SIF Beta Project Registration

Date of Submission

Nov 2023

Project Reference Number

CAD_SIF0005

Project Registration

Project Title

Digital Platform for Leakage Analytics – Beta Phase

Project Reference Number

CAD_SIF0005

Project Licensee(s)

Cadent

Project Start

Sep 2023

Project Duration

30 Months

Nominated Project Contact(s)

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Project Budget

£12,068,514.00

Funding Mechanism

SIF Beta - Round 1

SIF Funding

£9,496,476.00

Strategy Theme

Data and digitalisation

Challenge Area

Data and digitisation

Lead Sector

Gas Distribution

Other Related Sectors

Gas Distribution, Gas Transmission

Lead Funding Licensee

Cadent - Central

Funding Licensees

Cadent - Eastern, Cadent - North London, Cadent - North West, Cadent - West Midlands

Collaborating Networks

National Gas Transmission PLC

Technology Areas

Gas Distribution Networks

Summary

How DPLA meets the aim of SIF Challenge (Eligibility Criterion 1 and 3)

The DPLA addresses the whole system integration and data and digitalisation Innovation Challenges set by Ofgem, whilst simultaneously addressing a range of user needs. Comprising of eight work-packages (WP), the Project expects to be delivered over a two-and-a-half-year time frame. The Project will enhance the coordination between the distribution networks and regulatory bodies as they work towards a common goal: reduce carbon emissions, realise customer benefits, and improve safety in a cost-effective manner. By combining upgraded modelling capabilities, the Project will deliver the next generation of user driven digital processes accelerating progress in methane leakage detection, as well as unlock opportunities across hydrogen leakage detection. The DPLA will directly improve data monitoring and insights improving efficiency and resilience of the networks through the innovative system architecture unique to the Project.

The underlying system architecture has evolved to include an expert system and user interface

Prior to the DPLA project (Discovery and Alpha), an expert system based on weighted rule-based inferences combining individual leak detection was designed. Across Alpha, the Project Team demonstrated the provenance of the idea and the opportunities to synthesised outputs into a digitally driven user interface. It was determined that the user interface will enable Cadent's workforce to view and interact with leakage data quickly, easily, and effectively. Together with the hybrid hydraulic model and advanced analytics, the expert system and user interface should enhance network coordination, reduce operational complexities, and improve user experiences.

The perception of the problem evolving, demonstrated through a range of detailed user needs:

Whilst in the first instance the ambition of the DPLA was to address gas leakage, through engagements with all Great Britain's distribution networks, the use cases have expanded into a non-mutually exclusive set of regulatory, operational, and business use cases. Whilst eight key use cases were identified, the five with the highest relative importance were as follows:

Gas Leakage Regulatory Reporting -- a need to provide more accurate annual reports of gas leakage quantity to Ofgem, compared to the current Shrinkage and Leakage Model (SLM)
Condition based monitoring -- a need to improve the understanding of the state of network assets by proactively detecting leaks rather than relying on models alone
Regulatory Performance and Revenue Generation -- A need to accurately measure network performance in reducing shrinkage/leakage and develop a fair incentive mechanism for reward and/or penalty
Proactive emergency intervention -- a need to reduce the risk to humans and properties via smarter and earlier identification, characterisation, and localisation of gas leaks
Improved Asset Replacement and Maintenance -- a need to leverage an improved understanding of the network and leakage hotspots to tailor the schedule of the Mains Replacement Programme and better target maintenance cycles and AGI replacement
Moreover, informed by the above use cases, the user interface will leverage a dashboard to display key information providing a priority view to the intervention engineers. Outputs are planned to include real-time alerts of critical leaks, visual heatmaps and leakage reports.

The key learning from the Alpha phase was the importance of the hybrid hydraulic model and machine learning based approach to offsetting the cost of physical in-field sensors, to achieve the same level of emissions reduction. This is now a fundamental principle of the DPLA and this philosophy will underpin the concept build in Beta.

Scalable solution

The DPLA project recognises the importance of a scalable solution, and hence, an area reflective of asset availability (including low, medium, and high-pressure tiers), type of assets (plastic, cast iron, steel) and physical spatial features (e.g., Urban versus Rural, Coastal versus Inland). Areas across North London and East England should demonstrate the viability of the system architecture. During the project mobilisation phase (August -- October 2023), these regions should be reaffirmed based on available data (WP2). There are opportunities to expand the scope of the DPLA and include advanced criteria such as the application of the solution across the transmission system, as well as the proactive detection of hydrogen and carbon.

Participation from a range of stakeholders (Eligibility Criterion 6)

As detailed across the Beta plans, the DPLA will enable knowledge dissemination both internally and externally with regulatory bodies, the GDNs as well as customer/third sector groups (e.g., Citizens Advice, IGEM, and Fuel Bank) and governing bodies (e.g., Ofgem, Environmental Agency and HSE). Engagement with regulatory bodies and shippers have already commenced (Question 10). Opportunities to realise interconnected benefits across SIF funded projects are already being identified. For example, aligning DPLA with the LeakVISION, a patented in-pipe gas leakage detection sensor.

Project Description

The Digital Platform for Leakage Analytics (DPLA) Project aims to develop and demonstrate a Prototype for how data, analytics and models can be used to identify and locate gas leaks in the gas distribution network. The core functionality of the DPLA is data-driven leakage modelling, unlocking proactive leak detection capabilities, combined with testing the application of novel gas sensor technologies. Thus, creating opportunities to reduce the reliance on and cost of in-field specialised sensors. Shaping the future network, the DPLA's mission is to reduce carbon emissions, realise customer benefits and improve safety in a cost-effective way. The overarching DPLA deliverable is the demonstration of the viability of the completed system of models, combining upgraded modelling capabilities with innovative leak sensor technologies to detect, localise and characterise gas leaks.

