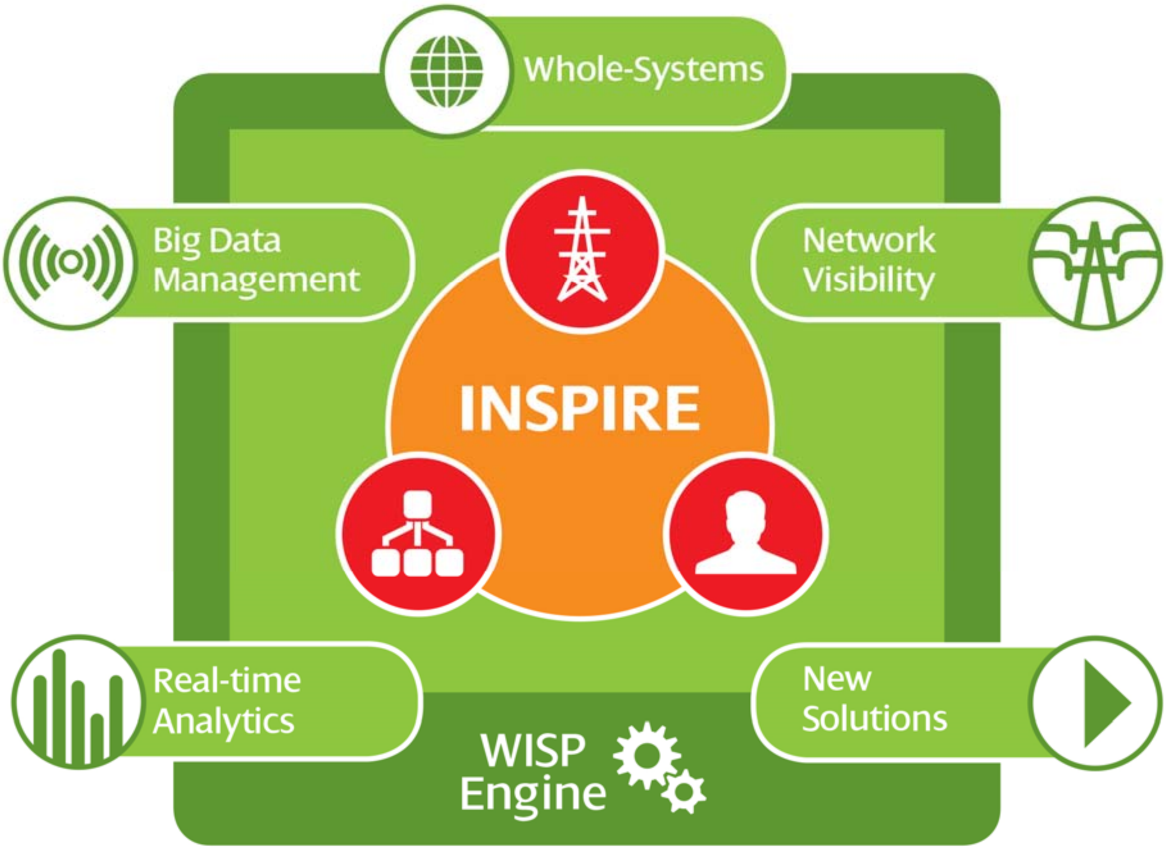
2016 Electricity Network Innovation Competition



Project Code/Version Number:
SPDEN02/V02

Section 1 Project Summary

1.1. Project Title	**INSPIRE**: *Whole-systems thinking for a more complex world of data*
1.2. Project Explanation	INSPIRE enables **a step-change to business as usual processes** by creating a Whole-systems Information Synthesis Platform (WISP). This fundamentally new approach accesses data from multiple Operational IT and Non-Operational IT systems and demonstrates four exemplar use-case applications that address Smart Grid and Low Carbon challenges. INSPIRE's WISP is tailored to the typical data systems architecture of GB DNOs and so is **capable of wide roll-out.** It employs an ambitious and innovative design that avoids data duplication, does not disturb existing systems, and provides **a step-change in capability** to create **new knowledge and services from data**.
1.3. Funding licensee:	SP Distribution
1.4. Project description:	1.4.1. *The Problem(s) it is exploring* Distribution companies increasingly require information to inform business functions as their networks transition from being passive to **actively-managed** and they adapt to provide new services to **active customers.** From network planning to design and operation, the number of interactions between **disparate data systems** will inevitably increase significantly, while needing to be agile **to accommodate on-going changes.** Today's system architecture and approach to data management is becoming **inflexible and inefficient** and increasing complexity means this **is a barrier to Business As Usual (BAU) innovation adoption.** 1.4.2. *The Method(s) that it will use to solve the Problem(s)* INSPIRE sets a new path for the future by taking a **whole-systems approach** that synthesises data from multiple IT systems. This change from 'point to point' data solutions is fundamental and provides the opportunity to establish a new and flexible platform approach, **breaking the cycle of incremental developments** seen across DNOs as a natural result of project-by-project working. 1.4.3. *The Solution(s) it is looking to reach by applying the Method(s)* The WISP provides **previously unavailable insights** and **responsiveness to on-going change.** It enables solutions through greatly improved data accessibility and utilisation - a requirement common to smart solutions and emerging customer services. 1.4.4. *The Benefit(s) of the project* The INSPIRE solution will reduce **distribution network costs** and provide **customer benefits** arising from service enhancements in network operation, asset management and network planning with the potential for positive impacts in many fields. Learning from the successful completion of INSPIRE will enable DNOs to replicate the approach for BAU roll out in **a complex environment.**

	The roll-out of the INSPIRE solution at GB level could bring a total savings of: • Savings of £93m by 2050; and • Carbon savings equating to 1,362,829 tCO_2e. Some intangible benefits, which are nevertheless valuable include: • Responsiveness to new customer and third party demands; • Reduced risk of data or cyber security breaches; • Experience with 'big data' analytics for later applications; and • Potential for application in other utility sectors, including creating jobs and export opportunities.

1.5. Funding

1.5.1 NIC Funding Request (£k)	£5995k	*1.5.2 Network Licensee Compulsory Contribution (£k)*	£677k
1.5.3 Network Licensee Extra Contribution (£k)	£956k	*1.5.4 External Funding – excluding from NICs (£k):*	£794k
1.5.5. Total Project Costs (£k)	£8517k		

1.6. List of Project Partners, External Funders and Project Supporters	**Project Partners:** During preparation of this proposal, SP Energy Networks has engaged with developers and suppliers, and those who may provide engineering and consultancy support for the delivery of the project. Project partners include; National Grid (GBSO), CGI, Smarter Grid Solutions, and Nortech. **Academic Partners:** Extensive engagement has been carried out between SP Energy Networks and academic institutions, with the **University of Strathclyde** being identified as an academic partner at the proposal stage. **Project Supporters: Strong support** has been received across industry from, among others, Energy Systems Catapult, GB DNOs, SGN, major suppliers, consultants and academia.

1.7. Timescale

1.7.1. Project Start Date	January 2017	*1.7.2. Project End Date*	March 2021

1.8. Project Manager Contact Details

1.8.1. Contact Name & Job Title	Watson Peat Lead Engineer Future Networks	*1.8.2. Email & Telephone Number*	Watson.Peat@spenergynetworks.co.uk 0141 614 1802
1.8.3. Contact Address	Future Networks, Scottish Power Energy Networks, Ochil House, 10 Technology Avenue, Hamilton International Technology Park Blantyre, G72 0HT		

Section 2 Project Description

2.1. Aims and objectives

To achieve transition to a smart grid by 2030, Distribution Network Operators (DNOs) require a step-change in the way they manage their networks. A whole-systems[1] approach to data and information is required. The National Infrastructure Commission report 'Smart Power' states, "for the smart power revolution to realise its full potential we must ensure that our Networks and systems keep up. This requires more active management of our local electricity network"[2].

As passive distribution networks transition to active distribution networks the increase in intelligence and active management throughout the network will **increase the need for creation, sharing and intelligent use of data**.

Led by a DNO, INSPIRE sets an innovative approach to addressing these new business challenges through **deployment of solutions enabled by a whole-systems approach to data and information.** INSPIRE seeks to demonstrate specific initial benefits of a whole-systems approach across the business, including the coordination of smart grid techniques, enhancing network planning and performance, and informing future information exchange with parties such as the System Operator (SO).

By developing a WISP, a Whole-systems Information Synthesis Platform, INSPIRE will show how a step-change to BAU processes can be achieved through application of integrated and synthesised data from existing disparate sources. Future needs driven by business and customer requirements will be accommodated, enabling network owners and operators to have interactive insight that was previously unavailable. Likely new required functions have been identified by initiatives such as the Department of Energy and Climate Change (DECC) Future Power System Architecture (FPSA) project[3].

2.1.1. *Problems which need to be resolved*

The Carbon Plan highlights electricity as a critical component in facilitating the decarbonisation of both heat and transport networks, suggesting that GB peak demand for electrical energy could more than double by 2050 if not addressed proactively and indicating that "Reform of the Electricity Grid" should be achieved by "paving the way towards a 'smarter' electricity grid in the UK"[4]. This call for reform is consistent with the vision of the Smart Grid Forum[5] and the FPSA project which has had wide stakeholder engagement with international activities.

Traditionally distribution networks were passive with unidirectional power flows but are now starting to become active to accommodate bidirectional power flows whilst also improving utilisation of the existing network assets. A number of smart grid techniques are already being deployed on the distribution network including Active Network Management (ANM), Demand Side Response (DSR), and Real Time Thermal Rating (RTTR). As a result of increasing levels of uptake, improvement in technology readiness level (TRL) and a growing number of suppliers, these technologies are becoming cheaper and more economical to install. This presents **a challenge in terms of the integration of existing and new smart grid techniques**, as up until now they have been deployed on an individual basis, in isolation with little integration or interaction to other

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[1] In this project, the term "whole-systems" encompasses power system and business system and future new systems (e.g. customer systems or aggregator systems)
[2] "Smart Power", National Infrastructure Commission, March 2016
[3] The Future Power System Architecture (FPSA) project, Department of Energy & Climate Change
[4] "The Carbon Plan: Delivering our low carbon future", HM Government, December 2011
[5] "a smart electricity grid that develops to support an efficient, timely transition to a low carbon economy to help the UK meet its carbon reduction targets, ensure energy security and wider energy goals while minimising costs to consumers"

schemes. This challenge was identified and described by the recently completed DS2030 project.[6] Complexity will increase many fold, resulting in processes that are beyond manual intervention and will depend on robust data automation.

As the volume of distributed generation (DG) continues to increase (26% of generation is now connected to the distribution networks with an additional 11% of capacity set to be released in the near future[7]) load/generation forecasting will become increasingly important. Full visibility and controllability of generators on the distribution network is beyond the current scope of the SO, prompting the potential emergence of a Distribution System Operator (DSO) role, responsible for planning and operational decisions such as generator dispatch and active power balancing on the distribution network. At present, the SO is updated with a snapshot baseline of the distribution network by the DNOs once per year. These changes will present a challenge to DNOs as there will be **a requirement for greater volume and frequency of information exchange with the SO to further enable operational planning and with other parties**, for example Community Energy projects, for local operational management.

There are already a number of protection, control and monitoring devices and systems on the network that are smart grid ready and have inbuilt data recording capability. For example, significant investment and developments have been undertaken in the area of Distribution Automation (DA). This is being applied for the primary purpose of automatic and fast response to power system outages and faults instead of traditional manual analysis and operation. Business and customer value is delivered through reductions in Customer Minutes Lost (CML) and Customer Interruptions (CI), and generally improvement of service levels. However, if accessed on-line and remotely, additional data held by these devices has the potential to provide the business with previously unavailable insight into how circuits perform and degrade in real time through the application of data analytics. The challenge for DNOs is that **the segmentation of data and existing ICT (Information & Communications Technology) system architectures inhibits the application of data analytics** and thus thwarts the realisation of potential network planning and operational benefits. Furthermore, traditional solutions in this area would be bespoke, for example tailored to match the known deployment of field devices. The WISP platform can be structured to **facilitate support of new devices and provide tools and quality checks to enable the operational and data analytics systems to accommodate them**. In a continuously changing world of new consumer requirements this will be key to agility, data security, and maintaining cyber security.

The UK's DG capacity has grown exponentially, rising by more than 50% between 2011 and 2014[8]. The network information available in its current static format (the Long Term Development Statements (LTDS)) might cause misunderstandings between DNOs and renewable developers in a context of continuous change, and result in delays for new connections and new services. The greater the accuracy of the network information available to developers, the more efficiently they can deploy new generation. One useful and effective tool will be for DNOs to produce a dynamically updated baseline of the whole network including constraints, latent demand, storage sources, planned network changes and available capacity that can then inform key decisions and enhance customer engagement.

Customer requirements for flexibility have created business challenges that arise from the shift from passive fit-and-forget networks to actively managed ones. At its core, the response to these challenges requires a coming-together of currently separate worlds

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[6] Smart Grid Forum Work Stream 7 – DS2030 http://www.smarternetworks.org/Project.aspx?ProjectID=1623
[7] Data gathered from GB DNO Long Term Development Statements
[8] Energy and Climate Change Committee, House of Commons, Low Carbon Network Infrastructure, 2016/2017

(network design, network operation and asset management), placing a burden on existing data systems and architectures for which they were not designed. **Open platforms** enable a flexible response to unforeseen requirements in reasonable timescales at reasonable costs. In this sense, the INSPIRE project is timely.

DNOs currently operate a number of data systems, but all rely on the three key Operational IT - also called Operational Technology (OT) - and Non-Operational IT systems as presented in Figure 2-1, as well as a number of secondary systems e.g. customer service systems, field force systems etc.

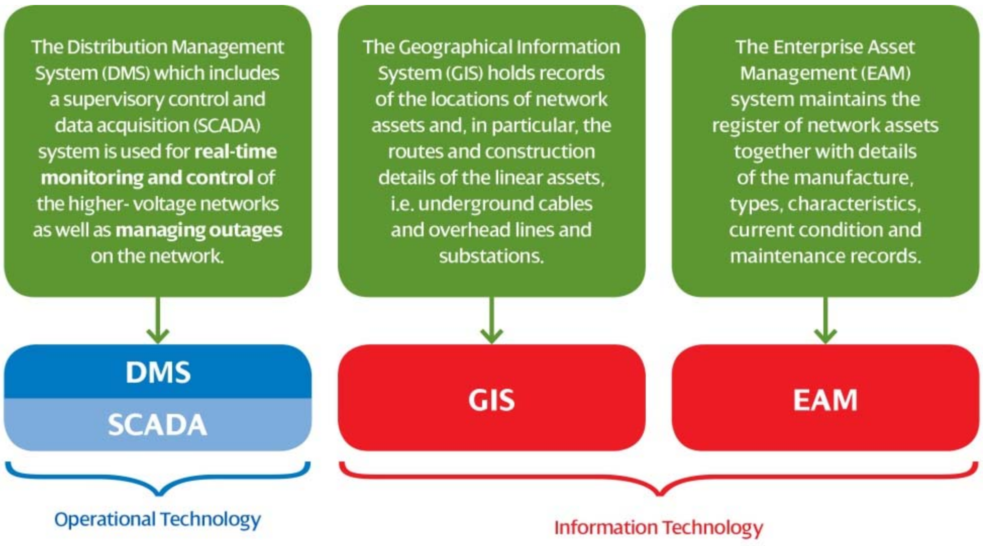

Figure 2-1: Summary of the Three Principal Systems

Historically, each of the principal systems has grown to support different functions within the DNO. The DMS supports real-time network operations, while EAM is used to support the management of the capital programme and the work required to maintain and expand the network. Other than for a small number of specific types of interaction, there have not yet been sufficient tangible benefits to warrant more sophisticated integration between these systems.

The **number of interactions between these disparate data systems is expected to increase significantly** presenting serious limitations to functionality and, indeed, to the adaptation and maintenance of the data systems themselves at the necessary pace. New requirements result from the move from passive to active networks, the need for information to inform business functions such as network planning and operation and the continually changing nature of the business landscape. It is widely recognised that the current information system architecture and approach to data management will soon be unfit for purpose.

If a whole-systems approach is not taken and data continues to be processed in isolation, commonly described as silos, **the consequence will be a highly complex, inefficient, inconsistent and inflexible system** as illustrated in Figure 2-2. This will be subject to quality control challenges, and increasingly difficult and ultimately impossible to implement and maintain.

Data management and ICT systems are critical in the ability to successfully and safely manage and operate the network, but changes cannot be accepted into BAU without managing risk through live design trials. There is a danger that **because of perceived risk and expense, a non-strategic approach is taken and DNOs continue to roll out short term, individual and discrete solutions with a point to point integration mind-set**. These are not scalable for the medium and long term and the whole-systems opportunity being explored by INSPIRE will be missed. INSPIRE's approach lowers the level of risk by giving access to better, more consistent data.

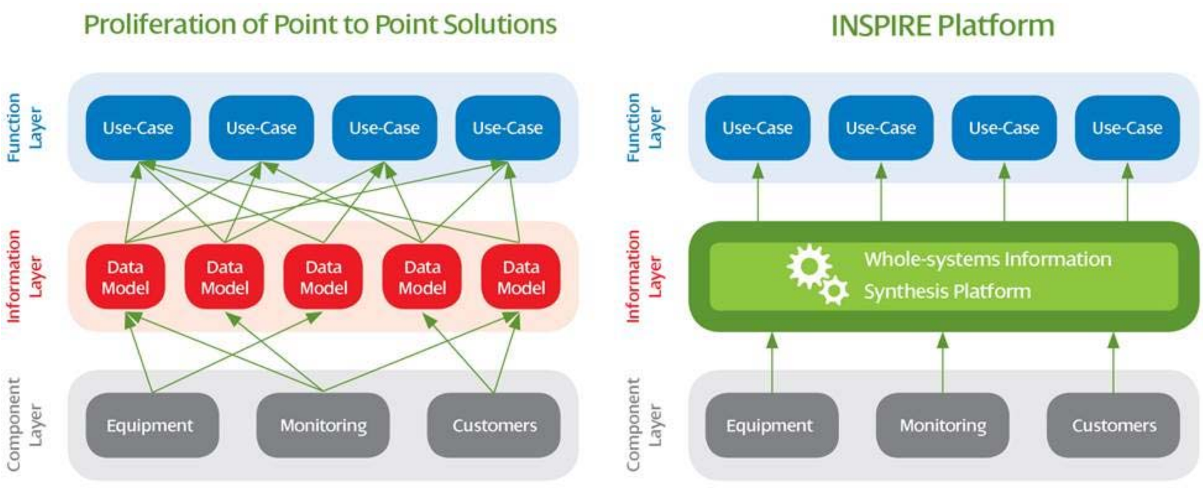

Figure 2-2: Business as Usual Approach Compared to INSPIRE Approach

INSPIRE is a critical step in developing and delivering a WISP that is sufficiently scalable, flexible, secure and open and thus fit for future BAU implementation.

2.1.2. *The Methods being trialled to solve the Problem*

INSPIRE aims to address the aforementioned problems by trialling an innovative process from business problem to solution using a WISP that will synthesise previously disparate data sets and enable integration and analysis at BAU scale through software applications. It will also accommodate on-going change, drive data quality improvements and ensure appropriate cyber-security mechanisms are incorporated to protect the data.

Stakeholder needs[9] are placed at the heart of design, with building and testing undertaken iteratively, working quickly to deliver innovative solutions to business problems. Application of systems engineering will ensure consideration of "both the business and the technical needs of all customers with the goal of providing a quality product that meets the user needs"[10]. The benefit of systems engineering is satisfaction of stakeholders' needs "in a high quality, trustworthy, cost-efficient and schedule-compliant manner throughout a system's entire life cycle".

The key technical method proposed under INSPIRE is to **select and synthesise existing data from a number of disparate data sources** and DNO functional departments, to **provide the consistency required to address whole-systems business problems** and to **enable operation in a context of continual change.** This approach is to relate data in different core systems that describe the same assets or related components, including communications equipment. This approach must be underpinned by appropriate and innovative interfacing between systems, without disturbing or replacing them. The information will be correlated into an integrated network dataset that is then made easily available to all the other applications. Anomalies between data held in different systems for the same components or topology will be identified and reported, thus exposing the actual quality of this data. This will empower the data managers and stewards to correct and improve the data as prioritised by the prevailing business needs. Figure 2-3 highlights the core methods that will be trialled in the INSPIRE project.

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[9] In this case stakeholders include; DNOs, customers, SO and TO.
[10] "What is Systems Engineering?" http://www.incose.org/AboutSE/WhatIsSE

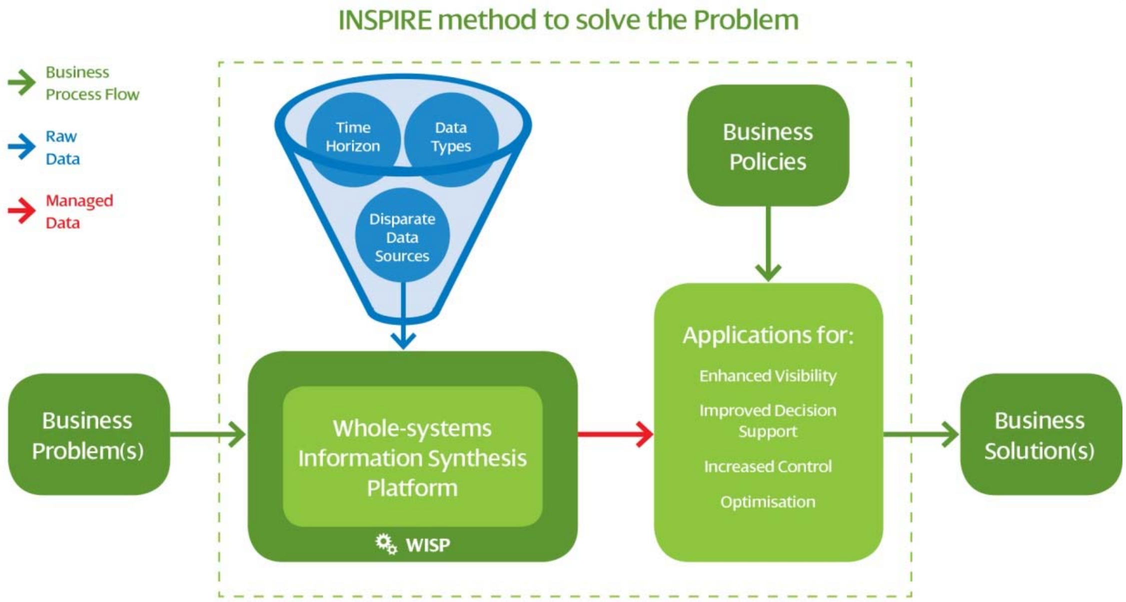

Figure 2-3: INSPIRE Method

The INSPIRE team has **engaged suppliers and stakeholders across sectors to ensure the maximum leverage of GB and European learning from other industries** (such as gas and construction). The project has held an open workshop[11] for industry stakeholders and received helpful feedback that has been incorporated into this document. The technical method proposed builds on the outcome from SP Energy Networks NIA project 'Data Intelligence for Network Operation (DINO)[12], manages data within a WISP and analyses key datasets at BAU scale thus releasing previously unrealised insights and benefits.

The sharing of learning from previous and on-going innovation projects by the DNOs has been helpful and derives additional value from those investments. These additional learnings are set out in Appendix K. Such an open and transparent approach will not only achieve value for money for the customers, but will also develop a solid foundation for designs and future roll out that is fit-for-purpose.

Whole-systems challenges by their nature require new approaches and need flexible solutions structured for agility such that they can address emerging business problems as they arise. The WISP is designed to facilitate extensibility, scaling and open systems. The INSPIRE platform will enable rapid deployment of needs-driven applications using the extendable and flexible architecture of the WISP. To this end, an innovation trial method will be deployed to evaluate the WISP approach by using it to deliver effective solutions for four use-cases, which each address a business challenge. The use-cases are discussed in the following section and span different aspects of challenges set out in the previous section.

2.1.3. *The Development or Demonstration being undertaken*

INSPIRE will develop a WISP and demonstrate four initial use-cases which have been selected to highlight the additional efficiencies and benefits of a whole-systems approach as well as thoroughly testing, identifying and overcoming development issues.

The four use-cases that will be demonstrated as part of INSPIRE are as follows (more information is described in Appendix C):

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[11] See Appendix M for more details on the stakeholder event on 9th May 2016
[12] NIA DINO, SP Energy Networks http://www.smarternetworks.org/Project.aspx?ProjectID=1768

1. **Use-case 1 Coordination of Smart Grid Techniques** – INSPIRE will demonstrate how coordination of a number of smart grid solutions, such as active network management, can be achieved;
2. **Use-case 2 Improved Network Visibility for 3rd Parties** – INSPIRE will demonstrate how enhanced network visibility and information exchange between the DNO and SO can be achieved;
3. **Use-case 3 Improved Network Performance via Data Analytics** – INSPIRE will demonstrate how network performance can be improved; and
4. **Use-case 4 Enhanced Network Planning** – INSPIRE will demonstrate enhanced network planning capability using the WISP.

Importantly the four use-cases were chosen to **cover different aspects of a DNO's business: network operations, SO interaction, asset performance and planning.** They will therefore test the INSPIRE Method by delivering a range of user services, employing algorithms of different complexities and accessing data from different sources and with different characteristics, such as time granularity and frequency of change. Each use-case has a number of already understood benefits, which can be enhanced when implemented within the WISP. INSPIRE will aim to demonstrate the derived further benefit to both the DNO and the customer.

2.1.4. *The Solutions which will be enabled by solving the Problem*

INSPIRE will deliver **a solution that improves a range of existing and future DNO business processes**, addressing the new challenges expected as networks incorporate new functions and capabilities in their transition to smart grids and as customers become more actively engaged.

The INSPIRE solution will reduce distribution network costs and provide customer benefits arising from enhancements in the operations, asset and planning areas with the potential for positive impacts in many more. Learning from the successful completion of **the INSPIRE project will equip DNOs to replicate the core transferable approaches to evolve harmonised business solutions.** INSPIRE is aligned with future data-rich developments associated with developments such as smart meters, the ‘Internet of Things’ and smart cities, and provides a cost-effective pragmatic first step towards DNO digital transformation, which is emerging as a requirement for BAU roll-out of smarter energy systems.

The future efficient and coordinated operation of increasingly complex, data-driven, distribution networks will be facilitated through the INSPIRE **systems engineering approach and the application of a WISP.** Applications will efficiently access integrated and managed data using standard formats that make INSPIRE scalable and interoperable. An advantage of using open standards is that subsequent new developments can be undertaken by multiple suppliers in a competitive and unrestricted environment to capitalise on individual specialisms. In addition the WISP will assist the DNOs to avoid 'lock-in' that can arise with bespoke data structures from product vendors and to ease the ICT and data transitions needed when moving from one product to another.

The methodology established through the development of applications for the trialled use-cases will **inform how further future applications can be created** by building on existing organised information. The potential to realise further intelligence and benefits from the application of integrated data will arise from demonstrating the design, build and operation of INSPIRE solutions. Future data sources are likely to be accompanied by the challenges known as 'big data', for example where data is derived from the customer side of the meter, potentially at large scale and with high variability. The design of the INSPIRE platform provides a step toward enablement of the DNO in accommodating new applications and techniques for processing big data.

INSPIRE will deliver specific solutions to the trialled use-cases and solve the associated business issues. In summary, the trial use-cases will:

- Reduce barriers to the connection of low-carbon technologies;
- Facilitate improvements in the aggregate impact of multiple smart grid techniques, releasing incremental capacity;
- Provide the SO with information on latent demand and DG - Improving visibility of available network capacity;
- Provide more connection options through the availability of better information;
- Enable opportunities for SME application developers to enter the marketplace;
- Correlate high volumes of data enabling advanced data analytics;
- Deliver customer benefits through better-informed network and connections planning avoiding network reinforcement; and
- Drive improvements to data quality with resulting business process and customer benefits.

2.2. Technical description of Project

INSPIRE aims to build a fully-functioning trial instance of a WISP and confirm its effectiveness in delivering the benefits identified for the four use-cases. To do this, a set of new applications to underpin the use-cases will also be delivered. To prove that the technology is sufficiently mature to be deployed post-project, it is important to ensure that the trial includes a deployment with all requisite technology components interacting in a representative manner as would a full-scale BAU deployment.

See Appendix D for a more detailed technical description, including a brief account of why past attempts to produce integrated data landscapes have mostly failed and how INSPIRE intends to resolve the underlying challenges.

2.2.1. *Overview of the WISP solution architecture*

The WISP, shown in green in Figure 2-4, forms the core of the information and operational technology solution to be trialled in INSPIRE. The proposed solution architecture is presented in Figure 2-4.

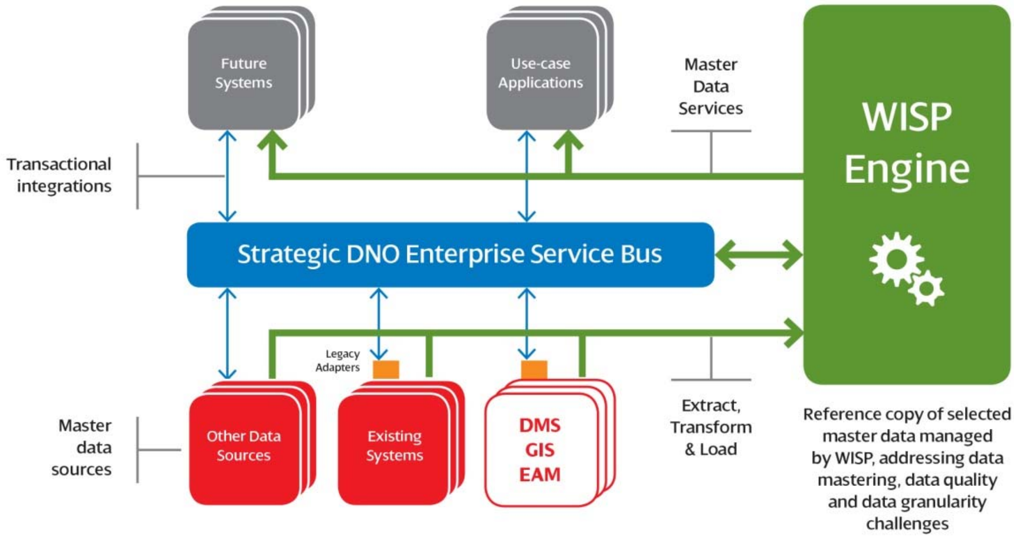

Figure 2-4: WISP Solution Architecture

The WISP will provide a trusted reference copy of selected key master data for the business to draw from when required, and will have the potential to incorporate existing processes such as regulatory reporting.

The WISP embraces the full range of modern-day best-practice information management disciplines and techniques to address the pitfalls of more simplistic integration models.

Data will be combined from the three principal systems, the DMS, GIS and EAM, to provide a single version of the truth. Mismatches and other inconsistencies do occur in the existing systems, even while following current practices: many stem from earlier inaccuracies or illegibility in subsequently digitised paper records, but human error on data entry still causes some errors, especially where the same data has to be separately entered into multiple systems, sometimes even at different times and/or by different people, because providing comprehensive and automated data entry validation is impracticable. Through the provision of validated and integrated information, the WISP enables software applications that have been developed to provide more effective solutions to business issues as identified in the use-cases.

It is critical for BAU implementation that the WISP is open, flexible and interoperable. This will support developers in building applications to address existing and future business needs, as well as accelerating adoption and uptake. To ensure that the WISP is open and accessible, it will conform to multiple standards, such as the Common Information Model (CIM)[13].

The WISP will enable substantive effort reductions in data preparation, and more repeatable outcomes for projects combined with higher confidence in the results due to the increased level of data provenance.

2.2.2. *Detailed description of the WISP*

The WISP, as detailed in Figure 2-5, complements the more conventional approach of connecting systems via an Enterprise Service Bus (ESB) by incorporating additional innovative facilities to deliver a complete and integrated DNO data platform.

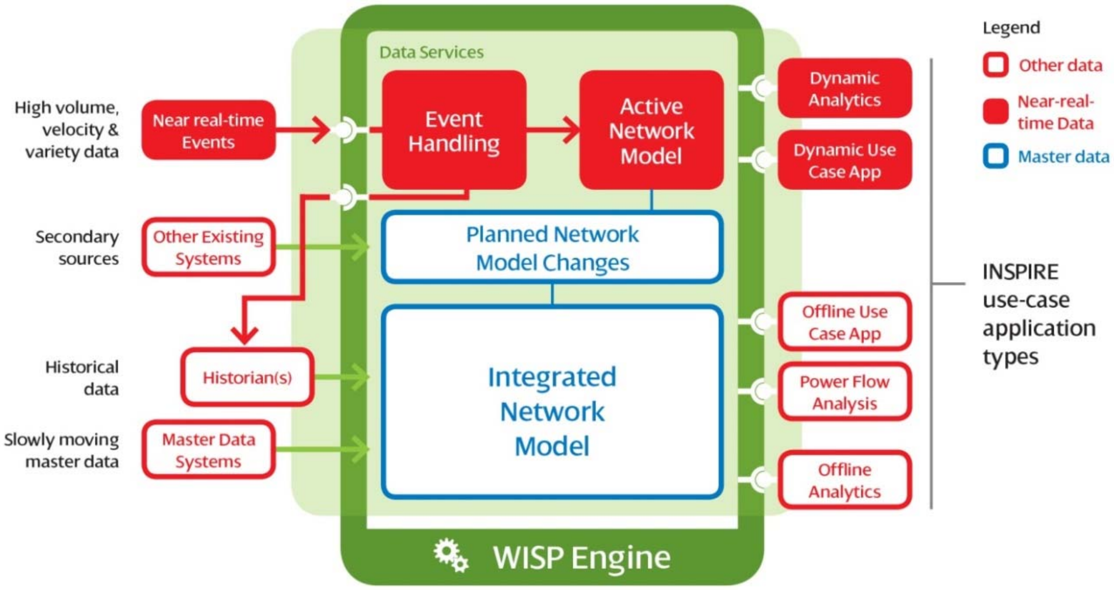

Figure 2-5: WISP

The WISP includes:

- A Master Data Management (MDM) "data backbone" tailored to distribution network operation in the form of an Integrated Network Model (INM);
- A Data Services framework which makes validated and reconciled master data readily available to existing DNO systems and to new "pluggable" applications;
- An active network model that is able to relate analogue and digital event data sources to the trusted master data backbone;

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[13] https://en.wikipedia.org/wiki/Common_Information_Model_(electricity)

- Capability to store future planned changes to the distribution system correlated from existing core DNO systems; and
- Standard mechanisms for capture and storage of new information such as key analysis or network modelling results, coherently against the master data backbone.

A core strategy for the WISP is a high focus on MDM, which is a recognised cross-industry discipline (with supporting standardised toolkits) used to support data management. See Appendix D.2 for more information on MDM principles.

INM regularly extracts the key master data from each authoritative data source (known as the system of record) and proceeds to integrate and reconcile this data using a set of configured business rules combined with inferencing rules that have been proven on past innovation projects including FALCON and DINO. INM then maintains a versioned historical copy of this so that the topology that existed on dates past can be obtained for retrospective modelling, analytics etc. when required.

Having obtained and reconciled the key network master data, INM makes this information available to other applications via a rich set of open data services, ESB interfacing and automatically replicating views of reconciled data to those that need to hold copies but are not the master systems for it.

The inventory of available historical measurements (analogue values, switch states, other event streams etc.) in the combined dataset allows the INM to incorporate CIM measurement points and link these to the correct positions in the network topology.

