Gas NIC Final Report

Clean Energy Balance - Hydrogen Injection for Carbon Displacement

Project Reference: WWU GN 01

REPORT from RUNE ASSOCIATES LTD

(Confidential)

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1. EXPLANATORY NOTES

This report is based on:

1. The Initial Screening Submission submitted on 29th April 2013
2. The Full Submission, submitted on 9th August 2013
3. Responses to Questions
4. Dialogue between the Rune Consultant and the Project Team on 3rd September 2013
5. Further information provided following the Project team meeting
6. Dialogue between the Project Team and the Expert Panel on 30th August and 24th September 2013
7. Dialogue between the Rune Consultants and the Expert Panel on 13th September 2013.
8. A Re-Submission of the proposal on 11th October 2013
9. The basis of the content of this report is as follows:
    - The text of Sections 2 through 11 is that in the Interim Report dated 18th September 2013.
    - The colour ratings shown in Sections 3 through 11 reflect an assessment of the Interim Report information, against the NIC Gas evaluation criteria.
    - Section 12 addresses the implications of the changes set out in the Re-Submission.
    - The colour ratings shown in Section 12 reflect an assessment of the total information provided in the Full Submission and Re-Submission, against the NIC Gas evaluation criteria.

2. SUMMARY OF PROJECT INFORMATION

2.1. SUMMARY DETAILS

Basic Project Information	
Project name	Clean Energy Balance (CEB) - Hydrogen Injection for Carbon Displacement
Project Short Name	WWU GN 01 Clean Energy Balance
The Funding Licensee	Wales & West Utilities Ltd. (WWU)
Total Project Cost (Cell I13[1])	£4,718k
External Funding. (Cell I25)	£252k
Network Licensee Compulsory Contribution. (Cell I66)	£447k
Network Licensee Extra Contribution. (Cell I37)	Nil
Gas NIC Funding Request. (Cell I85)	£3,900k
Direct Benefits.	Nil
Requested threshold for the funding of cost over-runs if different to the default.	Nil
Requested protection on Direct Benefits, if different to the default.	N/A

2.2. SYNOPSIS

Synopsis of Project Submission	
Description of the problem	The specific problem to be resolved is that although hydrogen has been identified by DECC as a low carbon source of gas that could displace natural gas, hydrogen gas injection technology has not been demonstrated in the UK. In addition, the volume of hydrogen currently permitted in the natural gas network, at 0.1% by volume, is too low to offer a material contribution to the displacement of natural gas. The current level of hydrogen allowed was based on the composition of natural gas available at the time it was set. A detailed analysis by British Gas in the 1980's to determine compositions of gases that could safely be used in the UK concluded that up to 10% hydrogen was possible. This work resulted in the Dutton diagram a 3D chart plotting Wobbe Index v's Propane Equivalent v's hydrogen content. The present legislation (GS(M)R) was drawn up in 1996 at which time work was undertaken to simplify the Dutton diagram from 3D to 2D. Since there were negligible levels of hydrogen in natural gas, the hydrogen axis was removed by stipulating that no more than 0.1% hydrogen could be present. WWU expects that the previous studies to demonstrate that 1% Oxygen was safe (compared to the current limit of 0.2%) will be of considerable help in seeking an exemption to

[1] Cell references relate to the NIC Funding request tab of the Financial workbook

Synopsis of Project Submission	
	increase the Hydrogen limit. The Gas NIC submission is part of a cross industry venture and linked to LCNF submission WPD T2 05 v1, which addresses the problem of constraints in the electricity network associated with the transition to electrical heating and transport and the consequential impact on peak demand. This will necessitate significant additional lower-level electricity network reinforcement unless local low carbon energy sources for power generation and/or methods of load smoothing can be found. WWU has indicated that the Gas NIC submission would not proceed in the absence of funding for the interlinked LCNF submission.
Description of the proposed method	The method proposed in this submission is to inject hydrogen, produced by electricity generation that would otherwise be constrained off and subsequently stored, into the gas distribution system. The hydrogen natural gas mixture will then be utilised by gas consumers for heating and/or electricity generation. A Network Innovation Allowance (NIA) strand is proposed to obtain an exemption from the Gas Safety (Management) Regulations (GS(M)R) to allow levels of hydrogen in excess of the current limit to be injected into the Wadebridge medium pressure network on a trial basis.
Description of proposed Trial(s)	Wadebridge in Cornwall has been chosen as the location for the trial of the cross industry venture; here the electricity network is constrained and the 33kV electricity distribution line runs very close to the WWU medium pressure (up to 2Bar(g)) pipeline that serves the Wadebridge low pressure network. Mixed gas injected into the medium pressure network will only be supplied to customers in Wadebrdge. The following aspects will be trialled: Gas Storage and Mixing - drawing natural gas from the medium pressure local network and hydrogen from pressurised storage. Mixed Gas Injection - into the gas network. Gas Export and Usage – at a point beyond the electricity network constraint mixed gas will either be burnt by existing gas consumers or used to fuel CHP units, Control System - to manage the end-to-end flow of energy, optimise generation export and gas injection. Commercial Modelling - analysis of the complete value chain from energy conversion through to injection and end usage including losses in conversion and transportation.
Intended outcomes (solutions)	Learning associated with the practical issues of the connection and management of hydrogen injection into the gas network. Learning associated with the end use, by consumers, of hydrogen /natural gas mixtures. Learning to support a potential increase in acceptable levels of hydrogen in gas distribution systems.

Synopsis of Project Submission	
Customer impact of Project implementation.	WWU indicates that the project provides value for money to customers insomuch as it avoids additional future expenditure relating to: • Decommissioning of the gas system • Migrating to an alternative low-carbon heat energy source (electricity or town gas) • Paying an increased share of the network maintenance cost. A process of appliance inspection and adaptation may be required if obtaining an exemption to inject higher levels of hydrogen than the current limit, identifies that this is required. In these circumstances, access to all customer premises and to all appliances would be required.
Key strengths of the proposal	Likely to add to knowledge that will assist the development of a low carbon energy sector. Relevant new learning for all UK GDNs can also be expected to arise from the control and management of the hydrogen natural gas mixtures to close tolerances and from the effects of hydrogen on gas transportation in low pressure distribution systems and utilisation. There is a strong commitment on the part of all Partners to this project and the linked LCNF submission. Partner confidence in their ability and readiness to commence the Programme in January 2014 appears well founded.
Key weaknesses of the proposal	Without an expected price, or range of prices, for the hydrogen when it is injected into the WWU network, it is not possible to assess the potential commercial feasibility of the project. The approach used to present financial benefits appears not to be consistent with NIC governance and the benefits claimed are unlikely to be achieved at the levels of hydrogen injection proposed. The proposals for customer engagement require further consideration, particularly in relation to accessing all premises and contingency arrangements if this is not achieved.
Project management structure and related information.	The project has been planned and will be delivered in accordance with an accepted project management methodology (PRINCE 2, adapted). The project governance and reporting structure is set out this includes oversight by a programme Review Board supported by a Project Assurance team. The roles and high level responsibilities of the Partners and their contractors are also set out. A detailed Microsoft Project plan which identifies tasks and the accountable company as well as interdependencies has been prepared.
Derogations/ Exemptions that the Project would/may require.	The project will require an exemption from the Gas Safety (Management) Regulations (GS(M)R) to allow levels of hydrogen in excess of the current limit to be injected into the Wadebridge medium pressure network on a trial basis .

