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Operation and integration considerations for distinct Qualifier trial providing units of system services.

D4.5

EU-SysFlex

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ABBREVIATIONS AND ACRONYMS

EU-SYSFLEX	Pan-European System with an efficient coordinated use of flexibilities for the integration of a large share of Renewable Energy Sources (RES)
DS3	Delivering a Secure Sustainable System
DSM	Demand Side Management
DSO	Distribution System Operator
DSR	Demand Side Response
DTS	Dispatcher Training Simulator
EED	Energy Efficiency Directive
EV	Electric Vehicles
GSM	Global System for Mobile Communications
NC	Nodal Controller
POAS	Power Off and Save
POR	Primary Operating Reserve
PV	Photovoltaic
QtP	Qualification Trial Process
RTU	Remote Terminal Unit
PPM	Power Park Module
SMS	Short Message Service
SOR	Secondary Operating Reserve
SNSP	System Non-Synchronous Penetration
SPAYG	Smart Pay As You Go
SSRP	Steady State Reactive Power
TOR	Tertiary Operating Reserve
TSO	Transmission System Operator
WFPS	Wind Farm Power Station
WP	Work Package

EXECUTIVE SUMMARY

This report provides details and the outcomes and progress of activities currently being carried out under the EU-SysFlex Qualification Trial Process (QTP) in Ireland and Northern Ireland, T4.3 of the H2020 EU-SysFlex project. The overall deliverable for the programme will be the publication of technical standards and operating protocols for new technologies, which will be completed annually. This includes identifying the appropriate testing and commissioning for the integration of new technologies, signalling requirements and real-time monitoring of service provision, scheduling and forecasting tools to facilitate dispatch in real-time to facilitate the utilisation of non-energy services provider. The QTP brings together many different strands including facilitating a range of new technologies classes to provide innovative system services.

The Qualification Trial Process (QTP) commenced in March 2017. The trials consisted of fifteen individual technology trials across twelve separate Providing Units. Following the completion of the QTP for 2017, the TSOs (EirGrid and SONI) identified twenty six learnings and outcomes. The TSOs have applied a number of the learnings based on the feedback from trial participants. As a result, the EirGrid and SONI have identified a need to expand on key topics for consideration as part of new technology integration through the QTP. The purpose of the QTP is to identify commercial and technical considerations for the qualification and large scale deployment of new technologies on the power system for 2030.

Building on the 2017/2018trials, the 2019 trials are now focussing on Solar, Residential Services and enhanced forms of communication for new and existing technology. Following a successful procurement in 2019, the EirGrid will be carrying out three new trials focussing on proving technology, measurability and capability in embedded technology. Table 1 presented below outlines the industry partners that were part of a successful tender application for the 2019 trials.

Trial	Trialists
Lot 1 - Solar	Bann Road Solar (Green Coat Capital)
Lot 2 – Residential Services	Energia
	Solo Energy
Lot 4 – Telecommunications	Energia
	Electricity Exchange

TABLE 1

In Parallel to the QTP for 2019, EirGrid and SONI have launched The FlexTech Technology Integration Initiative (FlexTech). The purpose of FlexTech is to provide a platform of engagement for the TSOs, DSOs, industry, regulators and other stakeholders. This platform is created in order to maximise the opportunities for effective use of new and existing technologies and to identify and break down key barriers to integrating renewables in order to meet the challenges associated with decarbonisation and to ensure the best use of new and existing technologies.

FlexTech will be act as platform of engagement as part of the EU-SysFlex project. The output of the initiative will develop a framework that is designed for positive and proactive engagement with all stakeholders. The FlexTech initiative is one that will be developed under Work Package 4, but practices and outcomes will be applicable to all system operators across Europe. Through collaboration the TSOs and DSOs can better understand the key challenges of participants in the electricity sector that, if resolved, will bring considerable benefits in the further integration of renewables to meet Ireland and Northern Ireland's needs.

1. INTRODUCTION

WORK PACKAGE 4

The EU-SysFlex project seeks to enable the European power system to utilise efficient, coordinated flexibilities in order to integrate high levels of renewable energy sources. One of the primary goals of the project is to examine the European power system with at least 50% of electricity coming from renewable energy sources (RES-E).

In order to reach at least 50% RES-E on a European scale, it will be necessary to integrate very high levels of variable non-synchronous renewable technologies such as wind and solar. Transitioning from a power system which has traditionally been dominated by large synchronous generating units to a system with high levels of variable non-synchronous renewable technologies has demonstrated complex system operational challenges in providing the necessary system resilience and reliability. This is due to the non-synchronous nature of these technologies as well as the variable and uncertain nature of the underlying resources.

The integration of nonsynchronous renewable generation results in the displacement of synchronous generators; this can consequently lead to technical scarcities in power systems. In order to address these scarcities, it will be necessary for new and existing technologies to provide flexible system services. In this regard, Work Package 4 (WP4) acts as a gateway, providing the technical platform to trial these services and technologies and provides a route to an enduring market. WP4 will also develop the system operator decision support tools required to operate the system in a secure manner with a high penetration of RES-E and system services. WP4 will also assess the system operator training needs for operating a system with a high penetration of RES-E and system services through a Dispatcher Training Simulator (DTS) of a significant part of the EU network.

WP4 interacts with other WPs within the EU-SysFlex project; the project structure can be seen in Figure 1. WP2 will identify the system scarcities associated with operating the system at high levels of renewables. In WP3 products will be designed to meet the needs of the scarcities identified in WP2. The decision support tool developed in T4.1 will use the services identified in WP3. The DTS in T4.2 will model a subset of the services identified in WP3 and will be based on the scenarios identified in WP2. The Qualification Trial Process in T4.3 will trial new and innovative technologies wishing to prove capability to provide system services and T4.4 will develop the operator protocols required for specific system and market conditions. This will act as a key input into the flexibility roadmap developed in WP10.

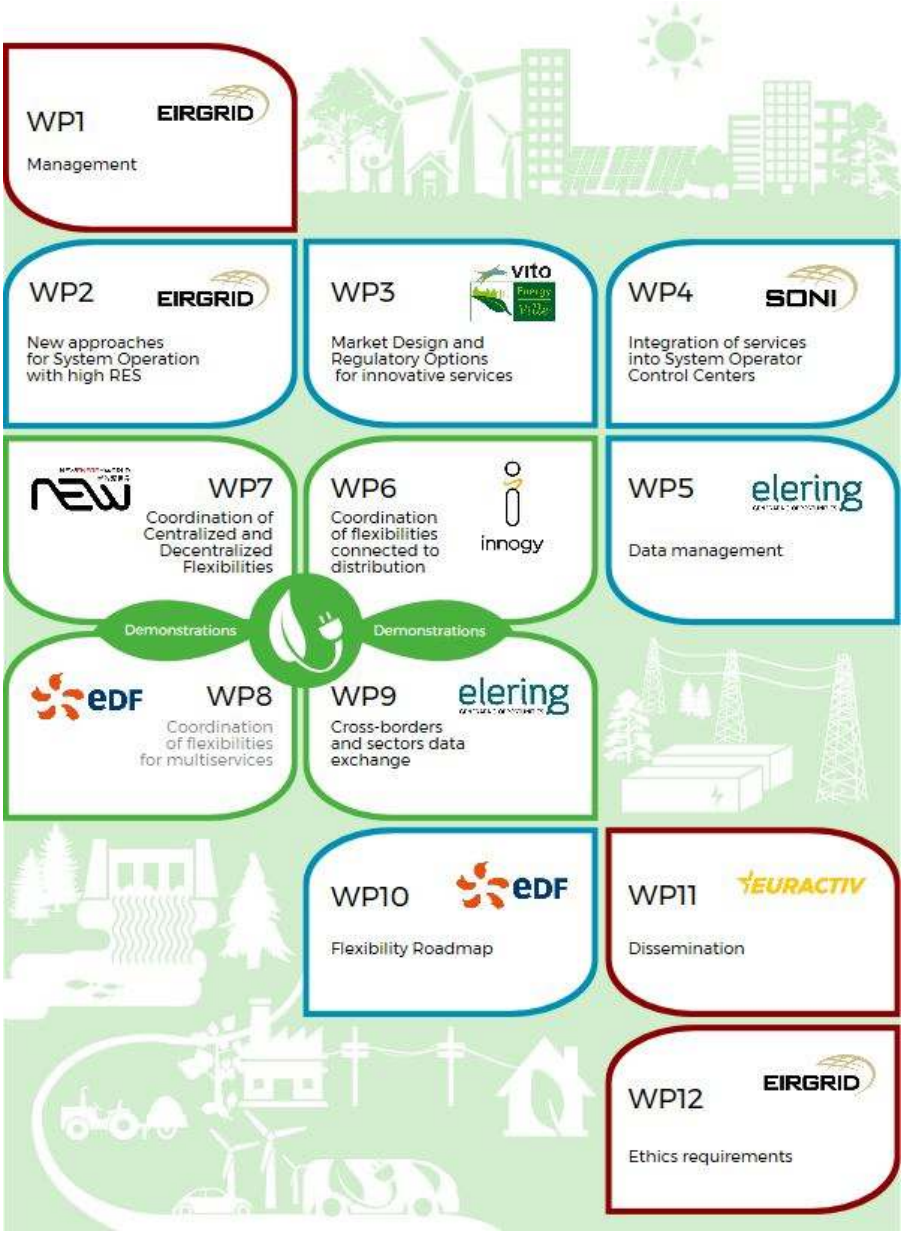

FIGURE 1- EU-SYSFLEX WORK PLAN

T4.3 WITHIN SYSFLEX

The Qualification Trial Process (QTP) in T4.3 provides the technical platform to trial resilience services from new technology providers and provides a route to an enduring services market. The QTP provides the link that facilitates the transition from fossil fuel tradition, to a sustainable renewable power system. It is a central piece of a much broader programme of work led by the EirGrid and SONI to meet the objectives of 40% electricity from renewables in Ireland and Northern Ireland by 2020. Today, Ireland & Northern Irelands' power system is the first in the world capable of delivering 65% of instantaneous electricity demand from non-synchronous sources including wind and solar.