The following benefits then stem from this approach:

- The translation of network topology master data into CIM format can thus be carried out in a single place, relieving the source applications of the need to each do this individually;
- Data housekeeping rules mandated by CIM can also be implemented once only in the INM;
- The need to develop complex ESB adapters, and/or re-engineer the cores of existing applications, is thus completely avoided, considerably reducing the cost of connecting these systems to an open and CIM-based ESB architecture for transactional and other messaging interactions;
- INM can identify and record a wide range of types of data inconsistency between the master systems, thus creating the raw information needed for a range of best-practice data management techniques;
- The need to revise the DNO's data mastering strategy (see Appendix D.2) by transferring the mastering of data from its natural homes into a single master system such as a GIS – often a complex and very extensive task – is completely avoided. Data can continue to be mastered in whichever system is most appropriate, and full advantage can therefore be taken in particular of the fact that the DMS already holds a high-quality model of the HV network topology and connectivity; and
- Data cleansing can be prioritised in accordance with the DNO's needs, rather than having to be done all at once in a single 'big bang'. In the meantime, INM will provide the best data that is currently available, and can include quality tags to highlight known shortcomings if appropriate.

2.2.3. *Use-case applications*

INSPIRE will also deliver the new applications required to support the four use-cases, and an appropriate set of frameworks (for analytics, visualisations etc.) required to support them. Additional integration points will also be made between the new applications and existing systems, where necessary, for the use-case solutions. All of these components, including the affected existing systems, will then be integrated using the relevant methods such as the ESB, data services or otherwise as appropriate.

2.2.4. *Implementation of the Solution*

The WISP and associated applications will be implemented in as production-ready a state as is compatible with their status as trials. For example, they will be connected to SP Energy Networks' standard IT system monitoring facilities so that any component failures are automatically reported to the 24/7 control bridge from where direct action can be taken to restore them. However unlike BAU ready systems, they will be supported by members of the project team for the duration of the trials execution, rather than SP Energy Networks' IT support providers.

2.3. Description of design of trials

INSPIRE has been divided into six work packages (WPs) as presented in Figure 2-6, and described in further detail in Appendix E. WP5 is based on knowledge dissemination and is described in further detail in Section 5.

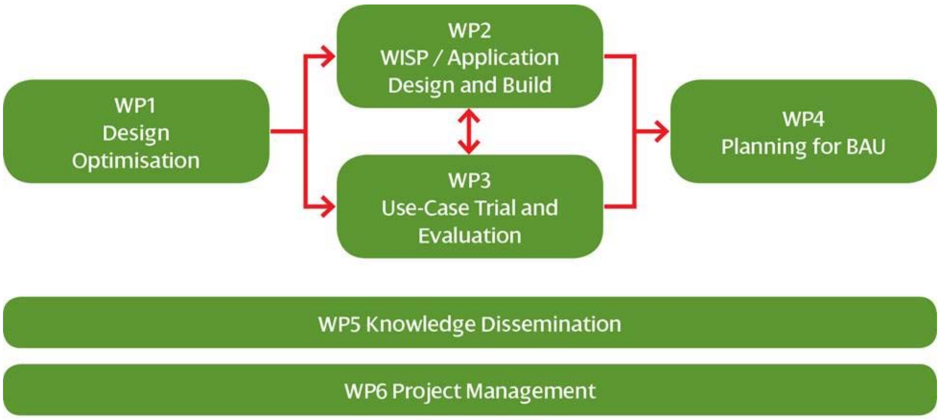

Figure 2-6: Work Package Structure

WISP and application design and build are encompassed in a single work package; WP2 because **an agile project management and delivery approach will be taken**. The agile approach to development is an ICT industry accepted alternative to traditional project management approaches. This approach is designed to help teams retain close engagement with the business areas and be more responsive to unpredictability through incremental, iterative work cadences, known as sprints. As such, in a trials project, such as INSPIRE, it is the most appropriate approach. Further information on the agile methodology is contained in Section 6.

2.4. Changes since Initial Screening Process (ISP)

There have been no substantive changes to the scope or scale of the project since the ISP was submitted. The project total costs have increased to £8.5m primarily as a result of contributions in kind from partners being explicitly included. **The NIC funding request is changed to £5.995m** reflecting inclusion of an extra contribution from SPEN and increased external funding.

During the full submission development we have further refined the project objectives through thorough stakeholder engagement and consultation, including engagement with GBSO and each DNO to leverage previous learning and avoid potential duplication. INSPIRE has received endorsements, and its need, benefits and timeliness have been recognised by cross-vector participants in the energy industry including Energy Systems Catapult and SGN. Project partners have been identified and selected with appropriate technical expertise matching the requirements of the deliverables in particular the WISP and the applications, for example National Grid GBSO will participate in use-case 2. Partners have provided technical guidance and accurate cost estimates to the development of the proposal to provide assurance that the project can be delivered to programme and budget. A technical working group has been created bringing together the partners with a range of business as usual departments ensuring engagement from project initiation to support project delivery.

Section 3 Project business case

The INSPIRE solution offers GB savings of £93m by 2050

3.1. Context

GB DNOs are facing an increasing number of challenges relating to the transition towards a low carbon economy and need to adapt for the future energy scenarios and smart grid technologies. A feature common to almost all smart solutions is a much greater need for network information, resulting in a greater dependency on data, and new challenges for managing data in an evolving customer and business context.

The National Grid 2016 Future Energy Scenarios (FES) highlights the increasing operability challenges that the electricity industry faces. Innovative challenges include greater flexibility from existing sources of generation and demand and more demand side response capabilities, both of which will be facilitated by INSPIRE's WISP.

The Smart Grid Forum's Work Stream 7 (DS2030) report[14] examined in some detail the future potential role of smart solutions. The report concluded that the ICT infrastructure that supports smart solutions should take a whole-systems approach to account for the complex interactions between the smart solutions, traditional solutions, the network and services offered and third parties. This whole-systems approach is integral to INSPIRE.

The Energy Systems Catapult and the Institution of Engineering and Technology recently collaborated on FPSA advising DECC on the anticipated developments for the power sector in the coming years. The project used systems engineering techniques to investigate "credible evolutionary pathways and new functionality" required to meet new customer and operational requirements that are starting to arise. The project identified seven major drivers and thirty five associated new functions that will be required for the system to adapt and meet 2030 power sector objectives. Those functions addressed by INSPIRE are denoted by a tick in Figure 3-1. This figure highlights that INSPIRE will address many areas identified by industry experts as particularly crucial to future network requirements, reinforcing the timeliness and business case for INSPIRE.

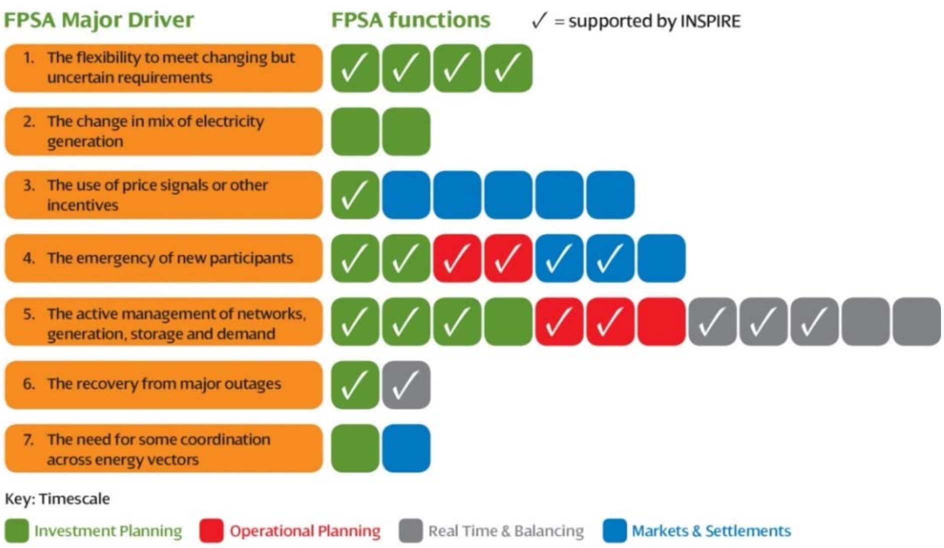

Figure 3-1: Thirty five FPSA functions – ticks indicate those addressed by INSPIRE

[14] http://www.smarternetworks.org/Project.aspx?ProjectID=1623

The trial use-case and some potential future INSPIRE use-cases have been classified with the FPSA timescales in mind as shown in Table 3-1. However, we anticipate there to be many more opportunities which are yet unidentified.

Table 3-1: Trial and future use-cases

Time Frames	Trial Exemplar Use-case	Potential Future Use-cases
Investment Planning	Use-case 4 – Enhanced Network Planning	• Incorporation of smart meter data • Customer connection self service • Move from deterministic to stochastic planning (ER P2 review[15]) • Enabling community energy customers and interfacing with peer-to-peer trading • Multi energy vector interfaces (heat, gas, transport) • Harmonics monitoring and mitigation
Operational Planning	Use-case 2- Improved Network Visibility for 3rd Parties	• Network optimisation e.g. based on losses • Utilisation of wide area and phasor monitoring • Optimised voltage control
Real Time and Balancing	Use-case 1- Co-ordination of Smart Grid Techniques	• Local balancing services • Interpretation of social media messaging
Markets and Settlements		• Interaction with time of use pricing, aggregators and energy service providers • Losses quantification using metering data
Review and Asset Management	Use-case 3- Improved Network Performance via Data Analytics	• Equipment performance high resolution waveform data analytics and condition monitoring • Better analysis and access to equipment performance data, such as transformer and switchgear condition monitoring

3.2. INSPIRE is in line with SP Energy Networks Innovation Strategy

SP Energy Networks are part of the Iberdrola Group, an energy company that has demonstrated its strong commitment to innovation. One example of this commitment is the ‘Innovation Policy’ approved by the Board of Directors that outlines corporate social responsibilities to actively seek out and engage in innovation projects to maximise learning throughout both the company and industry.

The SP Energy Networks “2015-2023 Business Plan” published in March 2014 outlines the continued support that innovation has within the company and a desire to address the issues of the future system through innovative measures. ‘Think Big, Start Small, Scale Fast’ ethos has been successfully exercised in numerous projects including Real Time Ratings for Overhead Lines, Accelerating Renewable Connections (ARC) and Flexible Networks and this approach will be maintained for INSPIRE.

Three innovation areas that SP Energy Networks seeks to deliver are technology innovation – operating the network more dynamically; operational and process innovation – driving efficiency and service benefits; and commercial innovation – providing new contractual arrangements with customers and suppliers. The INSPIRE

[15] http://www.energynetworks.org/news/press-releases/2015/may/electricity-networks-launch-a-review-of-engineering-recommendation-p2.html

project builds on the successful SP Energy Networks DINO project[16] and will directly address the first two areas and is an enabler for the third.

SP Energy Networks' Innovation Strategy also emphasises the importance of sharing knowledge with others in the industry (e.g. other utilities, DNOs, SMEs, amongst others) to enhance learning and provide an important input to designing the network of the future. The INSPIRE project also regards knowledge sharing as highly important and as such, has dedicated WP5 specifically to knowledge dissemination, which is an on-going activity throughout the lifecycle of the project. Aligned with the innovation strategy, INSPIRE will collaborate with other GB network companies by including experts from both industry and academia to ensure that all customers benefit from customer-funded innovation trials.

3.3. INSPIRE's Benefits

The business case for INSPIRE is built on benefits arising from new and improved business processes facilitated by applications. The INSPIRE approach facilitates multiple applications enabled through deployment of a WISP. **Benefits arise from the four demonstrator use-cases included in this Full Submission, and INSPIRE's scalability will provide subsequent opportunities for further use-cases to deliver further benefits.** New activities relating to additional distribution network functionality will be expedited efficiently and quickly to deliver benefits, along with those coming from the enhancement of existing processes as they acquire value from the use of INSPIRE's WISP.

Figure 3-2 illustrates how INSPIRE's financial benefits arise from the distribution network and the wider customer base through socialised savings, as well as **benefits for specific customers and communities** connecting low carbon technologies (LCTs) or distributed energy resources (DER), for example cheaper and quicker connections for generation and demand customers provided by the integration of smart solutions. For clarity, simplicity and because the financial benefits of the future applications are not known at this point, INSPIRE's business case focusses on the DNO's avoided costs. A consequence of this approach is that further financial benefits are likely beyond those presented here. INSPIRE will also deliver benefits other than financial that are more difficult to monetise, such as the examples identified in Figure 3-2.

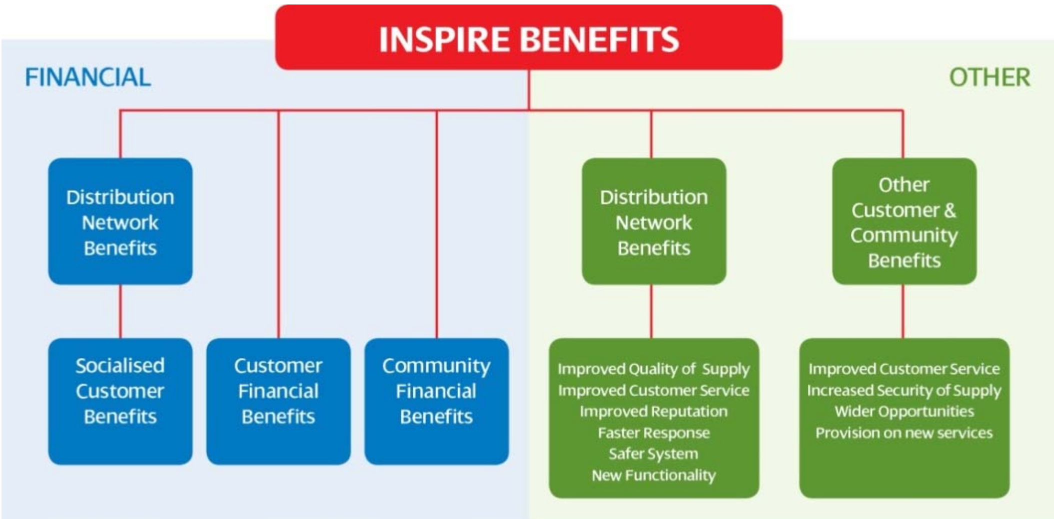

Figure 3-2: INSPIRE Benefits

[16] http://www.smarternetworks.org/Project.aspx?ProjectID=1770

3.3.1. *WISP Benefits*

In addition to the benefits arising from the business process improvements, INSPIRE's WISP will provide both financial and operational benefits to the DNO and its customers. The WISP will improve the efficiency of many parts of the business through managed data processing, e.g. the burden on resources to rectify data anomalies will be reduced as data sources will be integrated by means of the WISP. Also, a major requirement for the WISP is to be scalable and flexible to meet the changing requirements of the network business as it moves to incorporate smarter grid functionalities. This flexibility will also allow many other applications to be developed by SMEs to deliver financial savings and tap into a wider knowledge pool. These savings have not been quantified in INSPIRE benefit analysis due to the costs being particularly difficult to estimate; instead they are discussed qualitatively here.

The **WISP approach provides significant benefits over the alternative approaches** of point to point developments or Service Oriented Architecture (SOA) with a full width Enterprise Service Bus (ESB) as shown in Figure 2-4. The WISP approach is a major step forward offering the GB DNOs, and their customers, a lower cost and lower risk performance route to achieving the new functionalities required. Key to the approach's differentiation is the inclusion of data management and appropriate deployment of linking for future ICT techniques.

Using a "traffic light" rating, Figure 3-3 presents the historical DNO approach to data integration (point to point), alongside the most commonly deployed strategy (SOA using an ESB), against the novel WISP approach which pragmatically take takes a low cost "best of both worlds" approach.

The decision factors include the technical risk and cost of implementation and operation, the impact on DNO system data quality, the impact on data management business processes across DNO systems (for example distribution management, asset management and geographic information), and service risk (or customer impact).

	Decision Factors				
	Technical Risk	Cost	Data Quality	Data Management	Service Risk
Point to point integration approach	Perceived low risk, rising as complexity increases	££ Costs rapidly increase with complexity	Not directly addressed leading to degradation	Not directly addressed - additional facilities required	Service degradation highly likely over time
Service Oriented Architecture (SOA) ESB strategy	High number and disparity of participating systems	£££ Significant impact on all participating systems	Not directly addressed leading to degradation	Not directly addressed - some enablers provided	Delivers some improvement to service
INSPIRE WISP	Initial lower TRL level of this solution	£ Less impact on existing systems	Incrementable data improvements driven through integrated quality rules & issue management	Master data alignment provides trusted reference data	Improved service facilitated through access to better reference data

Figure 3-3: Comparison of INSPIRE to alternative integration approaches.

It can be seen that **the status quo** (point to point integration) **is not sustainable** in the face of future DNO data requirements. A pure SOA approach will deliver some benefits **but at a higher cost and greater technical risk**. However, the WISP is equal or superior to other options in all respects. The reason for this superiority is that the WISP approach focusses on DNO data quality and management ahead of integration technology, which is simply a delivery mechanism and alone cannot release valuable business insight from the data. **An important deliverable of the INSPIRE project will be validation of this assessment.**

3.3.2. *Use-case Benefits*

Table 3-2 summarises the basis of the financial benefits for the four INSPIRE project use-cases on which the INSPIRE benefits analysis are based. More detail is provided in Appendix B. The benefits are quantified in terms of DNO avoided expenditure and network investment alone. They vary according to the business process the application facilitates, covering a range as illustrated in Figure 3-4 than the values presented as customer benefits, expected to be delivered by the applications as discussed in Section 3.3, are not evaluated for simplicity.

Table 3-2: Use-case Financial Benefits

	Business Benefits	DNO Savings
Use-case 1	Improved coordination of smart solutions/ANM schemes	Avoided network investment through improved network utilisation as the integration of smart solutions releases capacity to accommodate more connections
Use-case 2	Enhanced network visibility for the SO by an increased level of information exchange between DNO and SO	Avoided manual processes to provide the network visibility that is required to facilitate DER services
Use-case 3	Improved network performance through fault predictions	Avoided field resources as fault prediction means that there are fewer emergency responses
Use-case 4	Smarter network planning	Avoided network investment through improved network utilisation delivered via increased visibility and accuracy of planning

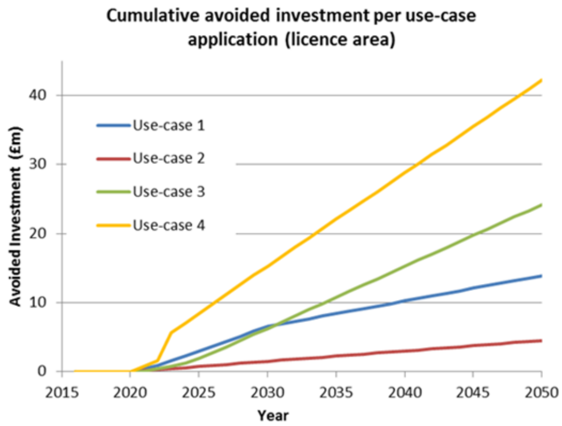

Figure 3-4: Avoided network investment per use-case application for licence area (2016/17 values)

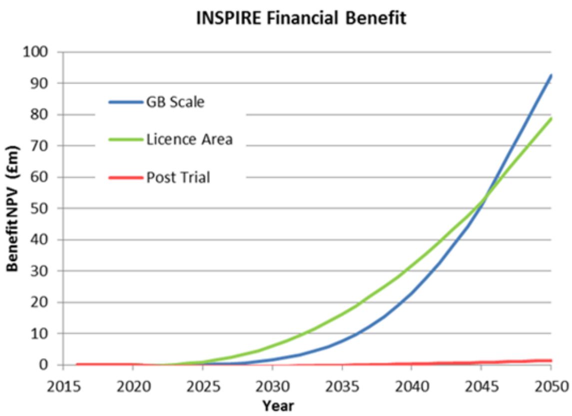

Figure 3-5: INSPIRE Financial Benefit (NPV)

3.3.3. *Summary of Financial Benefits*

The financial benefits of INSPIRE for post-trial, Licensee and GB roll out are presented in Figure 3-5 in terms of NPV based upon the methodology described in Appendix B. By **extrapolating to GB, the INSPIRE Solution offers £93m (NPV) savings by 2050** as a result of reduction in DNO costs provided by business process improvements addressing use-cases and facilitated by applications.

The **breakeven point based upon the assumed GB deployment is 4 years**.

We have also estimated the breakeven point **including payback of the initial NIC funding** for two conservative rollout scenarios (See Appendix B). The results show payback well within the RIIO ED2 period under both scenarios.

3.4. Capacity Released

Some of the INSPIRE applications will affect how connections are accommodated on the network and release capacity, for example use-cases 1 and 4 included in the INSPIRE project. Figure 3-6 shows the capacity released calculated based upon the methodology described in Appendix B.

By **extrapolating to GB, the INSPIRE Solution releases 1088 MVA capacity by 2050**.

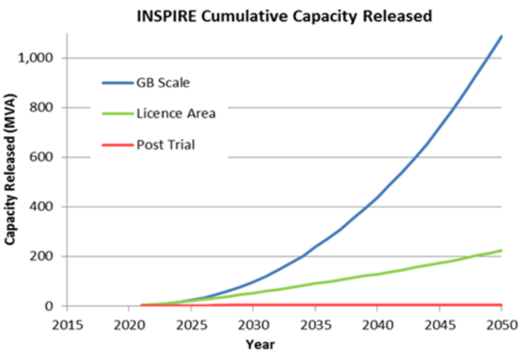

Figure 3-6: Capacity Released by INSPIRE

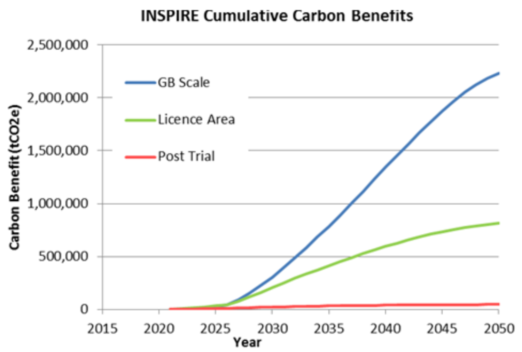

Figure 3-7: INSPIRE Cumulative Carbon Benefits

3.5. Carbon Benefits

INSPIRE will provide many carbon benefits as **INSPIRE will enable the network to move towards increasing deployment of LCTs** by reducing barriers currently in place such as long connection times and inaccurate offers. A predominant driver for this project is to optimise the use of smart solutions which will avoid costly circuit reinforcement – a cost financially and to the environment. The INSPIRE approach will also **enable greater connection of DG** throughout the network along with reducing constraints. Figure 3-7 shows the cumulative carbon benefit calculated based upon the methodology described in Appendix B.

3.6. Project Risks

To ensure successful delivery of INSPIRE's expected benefits and learning objectives, we will proactively identify risks to the project and provide mitigation plans. The risk register will be updated regularly during the course of the project. The three major risks (commercial, technical and resourcing) are listed in Table 3-3, see Appendix F for complete lists identified in the Full Submission preparation stage.

Table 3-3: Three major risks in different categories

Risk Category	Risk Description	Mitigation
Technical	IT integration is more difficult than expected	Utilise key CGI resources already familiar with SP Energy Networks data and systems, the WISP approach and successful innovation projects
Commercial	Development costs are significantly higher than estimated	Fixed price contracts with stated contingency to be allowed
Resources	Availability of experienced project staff	Effective resource planning and use of appropriate external resources where necessary

Section 4 Benefits, timeliness, and partners

4.1. Criterion (a) Accelerates the development of a low carbon energy sector and/or delivers environmental benefits whilst having the potential to deliver net financial benefits to future and/or existing Customers

SP Energy Networks is a key proponent of the UK's transition to a low carbon economy by enabling best practices throughout its distribution system. INSPIRE will demonstrate methods that will support and enable smart grids and thus have a direct impact on the UK's Carbon Plan[17] directives. This Plan indicates that reform of the electricity grid should be achieved by "paving the way towards a 'smarter' electricity grid in the UK, which will increase the efficiency and reliability of the network".

We believe that the enhancements in network management that will be developed and trialled under INSPIRE are amongst the **essential next steps in achieving the Carbon Plan**. This project will develop a range of techniques that facilitate the Carbon Plan:

1. The Carbon Plan, 2.146: "... our electricity system will need to become smarter at balancing demand and supply." The CLNR project undertaken by Northern Powergrid found that the "integration and optimisation of multiple solutions" addresses "more complex, perhaps multi-level constraints". INSPIRE **facilitates a fundamental shift towards creating a fully smart grid** by providing an integrated and flexible data platform which will aid continuing improvements in network planning and operation in a rapidly changing environment.
2. The Carbon Plan, Box 9: "The analysis showed that renewable electricity could provide 35–50 GW by 2030." The project will **facilitate growth in the connection of renewable generation** and energy storage and demand side response services. This will support the UK's long-term commitment to reducing the emission of greenhouse gases, satisfy the Carbon Plan and meet the EU 2020 renewables directive. These benefits, together with cost savings, will be achieved by optimising the design, operation and constraint management of these connections and services.
3. INSPIRE will **provide improved visibility of the power system to stakeholders**, improve planning services and enhance customer ability to connect low carbon technologies. The overall customer cost of the connections process will be reduced through a shorter process and more accurate quotes.
4. The Carbon Plan, 2.177: "The Government is taking action now to ensure that distribution networks can cope in the future. The Department of Energy and Climate change and Ofgem co-chaired Smart Grid Forum is developing shared assumptions of future electricity demands and necessary investment levels." Focussing on coordinating smart interventions at a distribution system level will avoid stranded assets by **minimising conventional reinforcement requirements**, resulting in reduced costs to customers.
5. **Enhanced network performance resulting in increased availability** will be secured as advanced analytics are deployed to identify asset health and predict faults. Data analytics also have great potential to improve asset management and system performance through realisations from previously unobserved data. This is potentially a component of the 'big data' challenges noted earlier.
6. Creating a platform that **facilitates sharing of accurate and secure operational information**, with appropriate parties, including the GB SO to understand balancing requirements; it will enable a more open and competitive market that will **facilitate future DSO** and delivers benefits for the customer.

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[17] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/47621/1358-the-carbon-plan.pdf

7. **The challenges and opportunities arising from future integration of smart meter data** are among the most significant drivers for implementing the INSPIRE method. It will permit the realisation of benefits from the integration of smart meter data with other distribution network information and maximise value from the smart meter deployment programme. SP Energy Networks have already commenced research and development into techniques that could eventually become applications supported by the WISP.

In many ways, having a WISP available will provide an **"innovation accelerator"** for future innovation projects as "high quality, available and topical data" is often a significant problem area leading to delays and repeat spend in innovation.

INSPIRE delivers environmental benefits.

Environmental benefits arise from the applications supported by the WISP and are demonstrated by the four exemplar use-cases included in the INSPIRE project which provide **increased renewable generation access to the distribution network** through:

- Improved utilisation of smart solutions that have already been installed on the network (use-case 1);
- Better outage planning and local balancing at distribution network level (use-case 2);
- Improved network availability by fault prediction through data analytics (use-case 3); and
- Optimised location and minimised conventional reinforcement for new network infrastructure for transmission, distribution and generation systems (use-case 4).

The forecast carbon benefits are shown in Figure 3-7 and tabulated in Appendix A as evaluated by the methodology explained in Appendix B.

INSPIRE delivers financial benefits.

Forecast financial benefits, specifically **£93m (NPV) savings by 2050** for GB roll out, are shown in Figure 3-5 and tabulated in Appendix A as evaluated by the methodology explained in Appendix B. The WISP will support future applications which will deliver financial benefits which are demonstrated by the project use-cases, in particular;

- Existing smart solutions are better integrated to release further capacity and defer conventional network reinforcement (use-case 1);
- DNO information is automatically prepared and shared with the SO, avoiding significant manual intervention and man-hour costs with consequential savings for customers (use-case 2);
- Business efficiencies through reduced SP Energy Networks engineer effort emergency fault location delivered through improved diagnostic analytics (use-case 3); and
- Avoided reinforcement through better informed and standardised network planning (use-case 4). Generation connection reinforcement reduced by attracting connections to sites with capacity, and influencing the size of connection requested by proactive information exchange.

4.2. Criterion (b) Provides value for money to gas/electricity distribution/transmission customers

INSPIRE will ensure value for money for existing and future customers via:

- Competitive selection of project partners and suppliers;
- Detailed and rigorous development of project programme and risk management;
- Efficient delivery of project including maximising learning leveraged;
- The project use-cases were carefully selected to address immediate business challenges and drive customer benefit; and

- The WISP has been structured to deliver further benefits by solving emerging issues.

We are confident that **INSPIRE will generate significant new learning and provide unique contributions to the Smart Grid transition proportional to the investment required.** INSPIRE has a clear and positive business case post trial. Through the analysis of the application of INSPIRE savings of the order of £1.47m post-trial and £93m (NPV) for roll out to GB up to 2050, could be achieved in future operation.

INSPIRE has direct impact on the electricity distribution network planning and operation and is relevant to challenges that affect the GB SO and all Network Licensees. **The methods developed will be scalable for utilisation within all DNOs** and also benefit the GB SO. This project will demonstrate techniques that are, we believe, essential enablers for a fully smart grid. Key learning from this project would address this by demonstrating how the integration of data collected from various systems can **be achieved in an open, transferable and interoperable manner**. The learning will be useful to DNOs/TOs and can be shared amongst appropriate parties. With this in mind, our proposal ensures that **the method can be replicated in other parts of the GB network.**

INSPIRE facilitates the BAU rollout of techniques developed in several previous innovation projects as described in Appendix K. The WISP demonstrated in INSPIRE **enables increased value for customers by leveraging findings from already funded GB network innovation projects.**

Over 20 key stakeholders were engaged on a one-to-one basis in addition to the open stakeholder event[18] organised covering academic, DNOs, other utilities, suppliers and policy makers (such as local government). **Such a thorough and proactive engagement generated first-hand knowledge of the market and pricing during the proposal stage.**

SP Energy Networks has a track record in **successfully and efficiently managing projects** of a similar nature. Such projects include VISOR, Flexible Networks, Accelerated Renewable Connections, FITNESS and DINO[19]. We have the appropriate delivery team for this project. The in-house project management expertise and technical ability are second to none. In this respect we believe that success breeds success.

SP Energy Networks employs a robust procurement process to ensure that the best value for money is achieved for the equipment and services required in the INSPIRE project. In addition to the work undertaken in the proposal preparation phase, we will continue to carry out market research and due diligence to identify the most capable suppliers and project partners. A fundamental principle of the INSPIRE approach is to avoid the lock-in to the proprietary systems of large vendors and open the market to SME's. This approach will be promoted during project delivery by competitively tendering for applications design and delivery. Engagement with SMEs during bid development has generated an enthusiastic response.

The scope of this project is appropriate in relation to the learning that is expected to be captured. The total project costs are c. £8.52m and the outstanding funding required is £6.09m (90% of the Initial Net Funding Required) as shown in Figure 4-1.

Costs of Work Package 2, corresponding to the design and build of the WISP and the applications, form a substantial proportion of the projects costs. The agile development

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[18] INSPIRE Stakeholder Engagement Event in London on 9-May, the details can be found in Appendix M
[19] NIA DINO, SP Energy Networks http://www.smarternetworks.org/Project.aspx?ProjectID=1768

approach that will be adopted means that design and build are integrated and must be considered together.

Table 4-1 gives the breakdown of the INSPIRE project costs for the SP Energy Networks staffing, contractor staffing, equipment and expenses for each work package and includes the number of days and the cost per day in accordance with NIC governance.

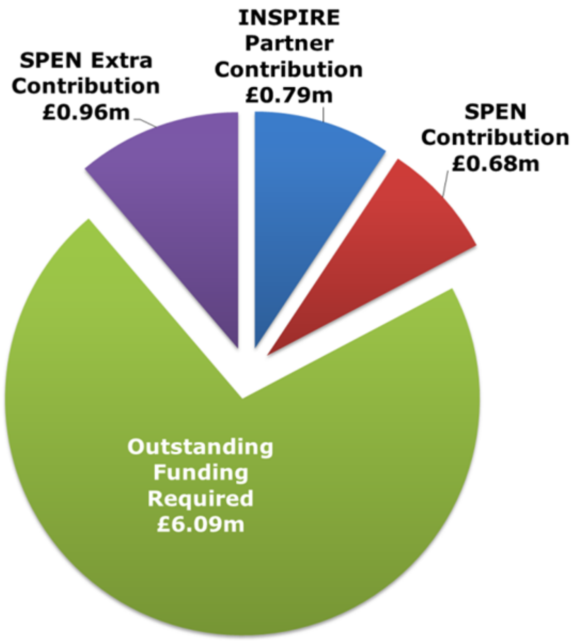

Figure 4-1: INSPIRE Funding Breakdown

[redacted]

Figure 4-2: INSPIRE Work Package Breakdown

Project costs have been developed based upon the following:

- SP Energy Networks' previous experience in the delivery of innovation projects and understanding of project management and disseminations costs;
- Close engagement with the project partners who have completed thorough bottom up costing of project deliverables; and
- Detailed costing of IT infrastructure requirements by Systems UK, the SP Energy Networks corporate IT function.

Where it is anticipated that project work will be undertaken by other suppliers, including SMEs, cost estimates have been estimated by SP Energy Networks or provided by the project partners on the basis that a competitive tender process will be undertaken during project delivery.

4.3. Criterion (d) Is innovative (i.e. not BAU) and has an unproven business case where the innovation risk warrants a limited Development or Demonstration Project to demonstrate its effectiveness

INSPIRE's proposal adopts an appropriate balance between innovation and technology risk. It uniquely and innovatively brings together new solutions along with commercial software, standards, previous project learning, techniques and frameworks. **Striking such a balance is critical so that customers have the opportunity to gain significant benefits from the innovation advancement but are not exposed to disproportionate risks.** The project is innovative from a business and ICT perspective and warrants development and trialling to prove the practicalities of deployment at scale and potential for wider application.

Table 4-1: Work Package detailed information

	Total Cost £											Labour Breakdown						
	SPEN Labour	Contractor Labour	Equipment	IT	IPR	Travel & Expenses	Payments to users	Contigency	Decommissionin	Other	Total	Duration (Days)	SPEN FTE	SPEN Number of Days	SPEN Cost per Day	Contractors FTE	Contractor Number of Days	Contractor Cost per Day
WP0 - Project Setup	[redacted]																	
WP1 - Design Optimisation	[redacted]																	
WP2.1 - Detailed Design of WISP and Use-cases	[redacted]																	
WP2.2 - Equipment Procurement	[redacted]																	
WP2.3 - Infrastructure installation and commissioning	[redacted]																	
WP2.4 - WISP Development	[redacted]																	
WP2.5 - Build And Deploy Use-case 1	[redacted]																	
WP2.6 - Build And Deploy Use-case 2	[redacted]																	
WP2.7 - Build And Deploy Use-case 3	[redacted]																	
WP2.8 - Build And Deploy Use-case 4	[redacted]																	
WP3 - Use-case Trial and Evaluation	[redacted]																	
WP4 - Planning for BAU	[redacted]																	
WP5 - Knowledge Dissemination	[redacted]																	
WP6 - Project Management	[redacted]																	
TOTAL	£2,100 k	£5,164 k	£ 267 k	£657 k	£ -	£103 k	£ -	£ 225 k	£ -	£ -	**£8,517 k**	[redacted]						

SPEN labour includes the dedicated services of a full time Project Manager and Technical Support Engineer for the whole duration of the project. Other SPEN resources will be drawn from the wider company for shorter periods according to the project requirements to provide specialist inputs, for example the SPEN IT and OT teams will assist with INSPIRE's design and build activities. Dissemination support will be provided by the SPEN Communications team. The Full Time Equivalent (FTE) values tabulated in Table 4-1 have been calculated upon the basis of the given project durations and reflect periods when multiple project partners and suppliers will be active.

