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_038

Project Registration

Project Title

Flexible biomethane production using carboxylic acids

Project Reference Number

NIA_WWU_038

Project Licensee(s)

Wales & West Utilities

Project Start

January 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 work builds on the proof of concept research undertaken at the USW on anaerobic biological processes' design and operation, profiling and development of enriched microbial cultures and implementation of novel monitoring, modelling and control strategies for hydrolysis, acid fermentations and methanogenic conversions, and their integration with electrochemical and physical separation and concentration processes.

- Task 1) MPhil/PhD registration, lab H&S inductions/training; gas network info login (provided by partner) and introduction of lab and modelling techniques (Month 1-3);
- Task 2) Evaluate the range of spatial and temporal demands within a variety of natural gas networks and select model regions/network conditions (Month 2-5);
- Task 3) Evaluate a selection of integrations between novel biotechnology reactors operating on a range of organics as well as inorganic gases with chemical/enzyme/membrane processing/separations to facilitate daily/weekly and inter-seasonal energy storage to enable rapid conversions to methane when necessary (Month 3- 30);
- Task 4) Establish and evaluate a supervisory control system that links predictive modelling for gas network demand with novel control strategies for the biotech plant operation (Month 12-32);
- Task 5) Establish the technical, economic and environmental feasibility for the implementation of this novel concept of energy storage, which is flexible and enhance green methane production using an integrated and low cost energy storage strategy which will facilitate a greater AD and other renewable energies deployment (Month 20-32);
- Task 6) Devise strategies for full scale implementation of the concept and quantify the potential for Wales/UK for such a technological concept (Month 30-36);

Nominated Contact Email Address(es)

innovation@wwutilities.co.uk

Problem Being Solved

Biomethane is typically injected into the Intermediate or Medium pressure tiers, most of the demand on these networks is heat related

and demand for gas and therefore the capacity available for biomethane injection falls considerably during the summer. Current biological processes used Anaerobic Digestion are slow and therefore cannot cope with short term changes in demand. In addition plant operators wish to maximise utilisation of their plants so will size them so that they can inject at times of lowest demand on the network. If they had a cost effective method of storing biomethane it would enable them to produce in the summer, store what could not be injected, and then inject it as demand picked up in the autumn. Other options to address this problem include compressing gas up the pressure tiers for example from intermediate to high pressure, however currently this has not been done operationally in Great Britain. WWU has done work to reconfigure networks to maximise the capacity available to biomethane plants but this is limited in scope and dependent on the individual characteristics of the network.

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 utilise carboxylic acids as an intermediate stage in the production of biomethane and also as a storage and fast acting production method to help address the issues associated with seasonal gas demands

Scope

The work builds on the proof of concept research undertaken at the USW on anaerobic biological processes' design and operation, profiling and development of enriched microbial cultures and implementation of novel monitoring, modelling and control strategies for hydrolysis, acid fermentations and methanogenic conversions, and their integration with electrochemical and physical separation and concentration processes.

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Stage Gates

- Stage 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 implement a novel concept of energy storage based on carboxylic acids for flexible and enhanced methane production to meet gas demand in various networks throughout the year

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

Producing clear evidence as to whether a novel concept of energy storage based on carboxylic acids would allow flexible biomethane production in various networks throughout the year.

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 ADs using carboxylic acids as an intermediate stage provides a technically and commercially viable solution.

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 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 of low summer capacity occurs 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.

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