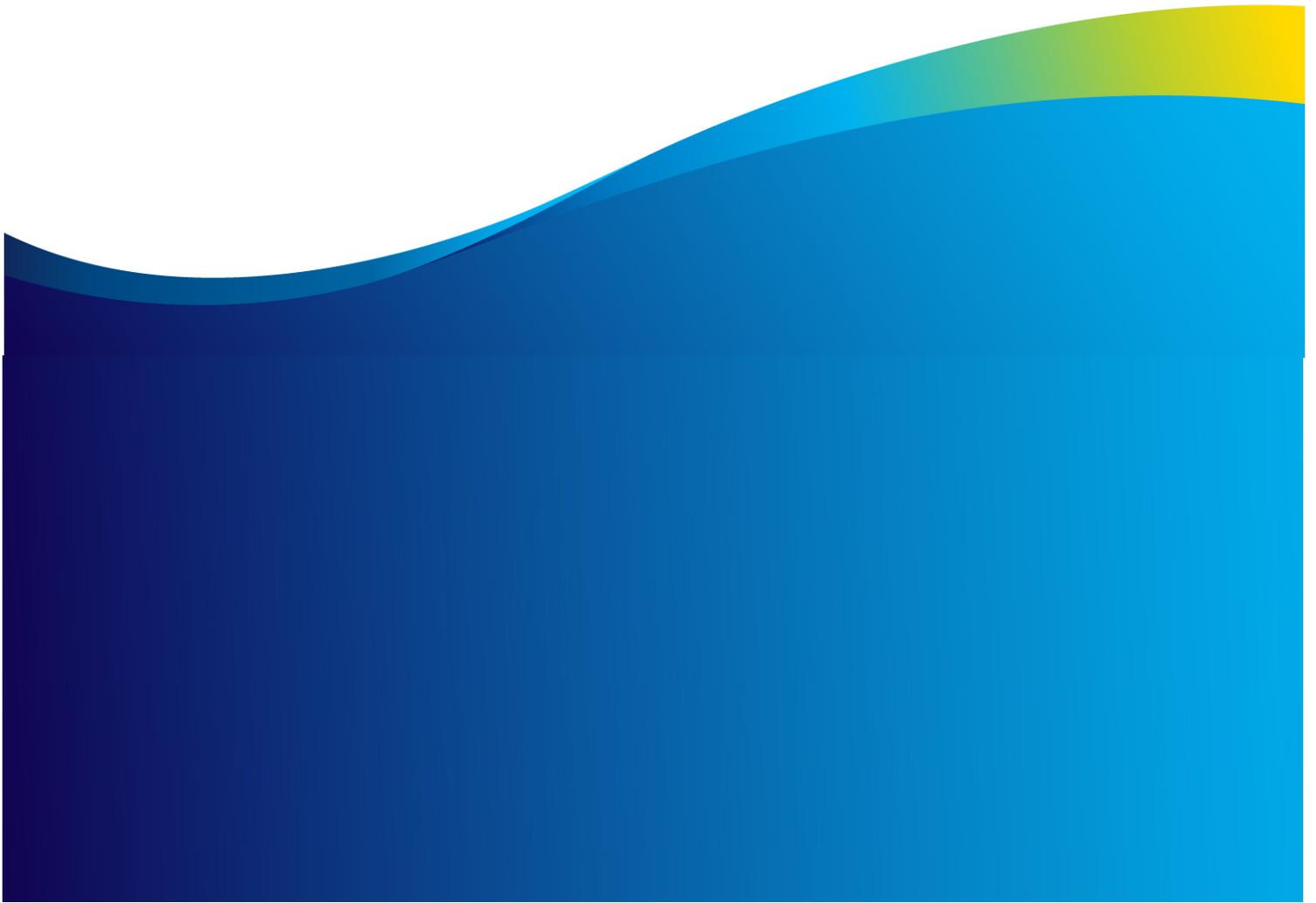




NETWORKS

ELECTRIC VEHICLE PILOT

R&D Project Submission Summary



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1. About this Document

This document summarises the proposal for the project trial, specifying the need for the research, the scope of the proposed trial, the research deliverables and cost of the research.

