Energy Networks Innovation Process

Project Close Down Form

Notes on Completion: Please refer to the NIA Governance Document to assist in the completion of this form.
Do not use tables

Step 1 - Initial Project Details

Project Title

Flexible Operation of Water Networks Enabling Response Services (FLOWERS)

Project Reference

NIA_WPD_063

Project Contact(s)

Laurence Hunter

Project Start Date

01/2022

Project End Date

07/2023

Scope (15000 Characters max)

FLOWERS' aim is to increase the capacity embedded within water networks to deliver flexibility for electricity distribution networks. Water utilities are one of the largest consumers of electrical power, about 1TWh of demand across National Grid Electricity Distribution's four licence areas. South West Water (SWW) contributes just over 300GWh of this demand. Developing new operational processes and removing commercial and regulatory barriers for water networks to deliver flexibility therefore presents a significant opportunity for unlocking of flexibility capacity which is value for money to customers.

The project builds upon a Network Innovation Allowance (NIA) project delivered by National Grid ESO to investigate the potential flexibility capacity in storm drains and wastewater catchments, which quantified capacity but did not create a commercial model for accessing it. The aim is twofold: uncover flexibility capacity that could be embedded in an entire water utility's network and develop a cost-saving commercial model for its delivery.

Originally, the scope of FLOWERS was to expand the search for capacity within water networks by quantifying the available capacity across both wastewater and drinking water systems within the inherent latency of their pumping operations. However, early on in the project it was concluded that focus on "latency flexibility" did not fully capture the range of related flexibility opportunities. As such, the scope expanded to include all feasible opportunities to embed flexibility in water network processes, referred to as "embedded flexibility" or "operative flexibility". This is discussed further in Required Modifications to the Planned Project Approach During the Course of the Project below.

Objective (15000 Characters max)

- Assess the technical and legal feasibility of embedding flexibility on water networks within the latency of their internal pumping operational processes.
- Quantify and map water latency flexibility capacity to understand the alignment between availability and network Constraint Managed Zones (CMZ).
- Determine the commercial arrangements necessary to procure flexibility capacity within water network processes.
- Understand the technical and operational requirements of the system that would trigger latency flexibility.

Success Criteria (15000 Characters max)

- A business case and cost-benefit analysis for using water network latency as a flexibility source will be created.
- The high-level specification of a latency flexibility system will be documented for implementation in an appropriate follow-on project.
- The capacity for latency flexibility on South West Water's network will be quantified, with a methodology that can be replicated by NGED or other DNOs for other water networks.
- A commercial proposal will be submitted to Ofgem and Ofwat for the implementation of the latency flexibility product.

Step 2 - Performance Outcomes

Performance Compared to Original Project Aims

Details of how the Project is investigating/solving the issue described in the NIA Project Registration Pro-forma. Details of how the Project is performing/performed relative to its aims, objectives and success criteria. (15000 Characters max)

Objectives

1. Assess the technical and legal feasibility of embedding flexibility on water networks within the latency of their internal pumping operational processes - **Complete**

   Early stage-gate milestones assessed whether there were no absolute technical or legal barriers. Assessment of the technical feasibility is documented in the deliverable for work package Latency Flexibility Analysis (LFA) 1. Discussion of legal feasibility is documented in the first deliverable for work package LFA 2.

2. Quantify and map water latency flexibility capacity to understand the alignment between availability and network constraint zones - **Complete**

   The maximum flexibility capacity across South West Water's network has been mapped against CMZs in LFA 3. Mapping alignment to half-hourly CMZ requirements for case study sites was carried out in work package LFA 5.

3. Determine the commercial arrangements necessary to procure flexibility capacity within water network processes - **Complete**

   A commercial proposal document identifying potential arrangements necessary for embedded flexibility has been produced as the final deliverable for work package LFA 2.

4. Understand the technical and operational requirements of the system that would trigger latency flexibility - **Complete**

   A high-level architecture report discussing technical and operational requirements for embedding flexibility has been produced as the final deliverable for work package LFA 4.

