SIF Project Registration

Date of Submission

Apr 2022

Project Reference Number

10027575

Project Registration

Project Title

NAVIGATION

Project Reference Number

10027575

Project Licensee(s)

SGN

Project Start

March 2022

Project Duration

2 Months

Nominated Project Contact(s)

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Project Budget

£149,725.00

Project Summary

Key to the UK's Zero Emission Transport strategy is alleviating consumer range anxiety and accelerating Electric Vehicles (EVs) adoption by deploying ultra-rapid (100-350 kW) EV chargers to high-utilisation locations. To deliver this will considerably affect "business as usual" for consumers and network businesses, at great capital expenditure.
This project brings together proven technologies and existing energy infrastructure to:

- introduce a direct alternative to capital-intensive network reinforcements;
- divert costs from consumers and create the technical framework for revenue
- streams to prosumers, and; scale EV uptake, furthering the UK's Net Zero agenda.

The 'Planning and EV Charging Operation Utilising Low-Carbon Generators' (NAVIGATION) Project aims to demonstrate how predictive grid mapping AI; fuel-flexible, pollutant-free power generation; and real-time optimisation and control technology can employ the gas network, as it evolves to 100% renewable, as an alternative energy vector for the power provision for ultra-rapid EV charging infrastructure.

Project NAVIGATION brings together world-class expertise across AI (Farad.ai), distributed, renewable-fuelled power generation (IPG), optimal real-time control (SMPnet) and a key energy sector stakeholder (SGN):

1. SGN is a leading gas network operator, already delivering on a number of innovation projects designed to enable and accelerate the transition to a hydrogen gas network.
2. Farad.ai's AI-powered Compass product will identify high-demand sites for ultra-rapid EV charging that currently cannot be served by electricity grid but are in proximity of a gas network connection (SGN). This technology is TRL 6/7.
3. IPG's pollutant-free, fuel-agnostic power generator, the IPG Flameless Generator, will provide the additional capacity and balancing services using the gas network, as it transitions to hydrogen. IPG's technology is proven to be a clean, off-grid EV charging solution in a £1 million SBRI project with National Highways, funded via Innovate UK. This technology is TRL 6/7.
4. SMPnet's Smart Network Controller (SNC), a high-computing, powerful controller, will supervise, optimise, and control multi-vector energy assets, in real-time and in a coordinated manner. This product has been developed through Innovate-UK-funded projects entitled 'LMEX', 'INFINITE' and Perth 'Smart Energy Network' at a TRL 6/7.

The end users of this project include funding schemes in charge of co-ordinating EV uptake, gas and electricity network owners and operators, EV users and indirectly regulators. The end users and wider stakeholders benefit from: faster EV charging in locations that meet demand; lower carbon emissions; higher air quality; access to new revenue streams; and, reduction of consumer costs by minimising network operators' capital expenditures.

Third Party Collaborators

IPG

SMP

Farad

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Problem Being Solved

Problem

Consumer range anxiety is a barrier to widescale adoption of Electric Vehicles (EVs), fuelled by low availability of public chargers and lengthy charging times at non-rapid charge points (<50 kW).
To overcome this barrier, the UK's Zero Emission Transport strategy includes the deployment of ultra-rapid EV charging network (100-350 kW) in high-utilisation locations to supplement home and work-based charging.
Ultra-rapid charging in these locations is subject to network constraints and issues such as balancing and decreasing system inertia. Meeting the intermittent, highly unpredictable demand of ultra-rapid chargers requires network reinforcements across multiple voltage levels. This is not always technically nor economically viable, particularly in city centres and remote locations with high traffic throughput (e.g. motorways), where this infrastructure is essential.
These reinforcements include network and generation capacity increases. The latter typically occurs at distances from the vicinity of the constraint with lack of utilisation of local resources (e.g. gas network) and lack of incentive for provision of V2G infrastructure (EV charge points with bi-directional power capability) which effectively underutilises EV's capability to provide flexibility back to the network and hinders EV users' ability to participate in markets with high revenue streams.

Opportunity

With UK gas network operators transitioning to biomethane and hydrogen, there is an opportunity to utilise this energy vector to support the growth of zero emission transport. Coupling local gas and electricity networks can alleviate capacity constraints and balancing issues of delivering ultra-rapid EV charging, preventing the need for city-wide reinforcement of the distribution and transmission networks.
This project underpins five core objectives with tangible opportunities for network consumers and wider stakeholders:

1. Combine greater visibility across different vectors of the energy network with predicted EV demand to identify optimal EV charger deployment
2. Couple local gas network with the low-voltage distribution network to alleviate grid constraints in key locations for ultra-rapid EV charging
3. Enable the gas network to transition to green hydrogen by deploying distributed, fuel-agnostic, zero-pollutant power generation assets
4. Optimally control energy assets in real-time to create G2V and V2G services business case and allow handles directly to network operators
5. Directly increase system inertia, minimising investment for equipment to alleviate inertia-induced issues

The network innovation represented by this project creates a blueprint for the
coupling of gas and electricity energy vectors that is applicable both across the UK, and in key export markets in the EU and beyond, where similar constraint and balancing issues exist.

