Notes on Completion: Please refer to the appropriate NIA Governance Document to assist in the completion of this form. The full completed submission should not exceed 6 pages in total.

NIA Project Registration and PEA Document

Date of Submission

Nov 2016

Project Reference Number

NIA_WWU_039

Project Registration

Project Title

Higher chain alkane gases from Anaerobic Digestion

Project Reference Number

NIA_WWU_039

Project Licensee(s)

Wales & West Utilities

Project Start

April 2017

Project Duration

3 years and 1 month

Nominated Project Contact(s)

Ian Marshall (Green Gas Development Manager)

Project Budget

£38,000.00

Summary

The project will investigate whether anaerobic digestion can produce higher chain alkane gases, initially ethane, with the aim of removing the need to add propane to biomethane before injection into gas distribution networks. This project is in partnership with the University of South Wales and will help fund a PhD studentship to investigate the feasibility of this process. It will build on preliminary research done by the University of South Wales Centre of Excellence for Anaerobic Digestion headed by Professor Sandra Esteves. A key consideration is to ensure that the solution is commercially viable, for example that any gain in ethane production is not at such a large loss in methane production to outweigh the benefits of not having to add propane. The University has the expertise in the biological research and WWU will contribute commercial and industry knowledge to ensure that any processes developed are commercially viable and meet regulatory requirements.

The project will:

- Task 1) MPhil/PhD registration, lab H&S inductions/training; network gas regulation information (provided by partner) and introduction to lab techniques (Month 1-3);
- Task 2) Refine methodologies for monitoring high chain C2-C4 alkane gases in the lab using GC and setup laboratory reactors for batch and continuous operation (Month 2-12);
- Task 3) Conduct a literature review and a technical investigation of the potential for anaerobic cultures i.e. pure and mixed cultures to convert organic wastes to higher chain alkane gases separately and in combination with methane as the output (Month 2-34);
- Task 4) Investigation of the possible process integrations with ethanol/yeast platforms (Month 2-28);
- Task 5) Evaluations of a selection of strategies for enrichment of the microbial populations capable of these conversions as well as operational regimes (Month 2-34);
- Task 6) Investigate process chemical matrices and inhibition conditions and their influence on gas yields (Month 4- 28)
- Task 7) Evaluate bioprocess stability and energetics as a comparison with methane only production (Month 28-34)

Nominated Contact Email Address(es)

innovation@wwutilities.co.uk

Problem Being Solved

Gas from biomethane plants contains methane and no higher chain hydrocarbons, it therefore has a lower energy (this is called Calorific Value or CV)per cubic metre than natural gas. To increase the CV producers add propane, this increases both capital and operational costs and complicates planning applications owing to the need to have propane storage on site and to pay for the propane which cost more than per kWh than the value of the biomethane per kWh. A solution that removed or reduced the requirement to add propane would therefore be benenficial to producers.

Method(s)

Utilising a combination of literature reviews, theoretical desktop studies, appropriate research and practical experimentation methods, the project will test and evaluate the opportunities and potential to generate higher chain alkanes (ethane, propane) through anaerobic digestion of organic wastes utilising a variety of different cultures of bacteria

Scope

The project will investigate whether anaerobic digestion can produce higher chain alkane gases, initially ethane, with the aim of removing the need to add propane to biomethane before injection into gas distribution networks. This project is in partnership with the University of South Wales and will help fund a PhD studentship to investigate the feasibility of this process. It will build on preliminary research done by the University of South Wales Centre of Excellence for Anaerobic Digestion headed by Professor Sandra Esteves. A key consideration is to ensure that the solution is commercially viable, for example that any gain in ethane production is not at such a large loss in methane production to outweigh the benefits of not having to add propane. The University has the expertise in the biological research and WWU will contribute commercial and industry knowledge to ensure that any processes developed are commercially viable and meet regulatory requirements.

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Stage Gates

- Staqe Gate 1) 12-18 months transfer from MPhil to PhD. This requires a transfer report (3000 to 600 word) an examination to make sure the student has defined sensible hypotheses, has appropriate aims/objectives, has selected appropriate methodologies to evaluate those hypotheses, is proficient in the methodologies, is able to critically review literature and has a future plan of work that will make sure enough work will be conducted and there will be novel work and contribution to knowledge to satisfy the PhD requirements. The transfer report will be provided to WWU with a summary for dissemination if required
- Stage Gate 2) Month 36 completion of PhD thesis and final report to WWU

Progress meetings and dissemination

There will be regular quarterly progress meetings, dissemination will be both to WWU to satisfy our internal and NIA reporting requirements and through academic routes to satisfy the University of South Wales' research criteria and the award of a PhD to the student.

- Quarterly progress meetings with WWU to discuss findings and discuss future work.
- 6 monthly presentations to WWU
- Annual report to WWU in April as required for NIA reporting
- Transfer report for transfer from MPhil to PhD
- End of project report (for a project for Welsh Water this comprised a 170 page report with a 10 page technical summary) that WWU can distribute to fulfil NIA requirements
- Academic conferences towards end of project
- Academic papers towards end of project these will be published in academic journals

- PhD thesis 40-50,000 words that WWU can distribute to fulfil NIA requirements

The output will be a process that has been demonstrated to work at a laboratory level test and is ready for developing as a demonstration project

Objective(s)

To determine whether it is both technically feasible and cost effective to produce higher chain alkanes from AD process to remove the need to add propane to biomethane to enable it to meet the required CV

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

Producing clear evidence as to whether production of higher chain alkanes is technically feasible and cost effective.