Synopsis of Project Submission	
Proposed Successful Delivery Reward Criteria for the Project.	The definition of the SDRCs is clear and tied to project milestones. The majority of the criteria refer to deliverables that cover both the NIC Gas project and the LCNF proposal. None of the criteria are linked to the key learning outputs of the project.
The key learning outcomes which the Project aims to deliver.	Learning associated with the practical issues of the connection and management of hydrogen injection into the gas network. Learning associated with the end use, by consumers, of hydrogen natural gas mixtures. Learning to support a potential increase in acceptable levels of hydrogen in gas distribution systems.

3. SUMMARY OF ASSESSMENT - INTERIM REPORT

3.1. OVERALL ASSESSMENT

Overall summary
The context for the project is that although hydrogen has been identified by DECC as a low carbon source of gas that could displace natural gas, hydrogen gas injection technology has not been demonstrated in the UK. In addition, the volume of hydrogen currently permitted in the natural gas network, at 0.1% by volume, is too low to offer a material contribution to the displacement of natural gas. The NIC Gas submission is part of a cross industry venture and linked to LCNF submission WPD T2 05 v1, which addresses the problem of constraints in the electricity network associated with the transition to electrical heating and transport and the consequential impact on peak demand. This will necessitate significant additional lower-level electricity network reinforcement unless local low carbon energy sources for power generation and/or methods of load smoothing can be found. WWU has indicated in the full submission proforma that the neither the NIC Gas submission nor the interlinked LCNF submission would proceed in the absence of funding for both of the projects. The NIC Gas submission does focus on demonstrating the practical feasibility of injecting hydrogen up to 2% by volume into the WWU gas distribution system. This is likely to add to knowledge that will assist the development of a low carbon energy sector. At this level of injection meaningful savings in CO2 emissions appear achievable. Relevant learning can also be expected to arise from the control and management of the hydrogen natural gas mixtures to close tolerances and from the effects of hydrogen on gas transportation and utilisation. This represents new learning for all UK GDNs, which will complement their existing understanding of the tools and techniques available for decarbonising their networks. The approach used to present financial benefits appears not to be consistent with NIC governance and the benefits claimed are based on significant decarbonisation of the gas network in the area of the trial. It is unlikely that injection of up to 2% of hydrogen will lead to such a possibility. In addition, without an expected price, or range of prices, for the hydrogen when it is injected into the WWU network, it is not possible to assess the potential commercial feasibility of the project. The project will require an exemption from the Gas Safety (Management) Regulations (GS(M)R) to allow levels of hydrogen in excess of the current limit to be injected into the gas distribution network on a trial basis. In considering such an exemption the HSE may require a programme of appliance inspection and adaption if found to be necessary. WWU has recognised this possibility but the proposals for customer engagement require further consideration, particularly in relation to accessing all premises and contingency arrangements if this is not achieved. HSE may also require assurance that injection of up to 2% of hydrogen will not have adverse effects on safe gas conveyance. The project draws on work to consider hydrogen injection into the natural gas distribution network in Germany and other European states; however the GB distribution system materials and appliance population differ as do the regulatory gas quality standards. The Partners and the processes by which they have been selected appear to be appropriate in the context of the NIC Gas project and the linked LCNF proposal. The arrangements for project planning, implementation and programme governance also appear to be robust. There is a strong commitment on the part of all Partners to this project and the linked LCNF submission. Partner confidence in their ability and readiness to commence the Programme in January 2014 appears well founded.

3.2. SUMMARY OF ASSESSMENT AGAINST INDIVIDUAL EVALUATION CRITERIA

Key to ratings		• Seems to be generally in line with the objectives and requirements of the NIC Gas evaluation criteria, • Whilst there are some areas where additional information would be useful, that provided is generally comprehensive and provides no immediate cause for concern.
		• Some indication that the project is in line with the objectives and requirements of the NIC Gas evaluation criteria. However further scrutiny is required to ensure this, • There are some gaps in the information provided, • Further assurance is needed to confirm that the project is viable and that risks are appropriately managed
		• Significantly more assurance is required that the project is in line with the objectives and requirements of the NIC Gas evaluation criteria, • There are some major gaps in the information provided, • Considerable scrutiny is needed to confirm that the project is viable and that risks are appropriately managed, • Potential major risks to the viability of the project.

Evaluation Criteria[2]	Rating	Assessment
Criterion A: Low carbon and benefits		The Future of Heating strategy, published by the Department of Energy and Climate Change, recognises the potential of hydrogen, produced using renewable energy sources, and injected into the gas network as one of the potential means of decarbonising heat. Demonstrating the practical feasibility of injecting hydrogen up to 2% by volume into the WWU gas distribution system is likely to add to knowledge that will assist the development of a low carbon energy sector. At this level of injection, meaningful savings in CO2 emissions appear achievable. If an exemption to allow 2% injection is not forthcoming, the materiality of carbon savings is doubtful. The approach used to present financial benefits appears not to be consistent with NIC governance and the benefits claimed are based on significant decarbonisation of the gas network in the area of the trial. It is unlikely that injection of up to 2% of hydrogen will lead to such a possibility and even less likely if the exemption is not agreed. It is also not possible to assess the potential commercial feasibility of hydrogen injection from the submission, which does

[2] Further information on evaluation criteria can be found in the Gas Network Innovation Competition Governance Document