To the best of our knowledge, **the methods to be trialled have not currently been implemented by any GB licensee**. Recent reports from national bodies support the need for a solution to be developed:

- The Technology Strategy Board (TSB) 'Distribution Management Coherence Engine' Final Report (see Appendix K.4) concluded that there would be **significant benefits** from implementing a platform like INSPIRE and recommended that a prototype be built; and
- The Royal Academy of Engineering/IET 'Connecting Data' report[20] concluded regarding data analytics in general 'The area is still immature and there remains great potential for innovation and value generation', and in relation to the energy sector stated "**A whole-systems approach, including the ability to exchange data, is key to achieving interoperability in an increasingly dynamic and complex sector"**.

INSPIRE is ambitious; there are multiple challenges to be resolved, including the scale and complexity of the work, interfacing with multiple legacy systems across two licence areas, including 'live' operational applications. However, INSPIRE addresses these challenges by proposing an incremental approach that is designed to not disturb existing systems and their respective data management.

From an ICT perspective the approach is novel, it builds on and substantially extends, previous innovation project advances and learning described in Appendix K. **INSPIRE takes an innovative approach by using a new inference method to correlate core datasets and harnesses new ICT technologies to link components innovatively into a new value chain**. These components include an Integrated Network Model (including communications), an Active Network Model and Complex Event Processing along with the capability to manage data quality. More technical information on these components can be found in **Appendix D**. In addition, the approach does not replace or disturb existing systems, instead is incremental in its build and benefits release, offering GB DNO's, with their NMS-centric architectures, a new cost effective route to integration and data management. This is a new alternative compared to high risk and high cost enterprise wide SOA and full width transactional ESB deployment. Figure 3-3 explains this further.

Learning from previous innovation projects now provides the opportunity for INSPIRE to deploy a WISP. The solution is innovative in its method of creation and offers an effective, low cost and risk approach minimising disturbance to existing ICT systems.

The key areas of innovation include:

- Creation of a new WISP;
- Applying advanced analytics; and
- Deployment of the above two elements at scale.

Importantly, **INSPIRE is driven by a synthesis algorithm that provides the 'engine' of the platform, enabling data to be accessed intelligently from other core systems** (such as the DNO's Network Management System), so minimising data duplication and ensuring quality, security and future adaptability.

The business case is unproven. **The Method would not currently be adopted as the BAU solution.** The traditionally perceived lower risk and lower initial cost approach is to put in bespoke point to point integrations to solve individual business problems as they arise. However this will not provide the holistic whole-systems view required to tackle the new DNO smart grid challenges. **There is currently perceived risk in making BAU investment in a WISP now that will facilitate introduction of**

[20] http://www.raeng.org.uk/publications/reports/connecting-data-driving-productivity

functionality later. With the support from innovation funding INSPIRE will address this issue by delivering functionality through the 4 use-cases to demonstrate that business and stakeholder benefit can be achieved.

The opportunity with INSPIRE is to prove an innovative, low cost, lower risk approach by delivering the WISP at scale with its associated business problem driven applications and data management capabilities. The technical complexity and risks of providing the operating interactive WISP components, including integrated and active networks models and time-series and event data processing, warrant the application of NIC funding.

4.4. Criterion (e) Involvement of other partners and external funding

Key features of INSPIRE are appropriate partnerships and well leveraged external funding. As highlighted in the previous sections, a thorough and proactive industry wide engagement has been carried out during the proposal stage. Table 4-2 denotes the scope and external funding provided by the project partners. Further information on the capabilities of the partners and their scope of work is included in Section 6.

Table 4-2: Details on Project Partners

Project Partner	Key Scope	External Funding
SP Energy Networks	Leading licensee and accountable for overall project delivery.	10% of Initial Net Funding plus extra. £1633k (£677k+£956k)
CGI	Main technical partner and systems integrator.	[redacted]
Smarter Grid Solutions	Will be a main partner for use-case 1. Algorithm developer for the integration of smart solutions.	
Nortech	Will provide specialist data retrieval equipment and technical support services primarily in use-case 3.	
University of Strathclyde (UoS)	Detailed development of use-case 3 building on their previous prototype PMAR diagnostic and prognostic algorithms. Also wider evaluation of trial results, interpretation of outcomes and assessment of trial and innovation methodologies.	
National Grid (GB SO)	Will agree the data transfer scope and verify that appropriate and accurate data is being transferred during the trial phase for use-case 2.	

4.5. Criterion (f) Relevance and timing

INSPIRE is relevant and timely; an optimised approach having direct impact on electricity distribution planning and operation.

The relevance and timeliness of the project is demonstrated by its alignment with the recommendations of a number of national projects and reports, including:

- Learning from relevant flagship LCNF projects as outlined in Appendix K;
- The Smart Grid Forum's Work Stream 7 (DS2030) report;
- The Energy Systems Catapult/IET Future Power Systems Architecture Report; and
- The Royal Academy of Engineering/IET 'Connecting Data' report.

The GB energy industry is at the start of an explosion of data – the requirements of the smart grid require that sensors and devices capable of generating large amounts of data are widely deployed. In this respect it is timely to consider how best to integrate this data and manage the issues related to interfacing to multiple manufacturers. The WISP is a key enabler - without the WISP as a data backbone, it will be difficult to integrate and interpret new data sources holistically in the context of the whole distribution system.

Technology has advanced with new ICT tools and techniques that can facilitate this solution. The approach being adopted under INSPIRE is informed by developments in data science, particularly over the past decade. **Data management and marshalling had not been specifically considered by most projects and we now understand that advances in data management needs to be at the forefront** of developments taking place in the distribution network, as well as advancing systems and architectures.

The WISP will be a timely enabler to the increased utilisation of smart solutions and it will facilitate and align with the desire to move towards the required DNO digital transformation. One key theme for the WISP design is interoperability, allowing SMEs (and others) to develop and build new applications, extending the capability of the Platform. The WISP provides a key-enabler for the creation and bringing to market of a wide range of new applications beyond those initially described in the INSPIRE project. The new applications can address some of the potential future use-cases non-exhaustively listed in Table 3-1 (Section 3.1). Not only will this increase learning throughout the industry but will also have the benefit of creating a more competitive market place as there will be a diminished risk of 'lock in' to the proprietary systems of large vendors.

4.5.1. *GB DNO business model and price control review periods*

INSPIRE will have a direct impact on future business planning and the deployment of innovative solutions.

SP Energy Networks have taken a lead role in developing data analytics solutions over a number of years. Our ED1 non-operational IT strategy states '…our longer term investments propose to implement advanced technologies for managing, distributing and analysing large volumes of data.' The strategy highlights the need for increased data integration in future to create business intelligence thereby driving efficiency and customer service improvement. Our strategy may differ from other DNOs depending on where they are in their ICT investment cycle however we believe that these requirements are common to all licensees over the medium to longer term.

The successful demonstration of the WISP will provide necessary learning and confidence for committing to BAU roll out in future price control review periods.

4.5.2. *Technology Readiness Level and Suppliers Engagement*

INSPIRE's WISP use-cases are at a TRL of 4-6, and elements of the platform are at a TRL of up to 7[21], which requires limited development. The method proposed by INSPIRE is not low TRL research. INSPIRE will build upon previous projects and recent advances in ICT areas.
The proposal team has effectively engaged with existing software suppliers and systems integrators together with SMEs who want to enter, or expand their role in the marketplace. Large international companies, such as GE, and ESRI together with SMEs, have their role to play in the project delivery. We believe that the involvement of a range of suppliers will accelerate progress to business as usual across the DNO community.

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[21] TRL 4: Component and/or breadboard validation in laboratory environment
TRL 5: Component and/or breadboard validation in relevant environment
TRL 6: System/subsystem model or prototype demonstration in a relevant environment
TRL 7: System prototype demonstration in an operational environment.

4.5.3. *Smart Grid Architecture Model (SGAM)*

Previous LCNF projects have addressed the Smart Grid Architecture Model[22] somewhat as illustrated in Table 4-3, but we believe that INSPIRE addresses multiple layers, in particular the information layer which has not been exploited by others in previous projects. INSPIRE will advance the information layer as importantly, this will enable advances in the function and business layers above – where tangible benefits are realised.

Table 4-3: Comparison to other LCNF Projects

	Potential Project	Previous LCNF Project Main Focuses											
SGAM layer	INSPIRE	C2C	CLASS	CLNR	MEA	FNLCF	LCL	FPP	LVT	BRISTOL	FALCON	LCH	NTVV
Business	✓	✓		✓			✓	✓				✓	✓
Function	✓	✓	✓	✓		✓	✓		✓		✓	✓	✓
Information	✓			✓									
Communication	✓				✓			✓			✓	✓	✓
Component			✓	✓	✓					✓			

Table 4-4: Description of acronyms used in Table 4-3

Acronym	LCNF Project	DNO
C2C	Capacity to Customers	ENW
CLASS	Customer Load Active System	ENW
CLNR	Customer-Led Network Revolution	NPG
MEA	My Electric Avenue	SSEPD
FNLCF	Flexible Networks for a Low Carbon Future	SPEN
LCL	Low Carbon London	UKPN
FPP	Flexible Plug and Play Low Carbon Networks	UKPN
LVT	LV Network Templates	WPD
BRISTOL	SoLa Bristol	WPD
FALCON	Flexible Approaches for Low Carbon Optimised Networks	WPD
LCH	Lincolnshire Low Carbon Hub	WPD
NTVV	New Thames Valley Vision	SSE

The links and relationships between INSPIRE and previous innovation funded projects are discussed further in Appendix K.

Section 5 Knowledge dissemination

Knowledge dissemination and stakeholder engagement have been key components of previous SP Energy Networks innovation funded projects and we plan for INSPIRE to continue this trend. In accordance with this, we conducted a stakeholder engagement event prior to this proposal to engage interested parties in May 2016 as summarised in Appendix M.

An industry collaborative working group will be set up at project inception to ensure the proposed methodology is replicable to other parts of the GB distribution network. Members of this working group could be from organisations who attended the stakeholder event. The group will comprise senior representatives from other licensees, major suppliers, academia, and other stakeholders. The group will meet at least twice

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[22] http://ec.europa.eu/energy/sites/ener/files/documents/xpert_group1_reference_architecture.pdf
SGAM has had SGF endorsement to encourage wider application by DNOs and it is being promoted currently by the work of SGF WS9.

per year and contribute to the detail of the project learning objectives to help ensure that the relevance of learning to the industry sector in the UK is maximised.

The primary focus of knowledge dissemination is to enable SP Energy Networks and other GB network owners and operators to apply learning from INSPIRE into business as usual. A separate knowledge dissemination work package will convey learning through a range of carefully planned mediums appropriate to the various audiences. The dissemination plan created at the start of the project will be continuously monitored to ensure its continuing effectiveness.

The primary focus of knowledge dissemination is twofold:

1) **Strong DNO influence to generate a fit for purpose WISP:** INSPIRE is unique in that the GB SO and DNOs (NPG, ENW, SSE and WPD) are both supportive on this project and involved in different levels. This approach ensures that the specifications and outcomes can be used directly by UK DNOs in due course.
2) **Cross sector learning and collaboration:** The challenges INSPIRE is helping to address within electricity distribution/transmission sector is actually a cross-industry issue. INSPIRE will be supported by the Scottish Enterprise's Open Innovation Consortium and Scottish Gas Networks to ensure insights are shared and effective knowledge is exchanged.

Such a transparent approach will help to ensure **multi-vendor interoperability**.

5.1 Learning Leveraged

Preparation for this proposal has included an extensive literature review focusing on the outcomes from other projects that have themes similar to those in INSPIRE, namely "Big Data" handling; real-time analytics; network visibility; data integration; whole-systems modelling and DNO/SO interfacing. This learning is summarised in Appendix K. These previous projects have generated significant leaning points which have helped to define INSPIRE's WISP and the subsequent use-cases.

5.2 Anticipated Learning Generated

INSPIRE will deliver learning throughout the project to ensure that opportunities for benefits are realised as soon as possible. The anticipated learning generated is presented in Table 5-1 along with the work package(s) that will generate outcomes from INSPIRE for a range of beneficiaries. The work packages are described in further detail in Appendix E.

5.2.1 Methodology for Learning Capture

Knowledge will be generated at all stages of INSPIRE therefore a consistent approach for learning capture is important to establish. Consequently, a clearly defined list of learning objectives has been created and a robust methodology has been developed, a summary view of the latter is shown in Figure 5-1.

Learning will be captured in the first instance by each work package lead and will be reported to the Project Manager and an appointed Knowledge Coordinator. The Knowledge Coordinator will work alongside the Project Manager in collating and managing all learning generated from the different work packages. In addition, the Knowledge Coordinator will review the lessons learned from other relevant innovation projects and notify the project delivery team.

Table 5-1: Expected Learning Generated and Beneficiaries

Work Package	Learning Objective	Beneficiaries
WP1 Design Optimisation	Development of user needs and design using systems engineering approach	DNO, S&D, C
	Build and deployment methodologies for the WISP	DNO, S&D
	Build and deployment methodologies for the WISP business use-case solutions	DNO, S&D, TO, SO
	Requirements for a generic and transferrable electricity distributor information platform and data services architecture	DNO, S&D
	Information security requirements for new class of business applications	DNO, TO, SO
	Informed set of requirements for data exchange with stakeholders - customer connections and future DSO requirements	DNO, C
WP2 Design and Build	Understanding integrated data quality and mitigation/management approaches	DNO
	Quantification methods for measuring data quality in core electricity distribution systems	DNO, A
	Quantification methods for measuring data alignment in core electricity distribution systems	DNO
	Business rules for data quality management in core electricity distribution systems	DNO, S&D
	Business rules for master data management across core electricity distribution systems	DNO, S&D
	Enhanced data management practices informed by the data quality and mastering learnings	DNO, S&D
	Understanding of how to standardise interfaces to enable third party applications	DNO, S&D
	Pragmatic understanding of how learning's from previous innovation around integrated network modelling, situational awareness and predictive analytics can be raised to a near business as usual technology readiness level.	DNO
	Proof of value of diagnostic and prognostic predictive analytics in the electricity distribution context.	DNO
	Proof of value of Smart Grid technology interaction management.	DNO, A, C
WP3 Use-case Trial and Deployment	Operational experience of use-case	DNO, S&D
	Update of benefits	TO, SO, IG
WP4 Planning for BAU	Produce roadmap for the WISP	DNO, S&D
	Produce roadmap for business use-case applications	DNO, S&D
	Identification of potential future WISP applications	DNO, S&D,
WP5 Dissemination	Guidance on maximising industry learning from project	DNO
	Guidance on optimising scope of Use-cases and applications	DNO
WP6 Project Management	Experience in managing a diverse range of suppliers, contractors and advisors in a project with a complex structure.	DNO

Table 5-2: Beneficiaries

A	Academia	**S&D**	Suppliers and Developers
C	Customers	**SO**	System Operator
DNO	Distribution Network Owner	**TO**	Transmission Network Owner
IG	Industry Governance		

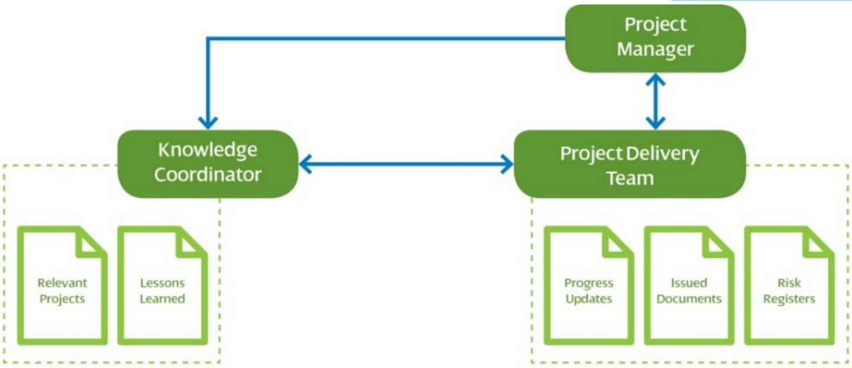

Figure 5-1: Learning Generation and Capture Methodology

Following knowledge capture, learning will be disseminated both internally and externally. The dissemination strategy that has been developed for INSPIRE aims to provide assurance that useful learning is identified throughout the project and shared amongst stakeholders and interested parties at all stages. The vital importance of sharing knowledge and creating learning internally is fully acknowledged, particularly for innovation projects, where discovered issues can be made known and thus avoided in future business as usual roll out. The Knowledge Coordinator will identify the most appropriate project partner(s) or supplier(s) to be responsible for the delivery of the dissemination.

The Knowledge Coordinator will establish the dissemination early after project commencement and when dissemination opportunities are identified will refine it along with the dissemination strategy throughout the course of the project. They will also manage the INSPIRE brand and liaise with stakeholders and other relevant projects.

5.2.2 Key Audiences

Knowledge arising from INSPIRE will be relevant and of interest to a range of stakeholders including some groups previously not engaged with NIC learning due to the nature of the project. These include technological companies who are perhaps unfamiliar with the complexities of the electricity network infrastructure. INSPIRE's dissemination will be tailored to ensure effective communication to multidisciplinary parties, recognising the wider audience including IT departments who may not already be familiar with innovation dissemination.

The key beneficiaries that have been identified include:

- **Academia** – INSPIRE will provide valuable learning to academics through design, implementation and trialling of INSPIRE. Specific benefits will arise from the learning relating to the use-cases, whilst there will be interest in the WISP and open approach to accommodate future innovation;
- **Customers** – Although INSPIRE will benefit all customers, it is expected that generators, energy communities and DER providers will be particularly interested in understanding how they can benefit from greater visibility and improved business processes;
- **Distribution Network Operators** – The primary focus for learning from INSPIRE are DNOs. Learning from INSPIRE will potentially influence future innovation projects, business processes and upgrades and future investment decisions;
- **Industry Governance** – INSPIRE will deliver learning outcomes that may inform best business practice and therefore influence future standard procedures. The on-going work of the FPSA project may be relevant here;
- **IT System Providers**– Learning from INSPIRE about a new scalable and open way of providing business processes will be of interest and benefit to developers including SMEs;

- **SP Energy Networks** – All of the SP Energy Networks community, including Innovation and Policy and Standards departments, will be interested in in all arising learning to establish how INSPIRE's knowledge can be incorporated into business as usual;
- **System Operator** – INSPIRE will provide greater visibility of the distribution network, this will enhance the SO's knowledge of the system enabling operational decisions to be better informed; and
- **Transmission Operators** – INSPIRE will facilitate business process to support operation and planning of the transmission network. Learning in relation to the provision of previously unavailable information will be useful to identify how INSPIRE can be used to provide benefits.

5.2.3 Methodology for Learning Dissemination

INSPIRE will employ a range of dissemination techniques to achieve maximum sharing of knowledge by matching with the audience, the nature of the content and dissemination event objectives. Methods will include:

Project Brand	•Establish an INSPIRE brand allowing all dissemination materials to be immediately recognisable.
Progress Reports	•Prepare regular progress reports highlighting knowledge captured in line with Ofgem requirements.
Workshops	•Deliver SP Energy Networks and external workshops tailored to the audience and content, to effectively share technical and non-technical learning and gather feedback.
Webinars	•Present webinars to efficiently update stakeholders and interested parties at their convenience avoiding the time and carbon impact of travel.
Low Carbon Network Innovation Conferences	•Participate in annual LCNI conferences to share INSPIRE's learning and progress with the large audiences of LCNI attendees.
SP Energy Networks Innovation Website	•Host categorised project reports, presentations and webinar recordings on the SP Energy Networks' innovation website.
Close-down Report	•At the end of the project, the close-down report will provide a comprehensive, detailed description of project findings and achievements.

Figure 5-2: Learning Dissemination Approach

5.3 IPR

INSPIRE will conform to the default intellectual property rights (IPR) arrangements outlined by Ofgem in the NIC governance document[23], specifically;

- All other Network Licensees will have the automatic right to use Relevant Foreground IPR for use within their network royalty-free.
- All other Network Licensees will have the automatic right to use the background IPR, limited to facilitating use of the Relevant Foreground IPR to reproduce the Project outcomes, for use within their network royalty-free.

[23] https://www.ofgem.gov.uk/ofgem-publications/53526/spnic.pdf

Section 6: Project Readiness

This section is used to access criterion (g): Demonstration of a robust methodology and that the Project is ready to implement.

Requested Level of Protection against cost over-runs	5%
Requested Level of Protection against unrealised Direct Benefits	n/a%

6.1 Evidence of why the Project can start in a Timely Manner

We are confident that the INSPIRE project will start in a timely manner based on the strong foundation of previous work it will build upon, the learning we have gathered and the strong project team that we have secured. INSPIRE intends to start in January 2017 and finish by March 2021. The following evidence outlined below provides confidence that INSPIRE will start on time:

- We have engaged with appropriate technical resources, suppliers; academic partners; DNOs and gas network owners to gather sufficient information for this Full Submission which will stand us in good stead for project commencement in January 2017;
- SP Energy Networks have the appropriate experienced resources to manage and deliver an innovation project of this magnitude;
- SP Energy Networks are committed to innovation as they have demonstrated with their previous innovation projects;
- Project partners have been selected for their technical expertise as well as their previous experience in delivering innovation projects;
- WISP delivery is able to proceed directly, through application of learning and functional modules from previous projects, utilising appropriate platform technologies and standard open-source software libraries, and wherever possible designing software generically so that its actual behaviour can be controlled using configurable tables/business rules.
- SP Energy Network's Legal and Procurement departments have been involved and informed during every stage of the proposal development to ensure streamlined procurement and award of contracts; and
- A well-developed project plan, scope of work and risk register have all been defined during submission preparation.

6.1.1 Appropriate Resources to Manage a Project of this Magnitude

The extensive wealth of in-house knowledge in power systems and in data systems, together with prior experience and adequate resources will ensure the successful outcome of the project. SP Energy Networks have a track record in successful project management from which INSPIRE will reap the benefits. There is strong commitment and support from the senior management team to ensure that subsequent to award funding, the project will commence on programme with a qualified project team and management oversight.

The Project Steering Committee comprises director level representatives: Head of Process & Systems; Head of System Design; Future Networks Manager and representatives of key stakeholders. The Project Manager will implement the Project Steering Committee's decisions via the Delivery Team.

6.1.2 Commitment to Previous Innovation Projects

We will draw on previous innovation project experience to ensure that INSPIRE follows the same successful delivery path. Some similar large scale innovation projects that we have been involved in are as follows:

- ARC – Accelerating Renewable Connections (ARC)
  This project had a total budget of £8.0m. We demonstrated our capability to trial a real-time active network management system which required a reliable communication architecture and control strategy to adjust the outputs of

generators. We developed several technical guidance and policy documents which will be used for full business adoption.

- Flexible Networks for Future Low Carbon Future (FLEXNET)
  This project had a total budget of £6.4m. In this project, we demonstrated our capability to deliver a multi-vendor project which involved trials of different innovative methods at different parts of distribution networks located in both SP Manweb and SP Distribution areas.
- Visualisation of Real Time System Dynamics using Enhanced Monitoring (VISOR):
  This is a NIC project with a total budget of £7.37m which includes the installation of phasor measurement units across the GB transmission network and real-time modelling and analysis of transmission network dynamic conditions.

6.1.3 Project Partners

INSPIRE's project partners, namely National Grid, CGI (primary technical partner), University of Strathclyde, Smarter Grid Solutions and Nortech have all been selected as they not only have extensive technical expertise but also previous NIC/NIA project experience. The combination of these two aspects will ensure INSPIRE can not only start in a timely manner but the project team will meet deadlines within budget throughout the whole project lifecycle.

6.1.3.1 National Grid

National Grid's role will be primarily in the delivery of use-case 2, helping to define key deliverables, verifying the application delivered during the trial phase, planning for business as usual implementation, and disseminating knowledge captured internally in National Grid and to DNO's. National Grid's involvement in use-case 2 will assist in the development of a data transfer process considerate of the needs of both the SO and DNO. The collaboration will ensure that the bi-lateral requirements are satisfied.

6.1.3.2 CGI

CGI has been selected as the main technical partner for INSPIRE as they bring – through previous innovation projects – a new, pragmatic and cost effective approach to providing a WISP. A full procurement exercise prior to the INSPIRE proposal stage was undertaken interviewing six suppliers. Through this process SP Energy Networks concluded that CGI has the necessary expertise, industry-wide visibility and strategic alignment to act as ICT system architect. It is therefore cost beneficial and in the interest of customers to appoint CGI as project partner.

In assisting DNO's to deploy and integrate major new systems such as NMS implementations, CGI have developed a methodology for relating data in different core systems that describe the same assets or related components. Having this grounding in the DNO data structures and systems CGI have been engaged on a series of pathfinder innovation projects where these specific skills have been required. Initially focused on producing datasets for populating power-flow analysis tools, the ability to correlate data from NMS, GIS and AMS has been successfully delivered.

Within its capacity of the system architect, CGI will enhance this approach to enable the INSPIRE platform to innovatively inference across systems, critically without disturbing or replacing them, to build an integrated network model that can also be used to manage the quality of the data between the core systems and provide datasets to other applications.

Specific innovation projects leading to INSPIRE that CGI have been proactively involved with are shown in Figure 6-1.

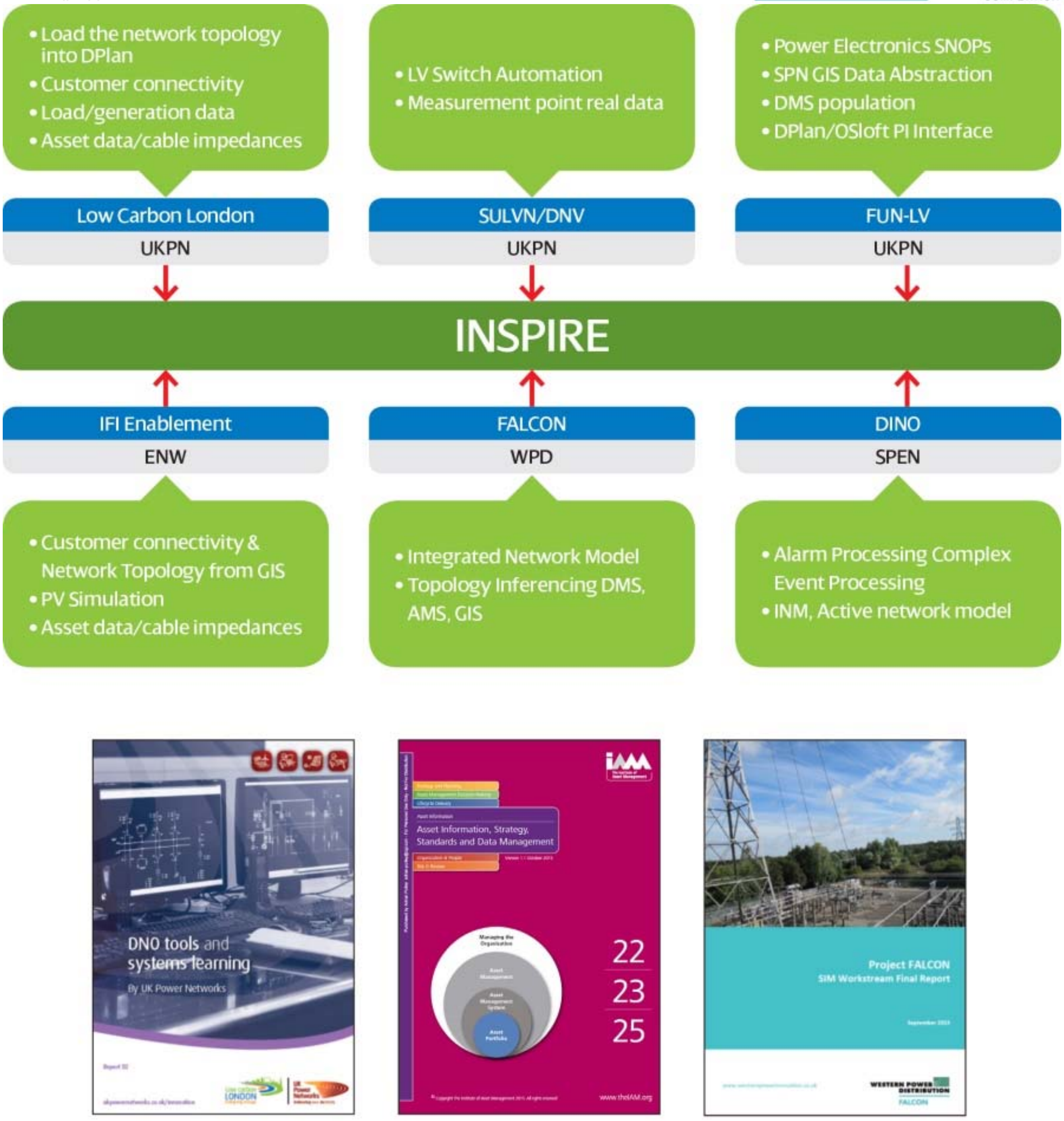

Figure 6-1: CGI's Learning Journey to the WISP

6.1.3.3 University of Strathclyde

University of Strathclyde will be engaged in the detailed development of use-case 3, and the wider evaluation of trial results, interpretation of outcomes and assessment of trial and innovation methodologies. The UoS developed the prototype PMAR diagnostic and prognostic algorithms that are the basis for use-case 3. Data science/data mining methodologies were evaluated and implemented by a team consisting of a Professor, Senior Researcher and PhD student within the University. This has led to prototype algorithms and user tools that will become the basis of the user requirement, development, trial and evaluation in use-case 3.

The specific role of UoS includes: further refinement of the data analytic methods and approaches, leading to specific algorithms to be implemented. This encompasses advice on algorithm implementation and data inputs. The UoS will also be directly involved in user requirement capture and linking the algorithms to the full application implementation. It will also evaluate and test the build, and then provide evaluation and interpretation of the results.

The UoS will also support the evaluation of trial results across all of the use-cases. Given its expertise in power systems, network management and control, and wider power system planning it is well placed to assess the rigour, results and value of all of the use-cases.

Knowledge dissemination is a key element of the INSPIRE project, and the UoS is able to support this fully. Its leadership role in the EPSRC HubNet (Energy Networks Hub) programme means it is directly engaged in the dissemination of research and innovation results throughout the academic and wider innovation community. It can ensure that INSPIRE results and outcomes are showcased at symposia, colloquia and in specific reports and publications around major advances in smart grids.

6.1.3.4 Smarter Grid Solutions

Smarter Grid Solutions has been selected as an additional technology and systems partner for design and requirements specification of use-case applications that are focused on smart grid technique operational coordination and network and DER connection planning. They have proven knowledge and capabilities in this area and have contributed to industry thinking, innovation projects and commercial exploitation of innovation outcomes – all of this is highly relevant to the INSPIRE project which seeks to draw together multiple strands of system thinking, emerging innovation outcomes and current and future needs. Their deep knowledge in smart grids, network control and power systems will provide benefits to the project and their approach to partner working will be an asset as this project tackles significant challenges and seeks to prove real value from the whole system approaches and common information methods.

6.1.3.5 Nortech

Nortech will provide a system which will collect the data required for use-case 3, “Data Analytics for Improved Network Performance”. To do this, Nortech will design, develop, build, deploy, operate, maintain and technically support a sub-system to collect, host and share the data required. The sub-system will include field devices, communications infrastructure and hosting.

They have allocated time to work with project partners, especially SP Energy Networks and Strathclyde, to ensure we deliver the required data in the timeframe and format required by other elements of the project.

They have also allocated time to work with project partners, especially SP Energy Networks and CGI, to ensure that their sub-system is a well formed element in the overall INSPIRE architecture providing excellent data access functions for third party users and expert systems.

6.1.4 Engagement with Appropriate Technical Resources

A Stakeholder Engagement event, described in Appendix M, was held on 9th May 2016 at The IET Building, Savoy Place, London. This event was well attended from industry and academia and feedback from these parties was used to refine the project proposal, informing the preparation of this submission, ensuring all relevant information is included and highlighted.

6.1.5 SP Energy Network’s Legal and Procurement Departments Involvement

The proposal development team have worked closely with SP Energy Network’s Legal and Procurement Departments from the project inception to the Full Submission to ensure that appropriate arrangements are in place to facilitate the project’s timely start.

6.1.6 Project Plan, Scope of Work and Risk Register

The project plan, scope of work and risk register have already been addressed as part of the submission preparation as found in Appendix H, Appendix E and Appendix F. All are required for project delivery and their early creation will facilitate the timely commencement of the project.

6.2 Evidence of how the Costs and Benefits have been Estimated

An important focus of the preparation of this submission has been the accurate evaluation of INSPIRE's costs and benefits as described in Appendix A, these results were presented in Sections 3 and 4.

SP Energy Networks and our project partners have extensive experience of project delivery and in-depth knowledge of the services and products to be provided. This has enabled a bottom-up make-up of the overall financial cost. Costs of implementing all four use-cases have been identified along with those for the WISP using expert estimates from suppliers.

Benefits have similarly been evaluated using expert inputs, for example Smarter Grid Solutions helped develop use-case 1's CBA as they have extensive experience in applying smart grid solutions in the UK and the US.

Evidence for the CBA was obtained from:

- National UK forums, projects, and reports such as Smart Grid Workstream 3, the Future Power Systems Architecture Project, and the National Infrastructure Commission 'Smart Power' report;
- Learning from related NIC, NIA and IFI projects (Distribution Network Visibility, Low Carbon London, Customer-Led Network Revolution,); and
- The cost of labour, consultancy services and contractors for each work package has been estimated based on our experience from previous similar projects.
  For the benefits quantified in the GB roll-out scenarios, an extrapolation technique was used to estimate the future GB benefits taking into account specific benefits estimated in the INSPIRE case.

6.3 Evidence of the measures the Network Licensee will employ to minimise the possibility of cost overruns or shortfalls in Direct Benefits

The first step to minimise the possibility of cost overruns or shortfalls in benefits has been the development of accurate cost and benefit estimates as discussed in section 6.2. The risk of overruns in INSPIRE are generally considered to be small (the associated Risk Register can be found in Appendix F). To ensure that this considered view turns into reality and the risk of cost overruns is minimised, we will use robust risk minimising methodologies throughout the lifetime of the project. These methodologies are outlined below:

- **Procurement process:** This process will start as soon as project funding is approved in order to achieve competitive tenders and provide the best value for money.

- **Separate work packages:** INSPIRE is a large-scale project and we have broken the project down into discrete work packages, each with their own allocated budget and tolerances, to aid project progress and monitoring. Monthly project cost review and cost at completion forecast will also be conducted for each work package to provide an accurate value of total project cost.
- **Focus on SDRCs and learning objectives:** The project team will maintain focus on achieving the SDRCs outlined in Section 9; this in turn will ensure the required project learning outcomes. Focussing on the defined SDRCs will help us prevent scope creep, and ensure that constraints on project budget and programme are observed.

6.3.1 Systems Engineering

The systems engineering method is a project delivery model which is used for the purposes of **verification and validation** in the design of complex projects. It focusses on combining both the business and technical requirements of all customers and stakeholders. Customer needs and required functionality are analysed during the initial project stages and requirements are fed into the development stage. Testing of the project is carried out and planned in parallel with the corresponding phase of decomposition (or top-down), as shown in Figure 6-2. This is beneficial as any errors are likely to be flagged at an earlier stage in the process than in other sequential methods, thus saving time and giving the project a higher chance of success.