Success Criteria

1. A business case and cost-benefit analysis for using water network latency as a flexibility source will be created - **Complete**

   An assessment of the value of unlocked flexibility has been produced in the deliverables for work packages LFA 3 and LFA 5, against a counterfactual of the cost of procuring flexibility capacity through current market mechanisms. Due to the high-level nature of the technical assessment, the costs of implementation are not included in this analysis.

2. The high-level specification of a latency flexibility system will be documented for implementation in an appropriate follow-on project - **Complete**

   Five potential methodologies for implementing embedded flexibility on water networks have been defined in work package LFA 4. The key capabilities and challenges to overcome are documented as learning from this work package to form a basis for follow-on activities.

3. The capacity for latency flexibility on SWW's network will be quantified, with a methodology that can be replicated by NGED or other DNOs for other water networks - **Complete**

   A methodology for quantifying flexibility capacity in water network operations has been produced. It is described in the first deliverable for work package LFA 3 for other DNOs or water utilities to replicate or adapt. The methodology is not specific to South West Water's network.

4. A commercial proposal will be submitted to Ofgem and Ofwat for the implementation of the latency flexibility product - **Complete**

   The commercial proposal document for embedded flexibility produced in LFA 2 was developed with engagement from regulators.

Required Modifications to the Planned Project Approach

The Network Licensee should state any changes to its planned methodology and describe why the planned approach proved to be inappropriate. Please confirm if no changes were required. (15000 Characters max)

"Latency Flexibility"

The initiation of the project is expected to focus on varying the time difference between pumping operations and the utilisation or treatment of drinking water and wastewater to unlock flexibility capacity. While this latency-type flexibility remains a core element of the potential capacity, it is limiting or limited in a number of fashions. It transpired that a wider process focused approach to flexibility could unlock further capacity under the same operational mechanisms. For example, wastewater treatment requires delicate control of biological processes that cannot be delayed by storing wastewater on site for longer during treatment. However, the same effect of flexibly shifting load could potentially be achieved by modifying arrival times of wastewater at treatment works through coordination of upstream and downstream pumping.

Consequently, the approach was changed to identify opportunities under a holistic banner of embedded flexibility or "operative flexibility". Operative flexibility is defined as a capability to adjust the timing and control of operations in response to signals from the electricity network.

Flexibility Service vs Flexible Connection

The above notwithstanding, the mechanisms for delivering and embedding flexibility in water networks blurs the distinction between flexibility products and a flexible connection. Flexibility is typically a service voluntarily offered to the DSO post-connection through market products. A flexible connection is one in which load or export may be limited by the DNO to remain compliant with operational and security of supply conditions by means required by the connection design and agreement. A process by which water networks can connect distributed generation through flexibility offerings embedded in the connection crosses both definitions.

While the project is not aiming to answer how blurring this distinction might be resolved, the approach to next steps is adapted to include consideration of the need to engage flexible connection stakeholders.

Technical Architecture
Due to the feasibility study nature of the project, "high-level specification" would always be exactly that. However, it was anticipated that some identification of individual processes would be included. In the course of the project, this proved not to be true. The first reason for this is the amount of variation between the operation and control of South West Water's network site-by-site. A too detailed process specification would likely exclude sites in the first instance, before development of processes on a more case-by-case basis. This does not even include comparisons with other water company's operations.

Secondly, it was also recognised that the timescale of planning, dispatch and implementation of embedded flexibility would have a significant implication for the process requirements. As such, high-level specification was specified across five potential methodologies rather than a singular method.

Cost-Benefit Analysis
The above two changes in scope had implications for considering the cost-benefit of embedded flexibility. By pulling back focus from individual assets and processes across the water network, it is difficult to identify specific costs for implementation of embedded flexibility on Drinking Water (DW) and Waste Water (WW) systems. As such, more focus was placed upon estimating the potential value of flexibility to DNO customers, as was reported in the D3-1 and D4-1 deliverables. This quantification of potential benefit can be considered in comparison to the cost of a follow-on development and trial project to demonstrate if continuation of this investigation is value for money.