Evaluation Criteria[2]	Rating	Assessment
		not indicate any expected price, or range of prices, for the hydrogen when it is injected into the WWU network.
Criterion B: Value for money for gas customers		Relevant learning can be expected to arise from the control and management of the hydrogen natural gas mixtures to close tolerances and from the effects of hydrogen on gas transportation and utilisation. The benefits from the learning of this project and its potential contribution to decarbonisation of the gas network will accrue entirely to customers of the gas network. However, many of the references to benefits in the submission relate to benefits that are only likely to be achieved with, if not decarbonisation of the gas distribution system, the injection of levels of hydrogen substantially greater than those proposed in the trial, particularly if the current 0.1% limit is unable to be increased. Partners are providing equipment at cost. The engagement of contractors is subject to the partners' procurement procedures. These arrangements appear to provide confidence that the project will be delivered at competitive cost levels.
Criterion C: Generates new knowledge		The project will provide new learning on the engineering and safety challenges of mixing and injection, the subsequent safe transport of hydrogen natural gas mixtures through the gas distribution network and safe utilisation by gas customers. It will also provide learning about the potential contribution of hydrogen to achieve reductions in carbon emissions from the gas network itself and also from the gas transported through the network. This represents new learning for all UK GDNs, which will complement their existing understanding of the tools and techniques available for decarbonising their networks. The knowledge capture strategy and processes covering both planned and unplanned learning appear to be well thought through and robust.
Criterion D: Innovative and unproven business case		Injecting hydrogen into the natural gas distribution network has not been demonstrated in the UK. Although similar technologies are being demonstrated in Germany the distribution system materials and appliance population differ as do the regulatory gas quality standards. WWU has indicated reasons why the project would not be funded as business as usual. These reasons appear appropriate if the project involves injection of hydrogen above the current limit of 0.1%. Thus successfully obtaining an exemption to allow this is an important outcome.

Evaluation Criteria[2]	Rating	Assessment
Criterion E: Involvement of other partners & external funding		The level of external funding is identified as £252k out of a total project cost of £4,718k. Each partner will provide external project funding through the provision of a 10% cost reduction in the cost of their services and equipment. The Partners and the processes by which they have been selected appear to be appropriate in the context of the NIC Gas project and the linked LCNF proposal. There appears to be a strong commitment on the part of all Partners to this project and the linked LCNF submission.
Criterion F: Relevance and timing		The DECC Carbon Plan Vision indicates that oil and gas need to be replaced by electricity, sustainable bioenergy, or hydrogen. The Future of Heating Strategy recognises the potential of hydrogen, produced from renewable energy sources, and injected into the gas network as one of the potential means of decarbonising heat. Developments and trials of hydrogen injection are under way in other European states. It would thus appear to be both relevant and timely to trial the injection of hydrogen into the GB gas distribution system.
Criterion G: Demonstration of robust methodology		The project methodology appears generally robust however the proposals for customer engagement if appliance inspection and possible adaption is required appear to require further consideration, particularly in relation to accessing all premises and contingency arrangements if this is not achieved. The arrangements for project planning, implementation and programme governance appear to be robust. From the information provided the process for compiling the project budget and the forecast costs appear to be consistent with good practice. There is evidence of risk identification, review, mitigating actions and contingency planning which appear to have identified key risks and the reaction to them although the risks associated with the potential appliance inspection programme have not yet been addressed. Partner confidence in their ability and readiness to commence the Programme in January 2014 appears well founded.
Criterion: Appropriateness of the SDRC definitions and timing and adequacy of links to key project milestones		The definition of the SDRCs is clear and tied to project milestones. The majority of the criteria refer to deliverables that cover both the NIC Gas project and the LCNF proposal. None of the criteria are linked to the key learning outputs of the project.

4. CRITERION A: LOW CARBON AND BENEFITS

Criteria	Rating	Overall assessment
Criterion A: Accelerates the development of a low carbon energy sector and/or environmental benefits & has the potential to deliver net financial benefits to existing and/or future customers Credibility of the carbon, environmental and financial benefits claimed for the project.		The Future of Heating strategy, published by the Department of Energy and Climate Change, recognises the potential of hydrogen, produced using renewable energy sources, and injected into the gas network as one of the potential means of decarbonising heat. Demonstrating the practical feasibility of injecting hydrogen up to 2% by volume into the WWU gas distribution system is likely to add to knowledge that will assist the development of a low carbon energy sector. At this level of injection, meaningful savings in CO2 emissions appear achievable. If an exemption to allow 2% injection is not forthcoming, the materiality of carbon savings is doubtful. The approach used to present financial benefits appears not to be consistent with NIC governance and the benefits claimed are based on significant decarbonisation of the gas network in the area of the trial. It is unlikely that injection of up to 2% of hydrogen will lead to such a possibility and even less likely if the exemption is not agreed. It is not possible to assess the potential commercial feasibility of hydrogen injection from the submission, which does not indicate any expected price, or range of prices, for the hydrogen when it is injected into the WWU network.

Sub-Criteria	Assessment and material document references
* contribution to what part of the DECC Plan?	The Carbon Plan Vision indicates that the oil and gas used to drive cars, heat buildings and power industry will, in large part, need to be replaced by electricity, sustainable bioenergy, or hydrogen. The focus of the project is associated with injecting hydrogen natural gas mixtures into the gas distribution network. The aim of the project is to test and demonstrate the practical feasibility of injecting hydrogen up to 2% by volume into the WWU gas distribution system. Injection at this level requires an exemption to allow levels in excess of the current limit of 0.1%. Section 1.3

Sub-Criteria	Assessment and material document references
* carbon benefits claimed & assumptions	Claimed carbon benefits materialise in two ways, Savings arising from utilisation of less methane, assuming 3,300 gas supply points and the Ofgem average consumption per household of 16,500kWh, with a 2% hydrogen content, this equates to 195 tonnes of CO2 per annum for Wadebridge. Replacing 0.1% of the methane (i.e. the current GS(M)R limit) in the WWU network would save approximately 500 tonnes of CO2 equivalent a year through reduced leakage of methane. If this was increased to 2%, the savings would be 10,000 tonnes of CO2 equivalent a year. Appendix F The benefits claimed appear appropriate on the basis of a 2% hydrogen in natural gas mixture supplied to customers who are connected to gas distribution network supplying Wadebridge. Sections 3.2, 3.6
* environmental benefits & assumptions	The submission refers to the sustainability challenge of ensuring that there is a longer term viability of gas networks, with lower environmental impact. WWU indicates that injection of hydrogen into the gas distribution network provides an effective and efficient means to decarbonise heat and maximise the continued use of the existing gas infrastructure. The environmental benefits are quantified in terms of CO2 reductions described above. Section 1.3
* financial benefits claimed, robustness of claims and assumptions	WWU has identified a Net Benefit of £963k over a 20 year period. This is based on Wadebridge and: An assumed gas demand reduction of 40% by 2050 resulting in a 25% reduction in customers connected but with the same extent of network . WWU has equated this to an increase of 25% x WWU's [redacted] annual network support cost for each of the remaining customers. Assuming 3300 supply points in Wadebridge from a total of 2.5m WWU supply points equates to an annual cost of circa [redacted] per annum for Wadebridge. As customer number reduction may be back end loaded, an annual figure [redacted] has been assumed for the next 20 years. This [redacted] is supplemented by [redacted] the value over 20 years of the 195 tonnes annually of CO2 saved at a carbon price of [redacted]/tonne, giving a Base Case cost of [redacted] The cost of delivering future hydrogen natural gas injection, estimated at [redacted] provides the Method cost. This approach does not appear to be consistent with the 'Gas NIC guidance for Full Submission documents' which indicates that the Base Case costs should refer to the costs of delivering the Solution(s) (at the scale being tested within the Project) through the most efficient method currently in use in GB's gas transportation system. It is also unlikely that the addition of 2% hydrogen will result in sufficient decarbonisation to prevent a reduction of 25% in customers on the Wadebridge gas network. It is not possible to assess the potential commercial feasibility of hydrogen injection from the submission, which does not indicate any expected price, or range of prices, for the hydrogen when it is injected into the WWU network.