MAIN CHALLENGES LINKED TO HIGH RES-E PENETRATION

In seeking to meet Ireland and Northern Irelands renewable objectives of 2020, the power system needs to be capable of operating at up to three quarters of the power being delivered from non-synchronous renewable technologies. As the current operational limit of 65% is increased to 75%, reliance on new technologies to provide the resilience of the system will increase. Today, Ireland and Northern Ireland are addressing the challenges that Europe will likely see in the near future. As Europe aims to achieve over 30% of its overall electricity needs from new renewable sources by 2030, this poses challenges to traditional system operation and new technology integration;

- How should a power system transition in order to obtain or procure these resilience services from new technologies when no one else in the world is seeing these issues?
- How will this transition succeed without threatening the security of the power system?
- How can a route to market be created to facilitate investment in demonstrations to satisfy technical scarcities?
- Can this be done in a way that links the commercial, technical and system integration aspects of not the one or the few, but the large scale deployment of these new technologies?

T4.3 will facilitate the real-time technology trials of new technologies for relevant system service provision on the Ireland and Northern Ireland power system. This will help to identify and to resolve operational protocols, technology capability and communication challenges and work with industry through a technology integration forum to address further system integration challenges. More generally, the trials will also consider the challenges associated with the large scale roll out of these new technologies. The output of this task is the appropriate solutions on operational protocols, dispatch tools and scheduling processes to qualify the new technology for system service provision on a large scale in the Ireland and Northern Ireland system in a prudent manner.

2. MANAGAGING THE TRANSITION TO NEW TECHNOLOGIES

Over the past ten years, the Transmission System Operators in Ireland and Northern Ireland have seen increasing changes in the technology that makes up our electric power system. Behind-the-meter technologies such as rooftop solar PV, Battery Storage, Vehicle to Grid Charging and energy management systems is changing the power system. The need for greater transparency of data and information will also drive change across the sector. As renewable generation (predominantly wind & solar in Ireland and Northern Ireland), displaces conventional generation on the system, these new technologies must also provide System Services to maintain resilience.

A transition to a power system with high levels of non-synchronous generation will result in new system scarcities. These scarcities are due to traditional providers of services (such as conventional generation) being displaced at times of high levels of non-synchronous generation. This drives the need for system services from an enhanced portfolio of service providers, consisting of a mixture of the existing services provider and new service providers with enhanced capabilities and new technologies.

A level of confidence and understanding of existing service providers' technologies has been built up through years of operating the power system with increasing reliance on these technologies. Confidence has been developed through operational practice, learnings and continual improvement. EirGrid and SONI also have well established policies, tools and systems in order to schedule, operate, remunerate and monitor the performance of these service providers. However, many new technologies fundamentally challenge these existing processes and operational confidence. Therefore the transition to an enhanced portfolio of services provider needs to be managed in a prudent manner, allowing the TSOs time to study and assess their impacts. This helps to ensure that outcome of an enhanced portfolio of services provider, whilst also ensuring the system is managed in a secure, reliable and efficient manner.

3. THE QUALIFICATION TRIAL PROCESS

The QTP is the mechanism through which the TSOs in Ireland and Northern Ireland are managing the transition to a wider portfolio of system service providers. The aim is to identify operational complexities that may be associated with new technologies, or delivery of new System Services. In doing so, the EirGrid and SONI can develop a deep understanding of these complexities and suggest solutions on how to best integrate these technologies at scale on the power system on the Island of Ireland and Europe. The trial process is depicted below in Figure 2 – Visualisation of how QtP facilitates changes in system operation.

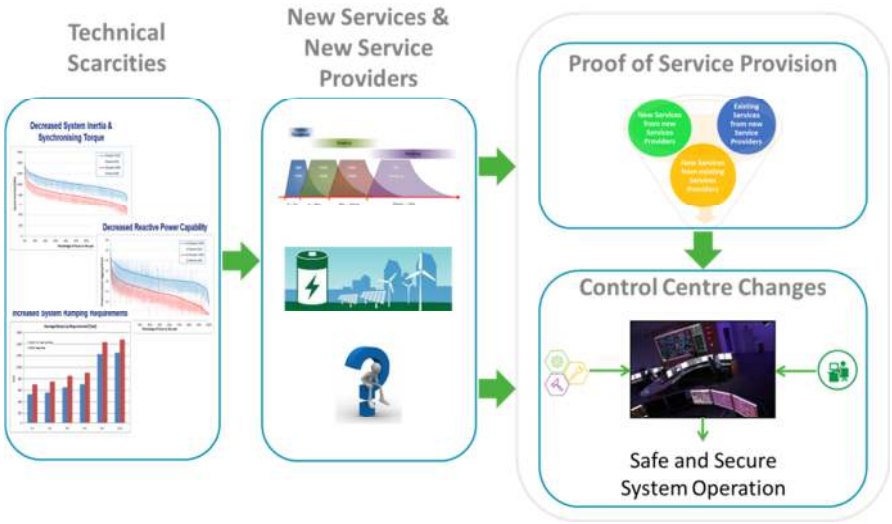

FIGURE 2 – VISUALISATION OF HOW QTP FACILITATES CHANGES IN SYSTEM OPERATION

TRIAL PRINCIPLES

There are a number of key principles which underpin the QTP;

1. The trials are run at small scale allowing participants to demonstrate provision of system services in small volumes. This demonstrates provision of services under real system operational conditions, but the small scale nature of the trials also ensures security of the power system.
2. Outcomes of a technology trial will inform whether the EirGrid and SONI consider a technology's ability to provide a number of system services within a service category as proven. An example of this is that a successful participation in a primary operating reserve trial may be considered as proof of the capability to also provide secondary.
3. The trials will inform whether the TSOs consider the capabilities of a technology class or sub-class as proven to provide a system service, and not a specific service provider or original equipment manufacturers. An example of this is that if a wind farm has been deemed to be proven under the wind category of trial for a service, this means that wind as a technology class has been deemed to be proven.
4. The failure of specific participant in the QTP does not necessarily exclude its technology class from provision of the service forever. Depending on the reasoning for the failure of a trial, EirGrid and SONI may elect to run a future trial with a separate service provider or alternatively consider other ways that may inform whether the TSOs consider the capabilities of a technology class or sub-class as proven.

5. Successful participation in a QTP does not guarantee that a service provider will obtain a contract in the main procurement process. This will be subject to the technical requirements set out as part of the procurement process.

THE TWO CORE OBJECTIVES:

1. To identify if the participants technologies could provide a response to an event in line with the definition of the System Service(s) being demonstrated and
2. To identify any operational complexities driven by the provision of services System Services from these technologies, and provide suggestions on how to approach or resolve them.

Objective 1 is considered a minimum requirement for a technology class to be considered as proven for the provision of relevant system services through the QTP. To achieve this objective, participants were required to demonstrate responses to real system events that occurred during the trial period, in line with the System Services definitions.

Objective 2 requires more careful consideration of how each technology provided the service being trialled and what impacts they had on current EirGrid and SONI processes and systems. The outputs of objective 2 will inform the development of TSO standards and processes to manage system services from different technologies.

4. DS3 SYSTEM SERVICE PRODUCTS – IRELAND AND NORTHERN IRELAND

New technologies seeking to demonstrate service provision and thereby fulfil the objectives set out above must show responses to system conditions and/or test injections which satisfy the local System Services definitions in Ireland and Northern Ireland. These are:

FAST FREQUENCY RESPONSE

Fast Frequency Response (FFR) is the additional MW output or MW reduction required compared to the pre-incident MW output or MW reduction, which is fully available from a providing unit within 2 seconds after the start of an event and sustainable up to 10 seconds after the start of the event. The extra energy provided in the 2 to 10 second timeframe must be greater than any loss of energy in the 10 to 20 second timeframe due to a reduction in MW output or MW reduction below the pre-incident MW output or MW reduction.

RESERVE

Primary Operating Reserve (POR) is the additional MW output and/or reduction in demand) required at the frequency nadir (minimum), compared to the pre-incident output (or demand) where the nadir occurs between 5 and 15 seconds after an event. If the actual frequency nadir is before 5 seconds or after 15 seconds after the event, then for the purpose of POR monitoring the nadir is deemed to be the lowest frequency which did occur between 5 and 15 seconds after the event.

Secondary Operating Reserve (SOR) is the additional MW output and/or reduction in demand) required compared to the pre-incident output (or demand), which is fully available and sustainable over the period from 15 to 90 seconds following an event.

Tertiary Operating Reserve 1 (TOR1) is the additional MW output and/or reduction in demand) required compared to the pre-incident output (or demand) which is fully available and sustainable over the period from 90 seconds to 5 minutes following an event.

FAST POST ACTIVE POWER RECOVERY

Fast Post-Fault Active Power Recovery (FPFAPR) service provides a positive contribution to system security. Fast Post-Fault Active Power Recovery is defined as having been provided when, for any fault disturbance that is cleared within 900ms, a plant that is exporting active power to the system recovers its active power to at least 90% of its pre-fault value within 250ms of the voltage recovering to at least 90% of its pre-fault value. The service provider must remain connected to the system for at least 15 minutes following the fault. The FPFAPR volume in a settlement period is based on MW output during that period

DYNAMIC REACTIVE RESPONSE

Dynamic Reactive Response (DRR) service is defined as the ability of a unit when connected to deliver a reactive current response for voltage dips in excess of 30% that would achieve at least a reactive power in MVAR of 31% of the registered capacity at nominal voltage. The reactive current response must be supplied with a rise time no greater than 40ms and a settling time no greater than 300ms. The volume is based on the unit's registered capacity when connected and capable of providing the required response. The measurement of this product requires that high quality phasor measurement units be installed at the provider's site with appropriate communication and access arrangements agreed with EirGrid and SONI.

