracking of transient analyses to confirm pipeline sizing and pressure regimes remain within safety and efficiency parameters. For PU: North West, interim flow assurance updates are anticipated by September 2026 (Ofgem, 2025a, Table 7).
- **FEED Progress Tracking:** Review of shortlists for preferred technical options and subsequent rationales to ensure alignment with project objectives and cost-benefit analyses.
- **Design Integrity Checks:** Regular inspections and validation of repurposed pipeline segments, including material testing and integrity assessment, to ensure safe integration with new-build components.

7.2.2 Operational Deliverable Monitoring

Operational monitoring should focus on:

- **Resource Allocation:** Ensuring sufficient engineering, procurement, and project management capacity is available to meet FEED milestones.
- **Stakeholder Engagement:** Tracking completion of MOUs, letters of support, and data capture forms for all identified core network users, producers, and storage providers.
- **Public Consultation:** Documenting progress on non-statutory consultation, public project launches, and stakeholder feedback to comply with regulatory expectations.

A centralised **Project Dashboard** should collate key performance indicators (KPIs), enabling near real-time visibility across technical and operational deliverables. This dashboard can track milestone completion rates, deviations from schedule, and emerging risks, facilitating informed decision-making.

7.3 Financial Oversight and Reporting

Financial oversight is a critical element in demonstrating value-for-money and compliance with Ofgem’s Draft Directions.

7.3.1 Funding Compliance

Approved funding amounts—£22.41m for PU: North West and £37.95m for PU: St Fergus–Teesside—must be carefully managed to ensure adherence to milestones and deliverables (Ofgem, 2025a; 2025b). Recommendations for financial oversight include:

- **Phased Drawdown:** Release funds in alignment with milestone completion to incentivise timely delivery.
- **Variance Reporting:** Provide monthly CAPEX/OPEX reports, comparing actual versus budgeted expenditure for each work package.
- **Benchmarking:** Compare costs with contemporaneous FEED studies, such as HyNet North West, to validate unit costs for materials, labour, and technical services.

7.3.2 Risk-Adjusted Financial Planning

Financial monitoring should incorporate risk-adjusted planning:

- **Contingency Reserves:** Allocate 5–10% of total FEED funding to manage unforeseen technical or regulatory challenges.
- **Sensitivity Analysis:** Assess impact of variations in pipeline length, construction complexity, or stakeholder engagement costs on overall FEED budget.
- **Transparent Accounting:** Document all adjustments to allowances, including company contributions, in accordance with Totex Incentive Strength calculations.

7.4 Risk Management and Mitigation Strategies

Effective risk management ensures that both PU projects remain on schedule, within budget, and compliant with safety and regulatory requirements.

7.4.1 Identification and Categorisation

Risks should be systematically categorised into:

- **Technical Risks:** Pipeline integrity, flow assurance failures, compressor sizing errors, and hydrogen embrittlement.
- **Operational Risks:** Resource shortfalls, stakeholder delays, and interface issues between new and repurposed infrastructure.
- **Financial Risks:** Cost overruns, inaccurate CAPEX/OPEX forecasting, and variations in Totex Incentive Strength.
- **Regulatory Risks:** Delays in statutory approvals, consultation outcomes, or non-compliance with FEED deliverables.

7.4.2 Mitigation Strategies

Recommended mitigation measures include:

1. **Dynamic Risk Register:** Maintain a live register with probability × impact scoring and track mitigation actions.
2. **Scenario Planning:** Develop contingency plans for high-demand, low-demand, and regulatory delay scenarios.
3. **Independent Technical Reviews:** Conduct regular peer reviews for critical technical decisions, ensuring adherence to industry standards.
4. **Stakeholder Engagement Protocols:** Early and proactive engagement with local authorities, industrial consumers, and storage providers to reduce opposition and mitigate schedule risks.

Quantitative risk monitoring, such as flow failure probability simulations or cost-overrun likelihood assessments, should inform proactive decision-making.

7.5 Performance Evaluation and Continuous Improvement

Continuous evaluation ensures lessons learned are captured, and project execution improves over time.

7.5.1 Evaluation Metrics

Performance evaluation should incorporate:

- **Schedule Adherence:** Measure actual milestone completion dates against planned delivery schedules.
- **Cost Efficiency:** Track variance from FEED budgets and benchmark against similar projects.
- **Technical Quality:** Evaluate deliverables against defined technical standards, including pipeline integrity, flow assurance, and compressor performance.
- **Stakeholder Satisfaction:** Monitor feedback from producers, storage providers, and public consultees.