Sub-Criteria	Assessment and material document references
	WWU indicates that there is currently no market for constrained off electricity in the UK and that a key output of the project will be the modelling of the end to end value chain to determine the value of storage and hence the value of the constrained generation and therefore the price of the electricity used to generate the hydrogen, which in turn, will determine the price of the hydrogen when it is injected into the WWU network. The need to establish suitable commercial arrangements under the Uniform Network Code is acknowledged in the submission but at the project team meeting, WWU indicated that detailed arrangements had not been explored, in particular the engagement of a shipper and /or supplier to manage the commercial aspects of natural gas offtake, supply of hydrogen to the mixing process and injection of the hydrogen natural gas mixture. Establishing these arrangements in the absence of some certainty in the price of the hydrogen appears to be challenging. Sections 2.1, 4.1, Appendix G
* quantitative analysis provided	The quantitative analysis is limited to that related to carbon and financial benefits, discussed above
* cost, time and speed to implement	The Project Plan seems realistic and achievable. The cost forecasts appear to have been compiled in a manner that is consistent with good practice but there is insufficient detailed information to verify that these costs are appropriate. Section 4.2, Appendix G
* claims for potential for replication across GB	WWU claims that the solution is replicable and that there is considerable scope to roll it out throughout GB.WWU indicates that it could be implemented at sites where the electricity and gas networks of appropriate capacities cross or are very close together and they have identified some 50 potential locations in Cornwall from a map examination of the gas and electricity distribution networks. Other than an indication that the main constraints on location will relate to the requirement for a water supply and planning consents, there is no further information or evidence to support the replication clams. Section 2.3
* claimed capacity released and how quickly released, if relevant	There are no references to claimed release of gas distribution network capacity from the project.

5. CRITERION B: VALUE FOR MONEY

Criteria	Rating	Overall assessment
Criterion B: Value for money for gas customers The size of benefits and learning from the project that is applicable to the relevant network		Relevant learning can be expected to arise from the control and management of the hydrogen natural gas mixtures to close tolerances and from the effects of hydrogen on gas transportation and utilisation. The benefits from the learning of this project and its potential contribution to decarbonisation of the gas network will accrue entirely to customers of the gas network. However, many of the references to benefits in the submission relate to benefits that are only likely to be achieved with, if not decarbonisation of the gas distribution system, the injection of levels of hydrogen substantially greater than those proposed in the trial, particularly if the current 0.1% limit is unable to be increased. Partners are providing equipment at cost. The engagement of contractors is subject to the partners' procurement procedures. These arrangements appear to provide confidence that the project will be delivered at competitive cost levels.

Sub-Criteria	Assessment and material document references
* Proportion of benefits to customers (the relevant network system) as opposed to elsewhere on the supply chain	The direct benefits from the learning of this project and its potential contribution to decarbonisation of the gas network will accrue entirely to customers of the gas network. Through the linked LCNF project, the programme will also indirectly benefit the electricity distribution network customers (which will comprise of the gas customers plus others not connected to the gas network) and renewable electricity generators. Hydrogen producers will benefit indirectly insofar as they can inject hydrogen but they will not receive any subsidy from the network and the charges they pay for entering gas will be cost reflective as they are for bio methane entry. Section 4.2
* how the project has a potential direct impact on the network	The WWU gas distribution network will be directly affected by the injection of hydrogen into the Wadebridge medium pressure system. The rate of injection will be controlled to maintain the regulated hydrogen fraction (i.e. 2%) and the network pressure within the regulated limits. WWU may need to make changes to the operation of the medium pressure network in the area to facilitate this. There will be a network entry agreement between WWU and the operator of the entry facility which will stipulate gas quality and other key requirements such as metering and gas quality measurement. Ofgem will be asked to agree not to require installation of CV measurement equipment at the site in order to reduce cost. The shipper injecting the gas into the network will be charged using the same principles as for bio methane although allowance will need to be made to take account of the gas being taken out of the network, blended and then re-injected.

Sub-Criteria	Assessment and material document references
	To allow levels of hydrogen in excess of the current 0.1% limit to be injected into the network, WWU will need to obtain an exemption from the Gas Safety (Management) Regulations (GS(M)R). The proposed operational arrangements for the trial appear appropriate and consistent with WWU's obligations under its gas transportation licence and Safety Case. Section 2.2
* justification that the scale & cost of the Project is appropriate in relation to the learning that is expected.	WWU claims that the programme will deliver significant learning, that it has the potential for providing the basis for the development of a substantial change to the GB gas industry and that the cost is relatively small for such a large potential gain. However, many of the references to benefits in the submission relate to benefits that are only likely to be achieved with, if not decarbonisation of the gas distribution system, the injection of levels of hydrogen substantially greater than those proposed in the trial, particularly if the current 0.1% limit is unable to be increased. Section 4.2
* the processes that have been employed to ensure that the Project is delivered at a market competitive cost	Partners, such as ITM Power (ITM), are providing equipment at cost. Where partners use established subcontractors, they will have been subject to the partners' procurement procedures. The IT integration service provider has been sourced using WPD's procurement processes. Payments to partners will be back-loaded and paid on completion of outputs rather than expenditure and so partners will have a strong incentive to manage costs and ensure delivery of outputs relevant to the programme's aims These arrangements appear to provide confidence that the project will be delivered at competitive cost levels. Section 4.2
* how Project Partners have been identified and selected including details of the process that has been followed and the rationale for selecting Participants and ideas for the Projects	WWU's partners are: • ITM Power Plc • Toshiba International (Europe) Ltd , • Wadebridge Renewable Energy Network Ltd (WREN) ITM and Toshiba are the initiators of the LCNF project and WWU was approached by the former to explore the possibility of an NIC Gas hydrogen injection project linked to the LCNF proposal. A key requirement for the LCNF strand was a renewable generator on a constrained network. WREN offered this opportunity and as a community group and developer of renewable generation, provides links to the community in Wadebridge. In addition Cornwall Development Company, have been engaged through Toshiba's procurement procedures to provide Programme Management. Similarly CGI IT UK Ltd has also been engaged through Toshiba's procurement procedures to provide IT services integration. The Partners and the processes by which they have been selected appear to be appropriate in the context of this project and the linked LCNF proposal. Section 4.2