DPLA's innovative nature consists of enhanced network coordination, reduced operational complexities, and improved user experiences, all evidenced via a key project output: the user interface. The user interface will enable Cadent's workforce to view and interact with leakage data quickly, easily, and effectively. Outputs will include real-time alerts of critical leaks, visual heatmaps, reports of calculated leakage emissions by period, region, and asset, and more.

Bringing together all of Great Britain's distribution networks, National Gas Transmission, regulatory bodies, governing bodies (such as the Health and Safety Executive) and more will realise cross industry collaboration as they work towards a common mission. By combining upgraded modelling capabilities, the project will deliver the next generation of user driven digital processes accelerating progress in methane leakage detection, as well as unlock opportunities across hydrogen leakage detection. The DPLA will directly improve data monitoring and insights improving efficiency and resilience of the networks.

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Project Description And Benefits

Applicants Location

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Project Short Description

The Digital Platform for Leakage Analytics' (DPLA) project aims to develop and demonstrate a Prototype for how data, analytics and models can be used to identify and locate gas leaks in the gas distribution network. The core functionality of the DPLA is data-driven leakage modelling, unlocking proactive leak detection capabilities, combined with testing the application of novel gas sensor technologies. Thus, creating opportunities to reduce the reliance on and cost of in-field specialised sensor. Shaping the future network, the DPLA's mission is to reduce carbon emissions, realise customer benefits and improve safety in a cost-effective manner. The overarching DPLA deliverable is the demonstration of the viability of the completed system of models, combining upgraded modelling capabilities with innovative leak sensor technologies to detect, localise and characterise gas leaks. DPLA's innovative nature consists of enhanced network coordination, reduced operational complexities, and improved user experiences, all evidenced via a key project output: the user interface. The user interface is designed to enable networks to view and interact with leakage data quickly, and effectively through real time alerts, visual heatmaps and detailed reports.

Innovation Justification

Current processes and available state of the art solutions

As part of their licence condition, Gas Distribution Networks (GDNs) report their annual leakage emissions using the Shrinkage and Leakage Model (SLM). The SLM provides a static theoretical value of total gas leakage and cannot identify actual leak locations or volumes. The SLM is based on legacy data and studies from 1994 and 2002. Small improvements have been made over the years as the GDNs are obliged to review and try to improve the SLM. However, progress has been slow, and it has remained a static, theoretical approach which lacks the accuracy and granularity needed to inform a cost-effective, strategic emissions reduction plan. In addition, the SLM is not compatible with a hydrogen blended network, which is likely to be a major issue for all GDNs in future.

More recently, companies have started to develop innovative in-field products, sensors, and tools to detect leak locations. Although several of the solutions have been successful in accurately locating leaks, they have narrow focus on specific assets and are challenging to scale cost effectively.

This project seeks to revolutionise the GDNs' approach to leakage by replacing the SLM with an innovative, dynamic approach. It will build on past leak detection projects such as NGN's "LeakVision", National Grid's "Monitoring of real-time fugitive emissions" and Cadent's "ThermalTrax", as well as global oil and gas leak detection projects like the Environment Defense Fund's "Methane Detectors Challenge".

DPLA's innovative nature and transformational approach

DPLA proposes a first-of-a-kind data driven approach to dynamically detect and locate methane leaks on distribution networks. The solution applies a combination of physics based hydraulic models and machine learning based models that leverage existing and new data to detect and locate gas leaks more accurately than the SLM. Although elements of the solution e.g., machine learning models, hydraulic models, and/or innovative in-field products have been demonstrated in isolation, they have never been integrated in an analytics platform to successfully deliver a holistic approach to leak detection. Q#5_Appendix Innovation Justification provides an overview of the novel solution architecture to be developed and trialled during the Beta phase.

Post-project IRL and CRL

The need for SIF funding and large-scale trial are also aligned with the current assessment of the integration readiness level (IRL) and commercial readiness level (CML) of the DPLA.

Data integration is a key component and challenge when it comes to large numbers of datasets from disparate sources. Although some extracts have been successfully delivered in Alpha phase, the Project estimates DPLA's IRL at level 2. DPLA's Beta phase is expected to successfully demonstrate full data integration within the trial area hence DPLA is expected to reach at least IRL 6. While IRL 7 is achievable for Cadent, further work is required for other GDNs.

Considering commercial readiness, all GDNs are supportive of the value from the DPLA and have demonstrated this by partnering on the project, however no commercially viable product is available, hence at Alpha conclusion the Project estimated the CRL at level 3. Following the Beta phase, the value of DPLA will be demonstrated on a trial area, however the platform will need development before scaling up to a Great Britain scale production solution, hence DPLA is expected to reach CRL 6-7.

DPLA and competitive markets development

DPLA is a project supported by all Great Britain's GDNs and National Gas Transmission (NGT). If proven successful during trials, the solution can be rolled out across GDNs. The Project will develop and demonstrate a blueprint for how data, analytics and models can be used to identify and locate leaks. The blueprint can be replicated by other GDNs using their own data and preferred technology vendors, hence enabling competitive markets to drive value for Great Britain's gas distribution customers.

Why is the proposed scale appropriate?

The proposed project activities will enable Cadent to successfully demonstrate the DPLA on a live gas distribution network. A live large-scale trial across multiple asset types and geographies is needed to build the confidence in the DPLA results, which will drive key operational and planning decisions in future and replace a solution (the SLM) used for circa 20 years.