Lessons Learnt For Future Projects

Describe how the project (methodology, stakeholder engagement etc.) changed, or provided opportunities, from your expectation at the start of the project and therefore could be useful for a future project. In addition, please discuss the effectiveness of the research development or demonstration undertaken. (15000 Characters max)

The learning from the FLOWERS project has been captured and shared in a variety of ways:

1) The final summary report documenting key learning from the entirety of the project
2) A report on the feasible initiatives for embedding flexibility in water networks
3) A report on quantifying the potential flexibility capacity unlocked from implementing these initiatives
4) A case study report examining the impact of feasible initiatives on a variety of water network site types
5) A report on the potential operational methodologies for embedding flexibility, the capabilities which require development and the operational and technical barriers to implementation
6) Two documents identifying the main commercial and regulatory challenges for embedding flexibility and proposing the commercial and regulatory arrangements to meet these challenges
7) Dissemination materials produced for FLOWERS.

A summary of the main conclusions from the project is presented below:

- The majority of accessible opportunities involve the planning and control of water pumping.
- Additional opportunities lie in the aeration and UV irradiation processes of wastewater treatment.
- Drinking and wastewater treatment sites are the largest energy consumers, and so initiatives including these sites are likely to provide the greatest return in terms of flexed capacity.
- Even with conservative estimations, the value of the unlocked flexibility in a single water utility could amount to thousands of pounds an hour across a licence area.
- The first key challenge for long-term flexibility is developing the necessary forecasting capability which integrates predicted water network operational electrical demand (including weather and seasonal population factors) and electricity network headroom and congestion.
- The second key challenge for long-term flexibility is ensuring firm electricity supply in order to guarantee the availability of flex weeks or months in advance.
- The key challenges for short-term flexibility are obtaining sub-metering data and automating command and control capability of water networks for dispatch and validation.
- Incentives for embedding operative flexibility could be built into connection agreements for renewable generation at water utility sites. These incentives would be aimed at achieving whole system net zero, and would include restrictions to prevent flexibility or connection market distortion.
- The proposed mechanisms for embedding operative flexibility crosses distinctions between flexibility services and flexible connections and subsequent work should engage stakeholders on both sides on how best to resolve this crossover.

FLOWERS is a feasibility project intended to identify potential embedded flexibility initiatives that could be developed and trialled in a follow-on project. However, the assumptions of replicability across the UK need to be tested and there was no real-life demonstration. Doing so carries significant risk due to the technical challenges to be overcome, such as coordinating between up and downstream water sites or accurately forecasting generation intensity and risk of curtailment. These innovations are significantly different from typical DNO flexibility procurement, and the development of this capability is not within the capacity of these business as usual (BAU) activities.
Consequently, planned implementation is directed towards further development to BAU readiness via follow on innovation projects.
A follow-on project would ideally look to develop the proposed solutions from concept to trial on multiple networks and in the following steps:

1. Assess the applicability of the FLOWERS solutions for each water network partner
2. Identify any additional requirements and challenges to overcome
3. Identify potential trial sites across a variety of networks and geographical areas
4. Produce a roadmap for design, trial and BAU
5. Develop a full system specification and design
6. Validate the design in electricity and water network models
7. Design and plan trials
8. Prepare trial sites as per the specification
9. Run the trial on a single site and evaluate the outcomes
10. Adapt and run the next trial on multiple sites, evaluating against success criteria
11. Finalise the BAU roadmap

Outcomes of the Project

When available, comprehensive details of the Project's outcomes are to be reported. Where quantitative data is available to describe these outcomes, it should be included in the report. Wherever possible, the performance improvement attributable to the Project should be described. If the TRL of the Method has changed as a result of the Project this should be reported. The Network Licensee should highlight any opportunities for future Projects to develop learning further. (15000 Characters max)