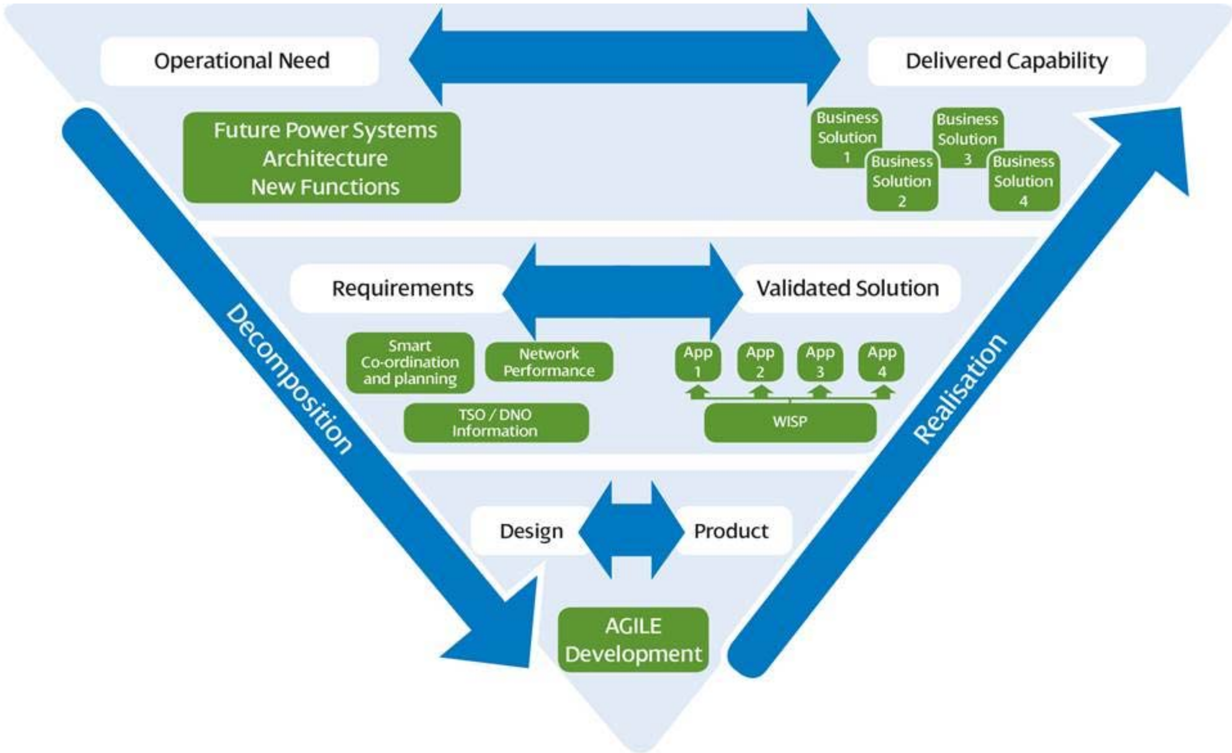

Figure 6-2: INSPIRE's System Engineering approach

Figure 6-2 shows the systems engineering method applied to INSPIRE. The business solutions that INSPIRE seeks to address are driven by the FPSA functions as discussed in Section 3.1. The Smart coordination and planning; network performance and TO/DNO information requirements have emphasised the need for a WISP and have steered the selection of the four use-cases; there is great potential for many other use-cases to be realised as to respond to existing as well as future challenges and opportunities. (Table 3-1 alludes to potential future use-cases).

6.3.2 Agile Methodology

In INSPIRE, an agile approach will be taken to provide optimum flexibility and aid parallel work streams to interact effectively, this will ensure project development is strongly aligned with the requirements but allow flexibility to accommodate change during delivery. In this way the risk of cost and programme overruns can be mitigated, and critically the deliverable outputs will be aligned to stakeholder's true needs.

The agile project methodology differs significantly from the traditional waterfall methodology as highlighted by Figure 6-2. The waterfall method follows a sequential process therefore parallel progress of two or more project phases cannot be undertaken without risky dependencies and/or synchronisation points. The waterfall also has the disadvantage of being inflexible to change until after the design is launched. The agile method is an incremental model where rather than viewing a project as a single large deliverable; it is broken down into a set of smaller iterations known as **sprints**. This method allows for continuous delivery of useful products/software and allows feedback from business users to be addressed during the next sprint. This means that requirements can be refined during the delivery process, which results in improved quality, and savings in cost and time compared to the alternative of making changes after a completed product has been delivered. The agile methodology has been applied successfully on the SP Energy Networks DINO project.

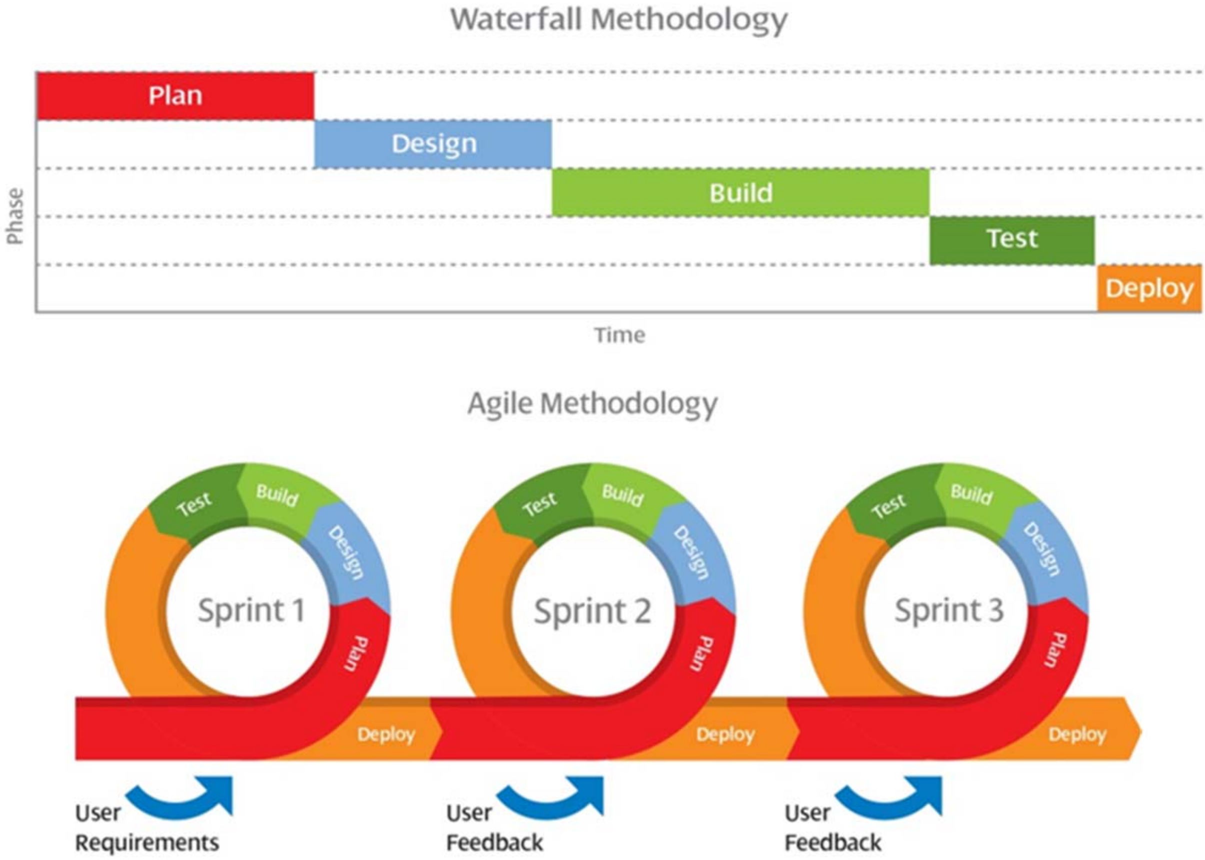

Figure 6-2: Waterfall vs. Agile Methodologies

WP2 will include multiple sprints, each sprint, once completed, allows, for example, user interfaces with limited functionality to be reviewed and suggested improvements can feed into the next sprint. Therefore the overall WISP/application design and build process is iterative. The agile approach is fundamental to ensure INSPIRE's success as this will ensure a close working relationship between the business and IT teams during the sprints and the ability to be more responsive to changes in detailed requirements that may arise. An agile method will also ensure project value for money as modifications are woven in during the design and build phase instead of at the end of the project when it may be technically harder and more expensive to implement changes.

As a result of the agile approach, design and build are encompassed by WP2. This work package is central to the project success and the agile approach will help with monitoring of progress, because early iterations of working software should be delivered in weeks rather than months allowing any issues to be identified and addressed much sooner.

6.4 A verification of all information included in the proposal (the processes a Network Licensee has in place to ensure the accuracy of information can be detailed in the appendices)

Information included within this proposal has been gathered by an experienced project team, led by a dedicated SP Energy Networks full-time proposal manager. The following process was undertaken to ensure that the information included in this submission and associated appendices is up-to-date and accurate:

- **Selection of Suitable Project Partners:** Following initial engagement, lead partners, engineering consultants and technical advisors were selected based on their expertise and knowledge. Their professional standards ensured the submission's information was accurate to the best of their knowledge.

- **Extensive Information Gathering:** The project team collated accurate information for the bid from within SP Energy Networks and partner organisations, as well as from other industry stakeholders and suppliers. Feedback from those parties at a workshop described in Appendix M allowed further sources of expertise to be identified. All information material to the bid such as cost estimates has undergone internal approval within partner organisations and has been evidenced in writing.
- **Documents Review:** This submission has gone through numerous quality control checks to maintain accuracy following each update. The Full Submission Pro-forma has undergone a final review by industry experts to ensure the accuracy of the information within.
- **SP Energy Networks Data Assurance Governance (DAG)**: A formal documented process has been undertaken during which the submission document was reviewed by a 'second person' who is also a bid manager, followed by senior manager review and then ultimately approval by our Engineering Services Director.

6.5 How the Project plan would still deliver learning in the event that the take up of low carbon technologies and renewable energy in the Trial area is lower than anticipated in the Full Submission

INSPIRE is about fundamentally changing the way that network information is managed to facilitate required future business processes – a change that is required as smart grid realisation advances. We believe that the take up of low carbon technologies and renewable energy in the SP Energy Networks licence areas is already sufficiently advanced to demonstrate the INSPIRE methods. We have identified potential **trial areas where challenges have already been recognised**. Therefore, if there is a lower take up of low carbon technologies and renewable energy resources than currently predicted more generally, this will not hinder this project's successful completion and learning will still be delivered.

The following criteria will be used to select appropriate trial areas:

1. High volume of Connection Requests from either embedded renewable generation, demand, or both;
2. Network topology and development;
3. Existing infrastructure, including Information/Communication Technology;
4. Capability to demonstrate the functions across distribution voltages;
5. Capability to demonstrate transmission/distribution interface

Further information on two potential trial areas is included in Appendix J.

Multiple applications in addition to the four use-cases outlined in this submission will be facilitated by INSPIRE. Business processes will be developed aligning with the SGAM[24] information layer. The SGAM model shows that the information layer directly interfaces to the function and business layers. In other words, INSPIRE has much wider applicability in addition to facilitating low carbon technology implementation, it will improve the intelligence available to improve the operation and planning of the electricity network. For example, INSPIRE will provide improved network visibility at distribution level allowing utilisation of network resources to be improved - especially important during times of network constraints.

Multiple applications of data analytics are also envisaged, supported by the INSPIRE architecture, that will improve asset management, network availability, quality of supply

[24] See Appendix D.5 for more information on SGAM

and customer service while reducing costs to customers. Typical examples of applications envisaged are detailed in Table 3-1.

6.6 The processes in place to identify circumstances where the most appropriate course of action will be to suspend the Project, pending permission from Ofgem that it can be halted

The INSPIRE project team will adopt the SP Energy Networks approach to risk mitigation. The project risk register, already been initiated and shown in Appendix F, will be regularly updated by the project team with stakeholder involvement. Following the completion of every work package stage, the associated work package tolerances in terms of budget, time and quality will be reviewed and risks will be assessed accordingly. The risk register will also be reviewed at monthly project meetings and quarterly Steering Committee meetings. If any risk is deemed of a serious nature, an Exception Report will be issued to the Steering Committee alongside possible mitigating actions by the Project Manager. The Steering Committee will collate this information and consult with the Project Delivery Team on the best course of action. If the severity of the risk poses a threat to the project's continuation then a Formal Report documenting why halting the project is most appropriate action will be issued to Ofgem, in accordance with Version 2.1 of the Electricity NIC Governance Document, 8.30 - 8.34. No action will be taken without the conclusion from this consultation with Ofgem.

Section 7: Regulatory issues

The scope of INSPIRE is concurrent with existing UK regulations.

7.1 Derogations

No derogations identified.

7.2 Licence Consents

No licence consents identified.

7.3 Licence Exemptions

No licence exemptions are required.

7.4 Changes to Regulatory Arrangements

No changes to regulatory arrangements are foreseen.

Section 8: Customer Impact

8.1 The Project

This project aims to provide a positive customer impact by improving DNO business processes through the use of a WISP to enhance network understanding, system operation and asset management therefore driving down costs passed on to customers.

Use-case 1 will demonstrate how better integration of smart solutions can result in increased utilisation of the existing system thus reducing generation constraints, avoiding costly reinforcement and providing quicker connection times to customers. Use-case 2 will facilitate DER services providing benefits to customers, for example, income to generation and demand customers providing this service and DNOs may provide services for which income would be socialised. INSPIRE will not negatively impact customers' security of supply or power quality; instead through the demonstration of use-case 3, this project seeks to predict and avoid faults thus improving the continuity of supply. Furthermore, use-case 4 will explore the concept that more accurate connection assessments will lead to cheaper and quicker connections for customers, ultimately resulting in increased revenue from their connection(s).

Importantly to customers, customer data will remain compliant with current IT security requirements and SP Energy Networks' data infrastructure to provide the necessary levels of confidentially. The risk of unauthorised data access via a cyber-attack will be mitigated by early engagement with SP Energy Networks IT security experts. INSPIRE will be designed to provide protection against any customer being affected by a cyber-attack.

8.2 Minimising Customer Impact

No detrimental customer impact has been identified.

8.3 Planned Interruptions

There will be no planned interruptions to customer supply.

8.4 Unplanned Interruptions

No unplanned interruptions are anticipated.

8.5 Engagement with Customers

As customer involvement is not anticipated, there will be no need for customer engagement.

8.6 Interaction with Customer's Premises

No customer premises will be used during this project.

8.7 Protection from Incentive Penalties

No protection from incentive penalties is required.

Section 9: Successful Delivery Reward Criteria (SDRCs)

Seven SMART[25] SDRCs in line with the outputs that will be expected to be delivered through the INSPIRE project have been identified. Sections 9.1 - 9.7 detail the delivery time of SDRCs and the link between SDRCs and work packages. All reports will be published in the public domain.

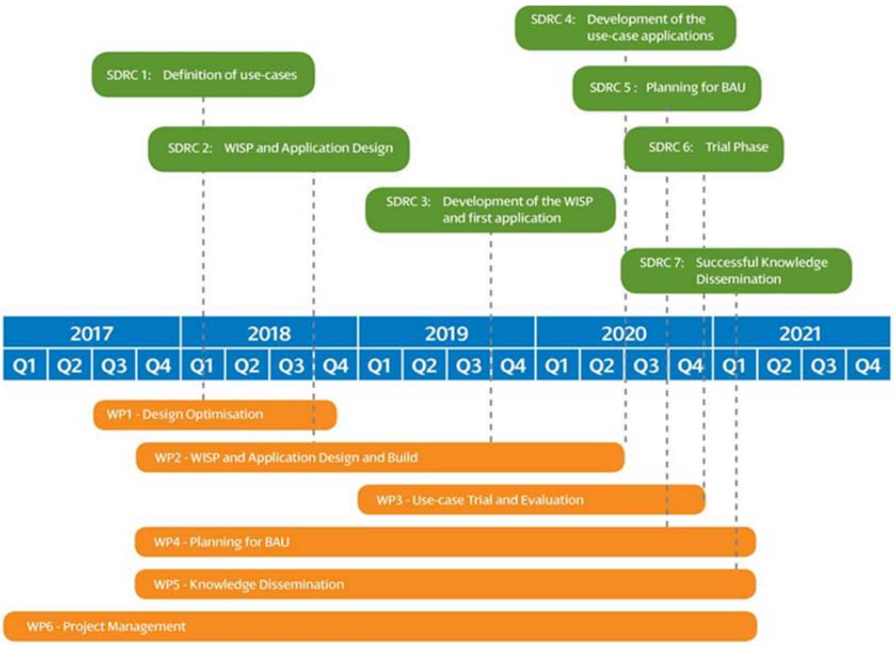

Figure 9-1: SDRC and Work Package Timeline

[25] SMART = Specific, Measurable, Achievable, Relevant and Time Bound

9.1 SDRC 1: Definition of INSPIRE demonstrator use-cases detailed business requirements

SDRC 1	*Definition of INSPIRE demonstrator use-cases detailed business requirements*	Due Date	February 2018
Criterion		**Evidence (WP1)**	
SPECIFIC Development of use-case definitions through the application of systems engineering methodologies and a workshop to ensure comprehensive capture of business and user requirements.		1. Use-case customer requirements focus workshop. 2. Business Requirements Specification report defining the use-cases.	
MEASURABLE A workshop process will be conducted to refine and conclude the use-case definitions. The output of this process will be presented in a report containing final use-case definitions.			
ACHIEVABLE The definition of the exemplar use-cases have been initiated as part of the full-submission process, meaning that there is a well-established starting point for building detail during project delivery. Systems engineering expertise and appropriate subject matter experts will be engaged to support application of the appropriate methodologies.			
RELEVANT This criterion corresponds to the definition of the four exemplar use-cases that will be used to explore the realisation of INSPIRE.			
TIME-BOUND Submitted February 2018			

9.2 SDRC 2: WISP and Application Design

SDRC 2	*WISP and Application Design*	Due Date	September 2018
Criterion		**Evidence (WP2)**	
SPECIFIC Design of WISP incorporating use-case applications.		1. Architecture and technical design report. 2. Report on results of initial high-level assessment of the quality of relevant data sources. 3. Application algorithms report describing how data will be used to fulfil business objectives as defined by the use-case.	
MEASURABLE The components required for implementing the WISP and the interfaces between these and existing SP Energy Networks systems will be defined. All of the critical datasets for the project use-cases will be identified along with the source systems, the details of how the data will be accessed will be established, and it will be confirmed that they fulfil the use-case requirements. An initial high-level assessment of data quality will be carried out.			
ACHIEVABLE Use-case definitions resulting from SDRC 1 will provide essential input to the design task. Suitable project partners have been selected based on not only their technical expertise in their field but also their previous involvement in innovation projects.			
RELEVANT This criterion corresponds to the preparation of the technical specification that is a vital step in the delivery of the INSPIRE method.			
TIME-BOUND Submitted July 2018			

9.3 SDRC 3: Development of the WISP and the first use-case application

SDRC 3	*Development of the WISP and the first use-case application*	**Due Date**	September 2019
Criterion		**Evidence (WP2)**	
SPECIFIC The WISP will be developed to a point where it can support the applications. The first use-case application will also be developed to the stage where it can be deployed for user acceptance testing of the WISP.		1. Satisfactory user acceptance test of the WISP implementation. 2. Satisfactory user acceptance test of the first application deployment.	
MEASURABLE The infrastructure, including hardware, software and communications links to support the WISP will be specified, procured and commissioned. Code to populate the WISP and data cleansing tasks will be developed. The first operational application will be developed and available to demonstrate the operation of the WISP through a satisfactory user acceptance test.			
ACHIEVABLE Completion of SDRC 1 and SDRC 2 provides the necessary information to support this criterion. Suitable project partners and use-cases will have been selected. The project plan will govern the timing of the infrastructure and application requirements and this will be adhered to by all parties.			
RELEVANT This criterion corresponds to the delivery of the WISP and its first application which are essential for beginning the operation of the INSPIRE trials.			
TIME-BOUND Submitted September 2019			

9.4 SDRC 4: Development of the use-case applications

SDRC 4	*Development of the use-case applications*	**Due Date**	June 2020
Criterion		**Evidence (WP2)**	
SPECIFIC Each of the applications for INSPIRE to meet its use-cases will be fully designed and developed. They will be configured as necessary to meet the use-case objectives and the requisite network equipment deployed. The whole implementation phase of INSPIRE will be assessed for efficacy, and for appropriate learning insights		1. Satisfactory user acceptance test of all of the application deployments. 2. Report on the lessons learnt from the implementation of the WISP and applications.	
MEASURABLE All operational applications will be available for user acceptance testing through the WISP. The report detailing what lessons and insights have been gained from the implementation of the WISP will also be available for dissemination.			
ACHIEVABLE Completion of SDRC 3 will provide the necessary base to support this criterion, with the WISP established, and the first use-case installed and in the testing phase. The framework for building and testing the remaining applications will be clear.			
RELEVANT This criterion corresponds to the delivery of the remaining applications which are essential for achieving the aims of the use-cases and proceeding into the trial analysis and evaluations.			
TIME-BOUND Submitted June 2020			

9.5 SDRC 5: Planning for BAU

SDRC 5	*Planning for BAU*	**Due Date**	September 2020
Criterion		**Evidence (WP4)**	
SPECIFIC Provide a plan showing the process necessary to transition the WISP into DNO business.		1. Internal workshop with BAU departments to seek inputs to the BAU plan. 2. Report on the Transition to BAU plan.	
MEASURABLE Produce a report documenting the plan for transition to BAU outlining recommendations for changes to systems, policies processes and support arrangements, and an updated Technical design. The transition plan and updated specifications will be presented at the appropriate approvals boards.			
ACHIEVABLE INSPIRE's design and implementation phases will be cognisant of integration with existing systems and transition to BAU, thus providing learning to inform WP6 and maintain the accuracy of the plan.			
RELEVANT This criterion corresponds to provision of information to allow DNOs to incorporate learning from INSPIRE into their business design.			
TIME-BOUND Submitted September 2020			

9.6 SDRC 6: Trial Phase

SDRC 6	*Trial Phase*	**Due Date**	November 2020
Criterion		**Evidence (WP1 & WP3)**	
SPECIFIC Trials of the INSPIRE applications will be undertaken to demonstrate their function and the operation of the WISP.		1. Trial methodology report describing how the trials will be conducted. 2. Four use-case trial reports.	
MEASURABLE Trial findings and results will be reported for each of the use-cases, incorporating learning relating to the WISP, data quality and data management.			
ACHIEVABLE SDRC 4 is considered achievable due to the completion of satisfactory user acceptance tests of SDRC 3.			
RELEVANT This criterion corresponds to the demonstration of INSPIRE and supported applications.			
TIME-BOUND Submitted November 2020			

9.7 SDRC 7: Successful Knowledge Dissemination

SDRC 7	*Successful Knowledge Capture and Dissemination*	**Due Date**	March 2021
Criterion		**Evidence (WP5 & WP6)**	
SPECIFIC Knowledge capture and dissemination amongst stakeholders including DNOs and industrial/academic communities.		1. Progress reports issued throughout the lifetime of the project in accordance with Ofgem's six monthly schedule. 2. Annual wider stakeholder dissemination events. 3. Annual innovation conference participation (2017-2020). Note: Project close-down report will follow within three months of the project end date.	
MEASURABLE Closedown report section will outline the learning reports, dissemination activities, workshops delivered and conferences presented.			
ACHIEVABLE SP Energy Networks has significant experience in delivering previous NIC/LCNF project of this size and have shown to be adept at capturing knowledge and feeding back learning to the industry. Dissemination deliverables will be produced throughout the project delivery. SP Energy Networks has an existing innovation section on their website available to host INSPIRE dissemination information.			
RELEVANT The project is of extensive interest to both industry and academic parties hence dissemination of project outcomes has strong support.			
TIME-BOUND Submitted March 2021			

Section 10: Appendices

Appendix	Title	Description
Appendix A	**Benefit Tables**	A brief summary of benefits analysis
Appendix B	**Business Case Supplement, Base Case Costs and Breakeven Analysis**	More detail on the cost benefit analysis
Appendix C	**INSPIRE Use-cases**	An extended discussion on the four use-cases proposed for INSPIRE
Appendix D	**Technical Description**	A more in-depth review of technical aspects associated with INSPIRE
Appendix E	**Project Work Packages**	An extended description of six WPs
Appendix F	**Risk Register**	INSPIRE's risk register
Appendix G	**Project Organogram**	Diagram showing the INSPIRE project team and the relationship between entities
Appendix H	**Project Programme**	A Gantt Chart detailing project milestones
Appendix I	**Project Partners**	Details regarding the INSPIRE's project partners
Appendix J	**Potential Trial Sites**	Information on the Four Crosses and Dumfries and Galloway networks
Appendix K	**Links to Other Innovation Projects**	Commentary about how INSPIRE will incorporate learning from various other projects
Appendix L	**INSPIRE and the Common Information Model**	Details on how INSPIRE will learn from previous CIM projects and expand upon this learning
Appendix M	**Stakeholder Engagement Event**	Description of stakeholder event held during the Full Submission preparation
Appendix N	**Letters of Support**	Summarising letters from 20 stakeholders who support the INSPIRE proposal
Appendix O	**Glossary of Terms**	List of acronyms

KEY

Method	Method name
Method 1	INSPIRE

Electricity NIC – financial benefits

	Cumulative net financial benefit (NPV terms; £m)									
Scale	**Method**	**Method Cost**	**Base Case Cost**	**Benefit**				**Notes**	**Cross-references**
				2020	**2030**	**2040**	**2050**		
Post-trial solution *(individual deployment)*	INSPIRE	[redacted]	[redacted]	£0.00	-£0.37	£0.32	£1.47	*Financial benefits presented are based upon analysis of the avoided DNO costs alone. Actual financial benefits are expected to be greater than the values presented as they include customer benefits expected to be delivered by the applications as discussed in Section 3.3. The financial benefits presented here have been evaluated using conservative approaches (detailed in Appendix B), in particular in regard of the DNO savings per INSPIRE application and the rate at which the WISP and additional applications are adopted.*	Appendix B
Licensee scale	INSPIRE	[redacted]	[redacted]	£0.00	£6.03	£31.74	£78.70	*1 WISP adopted up to 2050 with a conservative application deployment rate of 1 per year after 2021 (Total 30).*	
GB rollout scale	INSPIRE	[redacted]	[redacted]	£0.00	£1.75	£23.02	£92.54	*14 WISPs (i.e. one for each GB DNO licensee) installed at a cautious rate of one every 2 years supporting applications deployed at a conservative rate of 1 per year per WISP (Total 238 by 2050).*	

Electricity NIC – capacity released [if applicable]

	Cumulative capacity released (MVA)								
Scale	**Method**	**Method Cost**	**Base Case Cost**	**Benefit**				**Notes**	**Cross-references**
				2020	**2030**	**2040**	**2050**		
Post-trial solution *(individual deployment)*	INSPIRE			0	3.6	4.4	5.1	*Deployed applications are assumed to increase benefits from smart solutions and improve network planning accuracy leading to greater connection capacity.* *The actual capacity released could differ from the predicted values if the connection activity differs to the assumed NG FES Gone Green magnitude and profile.*	Appendix B
Licensee scale	INSPIRE			0	53	129	224	*Capacity is released through assumption of only 10% of the INSPIRE applications deployed up to 2050 at a rate of 1 per year after 2021 (Total 30).*	
GB rollout scale	INSPIRE			0	97	437	1088	*Capacity is released through 10% of the INSPIRE applications which are deployed up to 2050 at a rate of 1 per year per WISP (Total 238 by 2050).*	

	Cumulative carbon benefit (tCO2e)								
Scale	Method	Method Cost	Base Case Cost	Benefit				Notes	Cross-references
				2020	2030	2040	2050		
Post-trial solution *(individual deployment)*	INSPIRE			-	21,842	39,983	46,103	*Carbon benefits correlate with the proportion of deployed applications that increase low carbon DG and demand connection capacity, increase associated losses,avoid reinforcement and by balance of low carbon energy sources as per generation forecast in NG's FES[26]. Variances in actual capacity released are as per prior capacity released evaluation.*	Appendix B
Licensee scale	INSPIRE			-	204,768	595,764	813,335	*Carbon benefits are realised through 10% of the INSPIRE applications (that increase connection capacity) which are deployed up to 2050 at a rate of 1 per year after 2021 (Total 30 by 2050).*	
GB rollout scale	INSPIRE			-	305,728	1,343,949	2,230,988	*Carbon benefits are realised through 10% of the INSPIRE applications (that increase connection capacity) which are deployed up to 2050 at a rate of 1 per year per WISP (Total 238 by 2050).*	
If applicable, indicate any environmental benefits which cannot be expressed as tCO2e.	Carbon benefits are evaluated in terms of the additional generation that can be accommodated within the existing network based on an assumed percentage of applications creating capacity. In addition, the estimate assumes that capacity provided by INSPIRE allows LCTs to connect 6 months earlier than they otherwise would through conventional reinforcement, and also accounts for avoided 11kV circuit reinforcement.								

[26] http://fes.nationalgrid.com/fes-document

Appendix B Business Case Supplement, Base Case Costs and Breakeven Analysis

B.1 Benefits Table and Methodology

The benefits table is completed on a conservative basis with the benefits claimed for the INSPIRE Method being those derived from the business improvements enabled by applications supported by the WISP.

The financial savings have been taken to be the avoided DNO costs and estimated based upon the investment avoided by each use-case application – significant customer and wider stakeholder benefits are not included in this conservative approach (e.g. MW connected, MWh generated or traded, £ investment and revenue). **This is assumed to be the average of the (net) benefit values for the four exemplar use-cases** which is appropriate given the absence of knowledge or benefit parameters of additional specific use-cases enabled by the INSPIRE method in the future. Figure 10-1 shows the methodology for calculating INSPIRE savings, specifically how the average savings per application are multiplied by the number of applications for each year to 2050.

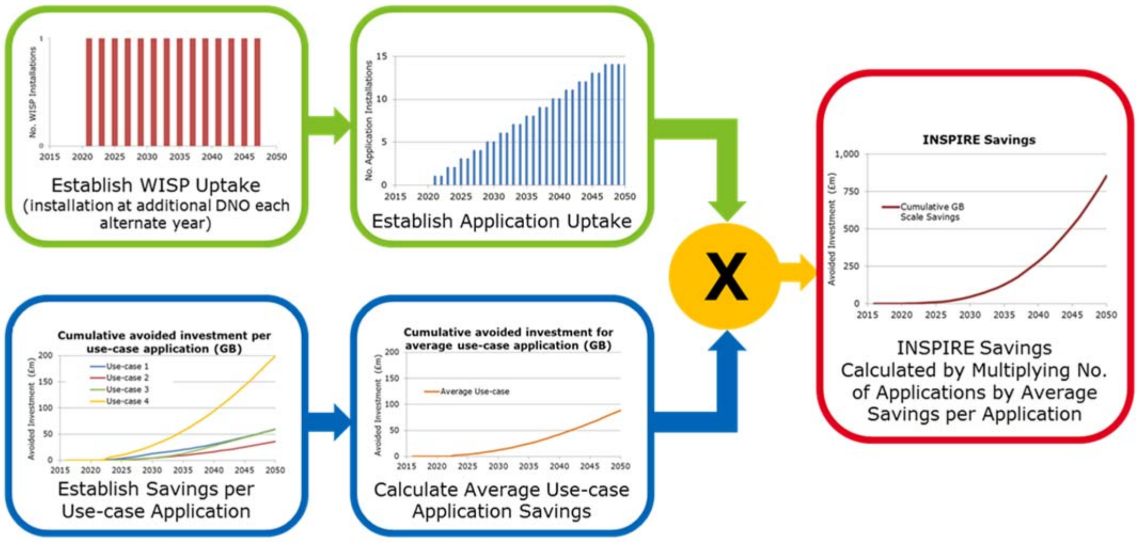

Figure 10-1: Methodology for Calculating INSPIRE Savings (repeated for Post-trial, Licence and GB scales)

It is considered that a new data integration and synthesis approach as demonstrated by INSPIRE is essential for the realisation of the benefits from efficient and effective use of data and its deployment in real, value-enhancing applications. Traditional point-to-point solutions are not considered suitable for the rapidly evolving electricity distribution industry's needs, as they will quickly become too complex and unmanageable as requirements evolve and further functionality is required. The banking sector has already reached this point where legacy IT systems are a constraint, finding that "layers and layers of IT have built up over the years, gradually hobbling banks' ability to innovate and respond to this new world."[27] Similar difficulties are being experienced in the telecoms industry which has reported that "Many projects failed to meet time, quality and budget targets due to unmanageable complexity"[28]. The WISP provides a credible and sustainable basis for enabling improvements to business processes and new functions, whilst the alternatives are not considered to be technically robust or sustainable for the long term.

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[27] Is old tech putting banks under threat of extinction?
[28] http://www.atkearney.co.uk/documents/10192/178350/it_in_the_telecom_industry.pdf/9c7abca8-1b22-4c7c-9450-73c9a01386c2

WSP|Parsons Brinkerhoff and SGS were commissioned to evaluate the benefits analysis for INSPIRE. Benefits are presented in NPV terms using a discount rate of 3.5% for the first 30 years and 3.0% thereafter and based on real time values for the presented 2016/17 prices.

B.1.1 Costs

The Base Case and Method Cost for this Project are contained in the benefits tables presented in Appendix A.

Base Case costs are those for the conventional approach that must be adopted in the absence of INSPIRE. The Base Case cost has been taken as the average of the avoided DNO conventional approach costs for the four exemplar use-case applications, i.e. they are the average amount that would need to be spent per application if INSPIRE was not available and a conventional approach had to be adopted. The methodologies for evaluating the avoided costs for each application are explained in subsequent subsections in this appendix.

Method costs are those for INSPIRE and specifically the development of a WISP and the applications it supports, also including infrastructure expenses. The 2016/2017 WISP and application costs used in the benefits analysis are presented in Table 10-1. It should be noted that the cost estimation reflects the belief that development costs will become cheaper when the approach is proven successful and learning can be reused in multiple further deployments of the WISP and developments of new applications enabled by the WISP. Costs also reflect that it is likely that a WISP will support more than one licence area since the 14 GB licenced DNOs are owned by six company groups; it is conservatively estimated that on average one WISP is required per two licence areas.

Table 10-1: Method Costs

	SPEN Licence Area	GB Roll Out
WISP	[redacted]	[redacted]
Each application	[redacted]	[redacted]

A bottom up approach has been adopted for building the cost model and top down reviews have been undertaken to ensure sensible cost allocations. During the submission development phases, we have spent time with our primary technical ICT partner, CGI, agreeing scope. Hardware and software costs have been included and have been derived by engaging our primary ICT partner to deliver a list of the likely requirements and costing these requirements through the SP Energy Networks Systems IT team, using existing purchasing agreements.

B.1.2 Losses

Applications supported by the WISP are expected to provide a wide range of functionality and some will affect network utilisation and losses, whilst many will not.

For example the use-case 1 application combining smart solutions will increase the capability to accommodate distributed generation connection in particular. Such connections will increase network utilisation by the increment provided by the application and losses could change depending upon the network conditions including generation and demand profiles; losses may increase incrementally if there is a more frequent net export, but equally could decrease as demand is supplied more locally. The use-case 2 application will only affect the temporary operation of DER to provide system services and therefore the overall impact on losses will be negligible (with reduction possible as system services could be viewed as more likely at peak demand periods). Similarly, prediction of faults through use-case 3 will not permanently affect network power flows and not significantly affect annual losses. Use-case 4 is expected to increase network utilisation by the increase in investment planning accuracy provided by an improved system model and, therefore, is likely to affect losses. Again losses increase or decrease depending upon the network conditions.

Within the INSPIRE benefits analysis for roll out to the Licensee area and GB scale, it is assumed that 10% of WISP enabled applications increase losses, on the basis that many applications will have no or insignificant effect on network utilisation and losses, whilst other applications will have an overall neutral effect on losses and some will reduce system losses. Future losses are anticipated to follow a U-shaped losses curve where greater distributed generation penetration and the application of smart solutions affect network utilisation. INSPIRE applications which are expected to provide incremental capacity increases will affect parts of the network where smart solutions have already increased network utilisation, therefore losses relating to INSPIRE are assumed to correspond to the latter half of the U-shaped curve (thus reflect increased losses).