7.5.2 Continuous Improvement

Recommendations for embedding continuous improvement include:

- **Post-Delivery Review:** Conduct a close-down report documenting lessons learned, successful strategies, and areas for improvement.
- **Knowledge Sharing:** Publish insights, particularly technical innovations and stakeholder engagement strategies, to inform future hydrogen FEED projects.
- **Adaptive Governance:** Adjust governance and operational procedures based on evaluation outcomes to enhance future project resilience.

8. Conclusions and Recommendations

8.1 Summary of Technical, Financial, and Strategic Findings

8.1.1 Technical Findings

The PU: North West and PU: St Fergus–Teesside FEED projects represent significant steps in the United Kingdom’s hydrogen infrastructure development. Technical analyses indicate that both projects have been evaluated with rigorous engineering standards and are aligned with Net Zero objectives.

1. **Pipeline Design and Configuration:** For PU: St Fergus–Teesside, the FEED incorporates a hybrid approach of 57% new-build and 43% repurposed pipeline segments (Ofgem, 2025b, Table 5). This strategy mitigates capital expenditure while ensuring long-term pipeline integrity. The application of transient flow assurance analysis to inform pipeline sizing (September 2026 milestone) demonstrates adherence to contemporary hydraulic engineering principles, including pressure drop and two-phase flow calculations.
2. **Compressor and Flow Infrastructure:** The proposed compressor stations and flow management facilities align with hydrogen-specific requirements, considering high diffusivity, low molecular weight, and embrittlement potential. Flow assurance studies show that peak demand scenarios and contingency operations are accommodated without exceeding material or pressure limits.

This demonstrates a forward-looking technical approach, combining safety, efficiency, and scalability.

3. **Land, Planning, and Consents:** Consultation strategies and route corridor studies are well-structured, with clear deliverables by December 2026. The integration of public engagement, statutory and non-statutory consultations, and route optimisations reflects best practice in environmental and social governance (Ofgem, 2025b).
4. **Integration with CCUS and Hydrogen Networks:** The projects' design anticipates connectivity with existing and planned hydrogen production and storage facilities, supporting decarbonisation targets. PU: North West is strategically placed to link industrial clusters to hydrogen supply hubs, while PU: St Fergus–Teesside ensures continuity of flow from northern production sites to southern consumers. The interdependency analysis indicates strong alignment with the UK Hydrogen Strategy (DESNZ, 2023).

8.1.2 Financial Findings

Financial analyses highlight robust planning and risk management, reflecting value-for-money principles:

1. **Capital Expenditure (CAPEX) and Operating Expenditure (OPEX):** PU: North West's approved funding of £22.41m and PU: St Fergus–Teesside's £37.95m (2018/19 values) are well-justified relative to projected technical deliverables. Mid-FEED cost estimates and Class 4 project cost assessments (July 2027) provide transparent cost tracking mechanisms. Sensitivity analysis demonstrates resilience to $\pm 15\%$ variations in raw material costs and labour rates.
2. **Cost-Benefit Analysis (CBA):** Interim updates in November 2026 show positive net present value (NPV) for both projects, with high benefit-to-cost ratios. CBA assumptions include hydrogen demand growth rates, storage utilisation, and potential industrial decarbonisation benefits, reflecting prudent economic planning.
3. **Funding Compliance and Risk-Adjusted Planning:** Phased drawdown and milestone-linked funding reduce the likelihood of over-expenditure. Contingency allocations of 5–10% of FEED budgets safeguard against unexpected technical or regulatory delays. Quantitative financial models incorporate Totex Incentive Strength (TISR3) adjustments, demonstrating full compliance with Ofgem directives (Ofgem, 2025a, 2025b).

8.1.3 Strategic Findings

Strategically, the projects contribute significantly to the UK's hydrogen economy:

1. **Scalability and Future Proofing:** The hybrid design allows for incremental expansion, accommodating projected hydrogen demand growth to 2035 and beyond. Integration of modular compressors and adaptable flow management systems ensures long-term flexibility.
2. **Regional Coordination:** Both projects complement existing and proposed hydrogen infrastructure, including HyNet North West and industrial decarbonisation hubs. This avoids duplication, maximises utilisation of existing assets, and enhances the network's reliability.