Why is the SIF the right funding mechanism?

Primarily, the GDN licence conditions mandate that the SLM is used, therefore there is no regulatory incentive for GDNs to consider adopting alternative solutions until these have been successful proven and mandated by Ofgem. If GDNs had the opportunity to develop new approaches and solutions, the innovative nature and associated risk in development of DPLA would prevent GDN's from funding the innovation. Furthermore, the scale of the project, focus on net zero transition, and collaboration across GDNs means that SIF funding is applicable rather than NIA funding.

Impacts and benefits

Environmental impacts

Key quantifiably evidenced benefits from DPLA implementation will be the 1) avoided gas loss and 2) avoided Greenhouse gas emissions. The Project performed a detailed cost benefit analysis in the Alpha phase, building on work in the Discovery phase with updated assumptions and more accurate costings. Assuming all GDNs were to implement the DPLA, updated values were:

12,435 GWh of avoided natural gas and/or hydrogen loss volumes by 2050 (benefit to the end consumer)
14,856 ktCO2e of avoided greenhouse gas emissions from distribution network shrinkage and leakage by 2050 (carbon reductions)
DPLA will reduce Greenhouse gas emissions from two gases with far greater global warming potential (GWP) than CO2: methane (GWP of 25 kg CO2e/ kg CH4) and hydrogen (GWP of approximately 11 kg CO2e/ kgH2). The DPLA will therefore continue to have a significant carbon reduction impact as GDNs begin to incorporate hydrogen into their networks, particularly since hydrogen has been shown to leak more readily than natural gas.

The avoided loss of natural gas/hydrogen and avoided equivalent greenhouse gas emissions will continue to be used as the metrics to track benefits as the business case is further refined and realised in the Beta phase.

Cost reductions in operating the network and wider energy system

Accounting for the total costs of DPLA deployment and assuming a representative forecasted cost of natural gas/hydrogen and carbon dioxide equivalent (see Appendix for trends and full list of assumptions), the above avoidance figures amount to net cumulative discounted financial benefits across GB of up to £2.86 billion by 2050 for our core modelled scenario in the Alpha phase. This is a fivefold increase on the initial financial benefits value calculated during the Discovery phase, largely due to the sustained long-term increase in forecasted gas prices.

The benefits are dominated by the cost of avoided emissions (~90% of the £2.86B), given the high GWP of the gases whose leakage is being minimised.

The precise magnitude of the benefits will depend on the future evolution of gas and carbon prices, the exact technology mix used for the remote leak sensing, and the pace of DPLA rollout across gas networks nationwide. The core assumed technology mix combines Picarro for rural and urban pipelines with SeekOps for large AGIs. The core scenario pace is that Cadent starts to test and deploy first, with other GDNs following a year later. Across three assumed paces and three technology options, the cumulative discounted net financial benefits range from £0.8 billion to £3.2 billion. Almost all combinations of the four factors listed above lead to the project breaking even by 2027.

Cost savings for network services users

The avoided volume losses could feed through as direct customer benefit by decreasing the cost of shrinkage and leakage gas which is passed on from GDNs to consumers' bills. At the very least, the DPLA will result in no net impact on customer bills, and could even lead to reductions in bills if less in-field monitoring is required as part of the DPLA's realisation, or if the baseline of methane emissions is found to be higher than the current modelled amount (through the SLM).

Impacts on consumers (individual and collectively) of the whole energy system

Further benefits to energy system consumers include:

Reduced carbon costs, representing a further environmental benefit to customers
Improved health and safety, with DPLA reducing the number of site visits required and thus also the risk of accidents
Lower fire risk, as DPLA allows networks to take immediate action to prevent ignition by providing real-time alerts.
Reduced disruption, as better localisation of leaks reduces the noise and time taken to fix them. This will improve public confidence and social acceptance.
Economic benefits to users and any other parts of the supply chain, broader (UK) economy

DPLA will provide improved certainty on operating conditions and modelled outlooks, resulting in gas shippers having to build less risk into their pricing strategies. This will lead to a narrower spread of prices which can feed through to consumer bills.

Impacts on government priorities

The estimated decrease in methane emissions from pipes and AGIs between 2020 to 2030 via DPLA is up to 58%, which supports the government priority to tackle methane emissions as a Participant of the Global Methane Pledge which was committed to at COP 26 in November 2021.

DPLA sends a strong message that GDNs are doing the right thing and sets an example for other networks and even other countries to do the same. It paves the way for best-in-class approaches to regulatory and operational methane emissions reduction.

Expected regional or wider energy supply resilience benefits

In future, the platform could be developed to perform predictive leak prevention as well as leak detection. This would further improve energy supply resilience by minimising system losses.

Project Plans And Milestones

Project Plans, Milestones & Risks

Project Plan's main work packages

The project is planned to be delivered across eight work-packages over a two-and-a-half-year period. The DPLA's management processes will be grounded in an agile product-centric delivery model using increment planning cycles and iterating principles. WP1, the programme management and business case, will be jointly led by Cadent and Guidehouse. WP3, WP5, WP6 and WP7 will be led by Cadent, determined by resourcing and capability availability. WP2, WP4, and WP8 will be led by Guidehouse, the Service Provider, via an apprenticeship model. This is a relationship-driven learning model where Guidehouse will work closely with Cadent to help foster skills development and professional growth to ensure the required expertise and experience is in place for BAU.

The work-packages essential to the building of the model and the solution operationalisation include WP2, WP3, WP4 and WP5.