A more detailed Project Implementation Document (PID) gives further detail on the scope of the trial, its governance and how the project will be delivered. The delivery of the project is broken down to eight specific work packages and the delivery objective and timeline for each work package is detailed in the PID.

2. Electric Vehicle (EV) Trial – Terms of Reference

Introduction

By 2020, it is expected that up to 230,000 electric vehicles will operate on Irish roads. This will require a distribution network which will safely host the charging load to meet the driving requirements of their owners, on a daily basis. In addition the Meter Operator Systems will need to be in place to ensure correct settlement of this “mobile” load. It is also anticipated that this will be a flexible load, capable of acting as a ballast for variable renewable generation and therefore the distribution system will need to facilitate this requirement in so far as is possible.

The realisation of this development is arguably one of the most difficult and complex challenges that ESB Networks have faced in its DSO/MRSO roles in recent years due to the uncertainty of the potential impact of this on the distribution network. The technical challenges presented by the mass market penetration of EVs are vast. Therefore, in order to manage this development as efficiently as possible, from a network operator and meter system operator viewpoint, significant research is now required to determine the most appropriate actions in terms of modifying existing networks’ operational codes and connection policies, developing new infrastructure and implementing new technologies or control systems to meet this load.

EU and National Policies Driving the Take-up of Electric Vehicles

The Irish Government has set an initial target of 10% of the car fleet or 230,000 cars to be electrified by 2020. This target is set in order to meet Ireland’s binding commitments under EU legislation. To facilitate this, a number of incentives in order to kick start the take up of electric vehicles have been implemented. It has been stated that the number of EVs will be comparable to fossil fueled cars by 2018 – without any incentivised supports. In addition the technology is developing rapidly to further ensure the success of EVs.

Therefore while the uptake of EVs to-date in Ireland has been slower than anticipated, there remain firm reasons to expect that these targets will be met. As DSO, we now have the responsibility to ensure that this integration is planned for and thus achieved in the most efficient way possible. In addition even if only a fraction of the targets above are achieved – this research is still required due to the potential impact it could have on the Distribution network.

Issues to be addressed in the Trial

Some of the specific uncertainties and concerns that currently exist with regards to planning for this new technology are as follows:

- As domestic customers already have MIC's (Maximum Import Capacities) capable of accommodating the charging demands of electric cars, this load currently could therefore be added to the customer's domestic load without any restrictions as per current connection and distribution code standards. However, a 100% take up of electric cars on a single LV circuit, could lead to 100% increase in the loading of that circuit – leading to overload and a significant electricity network reinforcement requirement.
- Without planning and anticipating the emergence of this load, huge network reinforcements could be required, the costs of which would need to be socialised across all users.
- ESB Networks have no control of the timing or the take-up of this new technology and therefore may not have adequate time to develop standards if we wait to do this as the market develops.
- Sufficient information is not available on charging behaviour in order to adequately plan for this new load and inform distribution/connection code changes that may be required. Though there are lots of trials on-going throughout the world – as was seen for the smart meter programme - the outcome of trials in other countries are not adequately reliable to forecast Irish customer behaviour.
- There is currently little or no knowledge about how this load will be distributed geographically – will clustering occur as outlined above or will a more even/random distribution of EV take up – will it be urban only?
- What mechanisms and incentives can be put in place to minimise the investment required in the network while at the same time not limiting the charging options for customers – Smart Charging.
- What are the market rules/process to govern how on-street charge points are metered and data collected for settlement, and how will this fit with existing settlement systems?
- What are the network planning rules that will apply for the connection of Charge Points to the network – what (if any) diversity can be applied to this load with respect to general network loading conditions?
- What is the expected on-street charging technology that will be adopted in Ireland? What is the appropriate safety standard that ESB Networks should enforce for connection to the Distribution system?