5. 2019 QUALIFICATION TRIAL PROCESS (QTP)

Following the completion of the QTP in 2017 and 2018, EirGrid and SONI have applied a number of the learnings based on the feedback from trial participants. As a result, the TSOs have expanded the scope of the QTP to incorporate a wider range of topics. The purpose for this is to develop a centralised workstream to identify commercial and technical considerations for the large scale deployment of new technologies on the power system for 2030. In 2019, three projects were selected to examine these barriers. The trials focus on three technical considerations, network, and communication and future barriers.

Trial 1 – Solar photovoltaic (PV) generation has become a more economically viable form of electricity generation in Ireland and Northern Ireland in recent years. It is likely that large scale solar PV will connect to the system at an increasing rate from the mid-2020s without the need for a subsidy due to decreasing capital costs. EirGrid's Tomorrow's Energy Scenarios consider a range of installed solar PV capacities between 200 MW and 2,500 MW in 2030 due to the uncertainty of how the technology will develop.

Trial 2 – Residential Service Providers - EirGrid and SONI are now investigating the operational complexities associated with automated response from in-home technology. The objective is to investigate the potential of- and challenges involved in leveraging the flexible capability of the residential sector to provide System Services in the future. The TSOs envisage real benefits from DSM in reducing peak demands to the power system and the provision of essential System Services, and recognise the importance of Demand Side Management to the delivery of energy efficiency targets. The system operators will use the project to investigate the potential delivery of wide-scale residential DSM which has benefits in assisting Ireland to reach its renewable energy targets by providing greater flexibility in operating the power system with up to 70% renewable generation, which will require the ability to operate the power system with as much as 95% of generation from renewables at times.

Trial 3 – Communication - Due to the increasing use of renewable energy sources, TSOs worldwide are seeing a shift from operating a centralized portfolio of large conventional fossil-fuel generators to a more widely distributed network which includes small-scale generation. The current communication method was designed for larger generators, which has resulted in a communication solution that may be inflexible or expensive for small scale generation or other service providers on the system such an aggregator. This project is to enable a two-way communication between a small scale service provider or aggregator and the system operator.

The following sections of the report provide a detailed overview of each of the trial and their individual objectives. Every trial is presented in a manner that permits individual reading for each. The background to each trial, project objectives and key milestones are presented for each of the trials. Section 6 of the report presents the Solar Trial. Section 8 & 9 presents the SOLO and Energia trials for residential services. Finally Section 10 & 11 outlines the communication trials.

6. SOLAR TRIAL

TRIAL OBJECTIVE

The overall objective is to prove solar technology capable of providing a range of the DS3 System Service products - FFR, POR, SOR, TOR1, SSRP, FPFAPR and DRR under the QTP and identify any operational complexities. During the Provenability Trial, EirGrid and SONI will monitor the provision of the Services in response to real events on the power systems of Ireland and Northern Ireland or the response to dispatch instructions issued to the Providing Unit. Should there be no suitable events on the system over the entire duration of the trial; the TSOs may utilize smaller frequency disturbances on the system to assess Service provision or testing as per the current DS3 test procedures to measure the capability. This project is being completed as part of the EU-SysFlex project which is tasked with testing a high level of integration of renewable energy sources in the pan-European electricity system. This project will be part of the EU-SysFlex in helping to identify the issues and solutions associated with the integration of renewable energy across Europe

SCOPE OF THE TRIAL

- Install the required measurements devices as per the DS3 Performance Measurement Device Standards for Fast Acting Services.
- Provide a detailed Project Progress Report (PPR) every three calendar months for the duration of the project.
- Submit a Findings Report to the EirGrid and SONI within two calendar months of the conclusion of the research.
- Following a system event, export data recordings in Comma Separated-Values in electronic reports via email to the EirGrid and SONI.

EXPECTED TRIAL OUTCOMES

It is expected that Bann Road will demonstrate Solar photovoltaic (PV) generation's ability to provide the DS3 services of FFR, POR, SOR, TOR, SSRP (while exporting active power), FPFAPR and DRR.

PROJECT APPROACH

DEMONSTRATION OF SERVICES

Bann Road had the ability to demonstrate the DS3 Services of FFR, POR, SOR, TOR, SSRP, FPFAPR and DRR. Certain wind turbine technologies have the ability to provide FFR and POR via a product known as "Emulated Inertia". As there a no moving parts in the solar project the provision of Emulated Inertia is not possible. The Services of FFR, POR, SOR and TOR may only be demonstrated when the Solar farm is curtailed. The Solar Farm is currently

importing and exporting VArs while set to voltage control, VAr control or power factor control by the TSO/DSO. The solar farm shall demonstrate the supply of "Steady State Reactive Power" (SSRP) while exporting active power.

FPFAPR and DRR shall be demonstrated by having a meter installed with the capability of recording high resolution pre fault and post fault data. The event data for these faults shall be automatically emailed from the meter to an agreed email address.

FAST ACTING SERVICES MONITORING EQUIPMENT

Within the first month of the Demonstration project an "EMS Subnet" power quality meter with the GPS option shall be installed at the connection point for the Bann Road site. The meter to be installed shall meet the "DS3-Performance-Measurement-Device-Standards-for-Fast-Acting-Services". The meter shall be fitted with an additional current measurement card. Five 4 to 20 mA signals will be connected to this card. The signals to be connected are:

- MW Availability (Available Active Power)
- Active Power Set point.
- Voltage Control Set point.
- MVar Control Set point.
- Power Factor Control Set point

The connection of the five additional signals will mean that all data pertinent to the demonstration of the above mentioned System Services will be available from the one source. The five additional signal values shall be contained in all event reports. Automated event reports can be sent direct from the meter to an email address nominated by EirGrid and SONI. All events will also be sent to the Owners project manager and response of the solar farm to these events will be illustrated in the "Project Progress Reports".

KEY DELIVERABLES

- Install the Subnet Meter on site and set the meter up to automatically email events to the TSO and the project manager.
- Obtain agreement with the TSO and DSO to change the frequency response characteristics of the site so that the site will provide reserve when curtailed in "Emergency Action ON".
- Carry out Operating reserve tests as per the operating reserve test procedure. Submit the report to the EirGrid.
- Obtain agreement from the TSO and DSO as to what Reactive Power Testing (if any, beyond Grid Code requirements) needs to be carried out in order to demonstrate Bann Road's ability to supply SSRP.
- Submit detailed "Project Progress Report" at least every three months.
- Upon completion submit a "Project Findings Report".
- Attend bi-monthly meetings with EirGrid and SONI.

REPORTING REQUIREMENTS

The project manager will provide a detailed Project Progress Report at least every three months.
The following information will be provided in the PPR in the order listed below:

- Executive summary: This section will provide an overview of the progress of the Project in the period to all interested parties not involved in the Project. The project manager will describe the general progress of the Project, including details of any delays or problems encountered, any notable milestones or deliverables achieved in the period.
- Project manager's report: The Project manager's report should be a more detailed version of the executive summary. This section should describe the progress made in the reporting period. Any key issues, deliverables or events will be drawn out and described in detail; referring where necessary to other sections of PPR.
- This section will also provide an outlook onto the next reporting period. It will describe any key issues or concerns which the Project manager considers will be a major challenge in the next reporting period.
- Progress against plan: This section will summarise the overall progress of the Project against the project plan.
- Learning outcomes: Bann Road will briefly describe the main learning outcomes from the reporting period.
- Data: The report where applicable will reference relevant data to demonstrate the solar farms ability to provide/monitor DS3 system services

PROJECT FINDINGS REPORT

A final Project Findings Report which will provide sufficient information for third parties to understand project outcomes, lessons learned and the next steps. The project manager will submit the findings report to EirGrid for approval within two Calendar Months of the Project completion date.

7. RESIDENTIAL TRIALS

Following on from the success of the EirGrid Power Off and Save project, operational complexities associated with automated response from in-home technology are now being investigated. The objective is to explore the potential of- and challenges involved in leveraging the flexible capability of the residential sector to provide System Services in the future. EirGrid and SONI envisage real benefits from DSM in reducing peak demands to the power system and the provision of essential System Services, and recognise the importance of Demand Side Management to the delivery of energy efficiency targets. The system operator will use the project to investigate the potential delivery of residential DSM at scale, which has benefits in assisting Ireland to reach its renewable energy targets by providing greater flexibility in operating the power system with up to 70% renewable generation, which will require the ability to operate the power system with as much as 95% of generation from renewables at times.

In the 2019 QTP, two participants were successful; Energia and Solo Energy. Both participants will use a different methodology and range of technologies as part of the trial demonstration of System Services capability. Both projects are being completed as part of the EU-SysFlex project which is tasked with testing a high level of integration of renewable energy sources in the pan-European electricity system. This project will be part of EU-SysFlex and will help to identify the issues and solutions associated with the integration of renewable energy across Europe.

8. SOLO ENERGY RESIDENTIAL TRIAL

Solo is an energy-storage-as-a-service business based in Cork, Ireland and Edinburgh, Scotland. Solo's cloud-based software platform *FlexiGrid* aggregates batteries, Electric Vehicles (EV) via unidirectional or Vehicle-to-Grid (V2G) chargers and other Distributed Energy Resources (DER) in order to operate as a centrally controllable Virtual Power Plant (VPP).