Consistent with projected increases in distributed generation connections, an 8.5% increase in 33kV and 11kV network losses without INSPIRE has been estimated based upon it providing an incremental increase in network utilisation of 2% for system intact (corresponding to a 4% increase in power flows during single circuit outage conditions which are normally planned for). Smart solutions have been assumed to increase network losses by 0.6% of the energy supplied over 10 years and 8.5% of this increase is attributed to INSPIRE, corresponding to 0.05% of energy supplied. The energy supplied each year has been assumed to follow National Grid's Gone Green Future Energy Scenarios.

B.1.3 Licensee Scale

When considering the roll out to the SP Distribution licence area, it is assumed that the WISP is adopted as BAU for the whole network at the end of the INSPIRE project in keeping with the enterprise-wide nature of a WISP.

Business improvements beyond the four exemplar use-cases addressed in the INSPIRE trial will be gained as more applications are supported. The number of applications has been assumed to increase by one each year. In practice we consider that the open nature of the WISP will encourage more than one new application per year, making their cost more competitive, so this assumption of projected benefits is viewed as conservative. However, some applications may be decommissioned as their function is superseded. Possible future use-cases are presented in Section 3.1.

B.1.4 GB Scale

It is assumed that all GB DNO licence areas will adopt the INSPIRE approach and each will establish an enterprise/licence-wide WISP between 2022 and 2050, which corresponds to an uptake rate of approximately one every two years based on 14 licence areas. In the case of INSPIRE, adoption depends upon individual DNO business requirements and systems investment cycle. This adoption rate is considered to be more realistic than an immediate uptake by all DNOs and leads to the resulting benefits claimed being more conservative than if a quicker uptake were assumed.

The uptake of applications in each licence area is again assumed to be one per year subsequent to the establishment of the WISP.

B.1.5 Use-case 1 Benefits

The WISP application for use-case 1 will allow the co-ordination of smart grid techniques by optimising the set points of interrelated systems to enable the connection of more generation with fewer constraints. The application will create incremental benefit by the whole (i.e. multiple smart solutions) being greater than the sum of its parts (i.e. the value of individual smart grid techniques deployed as stand-alone). The application enables the benefits delivered by individual smart solutions to be cumulative as they can be used concurrently in the same network, rather than additive when overlap of smart grid techniques is not feasible. The overall methodology for calculating the savings arising from the use-case 1 application is shown in Figure 10-2.

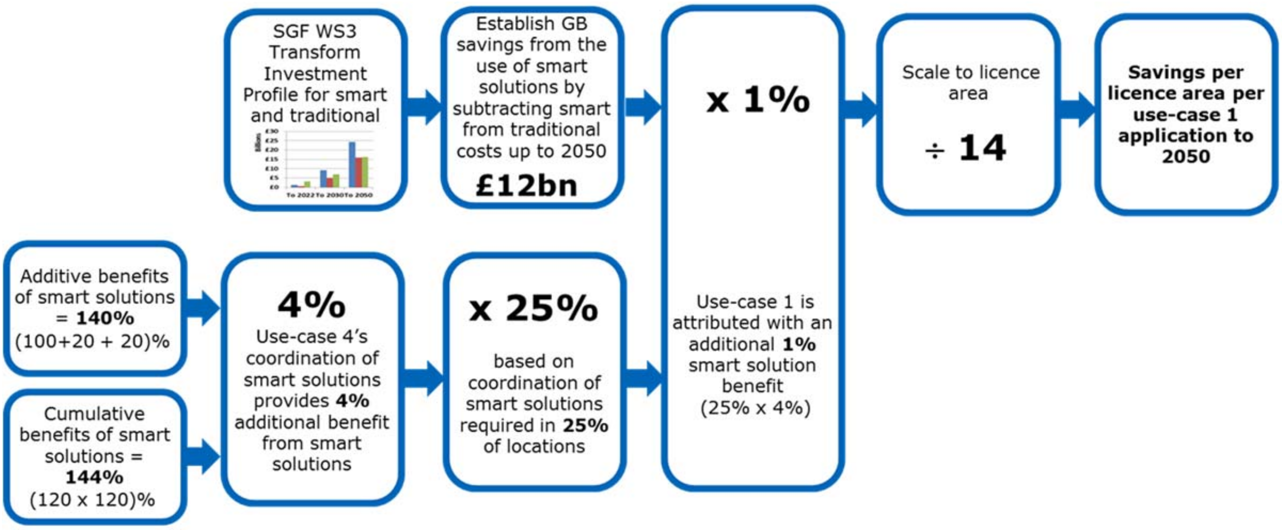


Figure 10-2: Methodology for the calculation of savings provided by use-case 1

The INSPIRE use-case 1 application is estimated to increase smart solution benefits by 1%. This is based on coordinating smart grid techniques creating 4% additional generation hosting capacity with coordination only being required in 25% of the smart solution locations. 4% additional capacity is the difference between the additive benefit from two solutions (not coordinated) each providing 20% increase in capacity (40%) whilst cumulative benefits are 44%. 20% additional hosting capacity is also a conservative estimate of average smart grid technique benefit with significantly higher benefit on the record for trial and early roll-out programmes for some smart grid techniques.

With coordination only being required in 25% of the locations where smart solutions are deployed. The overall increase in smart solution benefits is therefore: 25% x 4% = 1%.

The total avoided investment to 2050 delivered through the use of smart solutions across GB was taken to be £12bn according to the difference between conventional reinforcement and the cheapest smart solution (Selective Top Down) as identified by the Smart Grid Forum Work Stream 3 Transform project[29] as shown in Figure 10-3. This total benefit has been profiled over the years to 2050 also in accordance with information from the same report as shown in Figure 10-4. Finally, the GB benefits are scaled down to the licence area and trial area based upon the ratio of energy supplied to those areas compared to whole of GB. For example, in the SPD licence area, the energy supplied equates to 34,000 GWh compared to 290,000 GWh at GB level.

With the total percentage of use-case 1 application enabled smart solution benefits (1%), the total smart grid technique savings from Transform (£12bn) and the profile of benefits to 2050, an estimate of benefits for each year to 2050 has been calculated and presented in the tables in Appendix A.

[29] https://www.ofgem.gov.uk/sites/default/files/docs/2013/06/ws3-phase-3---84170-complete---issue-1.1_0.pdf (graph in the executive summary and section 3 Figure 2 for investment profile Scenario 3 high electrification of heat and transport)

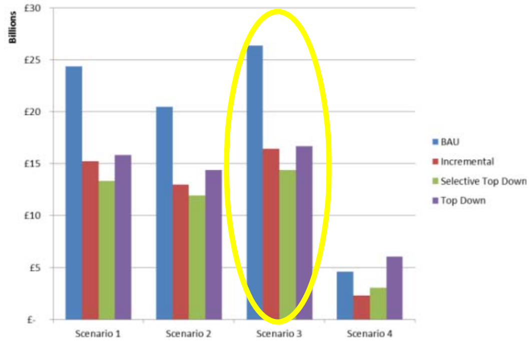


Figure 10-3: SGF WS3 Present value of total expenditure to 2050 [29]

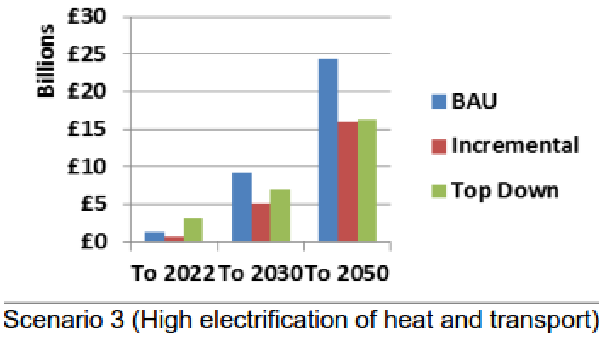


Figure 10-4: SGF WS3 predicted investment for GB model to 2050[29]

B.1.6 Use-case 2 Benefits

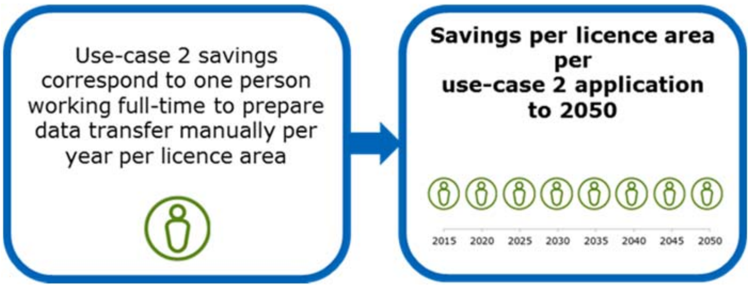


Figure 10-5: Methodology for the calculation of savings provided by use-case 2

The use-case 2 application will automatically give the SO greater knowledge and visibility of the capability of the network below GSP level so that distributed energy resources can provide coordinated SO-DNO services. The methodology for calculating the savings coming from the use-case 2 application, shown in Figure 10-5, is based on the traditional alternative to automatic data preparation and sharing being manual collation of DNO-SO information. It is assumed that each licence area will require one person working fulltime at a rate of [redacted] per day to complete this task. Man-hour costs are assumed to be constant due to uncertainty over the period to 2050. Whilst enhanced INSPIRE derived SO-DNO data exchanges are anticipated to help form early DSO functionality, no INSPIRE specific DSO benefits are included in the cost benefit analysis due to the early stage of DSO business model development.

B.1.7 Use-case 3 Benefits

Faults will be predicted and avoided through the analysis of Pole Mounted Auto Recloser analogue data facilitated by the INSPIRE use-case 3 application. The methodology for calculating the savings coming from the use-case 3 application is shown in Figure 10-6. Normally when a fault occurs, fault repair teams respond to emergency call outs at an assumed cost of approximately [redacted] per fault (this is also the target SP Energy Networks aims for). By predicting the faults before they occur, a less expensive routine visit can be made to explore the potential fault at a cost assumed to be half that of the emergency visit.

The expected number of faults each year has been calculated based on the length of 11kV overhead line being analysed by the application, along with the fault rates and an assumption that 45% of faults are predictable (estimated by looking at the common causes of faults and identifying which can be predicted by the proposed data analytics method). It has been assumed that an additional 1000km of overhead line, corresponding to approximately 50 circuits, is covered by the application each year until 50% of the licence or GB population of 11kV overhead lines is reached.

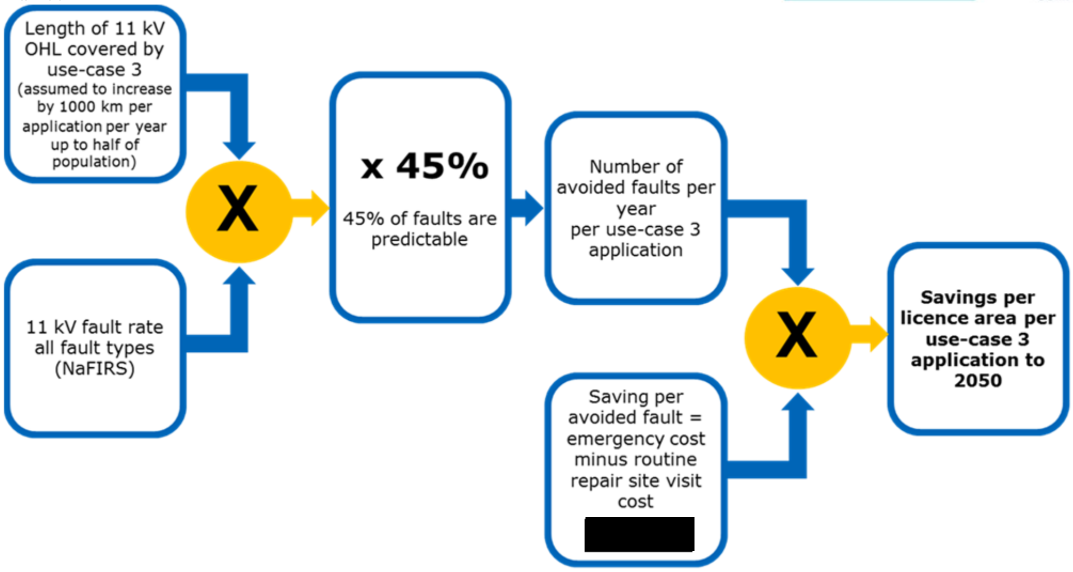


Figure 10-6: Methodology for the calculation of savings provided by use-case 3

The fault rate for the post-trial solution of 0.338 faults per km per year used in the calculation is the average fault rate for the SPD top 200 worst performing circuits on the basis that a proportion of these would be included in the trial where feasible. For the licence area the fault rate was taken to be 0.147 faults per year per km of 11 kV overhead line and the corresponding value for GB of 0.092 was taken, both rates as given in the 2014/2015 NaFIRs report.

B.1.8 Use-case 4 Benefits

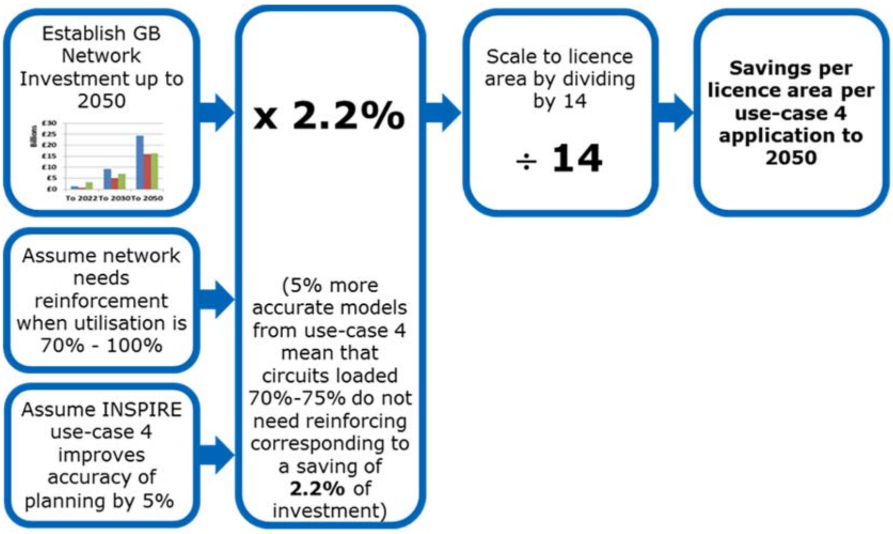


Figure 10-7: Methodology for the calculation of savings provided by use-case 4

The use-case 4 application will deliver improved network models to provide greater accuracy in planning and reduce network investment through increased utilisation of existing assets. The associated savings have been calculated using the methodology shown in Figure 10-7.

Existing planning practices include cautious assumptions when precise information is not available. It is considered that today's typical 5% network capacity planning margin will not be necessary when planning investment for connections or reinforcement with the improved information delivered by the use-case 4 application.

By considering typical connection capacities and circuit ratings, we estimate that circuits typically need reinforcing when their present loading lies in the range 70% to 100% for single circuit outage conditions. By removing the 5% margin, INSPIRE's improved model means that the investment associated with the cases corresponding to existing loadings between 70% and 75% will be avoided. Assuming that the investment value follows a normal distribution between 70% and 100% loading, then the avoided investment is 2.2% of the total investment.

The magnitude and profile of the future network investment has been assumed to follow the Transform model Work Stream 3 results for Scenario 3 Incremental approach[30] as this corresponds to a lower level of investment (£16bn by 2050). Again, GB benefits have been scaled to the licence area and trial area based upon the ratio of energy supplied to these areas compared with the GB total.

B.2 Capacity Released

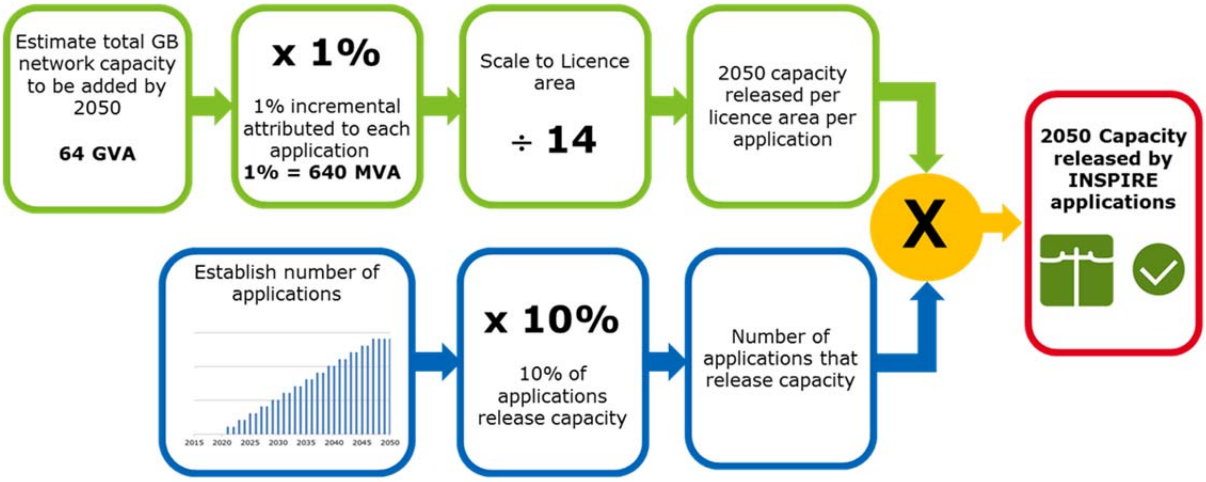


Figure 10-8: Capacity Release Methodology

Capacity will be released by some of the INSPIRE applications as they will affect how connections are accommodated on the network, for example, use-cases 1 and 4. Both of these use-cases enable incremental capacity hosting benefit over existing practices (including single smart grid technique deployment which is assumed BAU for this benefits assessment). Use-case 1 increases the capacity released by smart solutions and the more accurate planning models created for use-case 4 will permit greater capacity to connect. Based on these incremental benefits, it is assumed that the capacity released by INSPIRE applications is related to the additional future network capacity that must be provided by either smart solutions or conventional reinforcement.

INSPIRE applications will facilitate smart grid techniques to enable future network capacity to shift away from traditional reinforcement solutions to a market defined dynamic network capacity that depends on utility and customer economics that vary with time, location, feeder characteristics, and cost effective utility and DER smart grid technologies. Figure 10-8 illustrates the methodology used for calculating capacity released. We have estimated that network investments must deliver approximately 64GVA of additional capacity across GB by 2050 and that INSPIRE is able to be credited with 1% (640MVA) of this capacity as explained for use-case 1. This capacity is scaled to the licence and trial area according to the ratio of energy supplied.

[30]https://www.ofgem.gov.uk/sites/default/files/docs/2013/06/ws3-phase-3---84170-complete---issue-1.1_0.pdf (Section 3 Figure 2)

Additional capacity is assumed to be driven by generation connections with 79GVA of distributed generation to be connected by 2050 based on National Grid's FES[31] Gone Green Scenario and a simple growth between 2040 and 2050. A network utilisation factor of 85% is assumed meaning that the 79GVA of generation corresponds to a need for 93GVA of network capacity. The existing network is assumed to be capable of only accommodating 29GVA without intervention based on the network presently accommodating today's 64GVA of demand at an average utilisation of 75% during single outage conditions and generation only being attracted to 20% of the overall network. On the basis that the average utilisation of generation is 85%, then an additional 64GVA of network capacity is required (93-29GVA) by 2050. The capacity released is assumed to follow the generation uptake profile as generation is unlikely to fill up available network capacity from the start, but it will rather be used up over the years.

When assessing the Post-trial scale application of INSPIRE it is assumed that 2 applications (use-cases 1 and 4) release capacity. For the roll out of INSPIRE to the licence area and GB it is assumed that 10% of applications release capacity, on the basis that many applications will have no or insignificant effect on network utilisation. The capacity released is calculated by multiplying the number of applications effective in each year by the capacity released per licence area.

B.3 Carbon Benefits

INSPIRE will deliver carbon benefits as its applications enable more generation and LCTs to be accommodated while reinforcement is avoided. In our primary analysis carbon benefits have been evaluated, as shown in Figure 10-9, on the basis of the additional generation capacity released alone for reasons of simplicity and because this can be estimated with more certainty. The estimated capacity released, expressed as a ratio of overall capacity was used to scale the total generation export (MWh) forecast in National Grid's FES[31] to establish the generation export attributed to the capacity released by INSPIRE. This additional generation export has been converted to carbon benefits by multiplying by the Electricity GHG conversion factor (tonnes per MWh) applicable each year. The conversion factors are based on the assumption that the emissions level falls from the 2016 value of 412tCO2e/kWh[32] to 10tCO2 equivalent/kWh by 2050. Hence the carbon savings profile is falling year on year.

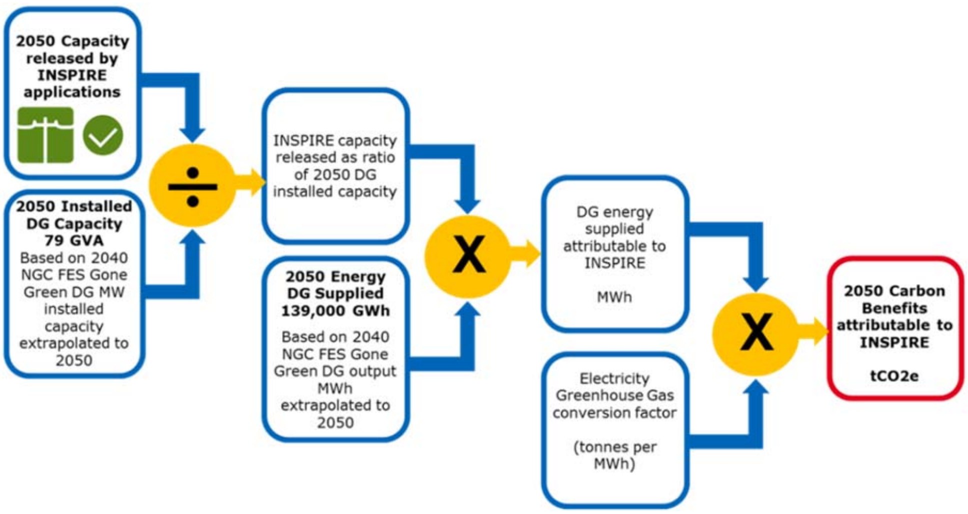


Figure 10-9: Carbon Benefits Methodology

[31] http://fes.nationalgrid.com/fes-document/
[32]https://www.gov.uk/government/collections/government-conversion-factors-for-company-reporting#conversion-factors-2016

In addition we have also estimated the wider carbon benefits of the solution from connection of LCTs and avoided reinforcement.

The estimate assumes that capacity provided by INSPIRE allows LCTs to connect 6 months earlier than they otherwise would through conventional reinforcement, and also accounts for avoided 11kV circuit reinforcement.

B.4 Breakeven Analysis

The breakeven point has been calculated for two rollout scenarios which are both considered to be conservative.

1. **SPEN only rollout –** Implementation for SPD and SPM in 2021 comprising a WISP and the four initial applications developed under the preceding NIC project. One additional application being developed in each subsequent year. Payback of the NIC project funding is achieved by 2028, after 7 years of rollout.
2. **Limited DNO rollout –** After the first DNO rollout in 2021, a second DNO adopts the solution in 2022 and a third DNO in 2023. Payback of the NIC project funding is achieved by 2026, after 5 years of rollout.

Table 10—2: Breakeven Analysis

	Cumulative Discounted Net Benefit (£m)									
	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
SPEN only (SPD and SPM)										
4 initial apps +1 app per year	(0.14)	(0.06)	0.82	1.60	2.59	3.82	5.32	**7.09**	9.22	11.75
Limited DNO rollout - 3 DNO Companies (6 Licence areas)										
4 initial apps +1 app per year	(0.29)	(0.62)	1.19	2.71	4.69	**7.16**	10.13	13.57	17.74	22.64

The breakeven analysis shows that INSPIRE's net benefit is expected to recover the project funding well within the RIIO-**ED2** price control **period** even when considering conservative uptake rates.

Appendix C INSPIRE Use-Cases

<table>
<tr><th colspan="2">Use-case 1 Co-ordination of Smart Grid Techniques</th></tr>
<tr><td>Lead: Smarter Grid Solutions / SPEN</td><td>Support: Use-case 1 Application Contractor / CGI / University of Strathclyde</td></tr>
<tr><td>Area: ANM/smart inventions – operational interactions</td><td>FPSA Timeframe: Operational Planning, Real-Time Control</td></tr>
<tr><td colspan="2">Business Issue:
Increasing numbers of Smart Grid techniques are currently being deployed on the distribution network including Active Network Management (ANM), Real Time Thermal Rating (RTTR), flexible network control, voltage control and storage. These more mature smart grid techniques are emerging from innovation trials and are in the process of being adopted by DNOs as BAU solutions in readiness for wider deployment.
As a result of the increasing number of suppliers in the marketplace, technology costs are reducing and schemes are being deployed for smaller load and generation connections. As the number of schemes increases on the network we believe the issues to be addressed include:
Providing visibility of the effect of these schemes on network performance, to verify that they are delivering what was intended and that their impact on the network is monitored.
Interfacing to multiple manufacturers products to create interoperable and interchangeable solutions.
Optimising the set points of interrelated systems to release headroom capacity for DER connections.
Achieving the above in a cost effective manner for immediate application to BAU.
The current approach to implementation of smart grid techniques is to apply a single smart grid technique in any single circuit or substation as the control interactions are not well understood or fully engineered.
This approach limits the deployability of smart grid techniques with the result that the additional value from multiple deployments in the same network area is missed. With the on-going and forecast growth in Distributed Energy Resources (DER) the current approach will be more limiting with greater missed value resulting over time.</td></tr>
<tr><td colspan="2">Objectives and Deliverables:
The objective is to enable coordinated implementation and operation of multiple smart grid techniques for enhanced performance. The Use-case 1 Smart Co-ordination Application will facilitate engineering configuration of multiple smart grid techniques based on static configuration data and in-flight operational data.
The Smart Configuration Application requires the single data model and information set from the WISP, bringing together: static data from select, mature smart grid solutions; network models; captured load and generation time-series data including demand and DER historic performance data; and smart grid technique parameters. The application will access live system operational data to identify in-flight enhancements to the configuration of smart grid techniques.
The fully delivered Use-case 1 solution will implement:
Interoperability of smart grid techniques through common interfaces to the WISP;
Smart grid technique coordinated control methodology and configuration settings (for autonomous implementation by each smart grid technique) with real time access to WISP data sources to optimise their own on-board operation; and
Smart grid techniques database as foundation for engineering management application, smart grid techniques simulator, optimisation of control parameters and operating performance appraisal for smart grid techniques.
This will be undertaken for existing Distribution Management Systems, automation</td></tr>
</table>

schemes and autonomous ANM scheme solutions on a test bed and in the trial networks.

Figure 10-10: Use-case 1 block diagram

Deliverables include:

- Approved design and fully tested (factory and site) build of the Smart Co-ordination Application to in-project agreed requirements and functional specification including:
    - Smart grid technique configuration settings database (the data sets will cover all relevant DER types in the trial area including different types of DG, DSR and Storage if this is developed in the trial area by third parties);
    - A common control supervision and engineering interface for the selected trial smart grid techniques;
    - Smart grid technique implementation guidelines;
    - Visualisation and analysis of smart grid technique operating data; and
    - Smart grid technique configuration management.
- Implemented WISP interfaces to GE PowerON DMS, SGS ANM system, NorTech ANM system, PowerFactory power system planning model;
- Field implementation in Dumfries & Galloway trial area interfacing to the multiple smart grid techniques implemented in the trial area;
- Implementation of simulated smart grid techniques coordination for trial area; and
- Evaluation of Smart Configuration Application with recommendations for solution maturing with required user documentation for BAU use.

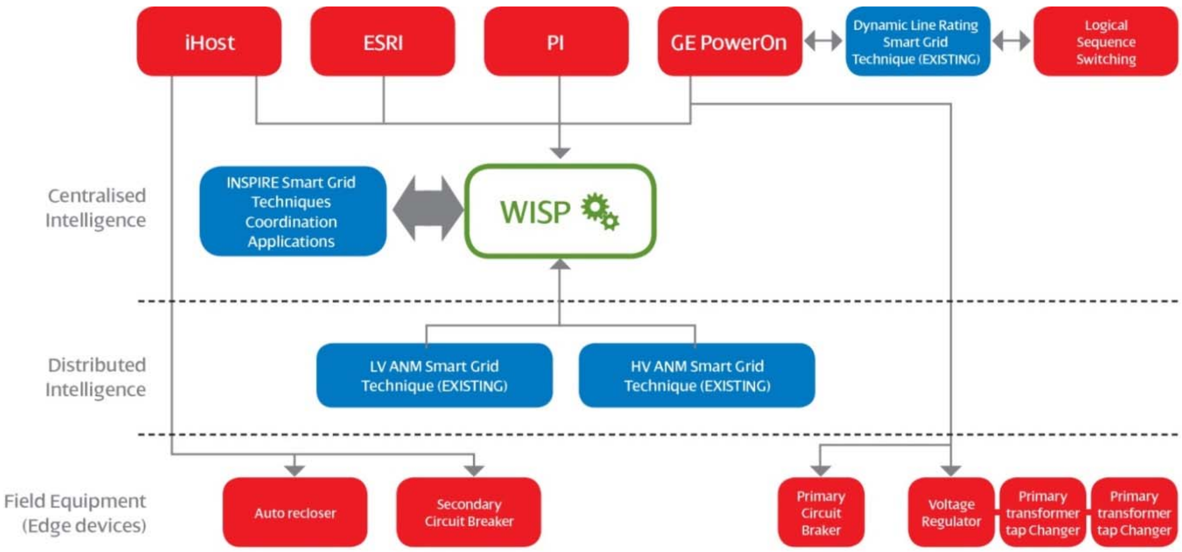


Figure 10-11: Use-case 1 Solution Overview

Key Learning:

The anticipated key learning from Use-case 1 includes how to:

- Facilitate the growing implementation of DG, distributed storage, energy efficiency, and customer equipment that can respond to demand response signals to turn on and off (all controllable DER) with benefits for the DER developer/owner and the DNO/customer.
- Connect and operate enhanced DG capacity.
- Enable distribution infrastructure to run closer to its capacity margin through the implementation of multiple smart grid techniques, deferring investment in network reinforcement with benefits to the DNO and connecting/bill-paying customer.
- Provide operators with transmission-like contingency options that reduce the impacts to customers due to shifting network conditions through the robust configuration of smart grid techniques with fail-safes.
- Build a platform for future multi-objective optimisation capability to address customer value, network capacity, economics, equipment life cycle, reliability, and impact to the environment.

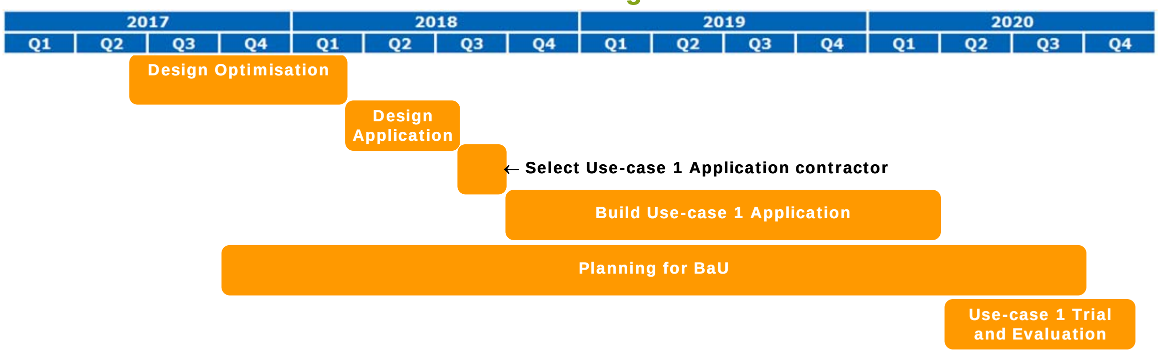
Trial:

Area: Dumfries and Galloway network within the SPD licence area.

The trial will;

1. Demonstrate the accurate provision of correlated smart solution and network data to the application, validated through sample checks.
2. Demonstrate the operation of the application to evaluate configuration parameters for the operation of multiple smart solutions.
3. Evaluate the effectiveness of the configuration parameters from the application by making comparisons with settings arising from a manual process.
4. Evaluate the benefit of the settings through studies of curtailment versus available capacity.

Use-case 1 Programme:



Use-case 2 Improved Network Visibility for 3rd Parties

Lead: SPEN/GBSO	**Support:** Use-case 2 Application Contractor / CGI /University of Strathclyde
Area: SO interaction	**FPSA Timeframe:** Investment Planning, Operational Planning

Business Issue:

DNOs and National Grid have a long track record of successful interaction in operational planning and investment planning co-ordination. However, the expected uptake of low carbon technologies and the advent of the Smart Grid will impact on the required level of interaction between the DNO and the SO in the future.

Greater interaction will be necessary as distributed energy resources (DER) become increasingly required to provide not just energy but whole-system services as well. For example, embedded generation, demand response and energy storage, along with distribution system services can contribute to system balancing. To achieve this, "full coordination across the SO/DSO boundary" will be required, as noted by the IET[33].

Presently, operational and planning information is transferred between the DNOs and SO in accordance with Grid Code requirements. For example, DNOs provide "Week 24" network planning data to National Grid annually and in return, National Grid supplies "Week 42" data, which is a network-equivalent data model for fault level assessments.

The "Week 24 Authorised Network Model" is an official snapshot in time of the distribution network and sets the baseline for all subsequent data exchange. This model includes all the detailed network data, including topology, connectivity, electrical parameters, and all embedded generation up to 1MW. It also contains the long-term (i.e. >12 months) demand and generation forecasts. Network changes (such as planned reinforcements and planned outages) are then represented relative to this baseline. These changes are date stamped and this information is updated and sent to the SO regularly. Short-term demand and generation forecasts make use of information and estimates associated with <1MW generation as well as weather forecast information and any active network constraints, such as unplanned outages and active ANM schemes.

The "Week 24 Authorised Network Model" is updated annually, having been checked against data held in the main data repositories (i.e. Power-On, GIS, SAP) for changed connectivity and new electrical parameters).

It is recognised[1] that future distribution system planning will require more extensive studies and forecasting to assess the performance of systems with increased levels of generation and to realise the potential whole-system benefits from distributed energy resources. The suggested requirement for more detailed models spanning transmission and distribution systems[34] is likely to necessitate the transfer of more information more frequently between the SO and DNO.

The existing method of information collection and submission between the DNO and SO is highly dependent on key personnel extracting data from a number of different systems manually. Furthermore, the analysis of the data is undertaken in uniform manner without taking into account the characteristics of the DNO region. This process is not sustainable when the requirement for more frequent transfers of a richer set of information outlined above is taken into consideration.

Objectives and Deliverables:

The objective is to provide the SO with greater visibility of what is happening on distribution networks in operational planning and design planning timescales. This will enable more frequent data exchanges, increasing from the current situation of annual data exchanges to (up to) daily exchange of data. This will in turn enable further integration of the DNO-SO data exchange processes. This will require DNOs to enhance their forecasting capabilities. For example, in the past, DNOs forecasted load growth by extrapolation based on historical load trends. With the shift to low carbon technologies, these forecasts will need to account more explicitly for the forecasted uptake of low carbon technologies, such as wind, PV, storage, electric heating and electric transport, taking into account future energy scenarios, such as those produced by DECC and National Grid in the longer term as well as shorter term influences such as the effect of weather.