Resources assigned

Refer to skills and expertise tab.

Interdependencies and critical path across the Plan

Interdependencies across all work packages have been detailed in the over-arching project plan detailed by the solid black line (critical path). The fundamental cross plan interdependencies have been detailed below:

The data selected for the model inputs in WP2 will inform which data pipelines have to be built in WP4, hence these activities will not begin until after the first data progress Stage Gate
The technologies trialled in WP3 will impact WP2 and WP3, as they will inform how and what data needs to be pulled from the technology providers to the DPLA models and MVP platform
Input of HSE feedback during engagements regarding the Safety Case (WP6) into to development plan for BaU rollout (WP5).
Ongoing engagement with other SIF related programmes (WP7) should work closely with WP8 to enhance existing project relationships (Leak Vision) and identify opportunities to build relationships (Intelligent Gas Grid).
Stage-gates, schedule and risk management

The plans have built-in flexibility into the delivery philosophy to continually align and iterate priorities in accordance with an agile approach. By nature, the decision framework at these stage-gates encapsulates the most significant risks. The project will conduct the stage-gates ahead of critical milestones which will mitigate the risk of sunk project costs.

In addition to engaging project partners on risks, the project will engage with Ofgem to discuss our regulatory risks and mitigation actions. Risks associated with cost of implementation with external platform providers are to be managed via programme management on an ongoing basis. Where risks become issues that impact the ability of the project to successfully deliver the success criteria and learning outcomes, these will be raised with the project steering committee as a first point of escalation. If no suitable actions can be undertaken to resolve the issue, the project will raise this with the project officer, Ofgem, and Innovate to agree on appropriate next steps that ensure value for money for customers. To ensure stakeholders benefit from the project, the project will inform stakeholders about notable open and closed risks at appropriate points. This approach ensures that stakeholder voices are considered carefully as part of the development of the DPLA

1) Stage-gate 1 and major risks:

Risk #R3 - The meta-data and data dictionary is representative and sufficiently granular for the pipeline asset type enabling model development, and the data is suitable for model development (29/01/2024)
Decision Framework: Should the data acquired not be representative, and or it is not suitable for model development, the project could face delays or project cancellations.

Risk #R4 - Determined by the physical trials, identify whether it is practically feasible and cost-effective to deploy additional fixed sensors. The Data Progress Review supports the need for additional sensors and the sensors are deployable within the model development phase (29/01/2024)
Decision Framework: Should the fixed sensors not be practically feasible nor deployable within the model development, the project could face delays or project cancellations.

Estimated total spend up to stage-gate 1 (contribution accounted for): £2,294,644

2) Stage-gate 2 and major risks:

Risk #R7 - All models are built and tested and produce adequate outputs and performance (to be tested by a revised iteration of the business case) (04/12/2024)
Decision Framework: Should the models not pass build and testing requirements (e.g., functional testing, release performance testing, system integration testing, user acceptance testing), the project could face delays or project cancellations.

Risk #R9: Determined by the operational change analysis, the business has the resources and change capacity to implement the operational change required for BaU (04/12/2024)
Decision Framework: Should the business be unable to identify new processes for the changes required, e.g., engineering procedures and or dispatcher's role in responding to an escape, the project could face delays.

Estimated total gross spend up to stage-gate 2 (contribution accounted for): £5,841,491

Regulatory Barriers

Regulatory Barriers to the delivery of Beta Phase project (Cross-cutting point #3)

There are no regulatory barriers to the delivery of DPLA Beta, nor are any derogations, licence exemptions or regulatory sandboxes required for delivery. However, the benefits for the Beta Phase Project will not be fully recognised within the current price control period and there are longer term barriers in transitioning the project from the Beta Phase to business as usual (BAU), explained further below.

Regulatory Barriers in transition to BAU

To transition to BAU, the DPLA project will likely require significant changes to the current regulatory framework to ensure it recognises the value and benefits to customers and wider society.

Firstly, the Shrinkage and Leakage model (SLM) currently used to measure the environmental emissions from gas lost from networks is predicated on asset leakage estimations from the National Leakage Tests (undertaken in 2002). DPLA will quantify actual leakage, providing a more accurate view of gas losses from network assets and their environmental impact. Whilst it is expected that the two models will co-exist for a short period, the long-term aim is for DPLA to replace the SLM. Hence, executing an impact analysis on the transition from the traditional SLM model to DPLA is paramount.

Secondly, for RIIO-GD2, shrinkage performance is measured through the reputational incentive to reduce shrinkage volumes (GWh) and a financial incentive to optimise average system pressures and gas conditioning. The DPLA rollout will necessitate re-consideration of how these outputs and incentives should be updated to continue encouraging networks to minimise shrinkage given the updated methodology. Subsequent changes to reflect enhanced leakage quantification may be required for the Gas Transporter licence, and the Uniform Network Code, which forms the basis of the arrangements between the Gas Transporter (GT) and the Shippers whose gas networks transport. These impact assessments have been reflected in WP6 of the project plan.

Thirdly, usage of DPLA, including integrated technology solutions to sense leakage in real-time, will better inform networks' asset management decisions, including targeted intervention in network areas with the most leakage. Regulatory mechanisms which monitor and measure our asset management performance will need to recognise this.

Finally, the annual Regulatory Reporting Pack (RRP) requires networks to report the volume of shrinkage gas and performance against the incentive. Changes to the way leakage is quantified and/or outputs and incentives are measured will require consideration of changes to the regulatory reporting requirements.