Project Partners and External Funding

n/a

Potential for New Learning

n/a

Scale of Project

This project is research and will part fund a PhD studentship and the University of South Wales. It will build on preliminary research conducted by the university and will research whether the production of higher chain alkane gases from AD is technically and commercially feasible.

The output will be a process that has been demonstrated to work at a laboratory level test and is ready for demonstrating at a demonstration project.

WWU's role will be to provide industry knowledge, for example regulatory requirements and to ensure that the options proposed are commercially attractive, as far as is possible for a research project.

Technology Readiness at Start

TRL2 Invention and Research

Technology Readiness at End

TRL3 Proof of Concept

Geographical Area

Research will be undertaken in the South Wales Area, with the research being releavant to the whole of the UK

Revenue Allowed for the RIIO Settlement

None

Indicative Total NIA Project Expenditure

External cost - £28,500

Internal costs – £9,500

Total - £38,000

Project Eligibility Assessment Part 1

There are slightly differing requirements for RIIO-1 and RIIO-2 NIA projects. This is noted in each case, with the requirement numbers listed for both where they differ (shown as RIIO-2 / RIIO-1).

Requirement 1

Facilitate the energy system transition and/or benefit consumers in vulnerable situations (Please complete sections 3.1.1 and 3.1.2 for RIIO-2 projects only)

Please answer **at least one** of the following:

How the Project has the potential to facilitate the energy system transition:

n/a

How the Project has potential to benefit consumer in vulnerable situations:

n/a

Requirement 2 / 2b

Has the potential to deliver net benefits to consumers

Project must have the potential to deliver a Solution that delivers a net benefit to consumers of the Gas Transporter and/or Electricity Transmission or Electricity Distribution licensee, as the context requires. This could include delivering a Solution at a lower cost than the most efficient Method currently in use on the GB Gas Transportation System, the Gas Transporter's and/or Electricity Transmission or Electricity Distribution licensee's network, or wider benefits, such as social or environmental.

Please provide an estimate of the saving if the Problem is solved (RIIO-1 projects only)

Networks support de-carbonisation of the gas supply chain as this facilitates continued use of the extensive gas networks in GB. Customers benefit as they avoid the cost and inconvenience of changes to the heating and cooking arrangements. The learning from this research project can be used by third parties to increase the volume of biomethane injected into gas distribution networks.

Please provide a calculation of the expected benefits the Solution

This is a research project

Please provide an estimate of how replicable the Method is across GB

This will benefit all injection sites across all networks

Please provide an outline of the costs of rolling out the Method across GB.

The final report will share the learning identified and will be applicable to GB. The outputs of the research project may indicate further areas of research that may need completing.

Requirement 3 / 1

Involve Research, Development or Demonstration

A RIIO-1 NIA Project must have the potential to have a Direct Impact on a Network Licensee's network or the operations of the System Operator and involve the Research, Development, or Demonstration of at least one of the following (please tick which applies):

☐ A specific piece of new (i.e. unproven in GB, or where a method has been trialled outside GB the Network Licensee must justify repeating it as part of a project) equipment (including control and communications system software).

☐ A specific novel arrangement or application of existing licensee equipment (including control and/or communications systems and/or software)

☑ A specific novel operational practice directly related to the operation of the Network Licensees system

☐ A specific novel commercial arrangement

RIIO-2 Projects

☐ A specific piece of new equipment (including monitoring, control and communications systems and software)

☐ A specific piece of new technology (including analysis and modelling systems or software), in relation to which the Method is unproven

☐ A new methodology (including the identification of specific new procedures or techniques used to identify, select, process, and analyse information)

☐ A specific novel arrangement or application of existing gas transportation, electricity transmission or electricity distribution equipment, technology or methodology

☐ A specific novel operational practice directly related to the operation of the GB Gas Transportation System, electricity transmission or electricity distribution

☐ A specific novel commercial arrangement

Specific Requirements 4 / 2a

Please explain how the learning that will be generated could be used by the relevant Network Licensees

This problem is common across all GB gas distribution networks and the solution will be applicable to new AD facilities and there may be existing sites where retrofitting this technology is cost effective. Apart from simplifying plant construction and reducing costs thereby facilitating the injection of biomethane, removing the requirement for propanation may reduce the risks of low CV gas being injected due to failure of the propanation system, this would reduce the risk of Shippers bearing the cost of CV shrinkage.

Or, please describe what specific challenge identified in the Network Licensee's innovation strategy that is being addressed by the project (RIIO-1 only)

n/a

☑ Has the Potential to Develop Learning That Can be Applied by all Relevant Network Licensees

Is the default IPR position being applied?

☑ Yes

Project Eligibility Assessment Part 2

Not lead to unnecessary duplication

A Project must not lead to unnecessary duplication of any other Project, including but not limited to IFI, LCNF, NIA, NIC or SIF projects already registered, being carried out or completed.

Please demonstrate below that no unnecessary duplication will occur as a result of the Project.

n/a

If applicable, justify why you are undertaking a Project similar to those being carried out by any other Network Licensees.

n/a

Additional Governance And Document Upload

Please identify why the project is innovative and has not been tried before

n/a

Relevant Foreground IPR

n/a

Data Access Details

n/a

Please identify why the Network Licensees will not fund the project as apart of it's business and usual activities

n/a

Please identify why the project can only be undertaken with the support of the NIA, including reference to the specific risks(e.g. commercial, technical, operational or regulatory) associated with the project

n/a

This project has been approved by a senior member of staff

☑ Yes