[33] http://www.theiet.org/sectors/energy/documents/modelling-6.cfm?type=pdf
[34] http://www.theiet.org/sectors/energy/documents/cst-part1-main.cfm?type=pdf

Figure 10-12: Use-case 2 Solution Overview

The fully delivered Use-case 2 solution will:

- Automate the creation of the annual "Week 24" DNO-SO data exchange using the WISP, including the bi-lateral QA checks with National Grid, for the whole of SPENs distribution network (i.e. both SPD and SPM distribution license areas), including periodic updates on network changes (i.e. planned reinforcements and planned outages).
- Trial the transfer of additional information arising from Use-case 1 including the expected state of active network management schemes. This aspect of the trial will cover the Dumfries & Galloway region of the SPD licence area.

Better co-ordination will result in better utilisation of the performance capabilities of all parties connected to the electricity distribution network - i.e. active customers, generators, and storage. For example, embedded generators may be able to add more value to the system than just power, reducing whole system costs and enhancing the embedded generation's value. This can lead to a more efficient network, resulting in lower costs for customers.

Use-case 2 can ultimately give the SO greater knowledge and visibility of the connected network below GSP level, including:

- Quantity, capacity and type of DG connected:
- DNO Network Configuration (e.g. connectivity model, including temporary reconfigurations such as planned and unplanned outages.);
- Configuration of Active Network Management Schemes;
- DSR/DG Contracts by the DNO; and
- Other DNO techniques that may affect load profile (e.g. energy storage, voltage control schemes).

Increased visibility of the Distribution Network by the SO will enable DNOs to increase their capabilities, for example, they may require:

- Local demand forecast capability;
- Local DG forecasting capability;
- Novel network management techniques;
- Improved information on fault levels; and
- Knowledge of the effect of SO actions on DNO Customers.

Key Learning:

Key learning from delivery of Use-case 2 solution includes:

- Software Interface List, and Communication Specifications;
- How to implement an Electronic Data Exchange (EDE) system between DNOs and GBSO;
- How to apply CIM standards to achieve a consistent data modelling specification across GBSO and DNOs (Applying CIM at DNO end and transferring compliant

model to the GBSO);
- Integration of Use-case 2 application and WISP to meet multi-party requirements.

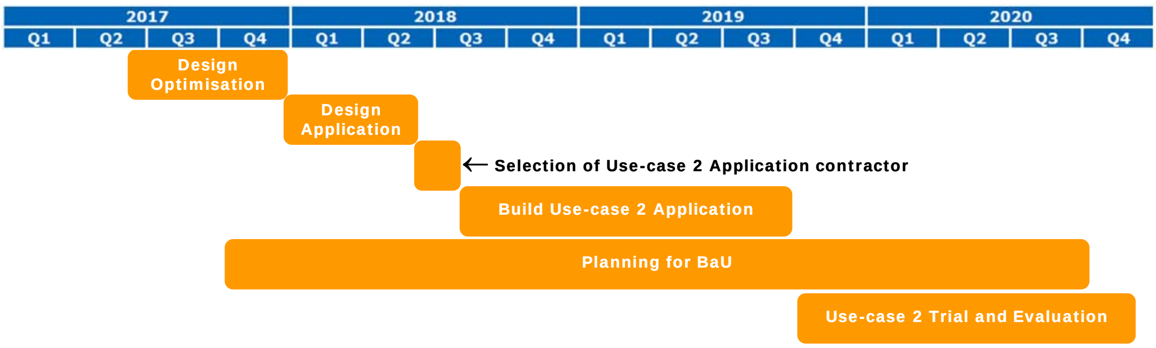
Trial:

Area: SPD and SPM distribution networks, with extended functionality for the Dumfries and Galloway region of the SPD licence area

The trial will;

1. Demonstrate the consistent accurate collection of data from a range of sources into a consolidated CIM compliant summary, to be checked by separate validation of a suitable number of samples.
2. Demonstrate accurate EDE, in particular accurate transfer of the data summary to GBSO to be checked for consistency with the source data.
3. Show that the process is repeatable on at least a daily basis.

Use-case 2 Programme:



Use-case 3 Improved Network Performance via Data Analytics

Lead: University of Strathclyde / SPEN	**Support:** Use-case 3 Application Contractor /Nortech /CGI /University of Strathclyde
Area: Predicted Fault Analysis	**FPSA Timeframe:** Investment Planning

Business Issue:

In order to effectively manage distribution networks and maintain customer satisfaction, major investments and developments have been undertaken in the area of Distribution Automation (DA). This is being applied for the purpose of automatic and fast response to power system outages and faults improving on traditional manual analysis and operation. The business value and customer value is delivered through reductions in Customer Minutes Lost (CML) and Customer Interruptions (CI), and general improvement of customer service.

Pole Mounted Auto Reclosers (PMARs) are protection/switching devices installed on 11kV overhead lines to clear transient faults and to sectionalise a line in the event of a permanent fault, minimising numbers of customers affected by the outage.

Modern DA devices and systems such as PMARs have inbuilt data recording capabilities which retain a number of analogue and digital data points related to the triggering and operation of the devices. Presently, this data is not routinely exploited by DNOs who can, as a result, be relatively uninformed about the network state because they do not have a good understanding of what information can be interpreted from the data. If automatically and remotely accessed on-line, this data has the potential to provide engineers with an indication of how circuits operate and degrade in real time providing intelligence to improve network performance.

In addition, if suitable data analysis and knowledge capture techniques were to be applied, the available data could be analysed for statistical trends to serve as the basis for fault classification models to diagnose root causes and predict the rate, severity and type of faults evolving on a circuit. Providing this on-line capability for enhanced diagnostics and to predict and classify future fault activity can result in the avoidance of permanent faults, or allow maintenance staff to take appropriate preventative action to improve network reliability, protect expensive plant, improve customer service and avoid regulatory penalties arising from unplanned network interruptions. Therefore, by harnessing DA data through enhanced situational awareness and data analytics further improvements in CML and CI from their current levels are possible.

Objectives and Deliverables:

The overall objective is to provide improved network performance through the use of the dynamic capabilities of the WISP to underpin the analysis and visibility of operational insights from network devices.

Use-case 3 is a specific exemplar case for PMARs. An opportunity has been recognised to improve network performance and work towards a solution has already been initiated; prototype data analytics algorithms developed by University of Strathclyde exist. The use-case will:

- Progress the analytic capability from prototype to near production readiness;
- Implement the algorithms in a new application which will interface with the WISP to obtain necessary data originating in disparate SPEN systems; and
- Trial the solution to confirm that the expected functionality is achieved, and to evaluate the results obtained in practice from part of the SPD 11kV network.

Use-case 3 will use data analytics to predict faults on the 11kV overhead line network. It will deploy algorithms developed by University of Strathclyde which analyse analogue log files from NOJA PMAR. The algorithms are currently coded as rules and run within a Java Eclipse environment as a standalone function.

The functions of the proposed application can be summarised as follows:

1. **Fault diagnosis** of known common faults associated with PMAR devices (detecting asset deterioration of the device itself);
2. **Diagnosis of semi-permanent faults** (detect patterns that represent the behaviour associated with semi-permanent faults); and
3. **Prediction for future PMAR operations** (the predictive function uses data mining and clustering to identify data clusters in the NOJA PMAR log files that indicate a likely trip within a certain time period).

There are three strands to the delivery of the solution:

- To facilitate the use-case - Nortech Envoy RTUs will be installed in PMARs in the trial area to recover log file data to a database;
- As part of WISP development - Data from disparate sources including real time DA data will be acquired and correlated along with information regarding the device and circuit and will be and made available at a standard interface for the use-case application; and
- Development of an application to provide the required functionality making use of learning from the techniques introduced on project DINO using a near-production environment.

Figure 10-13: Use-case 3 block diagram

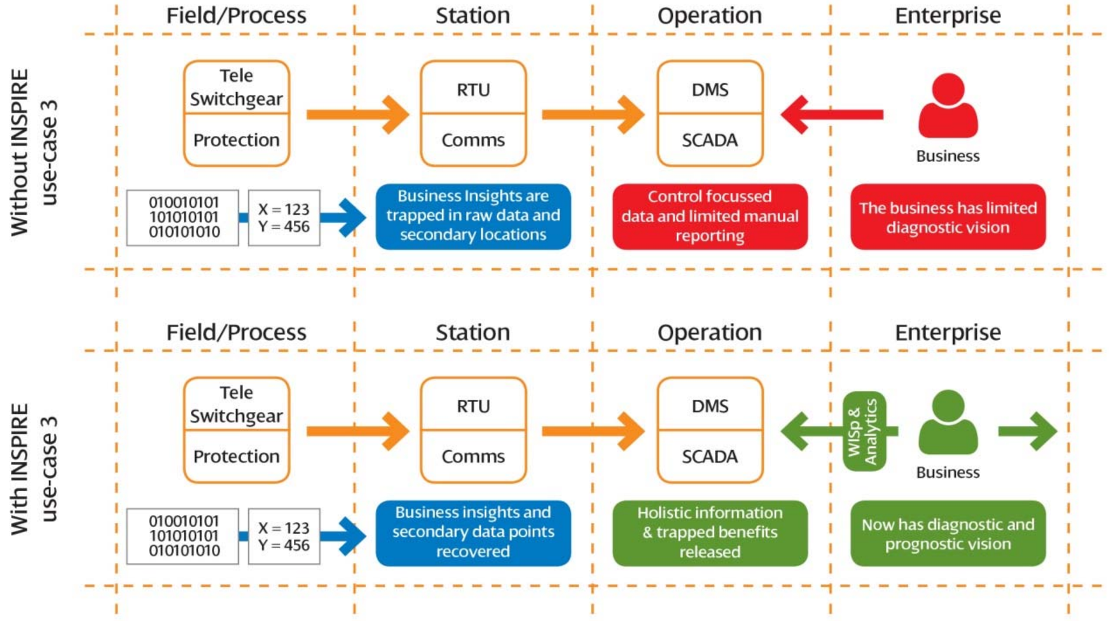


Figure 10-14: Use-case 3 Solution Overview

Key Learning:

By creating a base framework at near-to-production technology readiness level for event processing and data analytics, this use-case will demonstrate business value from analytics, event processing and industrialised data science processes while also informing network operators about the technologies, architectural patterns and methodologies that will allow wider implementation of event processing and data analytics. This will offer a rapid route to gaining the necessary key learnings for network operators on how to manage the ever increasing volume, velocity and variety of data that a Smart Grid future will bring, including how to:

- Improve utilisation of data from existing distribution automation devices to support customer service improvements;
- Enable a new class of dynamic application due to the availability of a cross-domain whole-system model with dynamic system state, not currently available in any other system;
- Ensure an appropriate evolution of strategy to deal with an increasing volume, velocity and variety of data sources; and
- Enhance ability to design, deliver and embed complex event rules and data analytics into a flexible and agile data environment, reducing implementation and management costs.

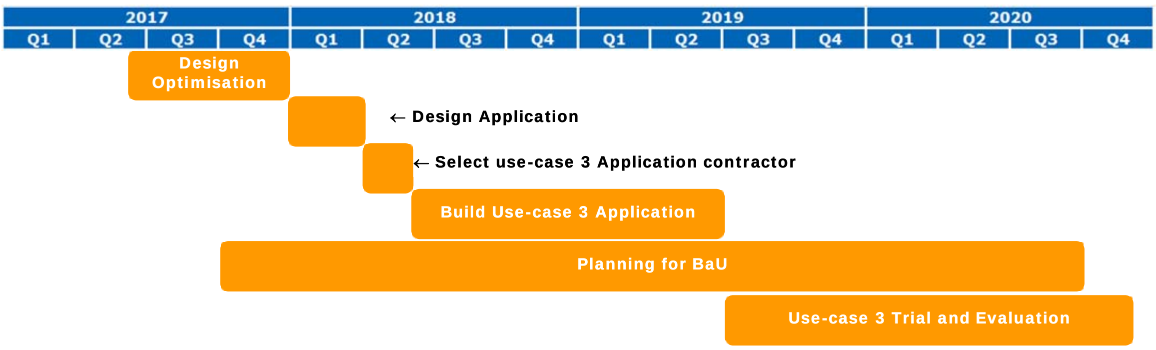
Trial:

Area: For the trial, 50 overhead lines with NOJA PMARs will be selected from the 142 worst performing 11kV overhead line circuits in SPD. Of these 50 lines, 17 are likely to be within the Dumfries and Galloway network. Therefore 34% of the trial (17/50) will be undertaken in the Dumfries and Galloway area.

The trial will;

1. Demonstrate incorporation of PMAR analogue data into the WISP for use in the Use-case 3 application and perform suitable validation.
2. Demonstrate a period of continuous operation of the use-case application and the prediction of faults with suitable reporting to provide DNO visibility.
3. Correlate outputs from the PMAR analytics algorithm with fault records in order to judge the performance and refine the algorithm.

Use-case 3 Programme:



Use-case 4 Enhanced Network Planning

Lead: SPEN	**Support:** Use-case 4 Application Contractor /CGI /University of Strathclyde
Area: Design	**FPSA Timeframe:** Investment Planning

Business Issue:

GB electrical networks are changing due to the connection of more distributed renewable generation and new low carbon technologies such as electric vehicles and heat pumps. The consequential and increasingly complex network operation means that business needs will progressively require better assessment and visualisation of power flows for planning purposes.

Network investments have historically been based upon planning techniques which consider the peak power flows associated with periods of maximum demand, measured from system monitoring. The increasing levels of embedded generation connected to the distribution network mean that it is now more difficult to identify the levels of latent demand through current network planning techniques. Lack of information or impracticalities in obtaining data can mean that planning decisions are based upon conservative assumptions.

The present lack of central data management and a facility to apply disparate activity data to network analysis also hinders the delivery of the increased numbers of distributed generation connection quotations. Existing processes require engineers to make judgements based on best data gathering ability within the time constraints implemented via the Guaranteed Standards of Performance.

Competition in Connections Code of Practice now enables self-determination of Point of Connection (PoC) by Independent Connection Providers (ICPs). Although network data is presently available through DNO Long Term Development Statements (LTDS), and indications of the ability to accommodate connections is visible through 'heat maps', an improved service could be provided by using the whole-system model with automated analysis to evaluate the connection.

This Use-case addresses the need for data integration to improve efficiencies in planning practices and the accuracy of information used to support planning decisions and enhance utilisation of the network.

Objective and Deliverables:

The objective is to offer an enhanced planning functionality to support improved business processes for network planning and customer connections activities. The Use-case 4 **Enhanced Planning Application** will provide this through use of the WISP with data management assuring the quality of the information to drive more accurate and efficient planning.

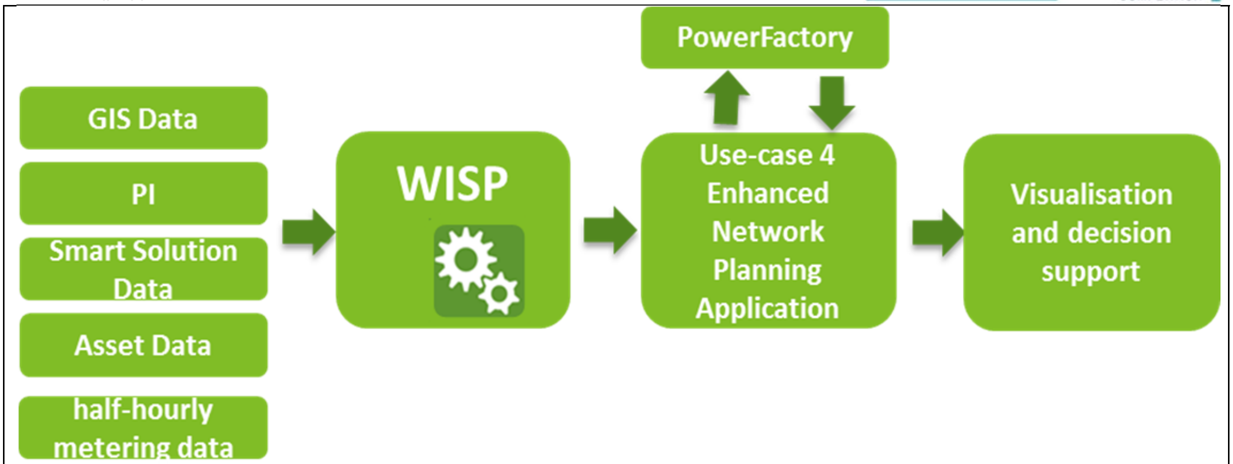


Figure 10-15: Use-case 4 block diagram

The WISP will enable access to and synthesis of the following data necessary for enhanced planning, utilisation of existing network capacity and better identification and justification of reinforcement needs:

- PI (Data Historian): current, voltage, real and reactive power flows;
- MPAN (meter readings database) for demand half-hourly data;
- DG metered data for half-hourly profiles;
- DG Tracker database for DG connections data;
- ESRI (Geographical Information System) Circuit data e.g. length, impedance;
- SAP: asset data (e.g. thermal ratings, impedances);
- Small scale DG penetration data;
- Historic DER performance data;
- Database of forecast, contracted and connected DER; and
- [Future: Smart meter data]

The Use-case 4 application will implement the following advanced functionality:

- **Integrated DER and Demand Connections Analysis:** This will be an internal DNO planning and design tool to underpin the complex nature of planning and connections tasks that are set to become more challenging as the decentralisation of energy and the implementation of smart grid techniques gathers pace.
- **Latent Demand Analysis:** Latent demand will be identified through the integration of power flow measurements from disparate sources. Cumulative export from small scale generation can have significant impact on the identification of latent demand. The export from small scale distributed generation will be assessed using state estimation techniques. Analysed latent demand will be used by SP Energy Networks and shared with the SO for network planning, information sharing and to underpin the connections portal functionality.

In order to provide the required functionality application will:

- Create a regularly updated network baseline;
- Automate the export of selectable areas of the network model to existing planning tools;
- Calculate demand connection headroom;
- Calculate latent demand for planning, operations and SO sharing;
- Provide visualisations of the resulting intelligence; and
- Develop a Portal for customer connection assessment interaction and gathering demand connection data (Stretch Goal).

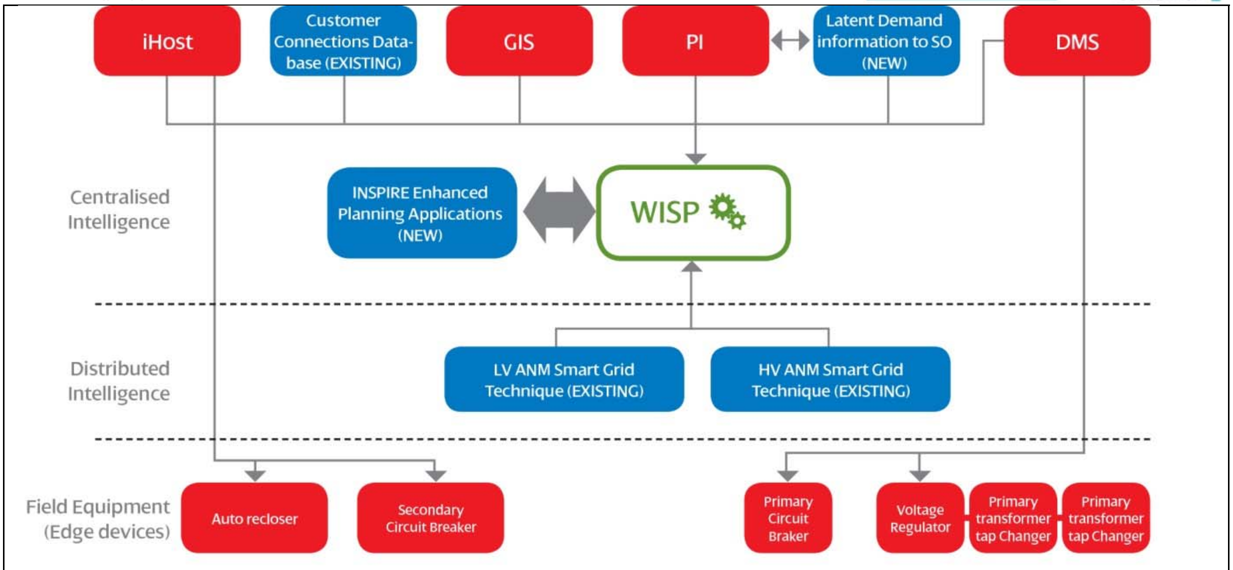


Figure 10-16: Use-case 4 Solution Overview

Key Learning:

The anticipated key learning from use-case 4 includes how to:

- Improve efficiency in network planning and connection assessments through the avoidance of collection and correlation of data from separate sources facilitating quicker planning studies and faster turnaround time for connections and planning activities.
- Improve consistency in planning decisions through the availability of quality-assured information.
- Improve utilisation of existing assets through use of accurate information rather than conservative assumptions.
- Make connections information (heat maps) available via a web portal (stretch goal).

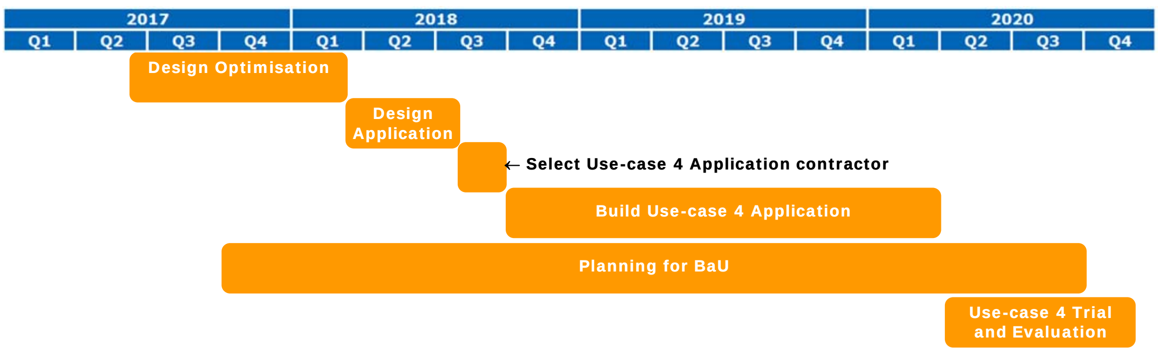
Trial:

Area: Two Grid Supply Points (GSPs) within the Dumfries and Galloway area (approximately 50 of the 176 11kV circuits).

The trial will;

1) Demonstrate the application's accurate provision of network information in the power systems analysis simulation tool to be validated through sample checks.
2) Demonstrate the performance of standardised pre-processing of loading data algorithms through comparison with results of previous analysis where available.
3) Demonstrate the effect of determining latent demand using the use-case 4 application compared to the manual process.
4) Undertake studies for sample networks to evaluate the impact of the use-case 4 application on network capacity compared to the use of cautious manual processes.
5) Deliver learning regards data quality issues, identified by the development of the application, to inform future roll out.

Use-case 4 Programme:



Appendix D Technical Description

D.1 How the WISP overcomes past data integration failures

D.1.1 The blockers to successful data integration

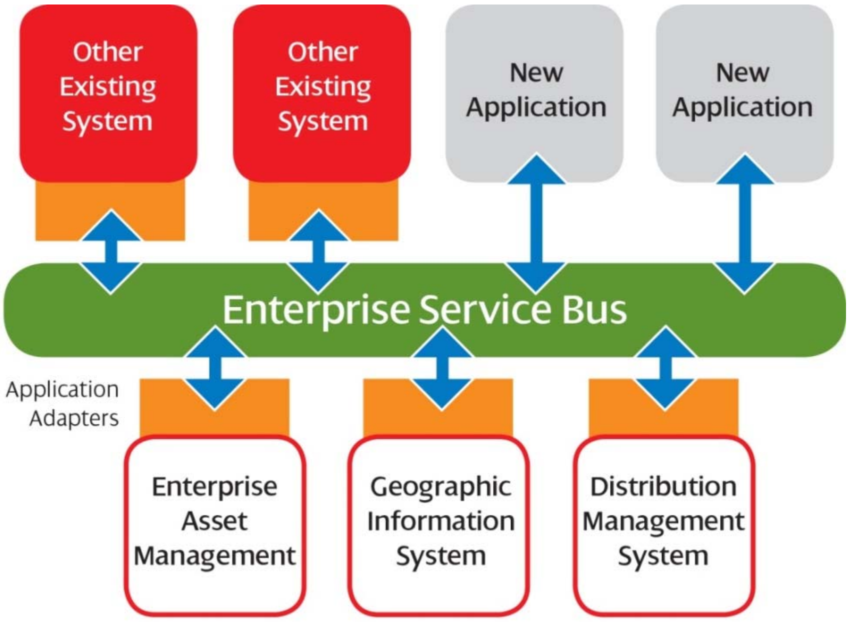


Figure 10-17: Service Orientated Architecture (SOA) with Enterprise Service Bus (ESB)

Though a lot of work has been put in, across all of the world, towards achieving more effective levels of integration between the IT systems of electricity distribution companies, including very considerable amounts of effort spent in developing key supporting standards such as the Common Information Model, relatively few distribution companies across the globe, and so far none in the UK, have achieved this end successfully. Looking at this situation today, the following key blockers to successful integration are apparent:

- The overly simplistic integration design pattern that has previously been toted, of simply connecting the various applications via service buses (SOA with ESB as illustrated in Figure 10-17) set up to carry only standardised message formats, does not meet the operational needs of DNOs' business requirements and resulting IT/OT landscapes. In this respect, unfortunately one size does not fit all.
- For various good reasons, different styles of IT architecture and landscape have emerged in different parts of the world. The two main variations encountered are summarised in Appendix D.3 below, where these are loosely characterised as the "US" and "UK" models. Unfortunately the latter presents greater challenges to successful data integration.
- The significant challenges that are presented by issues of Master Data Management (see Appendix D.2 below) have not been acknowledged until relatively recently.
- The CIM standard itself presents a number of "housekeeping" challenges to systems that wish to integrate using it – see Appendix L for further information regarding these.

Where effective data integration has been achieved in other countries, this has generally been accomplished using a US-model architecture in which most or all of the network topology and asset data is master in a GIS platform. But this is not the architecture that UK DNOs have followed, and several disadvantages are evident with the alternative proposal of migrating and then mastering all network-related master data into the GIS. Disadvantages of this alternative approach include:

- much higher project cost and risk,
- transactional interfacing based on transmission only of changes to master data would necessitate invasive changes to the existing master systems,
- moving mastering of data between systems such as from DMS to GIS involves expensive data cleansing (almost certainly more than really necessary), and
- challenging business process changes to ensure GIS data is updated before commissioning rather than afterwards as at present.

D.1.2 The rationale behind the WISP

Simply connecting applications together via an ESB and then relying solely on near-real-time transactional update messaging is not a sufficient approach to keeping all applications' databases synchronised, for the following reasons:

1. Though many electricity network applications rely on a connected model of the distribution network and the loads, generators and other DERs connected to it, different functions require, for optimum performance, models with different levels of granularity of different aspects of the network. For example, the DMS must know the exact locations of all possible isolation and earthing points, but DMS does not need to know the exact details of the physical locations of every underground cable or overhead line – it only needs an accurate summary of the connected topology between locations.
2. Not all applications need to permanently maintain their own copies of all of the network topology data. Some, such as modelling tools, can operate more efficiently by loading in required portions of the data only as and when they need them.
3. Though, as the CIM standards recognise, the maximum benefits are obtained from ESBs when a standard set of messages that can exchanged between all the applications, existing applications which do not natively exchange data using this agreed "language" then require Adaptors to be developed to sit between them and the ESB. These applications also have to conform to a set of CIM "housekeeping" rules, for example that all data objects must be identified with a universally unique identifier (see Appendix L.2.1 below). Many DNO systems, however, are based on Commercial Off-The Shelf (COTS) products such as SAP, Ellipse, ESRI etc. whose target marketplaces are much wider than just the electricity sector, and for whose vendors CIM compliance is a far lower priority. In some cases where existing COTS applications do not meet the required conventions, some re-engineering of the core product would also be needed in addition to the development of an adapter.
4. ESBs do not directly concern themselves with which systems are responsible for mastering which data items, or how the data is kept consistent across all of the applications. A separate Master Data Management (MDM – see Appendix D.2 below) approach is necessary to address this aspect.

D.1.3 Shaping the required solution

The WISP has been designed to incorporate solutions to all of the above challenges so that it will address the challenge of effective data integration at lower cost than that required to lift and shift significant aspects of data mastering between existing DNO systems, e.g. to move mastering of the DMS topology and control diagrams into the GIS.

A key starting point for the WISP architecture is the principle that most existing systems can continue to master the same data that they already manage today. So that:

- the high-quality network diagram and schematics can continue to be mastered in the DMS,
- the non-linear assets remain mastered in the EAM system,

- the geographical locations, routes and conductor details remain in the GIS,
- historical measurement data such as half-hourly current readings from outgoing primary feeders can remain in their existing historian(s), etc.

The WISP architecture thus minimises the duplication of data. Its INM component then

1. acquires a copy of the key network master data, including topology and connectivity information, from the existing master systems, reconciles the differing views of this, reports on all inconsistencies found, and retains this as a core network data backbone;
2. obtains catalogues of items held from the other systems, e.g. lists of historical analogue time series, and links them to this backbone; and
3. retains a historically versioned reference copy of the reconciled and connected backbone dataset, with planned forthcoming changes such as approved connection requests also incorporated.

The ANM component takes this process a stage further by overlaying dynamic state information, such as current switch states, onto the present-day INM backbone.

The resulting backbone datasets are then made readily available to the other applications by a rich variety of different methods. If, for example, an engineer wants to view a replay of the network loading in a modelling tool at a particular past time, the engineer's modelling tool will be able to request the appropriate (historical) network topology and electrical characteristics data from INM. This topology model will include the available measurement points together with their source system references, and the modelling tool can then request the corresponding values and switch states from the historian system(s) by making ESB requests using the references that INM has incorporated into the topology dataset.

This architecture also supports the case where reading/measurement data is retained by field devices for an interim period without being routinely collected into the centre, allowing these devices to be remotely interrogated for the data only when it is actually needed.

New and existing applications are still connected to the ESB and make use of it for the more dynamic, transactional style of interfacing by exchanging messages. These can include standard request-response and publish-subscribe interaction patterns in addition to simple messaging. This integration can now be based around whatever Application Program Interfaces (APIs) each application already has available for these purposes. The process of converting the data payloads of these interfaces to and from CIM format can now be carried out using the WISP reference data where needed for purposes such ID lookups, considerably reducing the extent of adapter facilities that need to be developed from scratch.

The WISP is also interfaced to the ESB[35] so that it can make its reference data easily available, for example via data service request functions that the other systems can then call as and when they need specific portions of data, or posting data updates for those that can, cost-effectively, maintain their copies via this method. But the reconciled information held by INM can equally be made available to other applications via other types of open data services, for example by Data Virtualisation or even methods as basic as Open or Java DataBase Connectivity (ODBC/JDBC). This provides a rich, open toolkit that new and existing applications can take advantage of to obtain their master data in the most efficient and economical way.

[35] INSPIRE will use cost effective, Open Source technology as an interim ESB to decouple from existing SP Energy Networks change programmes.

D.2 Key principles of Master Data Management

The term "master data" means data that only changes relatively slowly over time. In the context of DNOs this embraces datasets such as network topology, asset inventory and nameplate data, connected premise information and the standing data that relates to connected generation and other LCTs.

Master Data Management (MDM) is the discipline of ensuring that the data held by an organisation is properly managed and maintained, in particular so that:

- there is a clear data mastering strategy in which each item of data is mastered in a single known location, called its *system of record*;
- data does not have to be manually duplicated – where data is needed at any other locations than its system of record, some means of automatically replicating it are made available;
- data is provided to its users within the timescales in which they need it;
- any data anomalies that do arise can be rapidly identified and reported to data stewards for remediation; and
- business processes that involve data manipulation are structured appropriately to ensure that high levels of data quality are achieved and sustained.

The key objective of MDM is to ensure that everyone in the organisation has access to a single, centrally managed view of the truth for the data they require to perform their duties effectively and efficiently. Individual data records within this view are sometimes termed *golden records*.

Without MDM, an organisation has no reference framework with which its business process and IT solution designers can make appropriate decisions around how to implement business change and effectively manage data. This leads to a situation in which each project defines its own mechanisms for storage and management of data without reference to the whole of the wider picture. The organisation thus builds up a collection of data siloes where data is held but cannot readily be accessed by everyone who needs it, where data is manually duplicated into multiple systems, and where business processes conflict against one another rather than coherently delivering good performance. The result, in effect, borders on data anarchy.

D.3 A historical perspective on DNO IT architecture developments around the world

For historical reasons, two rather different Enterprise Architecture patterns have evolved for DNOs in different parts of the world. These will be referred to as the 'US model' and the 'UK model', though in fact examples of each can be found in a number of countries around the world.

D.3.1 The UK model

The UK model is characterised by having a very detailed model of the EHV and HV networks in a DMS application, with tightly integrated SCADA and, usually nowadays, a tightly integrated Outage Management System (OMS). GIS and the Enterprise Asset Management system, meanwhile, are regarded as as-built records systems that generally don't get updated until a short time after new network changes have been commissioned.

The development paths of each system that has led to this architecture were as follows:

1. Enterprise Asset Management systems originated as basic maintenance scheduling systems which were subsequently enhanced considerably.
2. The HV networks were historically managed from wallboards with magnetic 'dressing' symbols used to represent abnormal states, safety documents etc. As SCADA was rolled out, additional facilities were added to the SCADA systems to support an electrical connectivity model resulting in the first recognisable DMSs.

Over time, many additional facilities were added to the DMS products. Gradually the HV network control was also brought under the DMSs. It became relatively easy to implement OMS as a bolt-on, leveraging the high-quality connectivity model.

3. The main use of early GISs was to make map views visible to planners and enable printouts to be given to field crews to enable them to locate the lines or underground cables they needed to work on or avoid. Most of these early GISs just had raster scans of the hand-drawn paper records they replaced. No electrical connectivity details were stored. Digitisation of the GIS diagrams proceeded gradually. Some DNOs have still not completed this process even today.

A key driver for the UK model was the significant statutory and regulatory Health & Safety regimes that developed in countries such as Britain. Combined with the generally meshed topologies of the HV networks, this led to early development of strict safety rules and procedures, which the DMSs then had to support in considerable detail.

The natural data mastering strategy that emerged from the UK model architecture, in simple terms, is that **the DMS, GIS, and EAM systems act as systems of record for appropriate portions of the key master data.**

D.3.2 The US model

The US model is characterised by having all network topology and connectivity data mastered in a GIS, with other systems all obtaining the datasets they require from this. The development paths of each system that led to this architecture were as follows:

1. DNOs were early adopters of fully digitised GIS datasets, and took the opportunity to incorporate network connectivity at the same time as they did not then hold this anywhere else. With the systems then existing, OMS was implemented as a GIS add-on, with GIS-based add-on products emerging to meet this need. Later, as the advantages for centralising higher-voltage switching grew, DMSs began to be adopted, often being extensions of the OMSs. These also obtained their network topologies from the master GIS database.
2. SCADA was introduced at higher voltage substations but was initially independent. SCADA systems did not hold connectivity models or network schematics. The SCADA systems were subsequently integrated with the OMSs to provide real-time information on where circuit breakers had tripped etc.

Key drivers for the US model were the relatively low levels of statutory safety regulation and the largely radial nature of American distribution networks, typically localised around cities. There was thus far less of a need for sophisticated DMSs in the early stages of IT/OT landscape development.

The data mastering strategy implied by the US model architecture, at high level, is that **the GIS acts as the system of record for most of the key master data.**

D.4 Common Information Model (CIM)

The IEC 61968/61970/62325 Common Information Model and DNO interfacing standards originated in the USA and were originally based on the assumption of a US-model architecture. But, as they matured, these standards were generalised, and the assumptions about systems and data architecture were dropped, so CIM is now application-architecture agnostic and thus capable of supporting either architecture models (though it remains more widely adopted by DNOs that follow the US model).