Engagement on these challenges

Suppliers/Shippers

DPLA was presented at the Shrinkage & Leakage forum on 23rd November to onboard the shipper community. Ovo, Centrica, and SEPE all asked details around unidentified gas, information sharing, and transparency of the solution data. Bi-lateral meetings with these key stakeholders were subsequently held on the 2nd, 8th and 7th February 2023, respectively. The shippers confirmed that their concerns would be mitigated through the peer review of business rules, MOD panels and workgroup development (the industry standard practice). Hence, our plan accounts for these activities.

Ofgem and other regulatory bodies

The DPLA project has thus far delivered three positive engagements with Ofgem. One commented positively about DPLA and labelled it a 'game changer'. The initial engagement delivered an overview of DPLA, whereas the second detailed the four key areas of regulatory considerations to fully embed the core functionality of the DPLA solution. Upon request, the most recent engagement explored how DPLA can also play a leading role in better understanding and quantifying in-field hydrogen leakage.

In addition to evaluating the impact on the regulatory framework and network code changes, we recognise the importance in addressing barriers from national or international standards and are therefore executing a policy impact assessment. We have planned activities to review the impact of DPLA on the Gas Safety Management Regulations (GSMR), our Safety Case, and the Gas Act, demonstrating our recognition of the importance of engaging with policies governed by other bodies such as IGEM and the HSE.

Having already engaged with Andrew Barnes at The Environmental Agency (EA), Beta will prioritise engagement with customer groups (see question 8), including Citizens Advice, Sustainability First, and further meetings with the EA.

Support needed to develop policy for the future price control

The project has been planned to coordinate with development of the next price control. The project recognises the need for possible licence modifications (RIIO-3 or in-period) and has planned activities should code changes be required. The project also recognises the importance of maintaining on-going engagement with Ofgem on key areas of policy, such as clearly outlining any changes to the regulatory framework, licence modifications, and potential code impacted upon the immediate completion of the Beta phase. The project will provide periodic updates and where appropriate share key findings from WP5 project deliverables on an on-going basis.

Business As Usual

How and when the DPLA will become BaU

At the end of Beta, the Project will have set the framework for a full scale BaU rollout for Cadent's network.

The DPLA's Project Model will need to have completed function and viability testing for the hybrid hydraulic model, the three classes of ML-based leak detection models and the expert system, and user acceptance testing completed for the user interaction interface. The solution architecture should be configured and successfully integrated using Cadent's ecosystem with data pipelines designed, built, and operational to support the modelling platform. The completion of these activities will enable the Project Model to be scaled across Cadent's full network upon the completion of the Beta phase. Before the Prototype can be deployed across other GDN networks, the system will go through a customisation process. The framework and key learnings obtained across Beta can be leveraged to accelerate BaU rollout across the remaining networks.

Steps to ensure successful BaU implementation

A change impact assessment carried out in Alpha identified the following dimensions to be impacted by the DPLA. These areas will continue to be carefully managed across the Beta phase to enable a rapid rollout and ensure a scalable BaU innovation.

Job roles, people & skills will need to adapt to the changing landscape of a model driven approach to gas leak detection, monitoring and mitigation.
Process will need to deliver iterated engineering standards, policies and procedures and reflect the approach to achieve near real-time gas leak response.
Safety Case changes will need to be identified, impact assessed and managed accordingly
Systems and tools will need to evolve to support advanced analytics and a new user interface.
Behaviours and Attitudes will need to transform to a proactive mindset to support real time information flows and data driven decision making
Licence and network code changes will likely be required to address the implications of changing the current methodology (SLM model). There is currently a requirement for 28-day consultation, specialist industry review and final Ofgem approval. Hence, the project could lead to industry level changes, and thus it is paramount that the project accounts for the necessary steps for successful implementation of regulatory change (Question 10)
National or international standards will also need to be managed through engagement with governing bodies such as HSE and IGEM.
Change champions

The project has been sponsored by Cadent's Director of Asset Investment who is accountable for the current Shrinkage and Leakage Model (SLM) as well as Net Zero development, planning and analytics and is committed to championing the implementation. This is underpinned by several 'change champions' to ensure appropriate support and promotion and will be a part of the build and test stages. These change champions were involved in the Discovery and Alpha phases and thus support the adoption of the DPLA. They will be resourced to one of the DPLA steering, project management or delivery groups. Where possible, they will be resourced during BAU rollout due to their experience across the full project lifecycle.

Early interest indication in innovation adoption

All four UK GDNs, as well as National Gas Transmission, have demonstrated an early interest in the adoption of the DPLA solution through strong participation during the Alpha Phase Steering Meetings and wider stakeholder engagements (Ofgem and Shippers). Across Alpha and the Beta application, these parties raised minimal concerns regarding the expectations during a network wide BaU implementation, for example the possible business change requirements.

Dissemination and project learnings during implementation

To enable knowledge dissemination across GB networks, the networks will obtain a non-exclusive license to the DPLA's Beta phase Foreground IPR, as described in section 9 of the SIF Governance Document. To accelerate knowledge sharing, the project team will input considerations into responses to RIIO-3's draft and final determination and business plan. The project will participate in any required workgroup development and industry consultations to confirm that the required code changes are implemented prior the deployment of the execution of the BaU Business Plan.

Funding strategy for innovation adoption

The funding strategy beyond the Beta phase of the project will need careful consideration in line with RIIO-3 associated activities and discussions to ensure the appropriate approach to future funding. As established in RIIO-2, there are several potential options, in addition to consider incorporating into Cadent's baseline allowances, there are various alternatives, such as "Price control deliverables - PCD", "Use it or lose it -UIOLI" or a "Re-opener" approach. It is too early to confirm for this application but further development of the funding approach will take place during the Beta phase.