3. The Research and Deliverables

Proposed Research Requirements:

In order to address the issues and concerns highlighted above, ESB Networks propose to carry out extensive research on this new technology, how it may be adapted in Ireland and what measures can be taken to efficiently facilitate it on the distribution network. In order to get the answers required, it is absolutely necessary to establish the physical impact of EV charging on the full range of customer and network topologies.

The research will investigate the expected probability of certain impacts identified occurring based on a range of variables including network type, charging behaviour, penetration level, clustering factors and existing and potential technological or standards development. The physical trials will be supplemented by simulation to derive different risk scenarios based on different situations. This is particularly the case in terms of network types as these vary significantly between rural, urban, over-head and underground systems situations. Based on this, the key issues which must be addressed will be identified and their priority addressed in terms of the likelihood of occurrence and the resultant impact if they were to occur.

A range of smart charging options will be identified and trialled which will mitigate the impact of, and potentially facilitate the efficient hosting of, EV charging load. Those options deemed safe, feasible and cost effective, through desktop analysis based on scenarios or risk, must also be analysed and tested in the field to determine which solutions best meet specifications including, but not limited to issues of safety, functionality, cost effectiveness and practicability.

This will be best informed through work with a range of stakeholders to leverage different areas of expertise and experience, and ensure that international best practice is reflected in future plans. Ireland is likely to be a relatively small market in global EV terms. There is a risk that specific issues identified in the Irish context alone will not align with the development in EV charging technology and standards that will be driven by requirements of other larger markets. Working with international collaborators will mitigate the risk of addressing solutions which are likely to be stranded at a later stage due to divergence with technological development in larger markets for EVs. Additionally, working with research and academic bodies allows that broader areas of expertise on the likelihood of certain risk parameters can be addressed. As socioeconomic, socio-geographical, psychological and other areas beyond the domain of electrical networks will have a direct bearing on the likely distribution of EVs, which has a direct bearing on the impact on electricity networks, it is essential that the research delivered will inform on this.

Having identified the most appropriate solutions in terms of conventional network development and technological control integration, it is also necessary to identify and develop the systems required to support these solutions. These will include telecommunications links, ICT, monitoring and integration with existing systems.

The Trial will therefore involve:

- Recruiting a large number of potential EV owners and people willing to trial an EV across the age, socioeconomic and geographical spectrum to participate in the trial.
- Trialling a range of Electric Cars – across a range of potential users.
- Trialling a range of Electric Cars across a range of network topographies.
- Installing appropriate metering and communications systems to support the tracking of charging.
- Identifying and trialling solutions that can increase network hosting capacity of EV's without the customer's involvement.
- Working with EirGrid and Suppliers to develop pricing structures and incentives to encourage smart charging while ensuring the limitations of the local network are accommodated.

- Demonstrate a number of smart charging solutions that will enable the effective management of this load on local networks. These solutions shall also deliver flexibilities to the TSO for ballasting variable renewable generation at a system level, and will also enable customers to avail of low wholesale market prices through their supplier.
- Deployment of a range of Street Charge points across the country, 1000+ charge points to cover the various parts of the country, network and charge point types, to determine the appropriate connection method to ensure efficient and safe connections. The 1000+ spread (at ~ 700 locations) are required for the following reasons:
 - To get the geographical spread to develop information on usage profiles
 - To assess the full range of potential connection methods in various networks across the country, while liaising with local authorities to develop a range of potential public charge point locations. ESB Networks will need to agree standards with the local authorities that ensure public safety, and to ensure that the metering provisions are adequate (which in some situations may drive the need for additional street furniture which may be difficult for some local authorities)
 - To assess the various potential charger types and their limitations in certain situations.
- Participation in international collaborations to build up knowledge of the technology.
- Extensive collaboration with Irish academia for thorough analysis and simulation.
- Reviewing options for metering and settlement of mobile loads and implementation of a trial system to demonstrate how this could operate.
- Using results of physical trials with applicable international data, to deliver simulation studies, that will give a statistically reliable set of scenarios and probabilities.