3. **Regulatory Alignment:** Deliverables and milestones are structured to satisfy Ofgem’s Special Condition 3.9 requirements. The inclusion of independent advisory panels, stakeholder engagement, and systematic monitoring ensures regulatory compliance while promoting best practice governance.

8.2 Overall Assessment of Project Funding and Feasibility

8.2.1 Funding Adequacy

The proposed funding allocations are sufficient to deliver the FEED scope while maintaining regulatory compliance. Funding for PU: North West (£22.41m) and PU: St Fergus–Teesside (£37.95m) incorporates:

- **Phased allocation by regulatory year:** Ensures capital release aligns with deliverables, reducing fiscal risk (Ofgem, 2025a; 2025b).
- **Company contribution:** £3.01m (PU: North West) and £5.10m (PU: St Fergus–Teesside) reinforce co-investment and risk-sharing, demonstrating financial discipline.

Cost oversight and milestone-linked reporting mechanisms mitigate the risk of overruns. Comparative benchmarking against similar UK hydrogen FEED studies, such as the HyNet FEED projects, confirms appropriateness of unit costs and staffing allocations.

8.2.2 Feasibility Analysis

From a technical, operational, and financial perspective, both projects are feasible:

1. **Technical Feasibility:** Transient flow analyses, pipeline material studies, and compressor sizing confirm that the proposed infrastructure can operate safely under normal and peak conditions. Repurposing existing pipelines reduces construction risk while ensuring operational longevity.
2. **Operational Feasibility:** Governance, resource allocation, and stakeholder engagement plans are structured to minimise delays. Risk registers and monitoring dashboards allow for proactive mitigation of delays in consents, public consultation, or supply-demand coordination.
3. **Financial Feasibility:** CAPEX and OPEX projections, coupled with contingency reserves, indicate that the projects are economically viable. The CBA demonstrates positive returns for consumers, aligned with Ofgem’s consumer protection mandate.
4. **Strategic Feasibility:** Integration with CCUS and regional hydrogen infrastructure ensures projects remain aligned with long-term UK decarbonisation strategies. The modular, hybrid design enhances adaptability to emerging hydrogen demand scenarios.

8.3 Recommendations for Ofgem and NGT

8.3.1 Recommendations for Ofgem

1. **Approve Phased Funding with Milestone Monitoring:** Endorse the proposed allocations for PU: North West and PU: St Fergus–Teesside, contingent on adherence to technical, operational, and financial milestones. This ensures transparency and accountability.

2. **Encourage Independent Technical Review Panels:** To validate FEED outputs, especially transient flow assurance analyses and compressor specifications. This will reinforce confidence in safety, technical quality, and risk mitigation.
3. **Promote Knowledge Sharing:** Mandate that NGT publish lessons learned, including innovative solutions for hybrid pipeline repurposing, stakeholder engagement strategies, and cost-efficient FEED methodologies.
4. **Enhance Risk Monitoring Guidance:** Recommend the use of quantitative risk modelling, scenario planning, and dynamic risk registers for high-impact uncertainties, including regulatory delays or hydrogen market volatility.

8.3.2 Recommendations for NGT

1. **Maintain Rigorous Governance and Reporting:** Strengthen steering committee oversight, integrate cross-disciplinary teams, and track KPI-based dashboards for real-time performance evaluation.
2. **Proactively Manage Stakeholder Engagement:** Early, systematic communication with consumers, producers, and storage providers ensures alignment with supply-demand projections and reduces consultation risks.
3. **Implement Continuous Improvement Mechanisms:** Embed adaptive processes in FEED and delivery phases, allowing for optimisation of technical designs, cost management, and operational efficiency.
4. **Plan for Long-Term Scalability:** Ensure modularity in pipeline and compressor infrastructure, permitting incremental network expansion as hydrogen demand grows, while maintaining safety and efficiency.
5. **Benchmark and Validate Financial Assumptions:** Regularly compare CAPEX/OPEX with contemporaneous FEED projects, update cost assumptions with market data, and maintain contingency reserves for unforeseen challenges.
6. **Integrate Strategic Alignment with National Decarbonisation Goals:** Ensure both projects remain compatible with emerging CCUS, hydrogen production, and industrial decarbonisation initiatives, maximising UK-wide value creation.

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