Procurement Strategy

Procurement activities/strategy will need to be in line with relevant utility procurement regulations and will follow any policies and procedures that are already in place with Cadent (and other licensees)

Commercials

Consumer interaction and engagement

DPLA's interaction with energy consumers

During the Alpha phase, an omnibus survey was carried out to determine the public's perspectives regarding the DPLA solution. The Social Licence to Operate Framework supported the project in designing the engagement. The Project wanted to identify consumers beliefs behind the project's benefits and use these learnings to inform the messaging style and language for external engagement during the Beta phase.

Four key questions were mapped against the social licence to operate framework to ensure a holistic coverage addressing the trust in gas networks, concerns regarding the DPLA solution, the preferred technology to be used (helicopter, car, drone, fixed sensors) and the 'not in my back yard' concept, due to the possible disruption of the helicopter technology.

Overall, the omnibus survey suggested a positive story for the project with 75% supporting the DPLA, with only 3% opposing (22% remaining neutral). Majority of respondents supported the use of helicopters (58%) and drones (67%) in their area. Moreover, respondents generally supported the project with many keen for further engagement. Some individual feedback included "A very interesting and practical solution to a problem with multiple options available". Respondents requested further engagement and details on the pollution (emissions and noise) from the technology options and hence provided a direction when refining the knowledge sharing approach and channels during WP7.

Impact on existing or future energy consumers

We will further detail and specify external consumers stakeholder engagement during the 'refine knowledge sharing approach and channels' activity within WP7. During the Beta phase, outreach materials will be developed and shared accordingly on the determined platforms (e.g., social media, media, and newsletters). The Project will spread DPLA awareness through engagement with consumer stakeholder groups. Specific stakeholder groups relevant to consumers include Fuel Bank, Environmental Agency, and Citizens Advice.

As detailed in question 6, reduced disruption, due to less noise and time taken when fixing leaks due to better localisation, will be an added benefit to energy customers. Further, given the networks will be able to take immediate action when preventing ignition, due to real-time alerts, fire hazard prevention benefits will likely be realised.

As also detailed in question 9, there are no expectation to impact consumer contractual arrangements or require any gas supply interruptions.

Supply shortages and interruptions

The project does not plan to interrupt consumers' supply at any stage during Beta, nor does it expect to create/trigger any supply shortages, or network interferences meaning little to no direct impact to consumers.

Although physical trials will be conducted (e.g. vehicles and helicopters), these will be non-intrusive activities, mainly conducted in rural areas and will not have direct impacts on the operation of the gas system. Appropriate communications will be considered to ensure consumers are aware of any trials in their area that they may need to be aware of (e.g. to mitigate any concerns of helicopters overhead or additional vehicles in their street).

This can be compared to the National Leakage Test carried out in 2002-2003. In the event a total of 862 tests were carried out in the period from February 2002 to May 2003. The test sections measuring 80 to 120 metres length were excavated upon, isolated, capped off and any associated service pipes capped on the customers' side of the Emergency Control Valve.

Commercialisation

What considerations have you and your project partners made for the commercialisation strategy for this innovation? How does your project provide support for non-network partners to help move towards commercialisation of their innovation?For the purpose of Q12 and Q13:

The "Prototype" and the "Project Model" can be defined as:

The "Prototype" is the design of the Models that were developed by Guidehouse prior to the start of the project (including the source

code) (as set out in Guidehouse Background-IPR in Q13)

The "Project Model" is the deployment and operationalisation of the Prototype built during the Beta phase, developed by Guidehouse in cooperation with, and personalised for, Cadent and filled with Cadent's data and information (as set out in The DPLA's Combined Foreground-IPR in Q13)

The DPLA Project Partners recognise the following:

Each Project Participant shall own all Foreground-IPR that it independently creates as part of the Project, or where it is created jointly then it shall be owned in shares that are in proportion to the work done in its creation.

Each Project Participant in the Project shall retain all rights in and to its Background-IPR.

All other licensees will have the right to use Foreground-IPR within their network royalty-free.

Commercialisation Strategy

Whilst GDN only commercial design options (no third-party) enable an aligned vision for DPLA, there are limited vendors with known hybrid modelling capabilities, thus outsourcing the management of the algorithm was identified as a minimum criterion. Further, the following categories were identified as evaluation criteria when considering the commercialisation strategy:

Knowledge sharing and innovation: Distribution of ownership may encourage or discourage the sharing of knowledge and innovation.

Scalability and DPLA 2.0: Ensuring the commercial design solution enables continuous improvement (across the UK and wider) and prolonging benefits to the funding party.

Cloud Management: Cloud management requires sufficient expertise and capabilities to deliver the long-term maintenance for DPLA ensuring a positive on-going customer experience.

Data privacy: The GDNs are legally obliged to adhere to the network code and thus cross border privacy is essential. Generally, the data used for DPLA is gas network specific, rather than customer data, and thus GDPR issues are minimal.

As detailed by the commercialisation strategy development activity in the overarching plan, the DPLA project will work closely with Innovate UK to further refine the commercialisation strategy.

Primary Customer Segment Considerations

Ownership of DPLA:

Detail regarding the ownership of Background Intellectual Property Rights (IPR) and Foreground-IPR can be found in Q13.