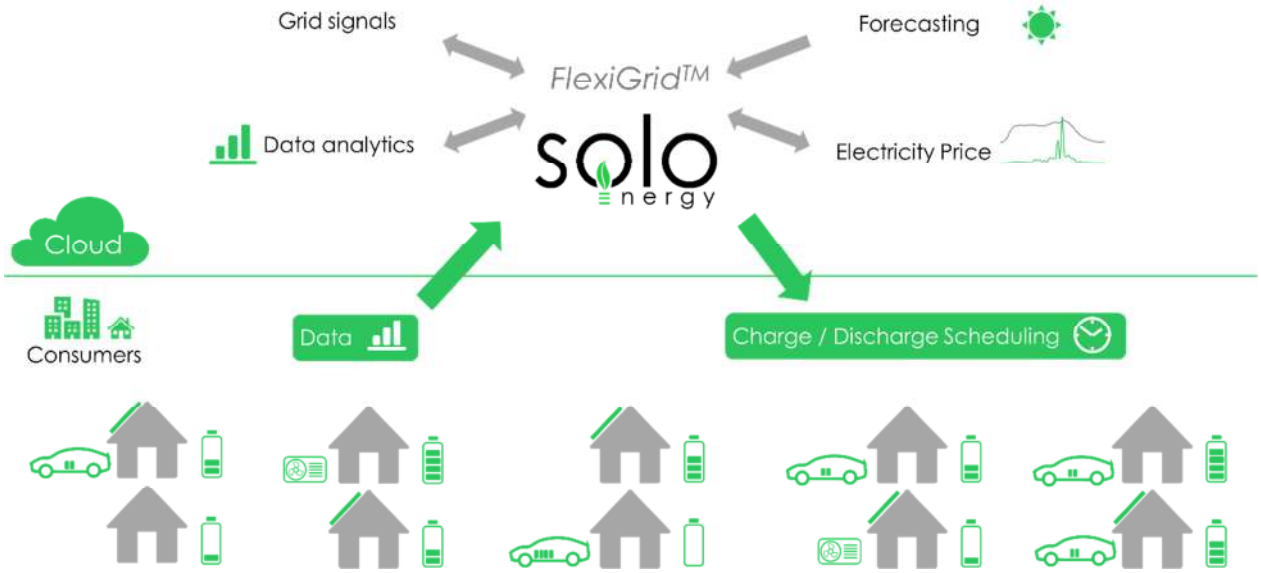

FIGURE 3 SOLO ENERGY VIRTUAL POWER PLANT

FlexiGrid consists of a Run-Time Environment, or dispatch engine, behind which sits a Decision Engine. The Decision Engine optimises assets from both a site and portfolio perspective through responding to key signals such as market pricing, grid signals and forecasts.

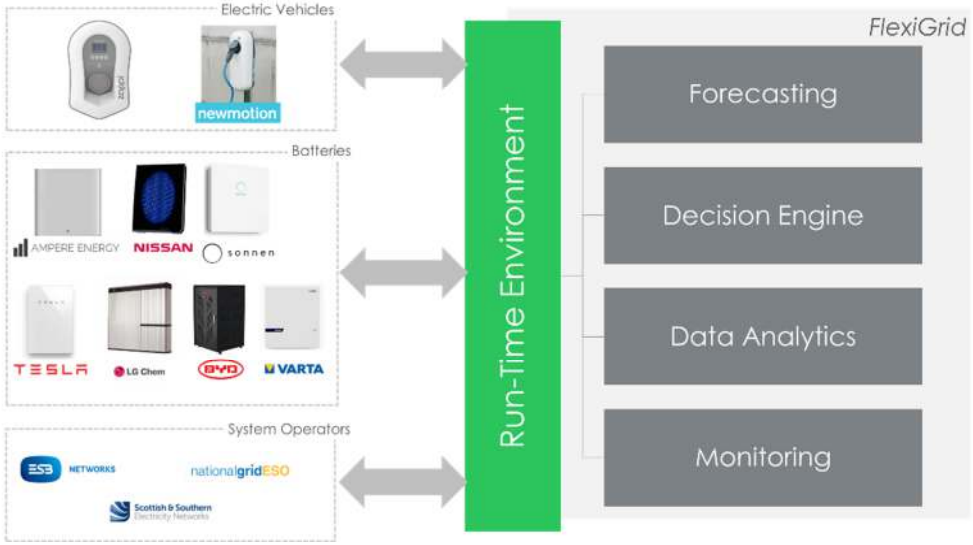

FIGURE 3 FLEXIGRID PLATFORM OVERVIEW

Over the past several years, Solo have undertaken projects across both the UK and Ireland, demonstrating manual and automated aggregated Edge-to-Cloud control of various battery and EV charging equipment solutions and trialling provision of services at distribution level to system operators such as ESB Networks. FlexiGrid is designed to be hardware agnostic; to-date Solo has integrated and controlled hardware from over ten different equipment manufacturers, including most of the major residential battery manufacturers and a smaller number of EV's.

As per the System Operator requirements, the overall objectives of the eServ project are as follows:

- Demonstrate the provision of DS3 System Services from residential premises
- Investigate the barriers within the current regulated arrangements that presently inhibit the participation of residential service providers

SCOPE OF THE TRIAL

- Modify existing signalling to ensure compliance with DS3 regulated arrangements signal requirements
- Submit connection applications (NC6 microgeneration) and install related hardware at new customer sites
- Install appropriate metering solutions and/or consider alternative standards
- Establish and successfully test two-way communication with the NCC via the EDIL interface
- Customer engagement and management throughout the project including, management of installations, communications, query handling, event notification and all necessary GDPR related activities
- Secure DSO consent prior to commencement of trial
- Monitor the performance of the systems during system events/disturbances and/or, should no such events occur, during test producers designed to mimic a system event/disturbance
- Provide monitoring and performance data to EirGrid upon each event/disturbance occurrence
- Project management: submit Project Initiation Document (PID), regular progress reports and attend related bi-monthly meetings.
- Final report, detailing project findings, performance versus original objectives, lessons learnt, next steps and assessing existing barriers and challenges relating to delivery of DS3 services from residential flexibility under the existing policies and regulations.

APPROACH

For the eServ project, Solo will leverage previous and ongoing projects as well as recruiting a limited set of new customers. A total of 34 customer sites located across Ireland are included within the eServ project. Of those sites, 25 are existing, four are new and the remaining five sites are subject to customer recruitment. All sites are residential premises.

The flexibility assets at each site comprise predominately of either residential battery systems or EV smart chargers. In addition, the installation and operation of a single Vehicle to Grid (V2G) system is also earmarked.
The existing/previous projects include customer sites from the following projects:

- **eStore (Cork, Dublin): June 2017 – March 2018:** eStore was an SEAI funded project in collaboration with ESBN incorporating the installed and aggregated operation of batteries installed at five premises. The project was used to demonstrate the operation of a distributed storage network as well provision of voltage support (reactive power response) to ESBN.
- **StoreNet (Kerry): December 2017 – present:** An International Energy Research Centre (IERC) co-ordinated project, in collaboration with Electric Ireland and ESB Networks which incorporates the installation of batteries at 20 residential premises and the delivery of optimised aggregated charge/discharge schedules and local voltage support services to ESBN.

FlexiGrid control capabilities for batteries includes charging and discharging to a specified power level (up to the inverter rating), setting the reactive/power factor (import or export), reserving battery capacity, setting the operating mode (load following, remotely controlled, maximising self-consumption, idle, etc.). Solo have similar controllability for the V2G units in terms of charge and discharge capabilities. For unidirectional EV chargers Solo can control the charge power level and the mode (charge, idle) but clearly cannot instruct the EV charger to discharge energy from the EV's battery. The Initial stages of the project will focus on modifying existing sites/solutions - where necessary to meet EirGrid DS3 requirements, recruitment of additional customers and installation and connection of new sites. The final ten months of the project will focus on ongoing monitoring and assessment of performance.

POTENTIAL BENEFITS

The potential for provision of System Services from residential consumers is relatively unknown in Ireland. The eServ project will serve as an important demonstrator project in this area and provide key learnings from a technical, commercial and consumer acceptance perspective. As Ireland moves towards a 2030 goal of 70% of all electricity being supplied from renewable energy and an instantaneous SNSP level of 95% there is a need to increase the number of flexibility services providers. The demonstration of provision of System Services within this project has the potential to significantly widen the number and type of service providers.

Opening up the opportunity for residential consumers to participate in the provision of System Services and enabling those consumers to share in the prospective benefits and/or revenues arising therefrom, will result in a fairer more equitable system for all consumers. Successful completion of the trial may facilitate further innovation trials in this area, including active modulation of residential demand to match national and/or local renewable generation. From the trial any significant barriers to participation within the existing framework will be identified and recommendations made on potential methods of reducing or removing those barriers.

KEY DELIVERABLES

The following are the deliverables from the eServ project:

- Project Initiation Document,
- Progress reports every three calendar months for the duration of the project,
- Provision of monitoring data and performance analysis of aggregated system performance during events/disturbances occurring during the project period or, where no such events occur, under test conditions,
- Provision of a final project report detailing the findings for the project as per tender requirements

The following DS3 services will be trialled on the eServ project:

- Fast Frequency Response (FFR)
- Primary Operating Reserve (POR)
- Secondary Operator Reserve (SOR)
- Tertiary Operating Reserve (TOR1, TOR2)
- Steady State Reactive Power (SSRP)

The key project deliverables are detailed in **Error! Reference source not found.**.

Milestone	Deliverables
1	Project initiation document
2	Monthly progress summary reports
3	Detailed Project Progress Report (PPR) every three months
4	Provision of monitoring data and performance analysis of aggregated system performance during events/disturbances occurring, and/or related tests taking place, during the project period
5	Project Findings Report

CUSTOMER ENGAGEMENT

For existing sites Solo, and relevant project partners, have an established customer engagement and management plan and methodology in place. For new customers the engagement and management process will be based on that implemented on previous and ongoing projects.

9. ENERGIA RESIDENTIAL TRIAL

Energia is a utility with a focus on renewable technology. Innovation is critically important to Energia; to date Energia has invested over €1 billion in renewables, flexible generation and customer solutions across the island of Ireland.