The mastering of a large amount of data in one single system – the GIS – however, does still make it considerably easier to implement CIM. But recent experience has shown that migrating from a UK-model to a US-model architecture can be extremely expensive. Though the more distributed mastering strategy inherent in the UK model presents considerable challenges for effective information exchange, the WISP addresses this by providing the richer level of data services and Master Data Management facilities needed to address this architecture.

D.5 Smart Grid Architecture Model (SGAM)

The Smart Grid Architecture Model (SGAM), as presented in Figure 10-18, is regarded as a potential breakthrough in providing a common conceptual view and point of reference for smart grid developers. It is believed that development of the information layer by DNOs has not kept pace with the component and communication layers.

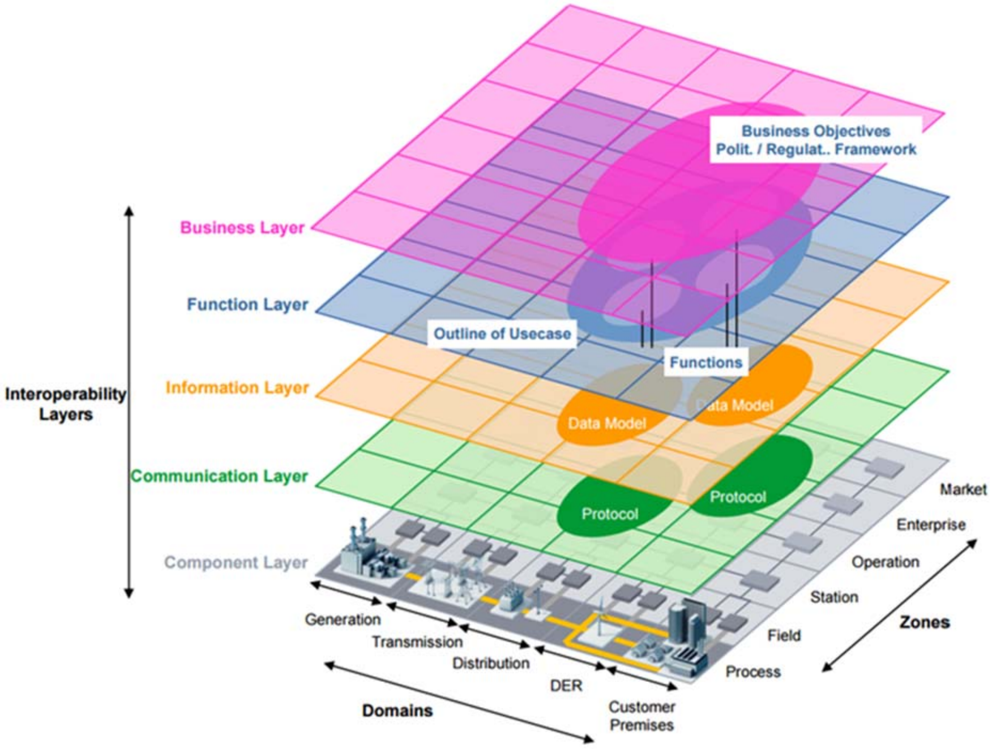


Figure 10-18 Smart Grid Architecture Model

SGAM is a top-level design framework that enables smart grid developers to describe and communication solution designs against the standard three-dimensional framework shown in the figure, and helps catalogue and identify all of the relevant published standards that should be considered when designing new facilities.

A key benefit of SGAM is that it includes an information layer where data content and its management strategy can be described. Requiring all new solution designs to include SGAM models therefore forces the designers to give full and proper consideration to the data requirements and data management facilities their solutions will require.

The WISP will, accordingly, be required to produce an SGAM model as part of its design so that its data mastering and marshalling aspects are fully documented.

Appendix E Project Work Packages

The project is divided into six work packages (WPs) including:

- WP1 Design Optimisation;
- WP2 WISP and Application Design and Build;
- WP3 Use-case Trial and Evaluation;
- WP4 Planning for BAU;
- WP5 Knowledge Dissemination; and
- WP6 Project Management.

E.1 WP1 Design Optimisation

INSPIRE will include a design optimisation phase. This phase will look at the business as it currently stands, defining its requirements and the potential specifications, ultimately leading to the full definition of INSPIRE's use-cases. During this phase INSPIRE will:

1. Carry out thorough research into the technologies that will be necessary to develop and deploy the WISP.
2. Apply Systems Engineering to the business and user requirements to develop the project scope, understanding of the requirements of the WISP, and the definition of its use-cases.
3. Report on the business requirements, and define INSPIRE's requirements.

E.2 WP2 WISP and Application Design and Build

INSPIRE will include a design and build phase for the WISP. One of the key aspects of INSPIRE's design and build is the interrelated nature of these processes; as an agile development strategy has been adopted, the WISP design can iteratively developed as the build process progresses, allowing it to continuously improve. During this phase INSPIRE will:

1. Carry out detailed design of the WISP and the use-case application algorithms.
2. Carry out an initial assessment of the data's quality, and assess how this will impact on the WISP.
3. Fully build the WISP – including integration of the core technologies with the BAU IT systems- and build the applications defined in WP1.
4. Carry out user acceptance tests
5. Report on the learnings from the implementation of the WISP and the development of its applications.

E.3 WP3 Use-case Trial and Evaluation

Agile approaches are not sequential, therefore INSPIRE will iteratively design and build the components of the use-case solutions with evaluation at each stage of production.

There will be considerable overlap between WP2 WISP Design and Build and WP3 Use-case Trial and Evaluation, with the evaluation of some aspects of the INSPIRE solution being undertaken at the same time as the build of other use-case applications. On this basis the INSPIRE Trial will extend over the majority of the project duration.

The evaluation phase will focus on checking the operation of the WISP and use-case applications, in particular:

1. Accurate operation of the integration of data from different sources.
2. Correct function of the data management processes.
3. The efficacy of INSPIRE in achieving the goal of the use-cases, particularly in the identified trial areas, and ensuring that they accurately use integrated data and are compliant with business rules.

E.4 WP4 Planning for BAU

The planning for INSPIRE to be integrated into BAU is key to its success. As it is a wide-ranging step change in the business, it will require a comprehensive plan to ensure effective roll-out through the business, and buy-in from its staff. The Planning for BAU phase will:

1. Update the business case to demonstrate the benefits of INSPIRE.
2. Engage in extensive internal engagement for business input regarding INSPIRE's rollout and generate wide-ranging buy-in.
3. Produce appropriate documentation to support transition into BAU, including:
    a. Policy documents.
    b. Technical, functional and operational specifications.
    c. Service Level Agreement (SLA) recommendations for each component of the WISP.
4. Generate training and transition support materials.

E.5 WP5 Knowledge Dissemination

The knowledge dissemination phase was discussed in detail in Section 5.

E.6 WP6 Project Management

INSPIRE brings together multiple partners, suppliers and stakeholders in achieving the project's aims. One of INSPIRE's key components is the ability to realise the benefits of using Small-to-Medium Enterprises and multiple suppliers. Effective project management is required, with a clear structure and regular engagement. As such, project management is a work package in and of itself. The project management phase will include the following:

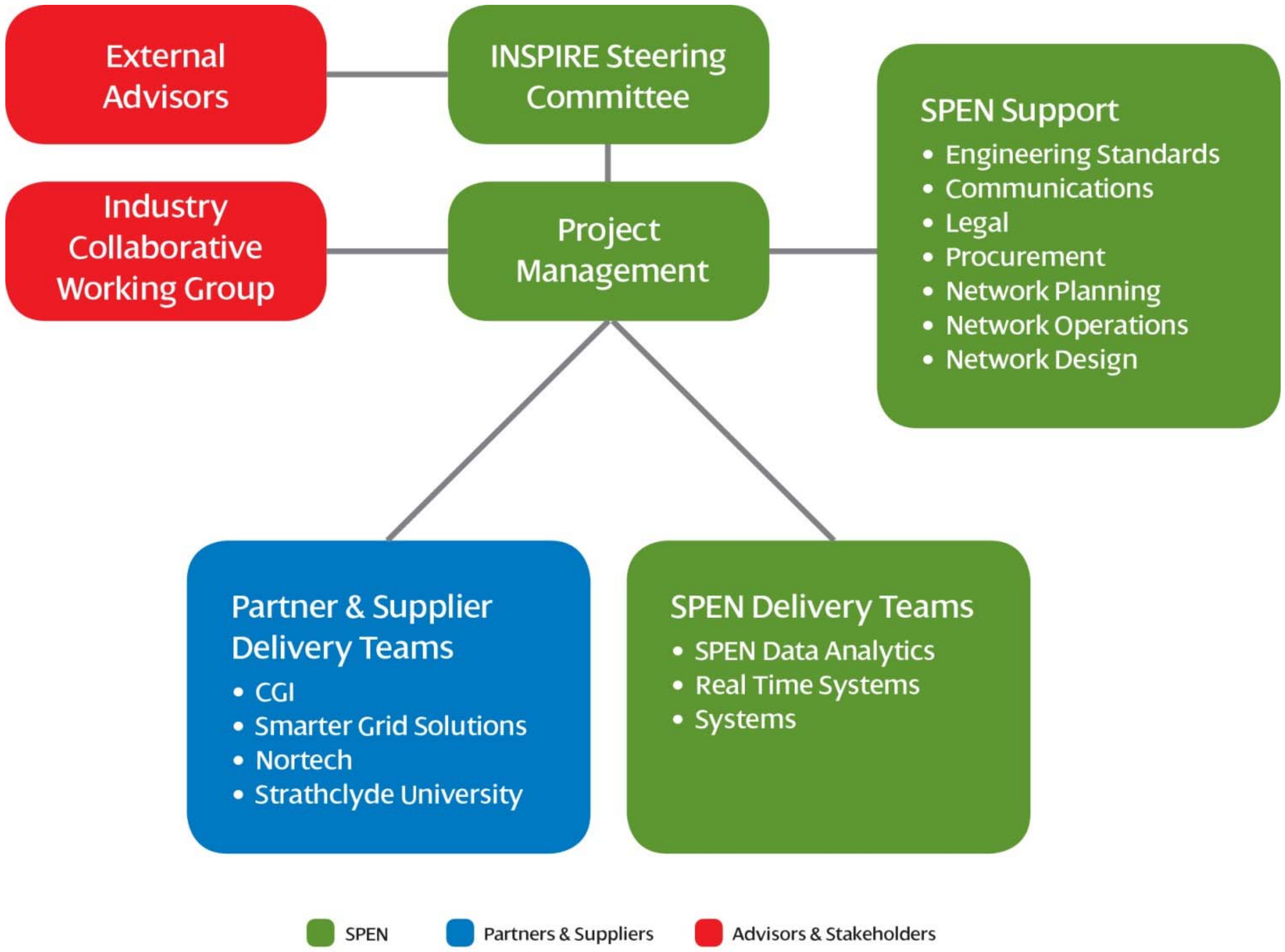
1. Establish project management structure and resourcing requirements.
2. Mobilisation of the project team.
3. Ensuring a competitive and constructive tender process for the project's main subcontractors.
4. Monthly and quarterly project management meetings and six monthly progress reporting.

Appendix F Risk Register

Risk no.	Issue	Risk Description	Potential Impact	Inherent Risk: Probability (1-5)	Inherent Risk: Financial Impact (1-5)	Inherent Risk: P x FI (1-25)	Inherent Risk: Reputation Impact (1-3)	Inherent Risk: P x RI (1-15)	Inherent Risk: Overall Risk (2-40)	Control Measures	Residual Risk: Probability (1-5)	Residual Risk: Financial Impact (1-5)	Residual Risk: P x FI (1-25)	Residual Risk: Reputation Impact (1-3)	Residual Risk: P x RI (1-15)	Residual Risk: Overall Risk (2-40)	Contingency Plan
1. Technical Risks																	
1.01	Data security	Bringing together information from multiple data sources introduces a potential security risk	Data used in the project could be compromised, leading to a potential security breach or cyber attack	2	3	6	3	6	12	Early involvement with SPEN IT security experts and relevant partners ensuring design conforms to SPEN IT security control regulations	1	2	2	2	2	4	Contingency plan to follow SPEN IT control regulations
1.02	Cyber security	If not managed correctly, the development of the INSPIRE platform and applications may not conform to a DNO security requirements	SPEN systems security could be compromised, leading to a potential security breach or cyber attack	2	3	6	3	6	12	Platform will be designed with SPEN IT security experts and relevant partners ensuring the system has appropriate security controls	1	2	2	2	2	4	Platform approach inherently dictates that security aspects of future applications are considered.
1.03	Technology development	Over the timespan of INSPIRE, the data handling and protocols of smart technology may develop	The technology that INSPIRE is designed for becomes obsolete, reducing INSPIRE's efficiency or useful scope	3	3	9	2	6	15	Ensure that INSPIRE is designed with capability to be developed for future changes	2	1	2	1	2	4	System fundamentally designed to utilise multiple sources of information.
1.04	Use-case achievement	Data Science 'Algorithms' to analyse the data to support the required use case results may not be able to be developed, or the data we currently hold may be insufficient	Inability to achieve project aims	2	2	4	2	4	8	Careful review and confirmation by SPEN of specific algorithms to be used ahead of engineering design phase	1	1	1	1	1	2	Third party review of algorithms selected
1.05	Scope	Technical language of business and IT teams leads to misunderstanding of scope and requirements	Misunderstanding in the delivery team leads to scope creep and programme slippage	3	2	6	2	6	12	Close engagement between main technical partner SPEN teams. Formalised requirements agreed in project documentation.	2	1	2	1	2	6	Residual issues will be identified early due to agile approach, with time to rectify.
1.06	SPEN support	Business, IT and operations team engagement or capacity insufficient to support design and delivery phases	Deadlines not met, knock on effects causing project delays and increased costs	4	3	12	2	8	20	Early sharing of project requirements and suitable support provided for all stakeholders to enable delivery of required tasks	1	1	1	1	1	2	Alternative arrangements such as hiring contractors to ensure project can continue as usual
1.07	Data quality	Lack of resources prevent required data cleansing in a timely manner	System does not have accurate data, meaning full potential of applications is not realised	4	2	8	3	12	20	System designed to automate some data cleansing and to be tolerance of data quality issues	2	1	2	1	2	6	Effective engagement at all levels to ensure data problems are highlighted in time to rectify
1.08	Data availability	Timely availability of sufficient data of a suitable quality to develop and test the solution	System does not reach full potential	4	3	12	2	8	20	Test to ensure adequate data provision mechanisms are in place to enable the release of data before the project begins	2	1	2	1	2	6	System designed to utilise what information it has access to
1.09	SPEN IT environments	The required SPEN in-house INSPIRE environments: "integration", "test", and "live trial" are not provisioned in accordance with plan timescales	Unable to commission project during all stages of installation	2	4	8	2	4	12	Early and ongoing engagement with SPEN IT/OT departments to ensure provision in accordance with timescales.	2	2	4	2	4	12	Deployment of SPEN framework suppliers to ensure project continuation

Risk no.	Issue	Risk Description	Potential Impact	Inherent Risk Probability (1-5)	Inherent Risk Financial Impact (1-5)	Inherent Risk P x FI (1-25)	Inherent Risk Reputation Impact (1-3)	Inherent Risk P x RI (1-15)	Inherent Risk Overall Risk (2-40)	Control Measures	Residual Risk Probability (1-5)	Residual Risk Financial Impact (1-5)	Residual Risk P x FI (1-25)	Residual Risk Reputation Impact (1-3)	Residual Risk P x RI (1-15)	Residual Risk Overall Risk (2-40)	Contingency Plan
1. Technical Risks																	
1.10	Engineering Design	Engineering design too slow to converge	Delays in project completion	3	3	9	3	9	18	Programme agreed and monitored to ensure all partners are focussed on meeting timescales	2	1	2	1	2	6	Regular team meetings and reporting to keep information exchange open on progress of project
1.11	Maintenance requirements	Complex system installed that is not practical to maintain	Interruption of data supply, increased costs of project	4	2	10	3	12	20	Engage closely with relevant manufacturers and design teams to fully understand the maintenance and data storage requirements, training needed and development to keep system maintained.	1	1	1	1	1	2	Close links with design and maintenance teams during and after commissioning
			Summative Risk Scores	**25**	**22**	**68**	**18**	**57**	**125**		**14**	**9**	**16**	**9**	**16**	**44**	
2. Procurement and Installation Risks																	
2.01	Cost of system is significantly higher than estimated	Prohibitive costs of integrating system as costs are dependent on systems and timeframes	Project budget is not enough for delivery of project	4	5	10	3	12	32	Develop optimum design to keep costs low. Tendering process to be competitive to ensure value for money	1	2	2	1	1	3	Limited contingency funding is available
			Summative Risk Scores	**4**	**5**	**10**	**3**	**12**	**32**		**1**	**2**	**2**	**1**	**1**	**3**	
3. Project Management Risks																	
3.01	Mobilisation	Risk attached to inability of project partners being able to commit resources to project because of existing obligations	Delay in reaching project milestones which may increase financial and reputational risks	3	3	10	2	6	15	Suitable partners are in place and sufficient resources are allocated to project	1	1	1	1	1	2	Partners delivery requirements clearly defined in contractually binding collaboration agreements.
3.02	Stakeholder management	Delays to decision-making and sign-offs	Disrupt progression of project	4	3	10	2	8	20	All stakeholders follow the designated time frame in project plan, any delays to sign-offs escalated to Project Manager/Steering Committee.	2	1	2	1	2	6	Continue with areas of project that are unaffected until existing issues can be rectified
3.03	Partner/supplier dependencies	Delivery of partner/supplier components to the solution in a timely manner and to the required quality	Delays in project completion	4	3	10	3	12	24	Procurement of components is completed with a maximum timeframe to prevent this risk	1	1	1	1	1	2	Procurement to locate several suppliers to ensure that the project is not held up by a single vendor
3.04	Experience and HSE	Staff lack knowledge of equipment	Inefficient use of staff time	3	4	10	3	9	21	Support from technical design team at all stages in project. Competent staff recruitment during project life cycle	1	1	1	2	2	3	Use competent external resources where required
			Summative Risk Scores	**14**	**13**	**40**	**10**	**35**	**80**		**5**	**4**	**5**	**5**	**6**	**13**	

Appendix G Project Organogram



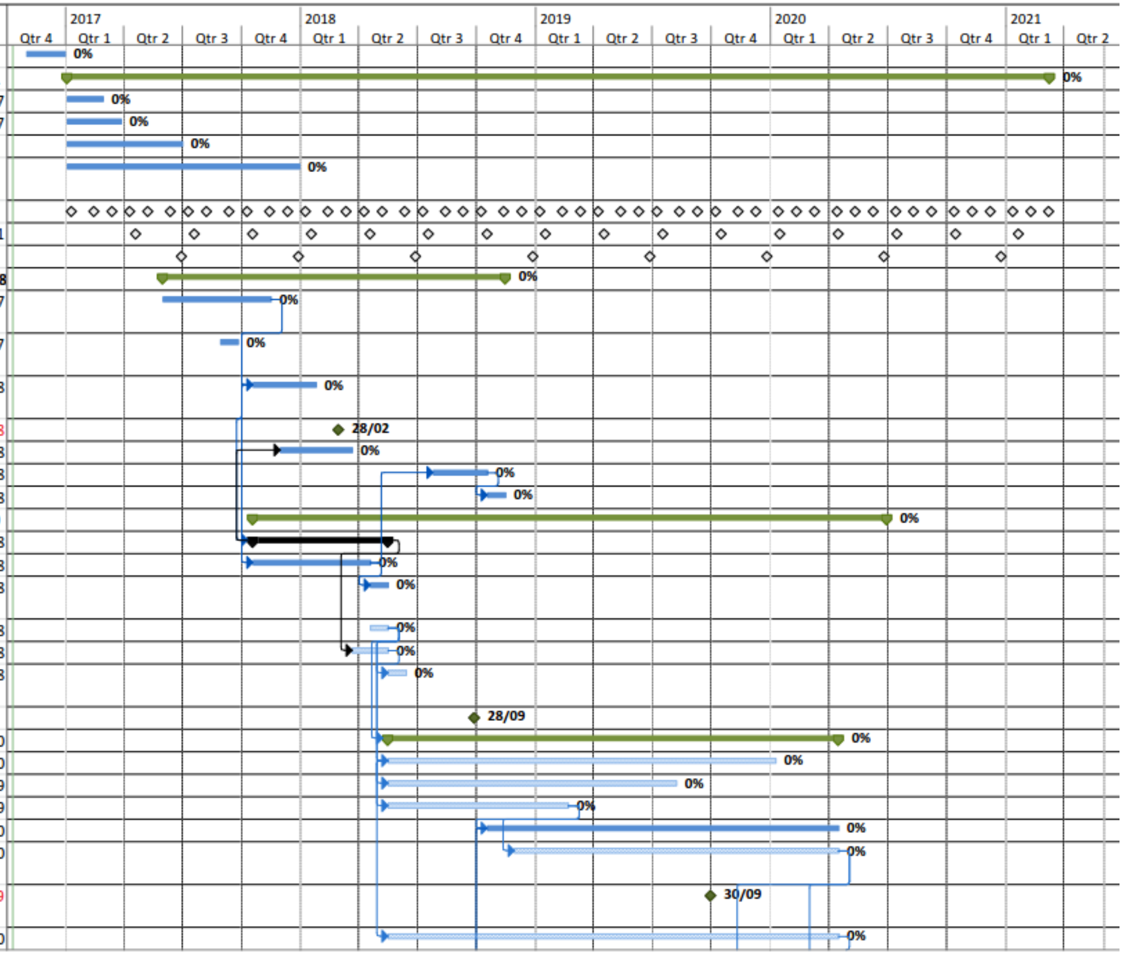
ofgem

RIIO NIC NETWORK INNOVATION COMPETITION

Appendix H Project Programme

Appendix H - Project Programme

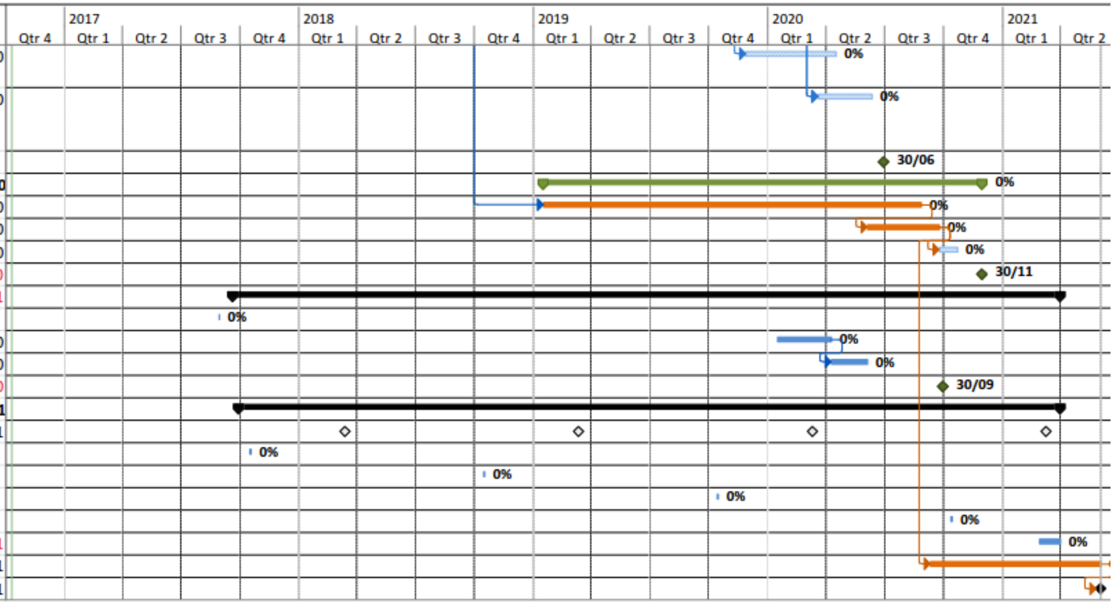
ID	Task Name	Start	Finish
1	Successful NIC Projects Announced	Tue 01/11/16	Fri 30/12/16
2	**Work Package 6 - Project Management**	**Tue 03/01/17**	**Tue 09/03/21**
3	Establish PM structure	Tue 03/01/17	Mon 27/02/17
4	Project Team Mobilisation	Tue 03/01/17	Mon 27/03/17
5	Develop and Establish Partner Contracts	Tue 03/01/17	Fri 30/06/17
6	Competitive Tender Process for Main Subcontractors	Tue 03/01/17	Fri 29/12/17
7	Monthly PM Meetings	Tue 10/01/17	Tue 09/03/21
59	Quarterly Steering Committee Meetings	Tue 10/01/17	Mon 01/02/21
76	6-month Progress Report	Fri 30/06/17	Fri 25/12/20
85	**Work Package 1 - Design Optimisation**	**Thu 01/06/17**	**Wed 14/11/18**
86	Application of Systems Engineering to Business and User Requirements	Thu 01/06/17	Wed 15/11/17
87	Use-case Customer Requirements Focus Workshop	Tue 29/08/17	Mon 25/09/17
88	Preparation of Business Requirements Specification Report	Thu 19/10/17	Wed 24/01/18
89	SDRC 1: Definition of INSPIRE Use-cases	Wed 28/02/18	Wed 28/02/18
90	Trial Site Identification	Thu 30/11/17	Wed 21/03/18
91	Develop Trial Methodology	Thu 26/07/18	Wed 17/10/18
92	Trial Methodology Report	Thu 18/10/18	Wed 14/11/18
93	**Work Package 2 -Design and Build**	**Thu 19/10/17**	**Tue 30/06/20**
94	Platform and Application Design	Thu 19/10/17	Wed 16/05/18
95	Application Algorithms Design	Thu 19/10/17	Wed 18/04/18
96	Preparation of Report on Application Algorithms	Thu 19/04/18	Wed 16/05/18
97	Preparation of Architecture and Design Repo	Thu 19/04/18	Wed 16/05/18
98	High-level Assessment of Data Sources	Thu 22/03/18	Wed 16/05/18
99	Report on Results of High-level Assessment of Data Sources	Thu 17/05/18	Wed 13/06/18
100	SDRC 2: WISP and Application Design	Fri 28/09/18	Fri 28/09/18
101	Platform Build	Thu 17/05/18	Wed 15/04/20
102	Work on Core Components	Thu 17/05/18	Wed 08/01/20
103	Work on OT Development/Configuration	Thu 17/05/18	Wed 07/08/19
104	BAU IT System Interfacing	Thu 17/05/18	Wed 20/02/19
105	Build and Integration	Thu 18/10/18	Wed 15/04/20
106	Satisfactory User Acceptance Test for WISP Implementation	Thu 29/11/18	Wed 15/04/20
107	SDRC 3: Development of the WISP and the First Use-case Application	Mon 30/09/19	Mon 30/09/19
108	Source Data Cleansing	Thu 17/05/18	Wed 15/04/20



Critical | Critical Split | Critical Progress | Task | Split | Task Progress | Manual Task | Start-only | Finish-only | Duration-only | Baseline | Baseline Split | Baseline Milestone | Milestone | Summary Progress | Summary | Manual Summary | Project Summary | External Tasks | External Milestone | Inactive Task | Inactive Milestone | Inactive Summary | Deadline

Appendix H - Project Programme

ID	Task Name	Start	Finish
109	Satisfactory User Acceptance Test for Use-case Applications	Thu 28/11/19	Wed 15/04/20
110	Preparation of Report on the Lessons Learnt from the Implementation of the WSIP and Applications	Thu 19/03/20	Wed 10/06/20
111	SDRC 4: Development of Use-case applications	Tue 30/06/20	Tue 30/06/20
112	**Work Package 3 - Use-case Trial and Evaluation**	**Thu 17/01/19**	**Mon 30/11/20**
113	Deployment and Trials	Thu 17/01/19	Wed 26/08/20
114	Preparation of Use-case Trial Reports	Thu 04/06/20	Wed 23/09/20
115	Delivery of Use-case Trial Reports	Thu 24/09/20	Wed 21/10/20
116	SDRC 6: Trial Phase	Mon 30/11/20	Mon 30/11/20
117	**Work Package 4 - Planning for BAU**	Wed 20/09/17	Wed 31/03/21
118	Internal BAU Workshop	Tue 29/08/17	Tue 29/08/17
119	Development of Progression to BAU Plan	Thu 16/01/20	Wed 08/04/20
120	Development of Report on BAU Transition	Thu 09/04/20	Wed 03/06/20
121	SDRC 5: Planning for BAU	Wed 30/09/20	Wed 30/09/20
122	**Work Package 5 - Dissemination**	**Fri 29/09/17**	**Wed 31/03/21**
123	Wider Stakeholder Dissemination Events	Wed 14/03/18	Wed 10/03/21
128	LCNI Conference 2017	Mon 16/10/17	Tue 17/10/17
129	LCNI Conference 2018	Mon 15/10/18	Tue 16/10/18
130	LCNI Conference 2019	Mon 14/10/19	Tue 15/10/19
131	LCNI Conference 2020	Mon 12/10/20	Tue 13/10/20
132	SDRC 7: Successful Knowledge Dissemination	Fri 26/02/21	Wed 31/03/21
133	Prepare Closedown Report	Thu 10/09/20	Wed 02/06/21
134	Publication of Project Closedown Report	Wed 02/06/21	Wed 02/06/21



Critical		Task Progress		Baseline		Summary		Inactive Task	
Critical Split		Manual Task		Baseline Split		Manual Summary		Inactive Milestone	
Critical Progress		Start-only		Baseline Milestone		Project Summary		Inactive Summary	
Task		Finish-only		Milestone		External Tasks		Deadline	
Split		Duration-only		Summary Progress		External Milestone			

Appendix I Project Partners

CGI is a global business with 65,000 professionals in 40 countries across the Americas, Asia-Pacific and Europe who provide end-to-end service offerings and rich IP-based solutions that advance clients' business goals. They have experience in delivering award-winning programmes in various sectors, including defence, health, and energy and utilities. They deliver solutions on a spectrum ranging from systems integration to flexible infrastructure services.

CGI has worked alongside and supported SP Energy Networks in developing its NIC submission for INSPIRE. During this time CGI have contributed towards INSPIRE's technical and delivery aspects, and have given their input on the preliminary definitions of business cases to be trialled and the benefits targeted from the proposed project. CGI are fully committed to providing on-going support in technical design and the ICT build to SP Energy Networks throughout the proposed project lifecycle.

CGI have recognised delivery capabilities within the utilities industry. With respect to LCNF/NIA/NIC projects, they have supported the UKPN Low Carbon London and FUNLV projects, and the WPD FALCON project. CGI are also working with SP ENERGY NETWORKS on the DINO IFI project, which can provide lessons on the tools and techniques deployed there which will ensure a more informed implementation of the trial techniques. CGI have used their learning from these projects to inform their approach to the WISP- INSPIRE now represents the opportunity to return additional value from this previous learning. CGI also have on-going projects and services provided to the UK DNOs and so can link the value in innovation projects to potential BAU deployments and therefore realise the INSPIRE benefits.

CGI has been involved in many of the significant changes in the energy industry in Britain (for example, the Pool, NETA, BETTA, smart metering), and are therefore equipped to participate in the process of digital transformation for the GB DNOs to support customers and deliver the benefits of the smart grid.

Nortech designs and supplies remote monitoring products and services to power utilities, generators and system integrators. Their flagship software platform, iHost, is a web-based SCADA system, enabling utilities to extend their data collection and control systems deep into the power network, facilitating renewable generator connections. Nortech's technology is an enabler for the transition to low carbon power networks. Nortech is actively involved in the UK electricity distribution industry and already provides SP Energy Networks with the iHost system and services. In recent years the capability of iHost has been extended to include the control and active network management of low carbon technologies, focusing on generation export limitation, demand-side response and network switching functions.

Nortech was a key strategic partner for SP Energy Networks in the LCN Fund Tier-2 project "**Flexible Networks a Low Carbon Future"**. Moreover, in the "**Accelerating Renewables Connections**" project for monitoring and ANM solutions. Nortech's iHost system is utilised by all UK DNOs and readily interfaces with their corporate systems. iHost provides a number of the building block functions (visibility, controllability and embedded intelligence) that are an integral part of a WISP being developed and demonstrated by INSPIRE.

Smarter Grid Solutions has spent ten years developing, deploying and proving our approach to managing the Smart Grid. We are recognized as **thought leaders** in this domain and have worked with and learned from electricity distribution companies, regulatory authorities, university research teams, DER developers, SCADA/DMS suppliers, grid edge device manufacturers and many others. Our Active Network Management (ANM) products are used in cities, rural areas and on islands, and we work with customers in the UK, Europe, and North America. Smarter Grid Solutions is **committed to supporting grid modernization**: we have developed ANM technology as a platform to facilitate a DSO market under high renewable energy scenarios. Smarter Grid Solutions' experience extends to provide consultancy, services and tools enabling utilities to adjust to the distributed energy future – providing turn-key support across smart grid planning, operations, and the utility business model.

The Institute for Energy and Environment at the University of Strathclyde is the **largest European electrical power engineering research group** with 33 Academics, 80 full-time research engineers and over 110 research students. It has research expertise in a wide range of topics including power system analysis, power system planning, active network management and data analytics.

The University's contribution will be led by Prof Stephen McArthur, the co-director of the InstEE. His personal research and expertise is in the field of intelligent system applications in power engineering covering active network management, smart grids, condition monitoring and data analytics. Through his expertise and research team the original PMAR data analytics research has been undertaken through a PhD student and senior researcher. This has led to the prototype algorithms that will be fully developed and deployed through INSPIRE. The InstEE also has extensive protection and control software and hardware simulation laboratories that can be used to support the INSPIRE project.

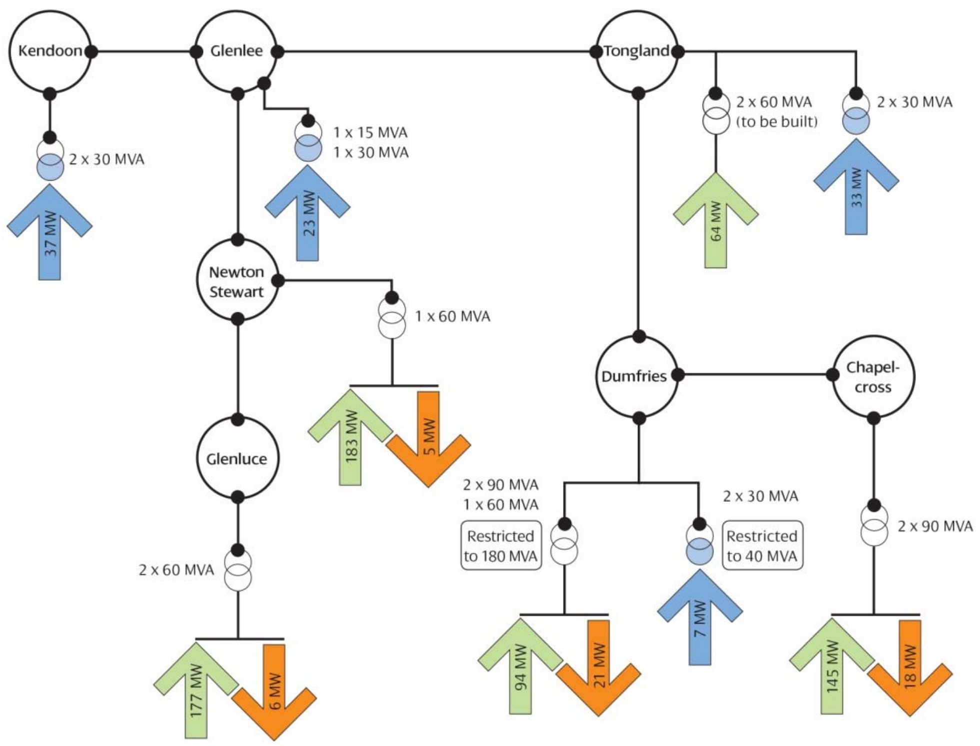
He is Principal Investigator for the EPSRC Centre for Doctoral Training in Future Power Networks and Smart Grids, a partnership with Imperial College. This centre will train 50 PhD students in the area of smart grids and provides access to an in kind research resource for INSPIRE.