Project Approaches And Desired Outcomes

The Big Idea

Project NAVIGATION provides a blueprint for coupling the gas network, as it evolves to 100% renewable, with the electricity network to alleviate the grid constraint and balancing issues preventing ultra-rapid EV charging in high utilisation locations. This offers a direct alternative to the capital-intensive network reinforcements required to mitigate range anxiety and charging time barriers hindering EV adoption.

Farad.ai's AI-powered Compass product combines grid capacity, land-use and socio-economic data to identify optimal siting for ultra-rapid EV charger. This will be overlaid by SGN's gas network to identify sites where existing gas infrastructure can reinforce the low-voltage network, via IPG's fuel-flexible, pollutant-free power generator. EV chargers and IPG's generators will then be operated and optimised by SMPnet's Smart Network Controller (SNC), ensuring compliance with the network's technical requirements and facilitating participation in balancing and flexibility markets directly or through an aggregator.

This project supports the following competition aims:

1. Decarbonise gas and electric distribution networks by coupling the gas and electricity vectors by integrating IPG's pollutant-free power generators that can seamlessly operate on pure and blended natural gas, biomethane, and hydrogen. This will not only enable decarbonisation of the gas network but also all fuel-based power generation assets in our distributed electricity network.
2. Develop infrastructure and processes required to support and accelerate at scale uptake of EV transport, whilst coordinating strategic network decisions with the transport sector by identifying grid constraint and predicting demand at the last mile of the grid with Farad.ai's Compass. This will create a roadmap for strategic installation of ultra-rapid EV chargers, supported by appropriate electricity infrastructure, to overcome range anxiety.
3. Maximise opportunities to integrate zero emission transport energy provision with the wider energy sector and provide certainty on options, costs and timeline for network availability by integrating IPG's generator and EV chargers at network nodes identified by Farad.ai's Compass, and controlling them in real-time with SMPnet's SNC, for secure, effective and efficient operation. This will provide insights into operating costs, forecasted network/asset availability, and enable participation in flexibility markets (e.g. demand side response through G2V and flexibility via V2G operations).

This project brings together three proven and distinct technologies, ready for commercial-scale demonstration. All IP is owned by the individual organisations and it is not expected that outputs from the Discovery Phase will include new IP.

However, any progress made on each of the technological innovations will remain the sole ownership of each company.

Innovation Justification

Project NAVIGATION creates a solution that redefines business as usual for energy network operators, by enabling systematic utilisation of AI, optimal real-time control and low-carbon generation utilising the existing gas network, as it transitions to hydrogen. The innovations underpinning the NAVIGATION Project, and the solution itself are first-of-a-kind both in the market today and in state-of-the- art applications.

Gas network operators are undertaking pilot projects to test and validate the feasibility of transitioning existing gas networks to 100% green hydrogen -- examples include SGN's H100 projects. However, the majority of these projects are focused on exploiting hydrogen for heat applications, with no evidence of similar projects with direct coupling of the transportation vector via the electricity network. Our long-term approach builds network resilience in anticipation of increased EV uptake, but also anticipates the growth of hydrogen use in carbon-free energy supply, supporting SGN's H100 and other innovation projects to help create UK's future hydrogen gas network.

The technologies that come together in this holistic network innovation are truly unique and cannot be procured by Distribution System Operators (DSOs) as part of business-as-usual:

1. The SNC is a first-of-a-kind technology with capabilities far beyond the present market, to control and optimise in real-time (to the millisecond) myriad energy assets, accounting for three-energy vectors (i.e. electricity, heat and transport). The cross-coupling nature of the proposed solution (enabled by the advanced optimisation engines and realised with the aid of the SNC) is a key novelty currently not found in any other technical solutions, which typically disregard the flexibility that can be shared between energy vectors.
2. IPG's breakthrough fuel-flexible flameless combustion innovation provides the pollutant-free, fuel-agnostic capabilities necessary for coupling the electricity network with the gas network at the Low-Voltage level. Whilst there are both pollutant-free generators and renewable-fuelled generators with some level of multi-fuel capabilities in the market, none offer the combined capabilities of zero-pollution with complete fuel-flexibility, i.e. operating on the varying qualities and blends of fuels that will be utilised in our gas network as it transitions to hydrogen.
3. Farad.ai's analytics ensure maximal usage of electricity from renewable sources by optimising EV charge point locations in conjunction with SGN's gas network. Farad.ai has carried out proofs of concept with 93% accuracy in modelling the last mile of the grid. This is a key innovation in the industry that has not yet been replicated, even by major players like Google and IBM.