BACKGROUND TO THE ENERGIA TRIAL

The following sections of the report are prepared by Energia to outline the project methodology and implementation plan. In an effort to reduce the impacts of climate change energy systems are changing dramatically as electricity generation is becoming increasingly decarbonised and decentralised and electricity supply moves towards a digital customer centric model. Today with the reduction in solar PV and battery costs and Government incentives individual consumers are starting to install their own Solar PV and battery systems to reduce their carbon footprint and save money on electricity, giving rise to the "prosumer".

Consumers are installing batteries alongside their solar systems to store surplus electricity generated during the day which can then be used when required. At the system level, operators must manage power with decreasing conventional fossil fuel generation and with an increase in intermittent non-synchronous renewable generation on the system. One solution to problems that emerge is to supply System Services using battery storage. Already large batteries are providing these services in some jurisdictions, and in some markets such as Germany, Japan and the UK use of residential solar and battery systems is also being investigated as a means of managing frequency, as well as voltage and grid constraints. Through this QTP project EirGrid and SONI will be investigating the viability of residential solar and battery systems for the delivery of System Services, and explore the value to the end consumer and grid operators.

OBJECTIVES OF THE ENERGIA PROJECT

The Energia project involves the aggregation of residential solar PV systems with smart battery storage solutions. 20 such systems will be installed in Ireland with scope for a further 5 battery installations in Northern Ireland (NI). The objectives for this Energia project are as follows;

- To prove aggregated residential electrical appliances as a technology class for the delivery of DS3 system services;
- To assess the operational complexities of the technology and the impacts this has on current TSO processes and systems;
- Investigate the barriers to System Services market entry for residential demand sites and investigate possible solutions,
- Operate the scheme with no adverse effects on the comfort of the consumer due to their involvement in the scheme,
- To maximise the value of smart products and develop a platform that facilitates individual residential customers to participate in demand side response and deliver System Services,

- The knowledge captured from the QTP will help shape service development in the future and enable EirGrid to adapt quickly to emerging digital trends in the residential energy market.

SCOPE OF THE ENERGIA TRIAL

Below are the scopes of requirements for the QTP trial:

- The Service Provider (Energia) will be required to provide a detailed Project Progress Report (PPR) every three calendar months for the duration of the project.
- The Service Provider must submit its Findings Report to EirGrid within two calendar months of the conclusion of the project.
- Following a system event the Service Provider will be required to export data recordings in common formats such as IEEE COMTRADE, Comma Separated-Values, or other compatible Microsoft Office application formats. Service Providers should be capable of sending data following events in electronic reports via a secured connection email to EirGrid or SONI following an event or within timeframes agreed with the respective TSO. Data will be assessed on an ex-post basis for performance monitoring.
- The QTP participants whose demand underpins the scheme must be residential consumers, specifically a household located in Ireland where the bill payer occupies the property as his/her primary residence.
- All installations must have the approval of the Distribution Network Operator in advance of the trial commencement and ensure there are no issues regarding congestion management.
- A central tenet of the Energia project is that, following its implementation, any residential consumers shall not be adversely affected. In the unlikely event that this occurs, it will be the sole responsibility of the Energia to manage.

The table below outlines the scope of the Energia Trial

What is in scope and what is out of scope.	
Technical overview of the trial	The trial will test whether the delivery of DS3 System Services is possible using domestic batteries. EirGrid and Energia will co-operate throughout the trial to fully understand the capabilities of DS3 System Services and Demand Side Management (DSM) in Ireland and the challenges it faces.
What technology is installed	Each home will be equipped with circa 2 kWh of Tier 1 Solar PV panels connected to the grid with an DC to AC solar inverter and a separately AC coupled Moixa Smart Battery fitted with a 2.4 kW inverter and 2 x 2.4kWh (Max 4.8kWh) LiFePO4 battery cells. The battery is fitted with Ethernet, Wi-Fi and GSM communications for remote monitoring and control. The battery is also equipped with meters to measure the output from the solar panels and battery and monitor in-home demand. The meters provided by Moixa comply where possible with the DS3 Performance Measurement Device Standards.

Services provided	The service provider will attempt to provide Secondary Operating Reserve (SOR), Tertiary Operating Reserve1 (TOR1) & Tertiary Operating Reserve2 (TOR2). In a frequency event the batteries are expected to respond as an aggregated unit within 15 seconds.
How the services are provided	A drop in frequency below 49.8Hz is measured using various frequency meters located at Huntstown Power Plant. This results in a trigger to be sent to Moixa's GridShare Platform. This in turn triggers the batteries to begin discharging to first the home and then the grid. The batteries can distribute charge for a maximum duration of 20 minutes.
Performance and data reporting and management	The GridShare platform will supply data for the project. The data from each event is stored on the GridShare Platform to carry out necessary performance assessments. For each event the expected response and achieved response will be measured. The extent of the difference between the expected response and the achieved response will determine how the Demand Side Unit (DSU) performed for each event. The performance of individual batteries will be reported at a sampling rate of 1 Hz (1 second granularity) in batches every 30 seconds.
What are the key results	To prove residential units can deliver DS3 System Service products with no adverse effects on the end consumer or local network
Primary Operating Reserve (POR) and Fast frequency Response (FFR)	Potentially but issues with aggregating the responses and communications may create latency problems with delivery. To overcome these latency issues Hardware (H/W) and Software (S/W) upgrades may be required which may prove to be a significant cost barrier.
What other services can be provided	Potentially over frequency response.
Scope for DSO (ESBN in Ireland and NIEN in Northern Ireland) involvement	Both DSOs can take learnings from grid connection processes specifically with Alternating Current (AC) coupled battery storage and solar systems where the battery and solar system are classed as 2 separate generators. Depending on interest in the project there may also be scope to install batteries in areas where the DSO experiences problems (due to constraints, for example) and explore the use of residential DSR as a way to potentially save cost through deferred grid upgrades.
Determine Grid Code, Metering Code, Connection Conditions derogation requirements	ESBN are required to grant a derogation from clause 4.7 as it is not applicable to domestic small-scale generation and energy storage, and from the requirement to reduce generation at 2%/0.1Hz between the frequencies of 50.2Hz and 50.5Hz as it is not applicable to micro-generation at the domestic level.

	Both have been granted for the QTP by ESBN, the DSO.
Assess barrier to entry	High prices of systems. Insufficient benefits to encourage battery uptake. Cost effectiveness.

EXPECTED TRIAL OUTCOMES EIRGRID & ENERGIA

- The expected outcome of this trial is that the delivery of DS3 System Services will be proven using domestic batteries. This is expected to be achieved through SOR, TOR1 & TOR2 with the potential for fast frequency response depending on expansion of fleet making faster responses more economical.
- The trial will establish the barriers to residential DSM that currently exist and identify possible solutions to these barriers.
- It is not expected that any residential consumers will be adversely affected by implementation of the trial.

PROJECT APPROACH

The project will run for 18 months and its operation will be the responsibility of Energia throughout. The trial project will be distributed to 20 Energia Group customers. Industry and customer research will be used to identify the consumer segments most likely to be interested and available to participate for the entire trial period. The sites chosen in the trial and the vendors responsible for the delivery of key services (Moixa & House2Home) will be at the discretion of Energia. The high-level project approach can be divided into a number of phases, these phases are summarised below. Every three months from the duration of the trial Energia will publish a progress report (including results from customer surveys) which will provide an update on progress to date of the QTP.

Phase 1

Mobilise the project - Relevant stakeholders agree the project scope and objectives set out in the PID are satisfactory to fulfilling the QTP requirements.

Phase 2

Testing the technology - After installing the technology, the selected test participants will go through the GridShare integration and test phase.

Phase 3

Go Live - Once all installations are satisfactory with the test participants, the remaining installations will be carried out and the QTP period officially starts when they are all operational. Energia will also work with EirGrid to ensure that the deliverables as outlined in the QTP are delivered. This will mean ensuring appropriate signal requirements and measurement devices are operating as per the DS3 System Services Regulated Arrangements where possible.

Phase 4

Measurement and reporting of Data to EirGrid - Energia will be responsible for exporting data recordings in compatible Microsoft Office Application formats. Triggered data will be sent following events in electronic reports via a secured connection email to EirGrid or SONI immediately following an event. Interpretation of this data and the learnings obtained from it will lead to a more in-depth understanding of the potential for residential

installations to provide greater flexibility in operating the power system, thereby facilitating higher levels of non-synchronous power generation.

Phase 5

Collation of learnings from the trial & trial conclusion - a final report will be delivered to EirGrid, the solar PV and battery systems installed as part of the trial will continue in a business as usual manner (generating electricity sustainably during the day which can be stored by the battery for night-time use). If the value and/or revenue streams become available in the future the functionality for delivery of system services can be re-instated.

INTERFACES

The key interfaces of the scheme are set out in the following info graphic;

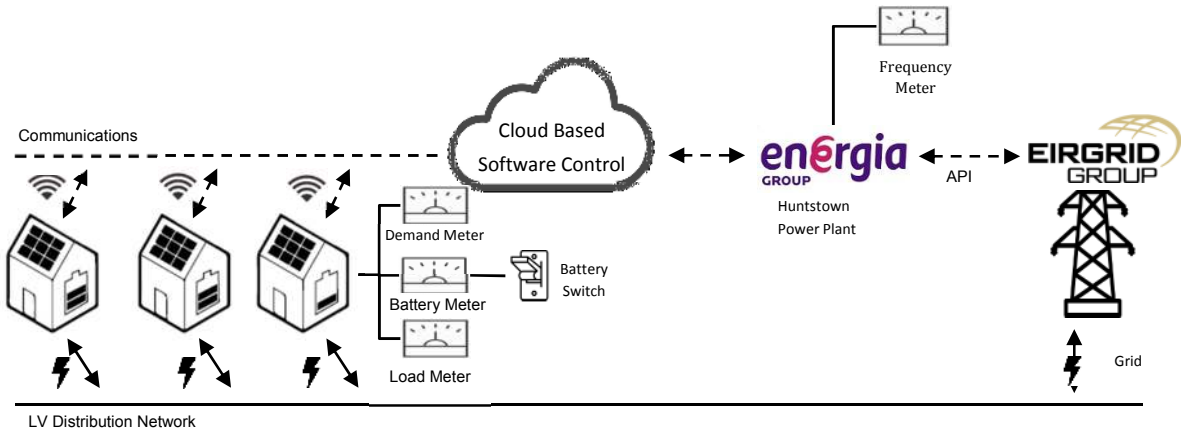

FIGURE 4 RESIDENTIAL TOPOLOGY

Frequency drop:

Energia frequency meters will integrate Moixa GridShare with Energia's Huntstown Power Plant. If the frequency falls below the reserve trigger (e.g. 49.8 Hz) this will send a signal to GridShare which will in turn trigger each of the batteries to respond to the system event.