Sub-Criteria	Assessment and material document references
* the costs associated with protection from reliability or availability incentives and the proportion of these costs compared to the proposed benefits of the Project	None have been claimed Section 4.2

6. CRITERION C: GENERATES NEW KNOWLEDGE

Criteria	Rating	Overall assessment
Criterion C: Generates new knowledge The potential for new learning to be generated by the project		The project will provide new learning on the engineering and safety challenges of mixing and injection and the subsequent safe transport of hydrogen natural gas mixtures through the gas distribution network. It will also provide learning about the potential contribution of hydrogen to achieve reductions in carbon emissions from both the gas network itself and the gas transported through the network. This represents new learning for all UK GDNs, which will complement their existing understanding of the tools and techniques available for decarbonising their networks. The knowledge capture strategy and processes covering both planned and unplanned learning appear to be well thought through and robust.

Sub-Criteria	Assessment and material document references
* the potential for new learning to be generated by the Project	The project will provide new learning, which will include: • The engineering and safety challenges of mixing and injection and the subsequent safe transport of the mixture through the low pressure distribution network, • The processes necessary to achieve an exemption to the Gas Safety (Management) Regulations 1996 (GS(M)R) • The contribution of hydrogen to enabling achievable reductions in carbon emissions from both the gas network (through leakage) and the gas transported through the network, while minimising network impact. Section 4.3
* how learning relates to the distribution system	In the past, the WWU gas distribution network has received all of its gas from the National Transmission System; however the introduction of bio methane injection now requires WWU to manage injection points embedded in its system. The hydrogen injection point will be another embedded input. Relevant learning can be expected to arise from the control and management of the hydrogen natural gas mixtures to close tolerances and from the effects of hydrogen on gas transportation and utilisation. Section 4.2
* applicability of learning to other network licensees	This represents new learning for all UK GDNs, which will complement their existing understanding of the tools and techniques available for decarbonising their networks, and the subsequent decarbonisation of the heat demand of connected customers. Section 4.3

Sub-Criteria	Assessment and material document references
* the proposed IP management strategy and conformance with the default principles	WWU has indicated that all learning from the programme (e.g. control algorithms, commercial models, etc) will be foreground IPR and as such will be shared amongst all GDNs. WWU confirm that the IPR arrangements conform to the default arrangements. Sections 4.3, 5.2
* credibility of the proposed methodology for capturing learning from the trial	The knowledge capture strategy and processes covering both planned and unplanned learning appear to be well thought through and robust. The proposals cross both this project and the linked LCNF proposal but identify key learning outcomes that relate specifically to the gas distribution network Sections 4.3, 5.1
* quality of plans for knowledge sharing	The proposals for knowledge dissemination cover a wide range of target audiences and media and appear to be thorough. They include • Technical reports made publicly available on the programme's website • Academic papers published in leading journals and conferences. • Workshops with relevant participants • Reports and white papers made available on the programme's website. • Reports made publicly available on the programme's website • Workshops with relevant participants • End of programme lessons learned booklet. In addition to this, social media channels (e.g. Twitter) will be used as a means of notifying and updating interested stakeholders on the progress of the project. Sections 4.3, 5.1
* how alternative IP strategy would deliver value for money to customers	As indicated above, the default IPR arrangements apply and no alternative strategies have been suggested. Sections 4.3, 5.2

7. CRITERION D: INNOVATIVE AND UNPROVEN BUSINESS CASE

Criteria	Rating	Overall assessment
Criterion D: Innovative and unproven business case The extent to which projects could not be performed as part of a network licensee's normal course of business.		Injecting hydrogen into the natural gas distribution network has not been demonstrated in the UK. Although similar technologies are being demonstrated in Germany the distribution system materials and appliance population differ as do the regulatory gas quality standards. WWU has indicated reasons why the project would not be funded as business as usual. These reasons appear appropriate if provided the project involves injection of hydrogen above the current limit of 0.1%. Thus, successfully obtaining an exemption to allow this is an important outcome.

Sub-Criteria	Assessment and material document references
* The justification that the project is truly innovative: how the project is innovative and evidence that it has not been tried before	Injecting hydrogen into the natural gas distribution network has not been demonstrated in the UK. The project involves mixing of low concentrations of hydrogen with natural gas extracted from a representative UK medium pressure gas network and the subsequent re introduction of the mixture back into the network at the same point. Although similar technologies are being demonstrated in Germany the distribution system materials and appliance population differ and the regulatory gas quality arrangements there allow up to 9.99% of hydrogen (although actual injection is limited to 2% due to CNG vehicle considerations) compared with 0.1% currently in GB. The GB limit will need to be increased above this level to make a meaningful contribution to decarbonising gas networks. The evidence indicates that GB trials will be required as part of increasing acceptable hydrogen levels and before hydrogen injection can be regarded as normal operational practice for GDNs. Section 4.4
* the credibility of why the network licensee could not fund such a project through its price control allowance	WWU indicates that it is unable to fund the programme as part of its business as usual activities because: 1. The programme is unlikely to deliver any benefits to customers in the current price control period. 2. The cost of the programme is too large to be funded entirely by WWU's customers at commercial rates. 3. Other parties will gain from the programme and therefore it is appropriate that they should provide contributions of expertise and products at cost. These points appear appropriate if the project involves injection of hydrogen above the current limit of 0.1%. If not, it might be argued that the techniques of controlling injection of gas into the gas distribution network

Sub-Criteria	Assessment and material document references
	against current quality limits, is business as usual drawing on bio methane experience for example. Section 4.4
* why the project can only be undertaken with the support of the NIC, including scrutiny of the claimed commercial, technical, or operational risks associated with the project	WWU indicates that the programme is appropriate for NIC funding for two main reasons: • There is considerable uncertainty over the timing of financial benefits to customers owing to uncertainty with government policy • The regulatory environment and cross sector nature of the programme is too risky for commercial funding. Whilst these comments almost certainly apply to the linked LCNF proposal and to some extent to this project in relation to the potential long term decarbonisation of the gas network, the learning benefits from the narrow scope of trialling hydrogen injection up to 2% are more certain and the risks to achieving a successful outcome are relatively low. Section 4.4

8. CRITERION E: INVOLVEMENT OF OTHER PARTNERS & EXTERNAL FUNDING

Criteria	Rating	Overall assessment
Criterion E: Involvement of other partners & external funding The level of external funding and appropriateness of collaborators involved in each project submission		The level of external funding is identified as £252k out of a total project cost of £4,718k. Each external partner will provide project funding through the provision of a 10% cost reduction in the cost of their services and equipment. The Partners and the processes by which they have been selected appear to be appropriate in the context of the NIC Gas project and the linked LCNF proposal. There appears to be a strong commitment on the part of all Partners to this project and the linked LCNF submission.