Project Plans And Milestones

Project Plan And Milestones

In the Discovery Phase, consortium partners will work to fill gaps in knowledge required to deliver the proposed Alpha Phase technical solution: a low-cost local grid reinforcement innovation, compatible with today's infrastructure and 2030 Net Zero ambitions. To achieve this, the consortium has identified the following key work packages:
WP 1: Evaluation and integration of relevant datasets:

Principal project partner: Farad.ai

Goal: Identifying target locations for the proposed solution - combining grid, gas and water network knowledge on AI platform

Risks: Data access and data quality. Mitigated with data acquisition budget and partnership with key data stakeholders including SGN and Thameswater. Using standardised and well-documented process to clean and integrate the data into data ingestion pipeline.

WP 2: Plan Principal project partner: IPG

Goal: Create an indicative plan for the implementation of the technical solution at a scale appropriate for Beta Phase. Identify riskier assumptions and technical aspects of the proposed solution at this scale and create a project plan for testing and validation of these aspects in an appropriately scaled Alpha Phase.

Risks: Regulatory concern regarding deployment of embedded generation assets that couple the gas network to the electricity network at a distributed level. Mitigated through partnerships with SGN and DSOs to identify potential impact on proposed project timelines.

WP 3: Integrate Principal project Partner: SMPnet

Goal: Identify methods and considerations for using SMPnet's technology to supervise, optimise and control involved energy assets (e.g. IPG's Flameless Generator, EV chargers, etc.). SMPnet will help electricity and gas networks to cooperate towards sharing existing flexibility.

Risks: Difficulties due to complexity of integration, leading to suboptimal system operation. Mitigated by utilising a rich library of industry-favoured communication protocols and standards.

WP 4: Scale Principal project Partner: All

Goal: Determine the best business model for deployment at-scale and establish additional partnerships for Alpha phase solution and commercial deployment

Risks: Difficulties in quantifying impact means we're unable to demonstrate success. As part of WP 4 and user engagement, we will define operational, commercial, and environmental metrics as framework to analyse our success. We will develop a full business case and impact assessment against this framework.

WP 5: Project Management Principal project Partner: SGN with input from all project partners

Goal: Maintain agile approach to project management, adapting to challenges and opportunities.

Risks: Milestone slip. Mitigated by using agile methodology and working with established consortium partners with significant project management experience.

Route To Market

Farad.ai, IPG and SMPnet have developed game-changing technologies, all at commercial demonstration stage, that together are able to bolster infrastructure required to accelerate at-scale uptake of zero emission transport options. Farad.ai's AI-powered Compass product combines several layers of data to identify optimal siting for EV chargers. IPG's Flameless Generator product offers distributed pollutant-free power from any renewable fuel, including hydrogen, for coupling the local gas and electricity vectors. SMPnet's first-of-a-kind Smart Network Controller optimises and controls energy assets of any kind and energy vector in real-time. Project NAVIGATION's proposition aligns with the strategic plans of regulatory bodies like Ofgem and network operators like SGN. SGN, the lead applicant, is currently demonstrating reliable distribution of 100% hydrogen via the existing gas network (H100Fife).

This collaboration provides multiple benefits for SGN's innovation growth, including the ability to provide an alternative energy vector for powering the EV transition, which could become business-as-usual. The proposed project will create a blueprint for utilising the gas network as an alternative to widescale electricity grid reinforcement.
This network innovation will benefit electricity and gas network operators, EV owners and local communities by coupling these energy vectors, optimising EV charger installations and effectively utilising the EV chargers and net-zero, pollutant-free power generation in real-time. The blueprint will be applicable to stand-alone projects, or services integrated with gas networks, DSOs and end users.
Farad.ai, IPG and SMPnet will explore to bring the solutions developed to market through several vehicles, including the option for an all-in-one suite of products via a joint venture. The consortium will explore the opportunity to act as a service provider for EV charging companies to increase their revenue from optimal EV charger placement and grid services (e.g. V2G) whilst mitigating the risks stemming from DSOs' hesitance to approve additional capacity for EV charging (currently suggested in RIIO -- ED2 business plan).
Following completion of this project, the consortium will leverage their deep network of contacts to identify further opportunities for expanding their client base and subsequently deploying this offering.
To broaden the applicability and impact of the proposed solution after Beta phase, the consortium will:

1. work closely with DSOs to integrate the solution into the procurement schemes for grid reinforcements for their end-customers;
2. market directly to EV charging companies as a more rapid and cost-effective solution.

The blueprint created by Project NAVIGATION's can then be readily exported to international markets where similar infrastructure constraints are present. It will equally be applicable to foundation industries that are high power users.

Costs

Total Project Costs

149725

SIF Funding

149725

This project has been approved by a senior member of staff

☑ Yes