Customer's battery frequency response:

For this trial it is expected that these 20 homes will provide a maximum combined static response of 48 kW for the DS3 System Services SOR, TOR1 and TOR2. These products require a response time of 15 seconds for a maximum duration of T+20 minutes.

Customer Communications:

Effective stakeholder communication is an important part of this QTP. A communication strategy will be developed to ensure consistent and timely communication. To recruit consumers for this trial Energia plans to employ industry and customer research, to identify the consumer segments most likely to be interested and available to participate in the trial e.g. early adopters and consumers with a preference for Electric Vehicles and Solar PV. To encourage consumer to participate in the trial they will be offered a discounted Solar and Battery system provided they are willing to provide data and feedback over the course of the trial. Details of the consumer on-boarding process are outlined in the programme of work.

PROJECT PLAN

A detailed project plan is provided below. Our proposed approach means that the project is deliverable with the 18 month timeframe outlined by EirGrid.

DELIVERABLES

The following high-level deliverables have been identified:

Deliverable ID	Date	Name
1	October 2019	Project Initiation Document (PID)
2	October 2019	Consumer Engagement/Recruitment Plan Initiated
5	December 2019	Progress update
6	February 2020	1st Project Progress Report
7	April 2020	Progress Update
8	June 2020	2nd Project Progress Report
9	August 2020	Progress Update
10	November 2020	Close Out Report

REPORTING REQUIREMENTS

After publication of this document (PID) Project Progress Reports will be issued every 3 months to provide updates on the status of the trial. Real time fleet availability generated through Moixa's Gridshare Platform is sent to the TSO control centre. As part of Energia's customer engagement plan, the company has ensured that all participants will also be obliged to complete a customer insight survey every 3 months, 2 weeks before each Project Progress Report (PPR) submission to EirGrid. The details and findings will analyse common issues and ensure no adverse effects are felt by trial participants.

Data will also be extracted from the GridShare platform to carry out performance monitoring and assessments to evaluate the response provided by the aggregated residential units to feed into the PPR. Both the consumer and technical data sets will be assessed on an on-going basis to derive learning outcomes which will determine the ability of aggregated residential units to deliver DS3 system services. As part of this process barriers to market entry or improvements in operational efficiency will be documented and put forward to EirGrid to ensure cost effective delivery of DS3 services provided by aggregated residential units. This process will be completed every 3 months and compiled as part of the final findings report.

DATA SECURITY

DATA MANAGEMENT OVERVIEW:

Energia takes the responsibility for protecting customers' data seriously; data protection is a priority, as Energia collect and maintain significant personal information concerning customers and employees. Such data is subject to data protection legislation. The relevant legislation in Ireland governing data protection is the Data Protection Acts 1988, 2003 and 2018. Energia will ensure that personal information about customers and staff is collected, used and maintained in conformity with this legislation. No personal data will be shared with System Operator, only data on aggregated and anonymous basis.

10. ENERGIA TELECOMMUNICATION TRIAL

BACKGROUND TO THE TRIAL

Due to the increasing use of renewable energy sources, TSOs worldwide are seeing a shift from operating a centralized portfolio of large conventional fossil-fuel generators to a more widely distributed network which includes small-scale generation. The current communication approach has been developed for larger generators, resulting in a communication solution that can be inflexible and costly on the grid for small-scale generation or other service providers~~..~~ This project will demonstrate two-way communication between a small scale service provider or aggregator and the network operator.

There is a need for system operators to ensure they are supporting the changes in industry. By implementing new communication methods and standards the cost to enter the System Services market can potentially be reduced. This has the potential to remove barriers for new technology to participate in an enduring market. In Ireland and Northern Ireland small scale generation may increase from 1,159 MW in 2018 to 1,402 MW in 2020, the alternative communication method trial will look at removing barriers to market participation and increasing System Operator visibility. Through allowing new methods (and hardware and protocols) to connect to the grid it should reduce the cost for small scale projects and reduce complexity, which will enable new technologies to connect to the grid.

OBJECTIVES & DELIVERABLES:

EirGrid is carrying out an assessment of the current telecommunication methods; the purpose of this trial is to seek industry participants that are interested in utilising a new telecommunications method, which is 1) fit-for-purpose 2) scalable 3) secure 4) prudent and 5) meets the shifting needs of the industry. At present, all service providers use a standard Remote Terminal Unit (RTU) interface device and IEC101 telecommunications protocol to exchange data with the TSO.

EirGrid will propose a new protocol and will acquire the gateway hardware for the participant to use in the QTP trial (unless the participant has the required gateway hardware on-site), and will also direct the participant to acquire additional hardware to support the TSO acquired gateway. The system trial will be completed on the telecommunication protocols and hardware proposed by EirGrid under the QTP trial process. The trial participants will work with the TSO to examine a number of factors such as the visibility, implementation, cyber security and reliability when compared against the current standards.

Based on the results of the trial, the TSO may update the telecommunications requirements and standards for all industry participants. The participants will be required to work with EirGrid in a collaborative approach throughout the trial which is expected to commence in Q3 2019.

HIGH LEVEL PROJECT SCOPE:

Energia's approach to this trial of alternative communication methods is to utilise equipment already installed, and modify where required to reduce the cost of works. Energia would support the installation of an extension module for IEC-61780 104 and would utilise GE as the vendor to perform signal mapping where required.

Phase 1

- Install TSO acquired hardware on site (where required).
- Install Energia hardware (if required) to implement the new protocol.
- Energia to develop and implement a system environment, capable of demonstrating the end-to-end trial of a communication protocol.
- EirGrid/SONI to successfully set up a test environment to receive signals from selected protocols.
- EirGrid/SONI to extensively test the end-to-end communication method including the monitoring of hardware and the selected protocol.
- Energia is required to undertake on-site bench testing & integration with EirGrid/SONI.

Phase 2

Additional testing may be required for any new equipment or for a change in protocol. A full assessment documenting the findings of the new protocols/hardware and the outcomes of the trial to be provided in a final report that is reviewed and signed off by EirGrid. The Service Provider must submit this Findings Report to EirGrid within three calendar months of the conclusion of the research (defined as the end of site testing).

Phase 3

Collaborate with EirGrid and provide required input when completing any additional TSO trial reports.

EirGrid to provide Go/No-Go recommendation on whether the communication method and/or hardware solution should be implemented industry wide.

PROJECT MANAGEMENT DOCUMENT DELIVERABLES:

The below deliverables will need to be submitted by Energia, please see deadlines in table below.

- Deliverable 1: Project initiation Document
- Deliverable 2: Project Progress Reports (PPR)
- Deliverable 3: Telecommunication Solution Document
- Deliverable 4: Test Plan
- Deliverable 5: Test Report
- Deliverable 5: Project Findings Report - Energia will provide a final Project Findings Report which will provide sufficient information for third parties to understand project outcomes, lessons learnt and the next steps. Energia must submit its Findings Report to EirGrid for approval within two Calendar Months of the Project completion date and it should be ready for publication on the EirGrid, SONI and EU-SysFlex websites.

PROJECT PLAN

Key Deliverables & Milestones

M/S	Deliverable	Date	Description
1	Project Initiation Document (PID) draft submitted	26/9/2019.	Agreed PID document between Energia and EirGrid
2	Draft submitted: Overview system design solution document	26/9/2019.	Document inclusive of TSO, DSO, Energia network infrastructure, automation hardware and signalling list (across both IEC104 and IEC 101 interfaces
3	Functional Design Specification	21/10/2019	Specification from Anodyne for site setup and EirGrid from NCC setup
4	Project Initiation Document (PID) signed off	21/10/2019	Signed off PID
5	Overview system design solution document signed off	25/10/19	Signed off solution document
6	Order Hardware	30/10/19	Hardware is ordered
7	Test Plan submitted	17/1/2020	Test Plan is submitted
8	Hardware arrives and is received by EirGrid	24/1/2020	Hardware arrives at EirGrid
9	Energia site changes complete	3/2/2020	Energia confirm changes made to site to allow signals to be sent
10	EirGrid to successfully receive a signal	14/2/2020	EirGrid to successfully set up a test environment and receive a signal from the selected protocols from Energia.

11	Test Report is submitted by Energia	27/9/2020	A high level report of the testing conducted
12	Final Report Submitted	20/10/2020	A full assessment documenting the findings of the new protocols/hardware and the outcomes of the trial to be provided in a final report.

APPROACH AND METHODOLOGY:

Energia have for a number of years worked towards implementing equipment on wind farm substation networks that would allow for accelerated implementation of digitalised protocols for communication with Power Park Modules (PPM's). Energia now operate four sites in the Northern Ireland jurisdiction connected to the NIE Network where a Siemens S7 1500 PLC is incorporated into the path of the analogue and digital signals going to the SONI RTU. Energia also operate a Siemens S7 1200 PLC on site within the same panel utilised for substation switching equipment communications.