Prof McArthur, and the wider academic and research team in the InstEE, has excellent experience of delivering impactful research into industry partners including network operators such as SP Energy Networks, SSE, National Grid, and ENW. A number of these projects, including ARC and Flexible Networks, have been run through Ofgem's innovation funding programmes.

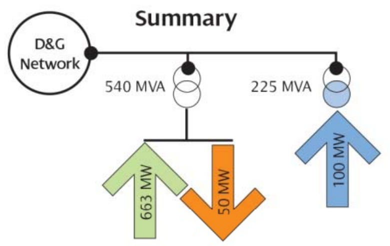
The Institute constructed and leads the Power Networks Demonstration Centre, a unique £12M test facility for smart grids, providing a fully operational 11kV and 400V electrical network. It is a joint venture between the University of Strathclyde, Scottish Enterprise, the Scottish Funding Council, SP Energy Networks and SSE aimed at accelerating the adoption of novel research and technologies into the electricity industry. Partners include S&C Electric, Omicron, UKPN, Vodafone and Locamation.

SP Energy Networks has engaged with National Grid GBSO during proposal development. Their role will be primarily in use-case 2 delivery, helping to define key deliverables, verifying the application delivered during the trial phase, planning for business as usual implementation, and disseminating knowledge captured internally in NGET and to DNO's.

Dumfries and Galloway 132kV Network



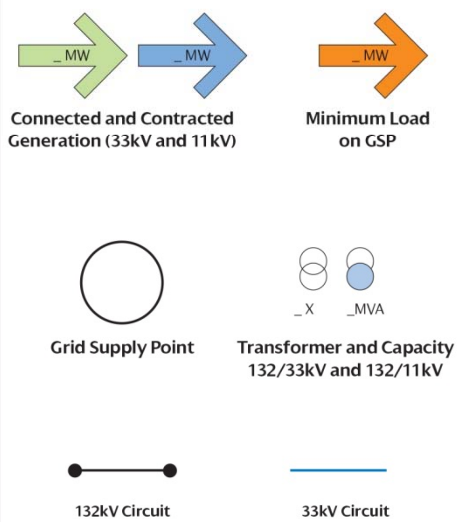
Summary



In Dumfries and Galloway, there is 540 MVA of transformer capacity between 132 and 33kV. There is also 663 MV of connected or contracted generation at 33kV, 100 MV of generation at 11kV and a minimum of 50 MV load. As such, were one of these GSPs to go out of service, or if one of the circuits connecting the GSPs were to develop a fault, there would be a significant risk to the remaining network assets, as well as to the security of supply to customers in this region. Additionally, the 132kV network is facing thermal overload issues, particularly at Tongland. There is significant planned reinforcement work in this region, but the level of generation here will only rise further - any additional capacity will be taken up with new generation quickly, given the rapid growth in generation in Dumfries & Galloway. Currently, there are few smart solutions deployed here. There are load management schemes deployed for windfarms, tripping generation when flow nears its rating.

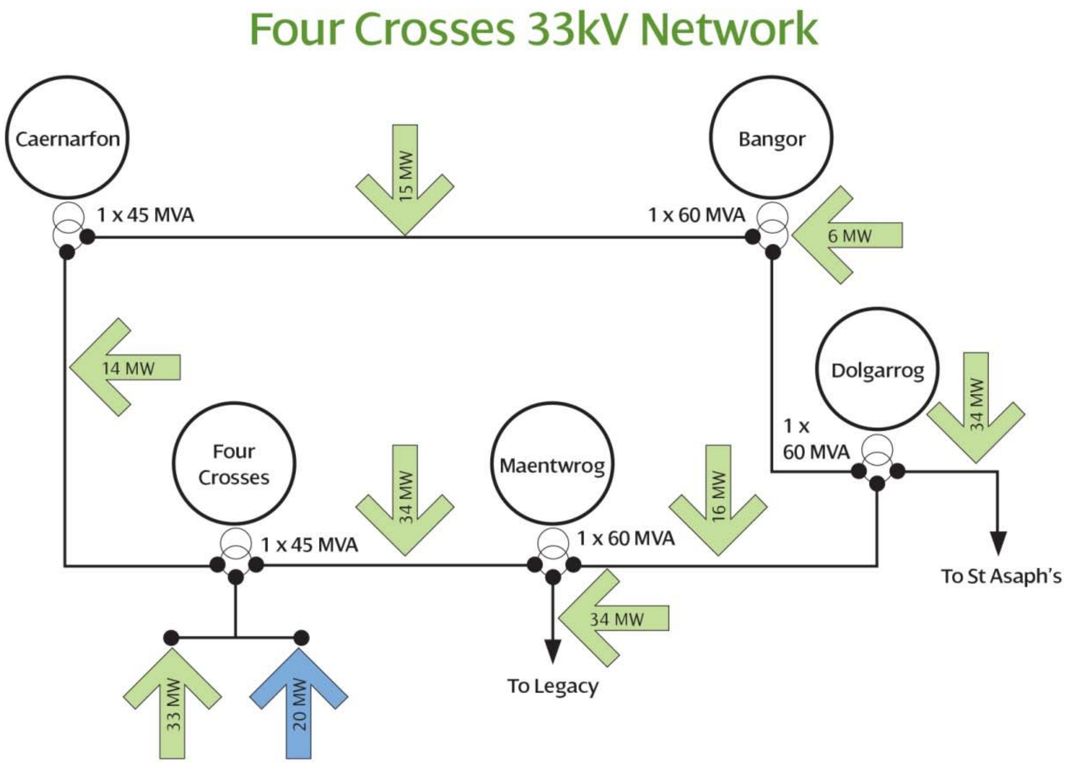
This is a suitable site for the INSPIRE Trial due to these generation constraints, and the projected rise in demand for generation capacity in this region. The increased use of ANM and other smart grid systems means that INSPIRE - particularly through use-cases 1 and 4 - will be beneficial in resolving the underlying issues here.

Key



Data from 2015/16 Long Term Development Statement

Figure 10-19: Dumfries and Galloway 132kV Network



Summary

There is significant interest in increasing the amount of generation connected to the - Four Crosses and Maentwrog Grid Group within North-West Wales. This Grid group is connected to National Grid's Trawsfynydd 275kV Grid Supply Point and is also interconnected to the wider 33kV network in North Wales via circuits to Caernarfon, Dolgarrog and Legacy Grid substations. There will be thermal and voltage constraints in this area during network contingencies as a result of the high numbers of current and planned connections. In addition, further enquiries for generation connections are still being received. There are ongoing works to install a second 132/33kV Grid transformer at Maentwrog, along with second 132kV circuit between Maentwrog and Trawsfynydd GSP. Additional reinforcement options are also being investigated. It should be noted that the network in SP Manweb is configured significantly differently to most UK+DNO distribution networks. Most UK DNOs operate radial networks, whereas the SP Manweb - network is designed to be operated interconnected. Whilst both network types face the same network limitations in terms of thermal, voltage (and fault level) constraints, the interconnected nature of the SP Manweb network mean that power flows can be more complex and changes in power flows occur over a wider area. However, whilst the network challenges may have some differences, the ANM solution will be similar and can be effectively managed within the INSPIRE project.

Key

Data from 2015/16 Long Term Development Statement

Figure 10-20: Four Crosses 33kV Network

Appendix K Links to Other Innovation Projects

Research has been carried out on projects with similar topics to ensure research is not duplicated, instead INSPIRE will build upon learning from a number of previous and on-going innovation projects. These projects include Low Carbon Network Fund projects, previous IFI projects, and SP Energy Networks NIA projects. These projects have generated significant learning points which have informed a number of decisions on INSPIRE's focus and use-cases.

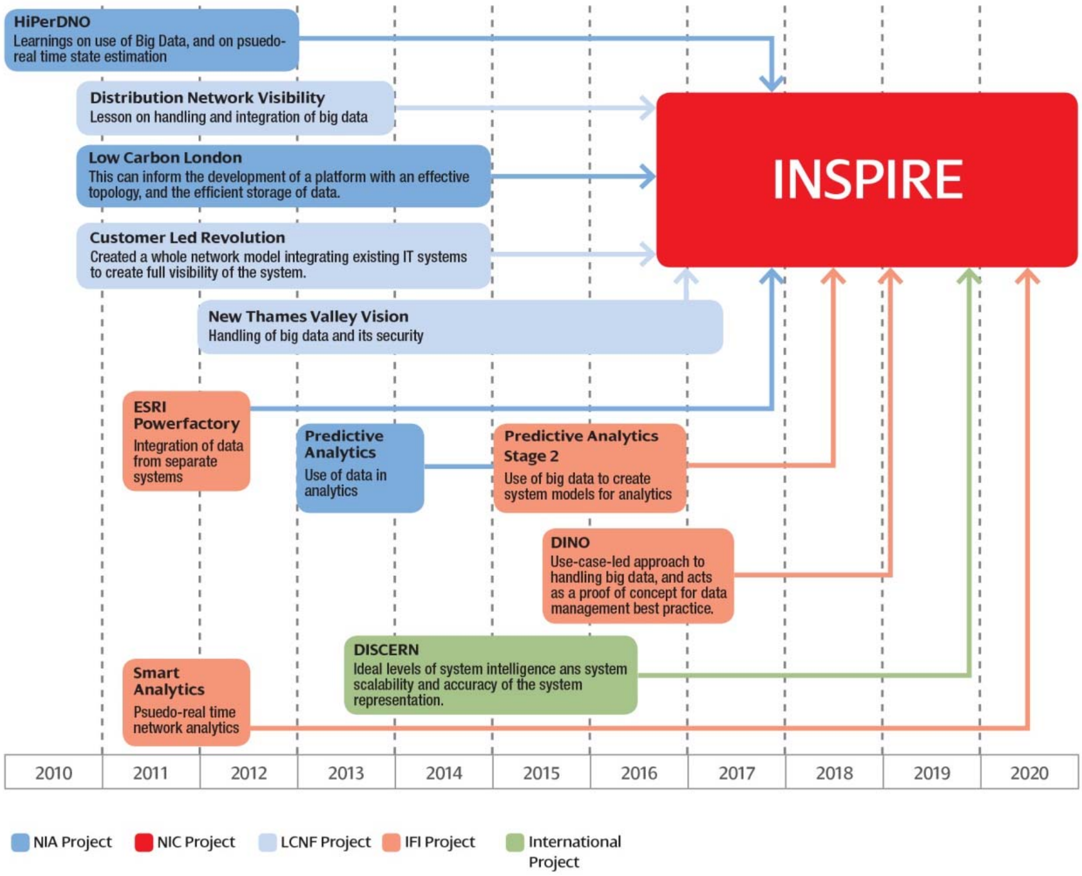


Figure 10-21 Timeline representing projects which feed into INSPIRE

K.1 Lessons from Previous Projects

There are six main categories which the learning from these projects fall under. These are:

- "Big Data" Handling (regarding the collection, communication, processing and security of the large amounts of data which can be gathered from Distribution Networks)
- Real-time Analytics (the analysis of the data in close-to-real time in order to understand the data and what it tells us about the state of the network)
- Network Visibility (The ability to have a full and accurate picture of the distribution network showing its current state in real time)
- Data Integration (The use of data from diverse sources and their combination into one platform)
- Whole-systems Modelling (The creation of one integrated model which takes in data from many sources and provides diverse functionality for end users)
- DNO/SO Interfacing (Concerning methods to improve interaction, co-ordination and whole system planning between the DNO and the SO).

Table 10-3 summarises these learning points.

Table 10-3: Summarised Learning Points

Project	Learning Point
"Big Data" Handling	
Distribution Network Visibility	Data Functionality must be clearly defined and linked to use-cases, and the Quality of captured data is crucial.
HiPerDNO	With Large Volumes of Data, a powerful platform and fast communications layer are necessary.
DINO	This demonstrated a use-case led approach to handling large data volumes.
New Thames Valley Vision	Data Security must be inherent in the handling of "Big Data".
Real-Time Analytics	
Smart Analytics	Analytics can be carried out in a psuedo-real-time manner accurately, given the right modelling.
Predictive Analytics	One of the most important aspects of data analytics is a deep understanding of available data.
Network Visibility	
DISCERN	The ability of the system to be Scaled and have replicable results must be considered to ensure the network visibility obtained is an accurate representation of the network.
Customer-Led Network Revolution	The Visibility of the NPG network obtained from this project came from having a whole-network system which integrates the existing IT systems.
Distribution Network Visibility	The analysis of existing unexploited data allows new network measurements or analysis to be carried out.
Data Integration	
Low-Carbon London	The advent of smart grids increases the needs for integration between data and systems, in particular an integrated network topology model
ESRI / PowerFactory Interface	Data Consistency between systems must be maintained.
New Thames Valley Vision	Before it can be integrated and considered to be useful, data must have a high level of validity, and the source data must be highly accurate.
Distribution Network Visibility	Each data set must be to be easily associable with the network measurement it is related to, to allow clear data combination.
Whole-systems Modelling	
Customer-Led Network Revolution	The use of the Grand Unified Scheme allowed network management and demand response technology to be more effectively used in the NPG network, and allowed consistent management of the network technology.

Predictive Analytics	The starting place of a successful Whole-systems Model starts with deep understanding of business needs and challenges.
FALCON	Modelled growth of Smart grid and Low carbon components into the Distribution network, and gave insights into network planning for their integration. Key algorithms for combining and reconciling data between DMS, GIS and EAM systems were successfully prototyped.
DNO/SO Interfacing	
CLASS	CLASS demonstrated the viability of new co-ordination techniques between DNOs and SO. INSPIRE will build upon this to facilitate whole-systems planning.
Low Carbon London	Demand Side Response can be more effectively implemented when there is co-ordination of smart techniques and technologies.

K.2 Other NIC Project Proposals

There are two other 2016 NIC projects being proposed to OFGEM which are relevant to INSPIRE. There will be ongoing and parallel learnings from these projects which can inform aspects of INSPIRE.

Table 10-4: Relevant 2016 NIC Proposals

Transmission Distribution Interface 2.0	**National Grid Electricity Transmission**
This project aims to demonstrate that there are untapped resources on the network which can be reliably tapped in real-time, and that it is possible to link DNO and SO approaches to resolve conflicts between their actions. INSPIRE will improve the data exchange between DNOs and the SO thereby helping to facilitate the new techniques developed under TDI 2.0. The SO are a partner on INSPIRE ensuring issues are considered from the SO perspective as well as a DNO perspective.	
ReZone	**Scottish and Southern Energy**
This project will assess the viability of using third party assets (such as storage and generation) to improve security of supply, avoid reinforcement, and minimise the use of mobile generators when faults occur on the network. INSPIRE will improve visibility of network information for both long and short term planning, facilitating the future roll-out of the techniques trialled under ReZone. SSEPD support the INSPIRE proposal.	

K.3 Office and Site Integration System (OASIS)

Over a decade ago, SP Energy Networks initiated the business as usual OASIS project, which was designed to replace a number of the core IT systems used by SP Energy Networks at the time. This was ultimately terminated without meeting its objectives. Some of the INSPIRE stakeholders have indicated there are similarities between the two projects based on the high level systems infrastructure architectures and the intention to use CIM. Table 10-5 compares the main features of these two projects, and shows that the projects are different in purpose, scope, and approach.

Table 10-5: INSPIRE vs OASIS

INSPIRE	OASIS
2016 NIC Innovation project	An IT programme, terminated 10 years ago
Innovative WISP architecture	SOA with ESB architecture
Will develop a network information model, separate from core systems but integrating information from core systems and other sources. Not intended to replace any current IT systems.	Responsible for replacing a number of the core IT systems.
Will demonstrate how diverse use-cases, driven by dynamic business requirements, can be addressed.	Focused on improving SP Energy Networks integration between office and site processes/systems.
Will consider 3rd party interfaces e.g. the GB SO and customers.	Only considered SP Energy Networks internal interfaces.
Timely due to emerging requirements of the smart grid and the recent advances ICT and understanding of data management techniques.	Programme ended before objectives were fully met.

K.4 Coherence Engine

The 'Distribution Management Coherence Engine' project conducted by Low Carbon South West, Grid Scientific and Bath University addressed the feasibility of designing and constructing a Coherence Engine product for the distribution network. This project recognised the need for such a product in order to "manage the evolving Smart Grid", and sought to provide a model and associated integration framework to facilitate the need for intelligent data integration anticipated in the future Smart Grid. The Coherence Engine report highlighted the need for a distribution network model that will be demonstrated through INSPIRE's WISP.

The feasibility study made reference to the Telecoms industry which has already undertaken comparable changes after its deregulation and privatisation. Some of the drivers of this, including the increase in data volume, the move towards customer-centric networks and increased flexibility, are aligned with the changes predicted in the electricity sector. The Telecoms industry concluded that an active, intelligent model-based approach to the integration framework was the way forward to allow vendors/network operators to create new applications. This approach was very successful in the Telecoms industry. Some of the pertinent lessons from this project are:

- Specialised, open-architectures and applications are required
- Integration of applications enables automation of end-to-end processes
- Providing applications with a shared view of managed networks, services and customers supports process consistency, accuracy and easier data management – and enables integration
- As business, operations and technology changes are introduced, there are substantial migration tasks – these need to be built in, not added on retrospectively
- Technology is only one component of a solution

INSPIRE seeks to incorporate and build upon these lessons in order to allow similar benefits to be realised in the electricity distribution industry.

Appendix L INSPIRE and the Common Information Model

The Common Information Model[36] for power systems was created as an EPRI initiative which aimed to create common definitions of power systems components to create a way of allowing vendors of Energy Management System components to support a common interface so that their customers could build systems using components from different suppliers. Since then it has grown to an IEC-maintained set of standards: IEC 61970 (EMS), IEC 61968 (DMS), and IEC 62325(Markets)[37].

Nationally, and globally, a number of different projects have tried to leverage the CIM to derive benefit in a number of different areas. These range from data transfer between different entities, e.g. SO, DSOs, aggregators, to data exchange between DNOs internal systems.

National Grid has identified the CIM as the key standard supporting the data strategy aimed at creating a new approach and capabilities through the composition of semantic data models and services leading to a more flexible and efficient business. They have adopted CIM as a mandatory standard for all new and updated data interfaces. Their communication with DNOs is now undertaken through a web platform where DNOs provide their network data using their own formats, which are automatically translated into CIM by a data exchange gateway. NG's lessons learnt helped improve the standard and can be very useful for DNOs when adopting the CIM in the near future.

The WPD CIM NIA project will build on work done by project FALCON, which successfully combined data for the 11kV network from key systems (DMS, GIS, and Asset Management) to create an Authorised Network Model, to create a comprehensive, accurate and portable network model in CIM format. The benefits of having a network model in CIM format will be tested in terms of software adoption and integration, in terms of data exchange with third parties and as a tool to create system interfaces. CGI are a significant participant in the WPD CIM project and will thus be ideally placed to carry forward the developments and learnings from this project into INSPIRE, which will further progress and enhance these learnings and integrate many further systems using CIM messaging to cover additional use-cases.

As the use of CIM has moved beyond its original intention, each new use-case highlights the potential benefits of a common information model but also the limitations and open questions surrounding CIM-based integration.

INSPIRE will take full advantage of the learnings from previous projects – particularly the WPD CIM project – to determine how and to what extent the CIM will be used in the WISP. The benefits and techniques associated with the CIM will be evaluated and enhanced by INSPIRE's WISP, which will integrate new systems not considered by WPD CIM and will cover additional use-cases**,** including coordination of smart grid techniques, improved network performance via data analytics, and enhanced network planning.

In summary, the CIM is one of the tools that INSPIRE will utilise in delivering its solution, rather than the primary focus of the project. However we do expect to deliver learnings in relation to the CIM as discussed further below.

[36] An introduction to what CIM is: http://www.epri.com/abstracts/Pages/ProductAbstract.aspx?ProductId=000000003002006001

L.1 Expected contributions of INSPIRE regarding the CIM

INSPIRE will use CIM to the maximum practicable extent that is appropriate, moving beyond its use by the WPD project for:

- exporting network topology/asset master data models of the whole or portions of the distribution network as data files;
- to communicating these between INM/SNM and the other INSPIRE applications; and
- for communicating transactional or historical information much more widely between INSPIRE applications across the ESB and via other integration services.

Data management and marshalling had not been specifically considered by most projects – even today these are still very much emerging disciplines with more and more learnings disseminated as different approaches are tried. INSPIRE's WISP will provide the data management strategies required to cope with the CIM limitations explained below, namely ID management, granularity, versioning and overlapping data models. EPRI themselves now recommend that a model manager is required to unlock the maximum benefits from CIM[38] and this is precisely what the WISP is.

Finally, **INSPIRE's systems-engineering approach will help define a cost-effective IT architecture that takes full advantage of the benefits of CIM** – i.e. interoperability and scalability – without incurring in major costs caused by modifications that in many cases would need to go to the hearts of core IT-systems. However, the proposed method to be deployed as part of INSPIRE is not dependent on core systems having CIM-compliant interfaces, since data will be taken in the format native to the core system and the CIM will be applied within the WISP. In that way, the INSPIRE approach with regard to CIM adoption is more incremental, cost effective and less risky. The WISP will provide a hybrid solution leveraging the CIM to form a lightweight canonical model embracing heritage (legacy) systems.

The core WISP components, and particularly the INM, will be developed to be open, configurable and re-usable so they can be made available to other DNOs as cost-effectively as possible. Whilst some of this software will be specific to the proprietary products used by SP Energy Networks' core systems, the remainder of this software will be generic and CIM-compliant and thus readily deliverable to other DNOs.

L.2 Limitations and open questions – challenges of CIM integration

Previous experience shows that CIM improves interoperability in a wide-range of functionalities within the electricity domain: from network model exchange to research and development projects that have explored its potential use for the integration to smart grid technologies, such as ANM, DER, DSM and Smart Metering. However, the CIM does not define data management strategies necessary to resolve the following interoperability issues.

L.2.1 ID management

The CIM standardises classes or types of objects, but not the values of object identifiers (IDs). Since version 15, CIM includes classes that enable to provide details on the application and authority that assigns a particular ID. Nonetheless, manual mapping of IDs is still required. Moreover, CIM assumes that applications which master CIM data will create unchanging Universally Unique IDs (UUIDs) for each data record they master. Unfortunately, most Commercial Off-The Shelf (COTS) application platforms (e.g. SAP, ESRI, PowerOn Fusion) do not do this. The WISP components will include appropriate ID

[38] It does not, however, cover all of the data types that are used by UK DNOs, particularly those that are specific to the UK power industry architecture, including many of the Master Registration Agency Data Transfer Catalogue field types and messages.

management facilities, and support easy mapping between alternative IDs, to address this issue.

L.2.2 Granularity

Different applications require different granularities of information about the same parts of the network. The WISP will address this by building a maximum-granularity model of the network from which it is then much easier to abstract the unwanted items of detail as appropriate for each receiving application.

L.2.3 Versioning

The CIM needs to evolve in order to meet the requirements of new applications and functionalities. Each year the working groups of experts within the IEC TC57 agree on a new version of the CIM. There are currently 16 versions and, although it is growing more mature and the core data model is now very stable, mismatches exist between previous versions of the model. Whilst versioning support can be built into application adapters that convert messages between CIM and its internal formats, this again adds to the cost of successful deployment, and these adapters still have to be modified each time a new version affects the data structures they are using. For INSPIRE we will incorporate support for future CIM versioning into all new applications and CIM adaptors used in order to make the WISP flexible enough to address future issues.

L.2.4 Overlapping data models

The CIM is the most relevant data model in smart grids, but there are other overlapping data models widely adopted in this domain, both proprietary and standardised models – such as the IEC 61850 System Configuration Language (SCL) for automation systems and network models and the DLMS/COSEM for smart metering. For example CIM does not cover data structures such as MPANs and the related entities that are specific to the UK industry architecture. CIM, however, does support extensions, so for INSPIRE we will define appropriate extensions to cover data types not currently embraced by CIM, looking first to see where any work already in progress elsewhere can provide relevant suggestions for filling in these gaps.

L.3 Summary

The above issues hinder implementation of enterprise-wide ESB CIM solutions, and have resulted in a number of past projects, such as OASIS, being unable to deliver their envisaged benefits, because the costs for replacing or adapting IT core systems can be prohibitive. In that way, **ESB-only CIM approaches have a number of disadvantages**, including much higher project costs and risks, transactional delta interfacing needing invasive changes to the existing master systems, need for expensive data cleansing to move data mastering between systems such as from DMS to GIS, and challenging business process changes to then ensure GIS data is updated before commissioning rather than afterwards as at present. WISP offers an innovative approach to driving out the main benefits of CIM interoperability but at a cost more affordable to DNOs and the UK power industry.

Appendix M Stakeholder Engagement Event

A Stakeholder Engagement event was held on 09/05/16 at the IET Building, Savoy Place, London. The event was well attended with many interested parties from both industry and academia – WPD, SSE, National Grid, Nortech, Smarter Grid Solutions, TNEI, GE, Open Utility, BEAMA, Chiltern Power, Gavin Jones Consulting, SGN, Open Grid Systems, Brunel University and University of Strathclyde. Interfacing with these attendees provided technical input and identified areas of scope in which INSPIRE could improve upon. This event was primarily to identify and attract project partners and external resourcing/funding.

The feedback questionnaire found that 93% of the attendees felt that INSPIRE is timely, and 87% said that it would contribute to the transition to a low carbon electricity network.

Key Messages

Academia:

"The use-cases, if done well, are key."

"Enable frequent update of the modelled network. Quick decisions will enable the network to be more efficient. Integrating data will allow network operators to take sensible, cost-effective overall optimised action."

Service Providers:

"Joining the four use-case areas is essential to the value demonstrated of data/model integration"

"INSPIRE can help to enable more effective adoption of embedded generation and flexibility services."

Suppliers:

"Focus on tangible benefits for distribution customers."

"INSPIRE could provide enhanced data availability / leeway, improved availability / reliability. Enable access to data by 3rd parties, therefore facilitating competition."

DNOs:

"Reduced costs, increased efficiency and increased customer satisfaction envisaged from INSPIRE."

"INSPIRE can provide standardisation of integration making the best of available data."

"There is uncertainty around data quality. Difficulty of evaluating benefits especially where these are to 3rd parties"

"Define objectives from the out-set to avoid scope drift"

Gas Sector:

"INSPIRE has the potential for further understanding of cross-sector constraint support."

Consultants:

"INSPIRE will start to address the big issues identified by DS2030, FPSA etc"

The INSPIRE team have undertaken a thorough and proactive stakeholder engagement to ensure that the proposal is fit for purpose, can leverage the learnings from and avoid the duplication of previous innovation. We have received 20 letters of support, representing the sectors of local government, national research institutes and consortia, DNOs, GBSO, academia and suppliers. This section presents some extracts and demonstrates the extensive support INSPIRE secured.

Key Stakeholders

Energy Systems Catapult

"...has the potential to enable capabilities identified in the work of the Smart Grid Forum in Work Stream 3: Transform, Work Stream 7: DS2030 and Work Stream 9: Smart Grid Supply chains."

"Importantly, the project proposes an approach which can be applied incrementally, and is flexible to meet as-yet unknown requirements."

"I also confirm that I will represent Energy Systems Catapult in the Project Steering Group."

National Grid

"Project team....Look forward to sharing learning from the INSPIRE projects outputs and will participate in the INSPIRE knowledge dissemination."

Chiltern Power

"INSPIRE is a challenging project but has been carefully structured in conjunction with specialist partners who are familiar with the data systems of GB network companies. The wider application potential is high, and the benefits for the future are significant"

Electricity North West

"INSPIRE projects potential benefits include optimising the planning and operation of multiple smart grid technologies, development of a transferable, standard information platform architecture which may include cost efficiencies."

"we look forward to sharing learning from the project outputs and participating in the stakeholder consultation."

Key Stakeholders

Northern Power Grid

"We support this approach as, dependent upon wider adoption by the industry of a standard information platform, it could provide the environment for the growth of a market in 'plug and play' applications for a range of current and future DNO functions"

SSEPD

"Better managing network data is obviously a key element of the delivery of a successful Smart Grid. This will be essential to GB achieving its carbon targets and also delivering benefits for customers. The INSPIRE project is obviously looking to deliver learning in this area."

SGN

"We believe that more intelligent networks can help to manage our constraints and deliver a more efficient, reliable, affordable, lower carbon supply to our customers in the future."

"...keen to share in the learning for this exciting innovative project."

Western Power Distribution

"Potential benefits include optimising the planning and operation of multiple smart grid technologies, and enabling their integration into existing networks, cost efficiencies through developing standard information platform architecture."

"....we look forward to sharing learning... we will participate in the INSPIRE stakeholder consultation and the proposed Industry Stakeholder Group."

Scottish Enterprise

"...project proposes an approach which can be applied incrementally, and is flexible to meet as yet unknown requirements"

"We are in support of the INSPIRE project objectives of developing and demonstrating an information system that enables the functionality required from the future distribution network"

Partners

CGI

"...recognise that the need to deliver smart grids and lower carbon emissions is substantive and the pace is now increasing..."

"CGI have invested significantly in designing the concept for INSPIRE and supporting you in the development of your proposal in order to provide the right solution for the industry. We would be proud to support you as the prime technical partner."

Nortech

"....Our view is that the INSPIRE project has the potential to narrow the gap between where we are now as an industry, in terms of managing network data and realising benefits from network information, and where we need to be in the future to accommodate a smarter UK electricity grid."

WSP Parsons Brinckerhoff

"...we believe these issues and the time spent to resolve them, could be significantly reduced through the method proposed by INSPIRE."

"...keen to participate in the stakeholder consolation and learn from the projects outcomes."

SGS

"INSPIRE project will..... create new intelligence that can help distributors more efficiently understand and manage distribution networks. Such a transition is of particular importance due to the transition towards smart power and energy systems..."

"...providing OPEX savings, improved asset management, delivering OPEX and CAPEX benefits and the ability to integrate operational technology across the energy sector."

University of Strathclyde

"For over 20 years we have been one of the leading international research teams in the application of data analytics and intelligent systems for power and energy applications"

"Our Learning from these activities is that the approach taken in the INSPIRE project will accelerate the uptake and effectiveness of data analytics in the industry"

Suppliers

GE

"...delighted to be involved ...ready to support and take on wider responsibilities as required."

"...value for money, robust delivery programme and seamless transfer to BaU (Business as Usual)..."

"...INSPIRE project will provide an effective and scalable solution that will deliver, business process improvement..."

TNEI

"...INSPIRE project has real potential to pave the way towards a 'smarter' electricity grid in the UK and reform the Electricity Grid as set out by the UK's 2050 Carbon Plan.... it will enable a coordinated approach to strategic network design..."

ESRI

"The INSPIRE project offers another opportunity for Esri UK to continue its multi-partner approach to project delivery in the innovation space. The project naturally aligns with our vision, technology capabilities and desire to drive the benefits of a geographic approach. Our proven, valuable and successful working relationship is something we'd like to continue into the future."

Arup

"...an important step in exploring the opportunities and addressing the challenges of this critical piece of the energy system jigsaw."

"Project INSPIRE clearly has the potential to deliver an important step change for the sector in terms of assessing the technical and economic benefits of intelligent and exchangeable network data management and insight."

"...delighted to share our cross-sector learning in support of the successful delivery."

Academic

University of Manchester

"...through careful management of massive quantities of data, application of efficient knowledge extraction techniques and its horizontal and vertical integration, the proposed approaches for future frequency response, or System Integrity Protection Schemes can be realised."

"Considering the importance of the project and its relevance to the future GB, I am delighted to provide my full support to the project with the hope that it will be approved by OFGEM."

Brunel University

"The INSPIRE project is an exciting and innovative...has real potential to pave the way towards a 'smarter' electricity grid in the UK and reform the Electricity Grid as set out by the UK's 2050 Carbon Plan."

Appendix O Glossary of Terms

Term	Definition
AD	Active Demand
ANM	Active Network Management
AMS	Asset Management System
ARC	Accelerating Renewable Connections
BAU	Business as Usual
BETTA	British Electricity Transmission and Trading Arrangements
CBA	Cost Benefit Analysis
CEP	Complex Event Processing
CI	Customer Interruptions
CIM	Common Information Model (IEC 61968)
CLNR	Customer Led Network Revolution
CML	Customer Minutes Lost
COSEM	Companion Specification for Energy Metering
COTS	Commercial Off The Shelf
DA	Distributed Automation
DAG	Data Assurance Governance
DECC	Department of Energy and Climate Change
DER	Distribution Energy Resource
DG	Distributed Generation
DINO	Data Intelligence for Network Operation
DLMS	Device Language Message Specification
DNO	Distribution Network Operator
DMS	Data Management System
DPlan	Power Systems Software
DSO	Distribution System Operator
DSR	Demand Side Response
EAM	Enterprise Asset Management
ENW	Electricity North West
EPRI	Electric Power Research Institute
ER P2	Engineering Recommendation P2
ESB	Enterprise Service Bus
EU	European Union
FES	Future Energy Scenarios
FLEX NET	Flexible Networks for Future Low Carbon Future
FPSA	Future Power System Architecture
FTE	Full Time Equivalent
GB	Great Britain
GE	General Electric
GIS	Geographical Information System
GSP	Grid Supply Point
GVA	Giga Volt-Amps
GW	Gigawatt
HV	High Voltage
ICP	Independent Connection Provider
ICT	Information and Communications Technology
IEC	International Electrotechnical Commission
IET	Inst. of Engineering and Technology
IFI	Innovation Funding Incentive
INM	Integrated Network Model
IPR	Intellectual Property Rights
ISP	Initial Screening Process
IT	Information Technology
km	Kilometres
kV	Kilo-Volts
LCNF	Low Carbon Network Fund
LCNI	Low Carbon Network Innovation
LCT	Low Carbon Technology
LTDS	Long Term Development Statement
LV	Low Voltage

MDM	Master Data Management
MPAN	Meter Point Administrator Number
MV	Medium Voltage
MVA	Mega-Volt Amps
MW	Mega-Watts
MWh	Mega-Watt hours
NaFIRS	National Fault and Interruption Reporting Scheme
NETA	New Electricity Trading Arrangements
NG	National Grid
NIA	Network Innovation Allowance
NIC	Network Innovation Competition
NMS	Network Management System
NPG	Northern Power Grid
NPV	Net Present Value
OCAT	Online Curtailment Analysis Tool
OHL	Overhead Line
OT	Operational Technology
PI	Historian of network measurements
PMAR	Pole Mounted Auto Recloser
PoC	Point of Connection
PV	Photovoltaic
RIIO-ED1	Electricity Distribution 1 Regulatory Period
RTTR	Real Time Thermal Rating
SCADA	Supervisory control and data acquisition
SCL	System Configuration Language
SDRC	Successful Reward Delivery Criteria
SGAM	Smart Grid Architecture Model
SLA	Service Level Agreement
SMART	Specific, Measurable, Achievable, Relevant and Time-Bound
SMEs	Small and medium-sized enterprises
SO	System Operator
SOA	Service Oriented Architecture
SPD	Scottish Power Distribution
SPEN	Scottish Power Energy Networks
SSE	Scottish and Southern Energy
SSEPD	Scottish and Southern Energy Power Dist.
tCO2e	Tonne of CO_2 equivalent
TO	Transmission Operator
TRL	Technology Readiness Level
TSB	Technology Strategy Board
UC	Use-case
UK	United Kingdom
UKPN	UK Power Networks
VISOR	Visualisation of Real Time System Dynamics using Enhanced Monitoring
WISP	Whole-systems Information Synthesis Platform
WP	Work Package
WPD	Western Power Distribution