Operationalisation of DPLA:

The development of the Project Model and the IS System Architecture will be executed by Guidehouse during the Beta phase due to the availability of expertise and resources (within Cadent's own cloud environment). The IS System Architecture will be delivered by an apprenticeship model. This is a relationship-driven-learning model where Guidehouse will work closely with Cadent to help foster skills development and professional growth to ensure the required expertise and experience is in place for BAU. Hence, once the IS System Architecture has been set up in Cadent's environment and fully operationalised, Cadent should be set up to operate the system architecture independently.

Commercialisation of the Project Model (Foreground-IPR):

Customer Value Proposition

The Project Partners (Gas Networks) will receive a non-exclusive license to the Foreground-IPR i.e., the "Project Model' and the deliverables developed across the Beta phase for the purpose of knowledge sharing and dissemination, demonstrating that UK customers will obtain a fair return (Cadent data retracted). Considerable customer insights, distilled across 38 deliverables, are to be produced as part of the Beta phase. Hence, extensive descriptions on the DPLA's unique solution as well as physical trials and regulatory research are to be shared with Project Partners and the Funding Party.

Purchasing the DPLA solution:

Other Utility Networks (excluding Project Partners) across the UK and outside of the UK (e.g., Water Networks) would have the option of purchasing the Combined Foreground-IPR (the Project Model, Cadent data removed), where any royalties earned by a license through the Combined Foreground-IPR (the Project Model), are to be shared with consumers in proportion to the funds that consumers have contributed to the Project. Where the Combined Foreground-IPR contains Guidehouse Background-IPR, after the project partners and Guidehouse agree on appropriate terms and conditions for any joint marketing and underlying contracts with third parties, Guidehouse would extend a non-exclusive license to third parties to develop the deployment and operationalisation of the Prototype (Guidehouse Background-IPR) customised for the third-party's use.

Route to market and potential/emerging partnerships

During the Alpha phase, a range of innovative in-field leak detection technologies were identified and analysed through provider interviews with Italgas (Picarro) and OGE (CHARM). The primary objective of these engagements was to evaluate the technologies required for the machine learning models. The secondary objective was to establish relationships with these networks, located in Italy and Germany respectively, for future routes to market. It is expected that these networks will open partnership opportunities across Italy and Germany, and in turn, Europe, Cadent have now established an initial relationship with Picarro for field trial activities.

Intellectual Property Rights

The DPLA Beta phase will deliver the Project Model i.e., deployment and operationalisation of the Prototype during the Beta phase, developed and personalised to Cadent's needs and filled with Cadent's data and information. The demonstration of the Project Model will determine the viability of the Prototype and is to be delivered by Guidehouse, in cooperation with Cadent within Cadent's own cloud environment. For each network, the "Prototype" will require customised iterations through an operationalisation and deployment service fee which is estimated to be less than half of the Beta phase total project costs, subject to scoping.

The following detail Cadent's and Guidehouse's Background-IPR and Foreground IP created as part of the Project.

Cadent Background-IPR

Cadent will retain full ownership of their Background-IPR in relation to the data and insights from the current Picarro trial. Cadent will continue to own these insights as Background-IPR and could bring these to other networks, separate from this project.

Guidehouse Background-IPR

Guidehouse will retain full ownership of its Background-IPR in relation to the knowledge and design of the models that it will provide and that are referred to as the 'Prototype' (the Models including hybrid hydraulic model, all the ML models, and the expert system model). Guidehouse shall continue to own the Prototype as Background-IPR and has the exclusive right to license the Background-IPR for other clients, separate from this project.

The Prototype consists of "Models" as detailed below:

1. An Enhanced Gas System Hybrid Hydraulic Simulation Model -- covers both the physics-base steady-state and transient versions of the hydraulic model as well as two machine learning based hybrid elements that address 1) the automated correction of hyperparameters (i.e. the physical characteristics of the gas distribution system assets) of the hydraulic models and 2) the automated establishment of accurate initial conditions of the Newton-Raphson algorithm used to solve the hydraulic models and finally how the hybrid hydraulic model would be used as part of a leak detection, localisation and characterisation process.

2. Machine Learning based Leak Detection, Localisation and Characterisation Methodologies -- covers the categorisation and description of numerous types of machine learning algorithms focused on time-series decomposition, prediction, anomaly detection, pattern recognition and nonlinear system identification, which are applicable to the data-driven, model-driven and hybrid leak detection, localisation and characterisation models.

3. An Advanced Expert System -- covers the design and specification of a dynamic probabilistic semantic reasoning system that integrates the following:

a. an advanced evidence-based reasoning/inference algorithm

b. a belief rule base system

c. a reinforcement learning-based rule adaptation algorithm

d. a graph-based knowledge base that integrates and inter-relates all data into the expert system

Guidehouse will have the right to provide licenses to our Background-IPR within and outside of the UK to any Party that is not deemed Cadent or Project Partner, during and outside of the term of the Project.

Cadent and its Project Participants shall not (i) resell, broker, redistribute, republish, transfer, sublicense or relicense the Prototype or use this for third-party transactions, services bureau use or publicly perform or publicly display the Prototype; (ii) cause or permit the reverse engineering, disassembly or de-compilation of the Prototype; or (iii) modify or otherwise create any derivative works of or from the Prototype. Cadent will not, and will not permit any individual other than authorized individuals to (i) allow any access to or use of the Prototype by any individual other than authorized individuals; (ii) remove, alter or obscure any proprietary notices (including, without

limitation, any copyright or trademark notices) of Guidehouse or its licensors from the Prototype; or (iii) access, use, reproduce, display, copy or use the Prototype for the benefit of any person or entity other than for Cadent's and Project Participant's internal use. Any and all rights not expressly granted to Cadent hereunder are reserved by Guidehouse.