APPROACH:

Energia's approach to this project would take a phased approach, to ensure that all risks associated with implementing a new communications method with PPM's are mitigated. Energia's approach to this trial would be to utilise already installed equipment, and extend where required to reduce cost of works. Energia would support the installation of an extension module for IEC-61780 104 and would utilise a current vendor Neodyne to perform signal mapping to the required signals for DS3.

PROJECT TIMELINES

Initial Phase (P1) Interface to S71200: September 2019 to January 2020

The Siemens S7 1200 PLC currently installed on site allows for an extension module to be added that allows it to communicate via IEC 61879-5-104. At present Energia do not have these signals wired within the CTC panel at Cornavarrow windfarm. Energia would arrange with EirGrid once a protocol and associated hardware is selected to meet on site with our vendor supporting to perform the installation of the associated equipment. The communications cable from the newly installed EirGrid equipment on site would be routed to the Energia termination panel.

Energia will install the tested extension module to the S71200 PLC with associated code to convert and output to the new analogue and digital signals required for Fast Frequency Response, Energia will work with NeoDyne prior to this on site work to implement a process within the PLC to allow for signal on and off to be selected. The signal's output for the S7 1200 will be used as a secondary input to the S7 1500 where once agreed upon with SONI/EirGrid the signal exchange and control can be tested on either pathway, I.e. RTU – S71500 – PPM or Mini-RTU –S71200 (Via IEC 60870-5-104) – S71500 – PPM.

Second Phase (P2) Interface to S71500: January 2020 to June 2020

Once 6 months of testing has been performed to validate the signal exchange methodology Energia would propose to install an extension module to the S7-1500 for IEC 60780-5-104 to allow direct input from the new EirGrid equipment on site associated with these works. E.g. Mini-RTU. Within this installation Energia would support EirGrid/SONI on installation and around the design of a method to switch between signal paths on the S7 1500.

Third Phase (P2): Interface to PPM: June 2020 to September 2020

Energia would work with EirGrid/SONI to trial a connection directly to the PPM of the site with the support of the OEM for the site. This final stage would only be implemented if tests from P1 and P2 above are successful.

11. ELECTRICIY EXCHANGE

INTRODUCTION

EirGrid is carrying out an assessment of the current telecommunication methods; the purpose of this trial is to seek industry participants that are interested in utilising a new telecommunications method, which is 1) fit-for-purpose 2) scalable 3) secure 4) prudent and 5) meets the shifting needs of the industry. At present, all service providers use a standard Remote Terminal Unit (RTU) interface device and IEC101 telecommunications protocol to exchange data with the TSO.

EirGrid will propose a new protocol and will acquire the gateway hardware for the participant to use in the QTP trial (to the extent this hardware is not already on-site). EirGrid will also direct the participant to acquire additional hardware to support the TSO acquired gateway. The system trial will be completed on the TSO proposed telecommunication protocols and hardware under the QTP trial process. The trial participants will work with EirGrid to examine a number of factors such as the visibility, implementation, cyber security and reliability when compared against the current standards. Based on the results of the trial, EirGrid and SONI may update the telecommunications requirements and standards for all industry participants. The participants will be required to work with the TSOs in a collaborative approach throughout the trial.

The scope of this project is to complete an assessment of both the protocol and the hardware to help identify the challenges of utilising a new telecommunications approach. EirGrid and Electricity exchange will test the proposed a protocol (DNP3), and will be assessed based on a range of criteria that would determine it is fit-for-purpose as alternative to the current communication approach.

BACKGROUND

As a result of increasing the use of renewable energy sources, TSOs worldwide are seeing a shift in the requirement from the support of a small number of large conventional fossil-fuel generators to the support of a higher volume of more widely distributed renewable energy source and small-scale generators. The telecommunication protocol to enable two-way communication between the generator and the TSO should be re-evaluated to ensure that the protocols are supporting the changes in industry and taking advantage of any advances in technology.

This project is being completed as part of the EU-SysFlex project which is tasked with testing a high level of integration of renewable energy sources in the pan-European electricity system. This project will be part of the EU-SysFlex in helping to identify the issues and solutions associated with the integration of renewable energy across Europe.

Electricity Exchange, as part of its R&D effort, has been working the development of communication protocol libraries, which allows the service to be operated on cloud-based servers. This provides access and redundancy across multiple availability zones increasing both the reliability and availability of the services across Ireland. Development of a high reliability messaging back end allows scalability to match the number of producers as well as efficient routing two-way data communications from each of the producers to EirGrid and SONI.

The proposed project offers several advantages over traditional RTU's:

- **Reduced Latency:** RTU's have an inherent delay between when a measurement is recorded in real time, converted from digital signal to an analogue signal and sent to the TSO control centre where it is converted from an analogue signal back into a digital signal. EirGrid, in its performance testing, assume a latency of approx. 30 secs for an RTU to deliver data. A VRTU can deliver the signal in 1-5 secs (depending on the recipient's hardware set up).

- **Significant Installation Efficiency**: At present if EirGrid wish to implement new services or offerings to a site it will need to create additional signal points. In the case of an RTU this entails the owner installing an additional data analogue card on its server. A telecoms provider must then attend site and install a new analogue data card into the RTU and undergo a number of installation tests with the generator. The Electricity Exchange VRTU solution can remotely add data points in a matter of minutes.

- **Enabler of DS3**: The additional signals referenced above are essential to the roll out of DS3 System Services. It is accepted by EirGrid that the successful roll out of increased providers of existing and new System Services to be procured from May 2018 will not happen without VRTUs.

- **Enabler of increased TSO control:** VRTUs will ensure speedy installation of more stringent controllability requirements should they be rolled out as expected. [ENTSOE Network Code requires that sub 5MW solar farms are controllable to a minimum of 100KW.]It will also provide a more cost-effective means to do so.

- **Scalable Service:** Traditional RTUs require that as a generator grows (more pertinent to the case of DSUs) that retesting and re calibration of milliamp to MW ratios need to be undertaken. It also requires frequent monitoring of DSU capacity thresholds. This is not the case with a VRTU.

- **Cost Efficiency:** The solutions that are offered by VRTU as well as and in addition to those offered by the incumbent RTU arrangement are offered at a cost-effective alternative.

The demonstrations planned as part of this project will show the capabilities of the system to handle the difference classes of generation from conventional power plants to wind farms and domestic PV systems.

HIGH LEVEL SCOPE

The scope for the project includes:

A data aggregator model to be provided by Electricity Exchange with a single point of communications connection with the TSO, this project will demonstrate significant diversity of applications by delivering duplex communications between the TSO control centres and sites that are diverse in terms of location and energy type.

Locations:

- Edenderry Power (remoteness: medium)
- Mountlucas Wind (remoteness: high)
- Electricity Exchange (remoteness: varied)
- Domestic PV (remoteness: varied)

Phase 1

- Install TSO acquired hardware on site (where EirGrid and/or SONI require).
- Install Electricity Exchange hardware (if required) to implement the new protocol.
- Electricity Exchange to develop and implement a system environment, capable of demonstrating the end to end trial of a communication protocol.
- EirGrid to successfully set up a test environment to receive signals from selected protocols.
- EirGrid to extensively test the end to end communication method including the monitoring of hardware and the selected protocol.
- Please note that EE is required to undertake on-site bench testing & integration with EirGrid.

Phase 2

- Additional testing may be required for any new equipment or for a change in protocol.
- A full assessment documenting the recommendations for new protocols and the outcomes of the trial to be provided in a final report that is reviewed and signed off by EirGrid.
- A full assessment documenting the recommendations for new protocols and the outcomes of the trial to be provided in a final report that is reviewed and signed off by EirGrid.

Phase 3

- Collaborate with EirGrid and provide required input when completing any additional TSO trial reports.
- EirGrid provide Go/No-Go recommendation on whether the communication method and/or hardware solution should be implemented industry wide.

TRIAL SUCCESS CRITERIA

The below indicators show if the project has been successful.

- Project team have a clear understanding of the effort required to implement the selected hardware.
- Project team have a clear understanding of the requirements to support the connection and whether there would be challenges with the connection being replicable.
- A clear understanding on any advantages and disadvantage of implementing the selected protocol.
- The project meets the obligations in the Grid Code, License and Trading conditions and follows the CPNI recommendations on best practice.
- A fully functional test environment has been set up within EirGrid for the proposed protocols.
- Cost estimates on the hardware and implementation are documented.
- Signals are successfully displayed in the EMS and fully tested.

12. FLEXTECH TECHNOLOGY INTEGRATION INITATIVE

The FlexTech Initiative is a platform of engagement for the Transmission System Operators – EirGrid and SONI, Distribution System Operators - ESB Networks and NIE Networks, industry, Regulatory Agencies and other stakeholders to maximise opportunities for effective use of new and existing technologies and to identify and break down key barriers to integrating renewables. To react to the pace of change, the transmission and distribution system operators need to work together in an agile and efficient way to embrace opportunities and resolve issues as they arise.

In June 2019, EirGrid and SONI, supported by ESB Networks and NIE Networks, held the first FlexTech Integration Initiative industry forum. At this forum, EirGrid and SONI outlined perspectives on the key challenges and barriers to renewable integration. It was a great opportunity to engage with industry and gain cross-sectoral insight. Following on from the forum, the System Operator published an industry wide consultation. The objective of this was to gain stakeholders' perspectives on the key challenges industry faces and what they believe are the priorities for the future. From this, EirGrid and SONI together with the System Operator Task Force (TSOs/DSOs) will assess feedback and identify actions to prioritise.

These opportunities and challenges will have to be prioritised to provide what the TSOs and DSOs consider will be the best outcomes to meet consumers' needs and operation of the future power system. Through collaboration EirGrid and SONI can better understand the key challenges of participants in the electricity sector that, if resolved, will bring considerable benefits in the further integration of renewables to meet Ireland and Northern Ireland's needs.

The FlexTech Initiative is a platform of engagement for the Transmission System Operators, Distribution System Operators, industry and regulators with the objective of identifying opportunities and removing barriers to renewable integration.