Sub-Criteria	Assessment and material document references
* appropriateness and affiliation of project partners	All of the partners are independent organisations. ITM and Toshiba are the initiators of the LCNF project and WWU was approached by the former to explore the possibility of an NIC Gas hydrogen injection project linked to the LCNF proposal. It would appear that the collaboration is appropriate in the context of the NIC Gas project and the linked LCNF proposal. Sections 4.2, 4.5
* level of external funding achieved, presented on a comparable basis	The level of external funding is identified as £252k out of a total project cost of £4,718k WWU indicates that each partner will provide a 10% cost reduction in the cost of their services and equipment, in addition to the considerable efforts already invested in designing and modelling the systems, components and Methods to be deployed by this programme. Section 4.2, Appendix G
* effectiveness of systems & processes to obtain partners and ideas	The Partners and the processes by which they have been selected appear to be appropriate in the context of the NIC Gas project and the linked LCNF proposal. Section 4.2
* robustness of contractual arrangements with partners	The submission does not set out the detailed contractual arrangements but Partners are providing funding outlines above. In addition WWU indicates that payments to partners will be back-loaded and paid on completion of outputs rather than expenditure and so partners will have a strong incentive to manage costs and ensure delivery of outputs relevant to the programme's aims. There appears to be a strong commitment on the part of all Partners to this project and the linked LCNF submission. Section 4.2

Sub-Criteria	Assessment and material document references
* funding and benefits for each partner	The level of external funding is identified as £252k out of a total project cost of £4,718k. the direct benefits from this project flow to customers of the gas distribution network. Section 4.2

9. CRITERION F: RELEVANCE AND TIMING

Criteria	Rating	Overall assessment
Criterion F: Relevance and timing		The DECC Carbon Plan Vision indicates that the oil and gas need to be replaced by electricity, sustainable bioenergy, or hydrogen The Future of Heating Strategy recognises the potential of hydrogen, produced from renewable energy sources, and injected into the gas network as one of the potential means of decarbonising heat. Developments and trials of hydrogen injection are under way in other European states. It would thus appear to be both relevant and timely to trial the injection of hydrogen into the GB gas distribution system.

Sub-Criteria	Assessment and material document references
* The significance of the project in: Overcoming current obstacles to a future low carbon economy Trialling new technologies that could have a major low carbon impact Demonstrating new system approaches that could have widespread application	The Carbon Plan Vision indicates that the oil and gas used to drive cars, heat buildings and power industry will, in large part, need to be replaced by electricity, sustainable bioenergy, or hydrogen. The focus of the project is associated with injecting hydrogen natural gas mixtures in to the gas distribution network. The Future of Heating Strategy recognises the potential of hydrogen, produced using renewable energy sources, and injected into the gas network as one of the potential means of decarbonising heat. Demonstrating the practical feasibility of injecting hydrogen up to 2% by volume into the WWU gas distribution system is likely to add to knowledge that will assist the development of a low carbon energy sector. At this level of injection, meaningful savings in CO2 emissions appear achievable. Sections 1.3, 4.6
* why the problem is relevant and warrants funding	As indicated above, the project is relevant by adding to knowledge regarding the injection of hydrogen into low pressure gas distribution systems and will potentially assist the development of a low carbon energy sector. Sections 1.3, 4.6
* how the GDN would use the method in future business planning	WWU indicates that hydrogen injection offers a potential opportunity of ensuring the long term viability of gas distribution networks and is hence directly relevant to its RIIO business plans. In addition it has identified the possibility that hydrogen could provide a way of building standalone low carbon energy systems to provide cheaper energy for potential customers who are not connected to the network. Section 4.6

Sub-Criteria	Assessment and material document references
* the appropriateness of the timing of the project	The timing would appear to be appropriate, as WWU has indicated, DECC is demonstrating increased interest in the exploitation of hydrogen. Developments and trials of hydrogen injection are under way in other European states and the programme is relevant, as it addresses government requirements and it draws on the European experience. Section 4.6

10. CRITERION G: DEMONSTRATION OF ROBUST METHODOLOGY

Criteria	Rating	Overall assessment
Criterion G: Demonstration of robust methodology The feasibility of the project proposals from technical, customer impact and safety perspectives		The project methodology appears generally robust however the proposals for customer engagement if appliance inspection and possible adaption is required appear to require further consideration, particularly in relation to accessing all premises and contingency arrangements if this is not achieved. The arrangements for project planning, implementation and programme governance appear to be robust. From the information provided, the process for compiling the project budget and the forecast costs appear to be consistent with good practice. There is evidence of risk identification, review, mitigating actions and contingency planning which appear to have identified key risks and the reaction to them although the risks associated with the potential appliance inspection programme have not yet been addressed. Partner confidence in their ability and readiness to commence the Programme in January 2014 appears well founded.

Sub-Criteria	Assessment and material document references
* the feasibility/quality of the project plan and programme governance, including responsibilities	WWU has indicated that the project has been planned and will be delivered in accordance with an accepted project management methodology (PRINCE 2, adapted) and within a robust governance structure. A detailed Microsoft Project plan which identifies tasks and the accountable company as well as interdependencies has been prepared. The project governance and reporting structure is set out which includes oversight by a Programme Review Board supported by a Project Assurance team. The roles and high level responsibilities of the Partners and their contractors are also set out. Gateway Reviews are scheduled for the end of each of the key programme delivery phases and are designed to determine whether or not the programme can successfully progress to the next phase of delivery These arrangements appear to be robust. Appendices I, J, Q
* All risks, including customer impact, exceeding forecast costs and missing the delivery date	There is evidence of risk identification, review, mitigating actions and contingency planning which appear to have identified key risks and the reaction to them. The risk of failure to gain access to all customer premises in the event that appliance inspection and possible adaption is required has not been identified although WWU indicated at the project team meeting that they intended this would be addressed. Appendices K, L