The DPLA's Combined Foreground-IPR jointly owned

The customisation of the Prototype for Cadent that sits on top of each model is defined as the "Project Model" and would be a combination of Cadent-specific data and Guidehouse developments. In addition, the deliverables developed across the Beta phase for the purpose of knowledge sharing and dissemination. Both will qualify as Foreground-IPR that would be owned jointly by Cadent and Guidehouse and that can be licensed royalty-free to the Project Partners within the UK (Cadent data retracted).

Guidehouse Foreground IP

Guidehouse will be the exclusive owner of all right, title and interest in and to the solution, any enhancements, modifications or derivative works to the Prototype and any and all reports, data, records, notes, files, plans, proposals, presentations, other lists, flow charts, spreadsheets, software code, designs, text, imagery, files, discoveries, inventions, documents or other creations (including without limitation patentable discoveries involving computer software or business methodology) that Guidehouse may conceive or make in the course of or in connection with Guidehouse services for Cadent.

Costs and Value for Money

Total project costs (inc. Subcontractor costs and their importance to the project)

The total project costs are £12,068,514 however due to contributions from Cadent and Guidehouse the funding requested is £9,496,476. The contribution balance of funding will be delivered through additional time, resource, and expertise commitment from both Cadent and Guidehouse.

Cadent and Guidehouse are committed to the successful delivery of this project. Together, £2,572,038 of expertise and resource will be contributed, across all 8 work packages. The four gas network partners, NGT, SGN, WWU, NGN will provide one day per month each of a gas emissions specialist's time across the project. This will ensure that the project benefits from the full breadth of UK gas emissions expertise concentrated over a short period of time to ensure the best outcome and value for money.

Changes to project team and resources used in previous phases

Thorough organisation charts were developed, and specific roles outlined, to detail the human capital required. Based on the WP2, as well as WP4, specific materials essential to the build and test of the current Alpha architecture were identified and total costs estimated. Further, the underlying DPLA solution relies on additional sensor technologies, and hence, the materials required to deploy WP3 were forecasted and included.

Human Capital Costs: Driven by the dependency on highly skilled expertise including an expert machine learning architect
Material Cost WP2 and WP3: The materials required for WP2 and WP3 include AWS Computing, Licensing Storage, Workspaces and Databricks
Trial and Sensor Costs: The material cost considerations for WP3 include the data loggers required across the geographic scope of the Beta Phase (a subset of North London and East England) as well as the trial costs for the vehicle-based, aerial-based and drone technologies.
Outsourced specialised expertise costs: The Project has identified the need for a single specialised individual to support with the data extraction and engineering activities required for WP2.
How the project delivers value for money and the balance of costs across SIF Project Partners

Cadent have extensive expertise in the transportation of gas from National Transmission offtakes down to customer connection points. This unique position provides opportunities to deliver innovation projects leveraging their specialist skills and experience, enhancing the realisation of value and benefits being passed onto the consumer. The Guidehouse team has over 15 years of agile software development experience, data management expertise, and successful enterprise scale DevOps implementations and will be driving the model and analytical platform design and build. Given the specialised skills required for the complex model build and software implementation, the DPLA Beta phase will require a greater proportion of Guidehouse skills and expertise, to complement the asset and regulatory expertise of Cadent. Typical blended day rates for Guidehouse assignments with Cadent are £1400 and the Discovery phase day rate was discounted from this to £1300 and subsequently to £1200 for Alpha phase. As a demonstration of commitment to efficient project delivery and value for money, the Beta phase blended day rate for the Guidehouse team will drop to £1096.

Guidehouse are critical to the successful delivery of this project:

Guidehouse have global subject matter expertise on leading practices around methane leakage monitoring and reduction techniques and delivered the successful outcome of the Discovery phase and Alpha phase. Thus, continuity of expertise through Beta is important. Guidehouse's team will play a core role in building and testing the model, analytics and data development

As 5 gas networks are partnering in this project and a 'beach to meter' approach is being taken, a central independent partner is necessary to successfully manage the change required and manage stakeholders across all 5 UK gas networks.

Contribution from private funds and how the project delivers value for money

As a show of commitment in the project concept, both Cadent and Guidehouse will contribute over 20% of costs to the project, to assure value for money for UK gas bill payer. In addition, Cadent will make a substantial £3.38m contribution-in-kind via the cost of data acquired from existing trials of the Picarro in-field sensor technology. In comparison, the National Leakage Tests cost in the region of £10m 20 years ago, to achieve an inferior model of national gas emissions.

Cost comparison to industry standards

The Beta Phase benchmarks strongly against similar past IT innovation projects

KASM (UKPN); 3 years; Developing real- time contingency analysis tools incl. load & generation forecasting tools; Budget = £3m (of which £1.5m IT component)

Power Potential (UKPN); 3 years; Developing DERMS to optimise dispatch of distribution connected generation; Budget = £10m (of which ~£3-4m IT component)

Optimise Prime (UKPN); 3 years; Developing IoT platform to manage EV fleet charging; Budget = £16m (of which ~£4-5m IT component)

DPLA = 3 years; Developing machine learning models and cloud architecture; Funding = ~£10m (of which ~£4m IT component)

Document upload

Documents Uploaded Where Applicable

Yes

Documents:

DPLA Beta Benefits Map.pdf

DPLA Model Diagram.pdf

SIF DPLA Project Management Book_21032023 (13).xls

SIF Beta Project Registration 2023-11-28 2_59

This project has been approved by a senior member of staff

☑ Yes