THE CHALLENGE

A further increase in renewable penetration will result in a power system heavily reliant on variable non-synchronous sources of energy, a reduction in system inertia, a more distributed and decentralised environment and increased system congestion. In order to help address these changes and ensure a safe, secure and reliable power system, there will be a need for large scale deployment of storage, increased interconnection, increased demand side participation, enhanced System Services market and products as well and changes to system operation policies, tools and procedures.

In parallel with these system evolutions, an increase in the electrification of transport and home heating is also anticipated. This, combined with the increase in the number of "smart" devices, will lead to changes in consumer

behaviour and the overall demand profile for electricity. In a world of 70% renewables in Ireland and potentially over 50% in Northern Ireland there will inevitably be many times during which the proportion of instantaneous power provided by non-synchronous, renewable sources will exceed 90%. This means displacement of conventional generation and reduced reliance on its inherent stabilising capabilities. There are several key factors which will impact ability to meet ambitious targets and address associated renewable integration requirements:

- The scale of RES-E must increase dramatically,
- The nature of RES-E technology will diversify on an all island basis, for example solar technology, offshore and small scale generation are likely to become far more prevalent,
- Increased consumer participation along with the adaptation of smart devices, will lead to further changes in consumer behaviour,
- RES-E generation is likely to become even more decentralised and distributed on an all island basis which will require greater interaction and co-operation of system operators,
- Disruptive technologies (such as in-home controllers, EVs) and participants (such as large energy users and micro generation) will present both opportunities and challenges to system flexibility and system management,
- System demand will increase dramatically given the increase in penetration of large energy users and the electrification of heat/cooling and transport,
- System wide flexibility will become more important than ever. Delivering a low carbon future power system will require a power system that is capable of operating above 90% SNSP. This will necessitate a significantly enhanced System Services market requiring a broader portfolio of services as well as provision of services from providers across the spectrum of electricity actors. It will require significant enhancement of control centre tools, operational policy and procedures.
- Limited network capacity leading to congestion may require consideration of new infrastructure and congestion management solutions, and tools relating to changing behaviour.

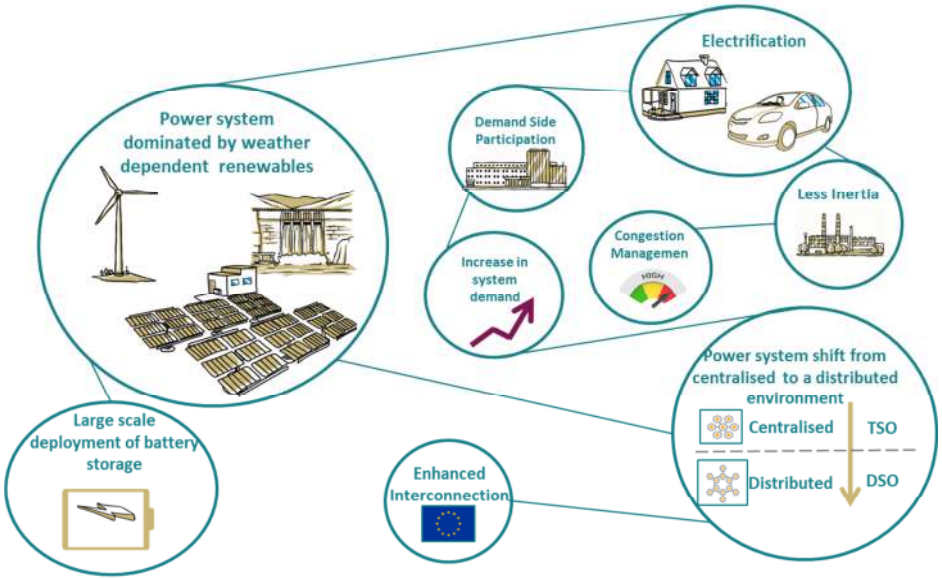

FIGURE 4 FLEXTECH VISION

FLEXTECH STRUCTURE

The FlexTech Integration Initiative will be an ongoing process consisting of three distinct functions:

- An Industry Forum;
- Internal EirGrid/SONI Working Groups;
- A System Operator Task Force (TSOs/ DSOs).

Figure 5 below illustrates the interaction between the distinct functions and the outputs of the process. The three functions will engage on an annual basis to identify and prioritise the key opportunities and issues affecting the integration of renewables and other supporting technologies. These will then form the basis of a consultation that will identify key tasks for the coming 12-month period.

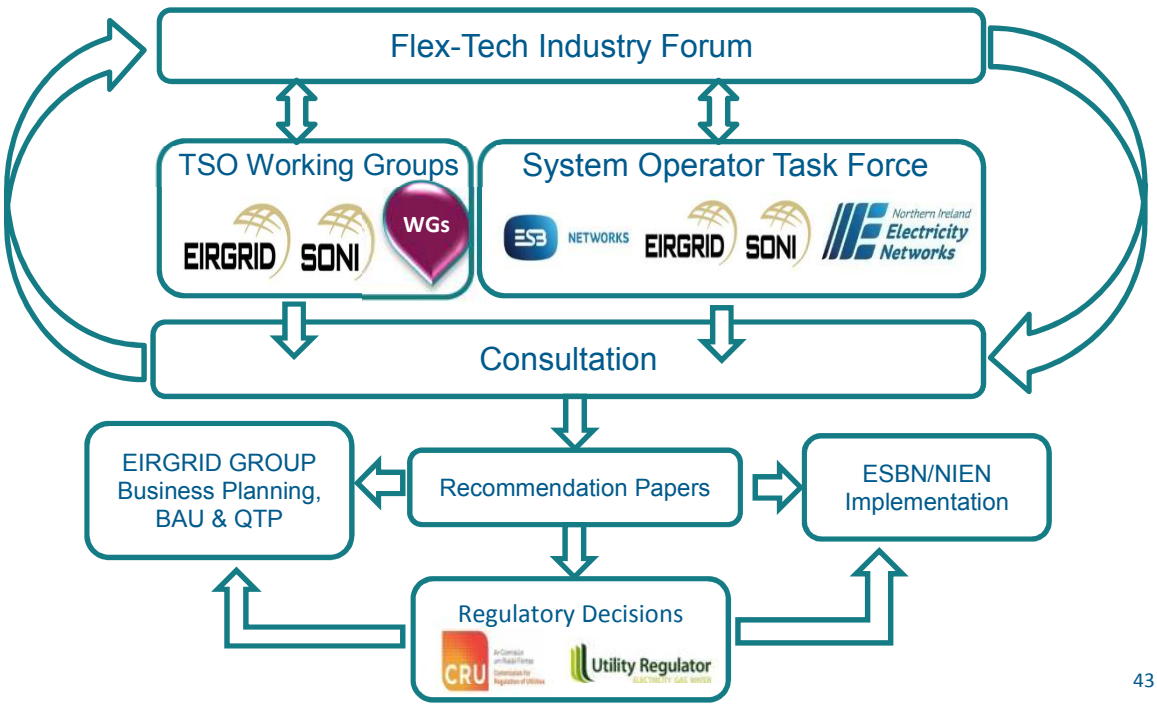

FIGURE 5 FLEXTECH STRUCTURE

ROLE OF INDUSTRY FORUM AND CONSULTATION PROCESS

The Industry Forum shall act as a consultative body focused on identifying key opportunities and potential solutions across a broad range of challenges associated with renewable integration. The forum will not be a decision-making or policy formulation body but rather an open and transparent platform of engagement and consultation with industry on key topics. It is envisaged that the forum will take place bi-annually. Initially, there will be five key strands addressed, namely:

- Hybrid Technology;
- Renewables & Small Scale Generation;
- Storage Technology;
- Demand Side Management;
- Large Scale Energy Users.

It is intended to hold an open consultation annually to reassess the terms of reference for the initiative and to identify the key deliverables for the following year. This will help inform the topics for further investigation and ensure the direction of the initiative remains relevant and effective.

To make substantial progress, it must be clearly understood from the outset that for TSO related matters, EirGrid and SONI shall be the decision makers regarding the final terms of reference and the topics for further investigation. In arriving at decisions, EirGrid and SONI will endeavour to address key concerns of industry while not compromising on the overall system needs regarding renewable integration for 2030. The TSOs anticipate that the DSOs will work in parallel to address issues specifically related to their systems and will also be the final decision makers on these issues. As for TSO-DSO related matters, the TSO & DSO in the relevant jurisdiction shall be the joint decision makers. Where issues impact across transmission and distribution networks, the System Operator Task Force shall seek to agree a way forward and progress solutions.

ROLE OF SYSTEM OPERATOR TASK FORCE

Many of the challenges facing the TSOs and DSOs are related to changes that require a synergistic approach. It is therefore essential that greater co-operation and collaboration be established. The System Operator Task Force will be made up of representatives from EirGrid, SONI, NIE Networks and ESB Networks. The industry forum and internal EirGrid/SONI working groups will inform the System Operator Task Force on relevant issues. The task force will be responsible for resolving issues of a cross-sectoral nature and finding common ground that can then be presented to industry and regulators.

13. SUMMARY

In 2019 EirGrid expanded the scope of the QTP to incorporate a wider range of projects. The 2019 trials focus on Solar, Residential Services and enhanced forms of communication for new and existing technology. Following a successful procurement in 2019, EirGrid will be carrying out three new trials focussing on proving technology, measurability and innovation in future service providers. In total five providers were successful in as part the 2019 QTP. The trial will be carried out over a 12- 18 month period September 2019 to September 2020.

In Parallel to the QTP for 2019, the system operator has launched The FlexTech Technology Integration Initiative. The purpose is to provide a platform of engagement for the Transmission System Operators, Distribution System Operators, industry, regulators and other stakeholders to maximise opportunities for effective use of new and existing technologies and to identify and break down key barriers to integrating renewables.

14. COPYRIGHT

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