Sub-Criteria	Assessment and material document references
* Whether items within the project budget appear to provide value for money	WWU has indicated that a thorough and rigorous analysis of the costs and benefits of the CEB programme has been undertaken. The approach to developing the project budget has been both bottom up and top down, Partners have quoted fixed prices for the majority of their services. From the information provided the process for compiling the project budget and the forecast costs appear to be consistent with good practice. Section 6.2, Appendix G
* whether the proposed resources are sufficient to deliver the project	The Project Plan identifies resources at a company level but the submission does not provide detail below this to appear to confirm whether resources are sufficient to deliver the project. Section 6.1, Appendix I
* whether the project can be started in a timely manner	WWU has indicated that he level of Partner readiness and commitment of key resource to the Programme underlines the ability and need to commence the Programme in January 2014. There appears to be no reason to doubt this confidence. Section 6.1
* the robustness of the project methodology, including technical rigour and statistically robust outputs.	The project methodology appears generally robust however the proposals for customer engagement if appliance inspection and possible adaption is required appear to require further consideration, particularly in relation to accessing all premises and contingency arrangements if this is not achieved. WWU indicated at the project team meeting that they intended this would be addressed and some further information has been provided in response to a question. WWU has recognised the difficulties in gaining access to customers' premises when the work has not been requested by the customer and intends to draw on its experience particularly associated with meter replacement also quoting the involvement of WREN and the high density of premises facilitating call backs, as mitigating factors. WWU has also indicated that if access to the required premises is not achieved it is likely that the hydrogen injection would have to remain within current limits; in this case they indicate a contingency that the project could continue without an exemption and demonstrate the technical feasibility of hydrogen injection. Despite this further information, WWU appears to be hoping that a programme of appliance inspection won't be required and not fully addressing the potential challenges, if it is. The proposed approach to seeking an exemption from HSE for hydrogen injection up to 2%, outlined in the submission and supported with further detail in response to a question, appears appropriate. Sections 2.2, 7, Responses to Q7 and Q8
* the appropriateness of the risk mitigation processes	The processes for risk identification, review, developing mitigating actions and contingency planning appear to be appropriate. As indicated above, the risk of failure to gain access to all customer premises in the event that appliance inspection and possible adaption is required had not been identified but is now be addressed. Appendices K, L
* Clear vision for the project	The vision for the NIC Gas project is clear but references to the linked LCNF proposal lack clarity.

Sub-Criteria	Assessment and material document references
* Value of the project clear	The value of the NIC Gas project is clear but references to the linked LCNF proposal lack clarity.
* Impact of the project clear	The impact of the NIC Gas project is clear but references to the linked LCNF proposal lack clarity.
* Obstacles and impediments identified	These matters are addressed in the project description, at high level in the risk and contingency plan and in the project team meeting presentation.
* Project outcomes clear	The direct outcome of the NIC Gas project is clear but references to the linked LCNF proposal lack clarity.
* Means to achieve outcomes identified	The proposed methodology is generally both appropriate and credible in terms of delivery of objectives.
* Risks that may prevent outcomes identified and managed	These matters are addressed in the project description, at high level in the risk and contingency plan and in the project team meeting presentation.
* Project well planned	The information provided regarding the planning process is comprehensive and robust.
* Resources clearly identified	The proposed project team manpower, external support and financial resources are set out at high level.
* Project timeline justified	The project timeline is clearly specified in the Project Plan and Section 6 – Project Readiness.
* Technical standards clear	The submission includes appropriate references to technical standards.
* Performance requirements clear	Performance requirements for the hydrogen injection trial are clear.
* Evidence of research of existing solutions	Significant reference is made to European developments and experience.
* Collaboration options described	Rationale for partnership arrangements and details of Partners are provided.
* Project informed by data	Relatively little use of data other than in the area of carbon benefits.
* Clear technical governance	Technical governance is incorporated in the project management proposals.
* Clear Project Management	Project management arrangements in terms of resources and governance processes are clear.

11. SUCCESSFUL DELIVERY REWARD CRITERIA

Criteria	Rating	Overall assessment
Criterion: Appropriateness of the SDRC definitions and timing and adequacy of links to key project milestones		The definition of the SDRCs is clear and tied to project milestones. The majority of the criteria refer to deliverables that cover both the NIC Gas project and the LCNF proposal. None of the criteria are linked to the key learning outputs of the project.

Detailed comments

The following criteria are proposed:

1. Complete the Delivery Phase Project Plan
2. Trial design
3. IT architecture and system design
4. Gas mixing and injection passes Factory Acceptance Test
5. Sign Network Entry Agreement
6. Report on readiness to commence trials
7. Report on the commercial models
8. Report on the community engagement approach

The definition of these criteria is clear and tied to project milestones.

The majority of the criteria refer to deliverables that cover both the NIC Gas project and the LCNF proposal and feature in the project plan for the latter, only criteria 4 and 5 principally relate to the NIC Gas project. This reflects the linked nature of the projects but will require evidence from the LCNF project to be provided at the time the rewards are claimed.

It is surprising that none of the criteria are linked to the key learning outputs:

- Learning associated with the practical issues of the connection and management of hydrogen injection into the gas network.
- Learning associated with the end use, by consumers, of hydrogen natural gas mixtures.

or even to achieving injection of hydrogen into the Wadebridge gas distribution network, the key means identified.

12. ADDENDUM: SYNOPSIS OF CHANGES TO THE SUBMISSION

WWU re-submitted their proposal on 11th October 2013 following meetings and discussions with the Expert Panel and Rune Associates, and after receiving and responding to written questions. The re-submission includes a substantial number of textual amendments, a number of changes to Appendix G, the cost spreadsheet and the removal of one appendix.

12.1. SUMMARY OF CHANGES

The following table provides a summary of the material changes from the original proposal:

<table>
<tr><th>Topic Area</th><th colspan="2">Changes at resubmission</th></tr>
<tr><td rowspan="6">Funding arrangements</td><td colspan="2">WWU has indicated that the funding arrangements have changed as a result of a reduction in gas mixing costs of approximately £400k.
WWU also indicated that the costs of activities which are shared between the LCNF submission and this project have now been primarily allocated in line with the ratio of initial direct strand costs. This has resulted in approximately 80% of shared costs being allocated to the LCNF and 20% to the NIC, whereas the previous split was 6:1.
The only change to project costs in the revised spreadsheet appears to be that associated with gas mixing facilities and the effect of the revised approach to cost sharing is not evident.
The revised Full Submission Cost Spreadsheet indicates the following:</td></tr>
<tr><td>Total Project Cost (Cell I13)</td><td>£4,290k (was £4,718k)</td></tr>
<tr><td>External Funding. (Cell I25)</td><td>£213k (was £252k)</td></tr>
<tr><td>Network Licensee Compulsory Contribution. (Cell I66)</td><td>£408k (was £447k)</td></tr>
<tr><td>Network Licensee Extra Contribution.
(Cell I37)</td><td>Nil (unchanged)</td></tr>
<tr><td>Gas NIC Funding Request. (Cell I85)</td><td>£3,565k (was £3,900k)</td></tr>
<tr><td>Project benefits</td><td colspan="2">In the re-submission, WWU recognised that the benefits of decarbonising the gas network will only be seen with levels of hydrogen injection higher than the 2% proposed; and indicated its view that the project should be seen as a project that demonstrates the feasibility of hydrogen injection and could lead to higher levels of hydrogen being injected.
WWU suggested that at 10% or 20% the level of decarbonisation starts to become significant and in their view it is reasonable to start claiming some of the decarbonisation benefits. In revising the Net Benefits in the re-submission, WWU has assumed that rollout is achieved at 10% volume of hydrogen and hence the potential benefits are based on 10% of the benefits of full decarbonisation.
WWU has also provided further information regarding potential benefits</td></tr>
</table>