Reported outcomes of the project are as follows:

- The project has generated a set of reports documenting learning on the potential for embedding flexibility in the operations of water networks, including technical, operational and commercial considerations.
- A set of drinking water and wastewater system processes has been identified which could have flexible operation embedded within them. The development process included significant water operative expertise to validate the assumptions as genuine and feasible.
- Reasoned assumptions have been generated for the impact of these opportunities on NGED's network, in a manner which is replicable for other DNO/DSOs and water companies.
- The value of the potential embedded flexibility has been calculated for SWW's sites, both in terms of power and customer financial benefits. The quantitative data for this valuation is presented in the Capacity Evaluation and Case Study reports. The calculation method is applicable to all DNOs, based on their own per MWh valuation of flexibility. This is typically the same as NGED's, as the majority of DNOs share the Flexible Power platform.
- Five potential methodologies for embedding flexibility in operations have been developed by the project, differentiated by the timescales over planning, dispatch and implementation. The main technical and operational challenges for each method have been documented.
- The project has highlighted the commercial incentives and company priorities which would drive greater water utility engagement with flexibility, particularly surrounding the achievement of water company net zero objectives.
- A commercial proposal for implementing embedded flexibility has been delivered to address the regulatory and commercial challenges. It focuses on an alternative process for connecting renewable generation at water network sites, with appropriate restrictions to prevent distortions to the commercial flexibility and generation markets.
- Learning from project FLOWERS has been informally shared with additional water companies. Consequently, most water companies across NGED's licence areas are partners to funding applications.
- The project has increased knowledge sharing and engagement between electricity and water industries and begun to break the silos between them, including identifying separate potential areas of enquiry.
- The project has highlighted additional learning on the energy efficiency and maintenance of water networks that could produce additional benefits to electricity and water network customers.

Step 3 - Outputs And Implementation

Data Access Level
A description of how any network or consumption data (anonymised where necessary) gathered in the course of the Project can be requested by interested parties. Please include a link to the publicly available data policy. (15000 Characters max)

No new data has been generated for this project, only existing NGED and SWW data has been used in the analysis.

NGED data can be requested via the National Grid Connected Data Portal (https://connecteddata.nationalgrid.co.uk/).

South West Water asset and demand data was obtained to facilitate analysis of capacity. This data is confidential to South West Water and can only be released to interested parties with South West Water consent. This can be requested by contacting Angus Berry, Energy Manager at aberry@southwestwater.co.uk.

Foreground IPR
A description of any foreground IPR that have been developed by the project and how this will be owned. (15000 Characters max)

New foreground IPR has been created in the project reports. These are published and freely available on the NGED Innovation website.

Planned Implementation

Please describe the next steps to implement this innovation project. What policies and standards need to be updated or created as part of this implementation. (15000 Characters max)

FLOWERS was a feasibility project intended to identify potential embedded flexibility initiatives that could be developed and trialled in a follow-on project. However, the assumptions of replicability across the UK need to be tested and there was no real-life demonstration. Doing so carries significant risk due to the technical challenges to be overcome, such as coordinating between up and downstream water sites or accurately forecasting generation intensity and risk of curtailment. These innovations are significantly different than typical DNO flexibility procurement, and the development of this capability is not within the capacity of these business as usual (BAU) activities.

Consequently, planned implementation is directed towards further development to BAU readiness via follow on innovation projects. One application has been submitted to Ofgem Innovation processes, and alternative options are in scope if this is unsuccessful.

A follow-on project would ideally look to develop the proposed solutions from concept to trial on multiple networks and in the following steps:

1. Assess the applicability of the FLOWERS solutions for each water network partner
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Other Comments

Not applicable

Standards Documents

Identify any industry standards that may require updating due to the outcomes or understanding developed from this innovation project. If no standards will need to be updated, please state - not applicable

Not applicable