Topic Area	Changes at resubmission
	associated with carbon reductions and avoidance of future investment by customers.
Hydrogen pricing assumptions	WWU indicated that a key determinant of whether hydrogen injection is commercially viable is the price of hydrogen so the value chain from generation, through electrolyser and energy storage and gas injection will be modelled. It has not included any assumptions on the range of price. A revised cost benefit analysis in the form of a single table with limited supporting narrative does not appear to address this point. (WWU did however provide some information on hydrogen pricing in response to a question from the Panel – WWUGN01 Question 14)
Customer interaction	WWU has expanded substantially on its intentions in relation to appliance inspection, if this is necessary. WWU has also included information and feedback, on a recent exhibition organised by WREN on the theme of Wadebridge Energy Futures which was attended by 463 people. WWU has added 2 additional entries to the risk register that are associated with appliance inspection.
Potential for replication	WWU has carried out further work in South East Wales to identify potential sites similar to Wadebridge where 132kV or 33kV cables cross intermediate pressure or medium pressure pipelines. From this and the previous review of Cornwall, they have suggested that there may be around 6,300 possible sites in GB.
Existing knowledge	WWU has provided detailed information on the NaturalHy project and work by the European Gas Research Group (GERG), associated with hydrogen injection into natural gas transportation systems.
GSMR gas quality exemption	WWU has provided additional information on the process that it would utilise to support an application for an exemption to enable injection of hydrogen. This includes an additional step to demonstrate that an exemption is required and WWU has included work on hydrogen embrittlement of metallic pipes as part of understanding the hazards.
Successful Delivery Reward Criteria	WWU has amended and added to, the proposed SDRC to include hydrogen injection; full system trials completion; customer experiences and to include learning from hydrogen injection and mixing

12.2. REVIEW OF DETAILED CHANGES

The following table indicates how the changes set out in the resubmission, impact on the assessment against the individual evaluation criteria:

Criteria	Rating	Assessment of changes including material document references
A: Low carbon and benefits		The concern expressed earlier in the report regarding the robustness of the financial benefits claimed has not been mitigated by either the responses to the relevant questions nor the re-submission. Indeed the acknowledgement that benefits of decarbonising the gas network will only be seen with levels of hydrogen injection significantly higher than 2% and the use of 10% in the net benefit calculations increase those concerns. The project does not address in any detail the question of roll out at hydrogen injection levels above 2% and it seems unlikely that robust conclusions regarding injection levels of 10% or greater, will be possible be from the potential outcomes and learning achieved by trialling a maximum hydrogen injection level of 2%. Although WWU recognises that a key determinant of whether hydrogen injection is commercially viable is the price of the hydrogen to be injected, the re-submission does not indicate any expected price, or range of prices, for the hydrogen. In a Q&A response, WWU has indicated a range between [redacted] WWU further indicated that using an assumed value of [redacted] and the 1MW electrolyser proposed, the breakeven period for gas injection is greater than 20 years. The information in the re-submission covering replication potential across GB has been compiled on a basis of one possible site per 10,000 of population which has been derived from map based reviews of Cornwall and South East Wales. The justification of this approach has not been demonstrated and confidence in the number of potential sites at GB level suggested by scaling up based on total population, must be low. Sections 3.2, 3.3, 3.4 and 4.1, NIC QA Response 14, Appendices G and M
B: Value for money		The funding requirement has been reduced by around 9% following the changed approach to procurement of the gas mixing equipment however the investment is still substantial given the limited benefit which is likely to emerge from a maximum hydrogen injection level of 2%. In addition the cost benefit analysis provided in the resubmission does not provide compelling evidence of value for money from the project. Sections 2.4, 3.2, 3.3, and 4.2, Appendices G and M

Criteria	Rating	Assessment of changes including material document references
C: Generates new knowledge		WWU has indicated that the reduction in gas mixing costs is a result of the use of German suppliers rather than UK based suppliers, who would have needed to design the system. This existing knowledge, together with learning already available from relevant European projects, suggests that the new knowledge generated by this project will be limited in both scale and applicability at the level of hydrogen injection proposed. Sections 2.4 and 4.4
D: Innovative and unproven business case		WWU has not provided further information to demonstrate the degree to which the project is innovative at the level of hydrogen injection proposed. Indeed, the additional information provided on the NaturalHy project and work by GERG, associated with hydrogen injection into natural gas transportation systems, together with the recognition that 10% hydrogen injection is necessary to deliver significant benefits, appears to indicate that the level of innovation delivered under this project is limited. Sections 4.1 and 4.4
E: Involvement of other partners & external funding		Although the re-submission does not include any new or changed information, dialogue at the Project Team/Consultant meetings and the bilateral meetings has indicated some lack and coherence within the team. In particular in the former, it appeared that there was not a common strategic approach if the linked LCNF project did not also receive funding. The response to a subsequent question failed to dispel this impression. Section 4.5 NIC QA Response 6
F: Relevance and timing		Although the re-submission does not include any new or changed information, the acknowledgement by WWU that decarbonisation benefits will only be realised with levels of hydrogen injection significantly higher than 2%, suggests that this project has little relevance to overcoming current obstacles to a future low carbon economy. Whilst the trialling of significant levels of hydrogen injection, say 10%, might be timely, this project appears unlikely to have a major low carbon impact. Sections 2.1, 3.2, 3.3, 3.4, 3.5 and 4.1
G: Demonstration of robust methodology		The project methodology remains generally robust however previous concerns regarding the proposals for customer engagement if appliance inspection and possible adaption is required, remain. The issue has been addressed in the re-submission and mitigated to some extent and more detail has been provided in relation to customer interaction, accessing premises and the management processes. Two risks associated with the appliance inspection programme have been added to the risk register but the mitigation action plans are not detailed and contingency arrangements are not addressed in these nor have these risks been included in the Project Contingency Plan. Section 8, Appendices K and L

Criteria	Rating	Assessment of changes **including material document references**
Successful Delivery Reward Criteria		The inclusion in the re-submission of criteria that are related to the key learning outputs from the project rather than project process matters, has to a large extent, addressed the earlier concerns. Section 9