Expected Outcomes / Trial Deliverables:

Identifying these needs and addressing their integrated development from an early stage will ensure the most efficient and functional infrastructure deployment possible. As a direct result, those changes to the Distribution Code and connection policies as well as network policies for the home and street charging of electric vehicles will be well informed. All changes in policy should ensure that their impact on the distribution network is minimised while also ensuring the customer benefits from maximum convenience whilst charging. This will permit the full benefit of EVs to be leveraged by the TSO/Suppliers or other entities that may use this as a flexible load.

Developing and testing these solutions in an integrated manner with the primary solutions for EV integration mentioned above is the most effective means of ensuring that they are inter-operable and meet operational needs. Specifically, the proposed trial will therefore enable the following:

- Inform the connection requirements, safety standards and metering standards for on-street charging infrastructure to facilitate their connection and settlement of the charging load in a safe and cost effective manner.
- Inform future network development through identified EV penetration scenarios and development solutions to allow efficient network planning.
- Evaluate the benefits to the electricity system in terms of Demand Side Management, optimising the use of renewables and how this can be integrated, while minimising the impact on the distribution network.
- Identify the functional needs and connection standards to realise such demand side management and control, and where suitable, allow for their integration into physical infrastructure and IT system rollouts.
- Identify the DSO measurement, protection, visibility, control and management systems that are required to oversee the correct implementation of smart charging with appropriate protection/control capability to intervene where the capability of the network is being exceeded.
- Evaluate the overall impact on all electricity consumers – both those with EVs and all other users of the electricity networks under a number of penetration, clustering geographical, and car owner charging behaviour trials. Demonstrate how the overall cost to society can be minimised through efficient future planning and imposing minimal obligations on home and on-street charging behaviour.
- Based on the above points – inform the changes to the Distribution Code and connection policy to cater for Evs, and inform the obligations that should be imposed on potential EV owners, car manufacturers and on-street charge point operators.
- Develop a trial IT system to support charge point management and control including data collection and settlement, retail competition and integration, at minimal impact, to existing market systems and networks. This system will be developed for the purpose of the trial but designed so as to be scalable for full charge point deployment in the future.

A significant element of the trial is the procurement, installation and operation of charging networks with the necessary supporting systems. ESB Networks has already made significant progress in this area and has placed emphasis on the long term durability of any solution in order that any investment in this trial may have a potential value beyond the pilot period, subject to any CER decision in this area. Key to this is that ESB Networks plays a role in the development of standards pertaining to EVs and their charging technologies to ensure minimal impact on the cost of their integration onto the existing network infrastructure.

As Distribution System Operator for Ireland, ESB Networks has considerable expertise in the factors which will influence the quality and security of electricity supply. As a result we shall continue to work with all relevant stakeholders to ensure that these are taken into consideration in the development of new technologies.

4. Primary Project Elements

Charging Infrastructure

A base infrastructure of on-street and home charging points will be installed, requiring the rollout of up to 1,500 AC charge points (750 - 800 locations providing double headed chargers in specified locations), up to 29 DC Fast-Charge points and up to 2,000 home chargers.

This will demonstrate the diverse network conditions where charge points will need connection and identify fundamental safety parameters in relation to EV charging and how the metering requirement of settlement can be catered for across a number of charge points and a number of network and location situations.

In addition it will facilitate the collection of behavioural data to enable the accurate assessment of the expected load profile for both home and on-street charging.

It is anticipated that the vast majority of EV charging will take place in the domestic environment, with public infrastructure being used as a source of 'top up' energy and to provide a confidence factor in terms of range anxiety. As such, the safe and effective integration of domestic charging on public electricity networks is vital. Many of the long term benefits to the electricity system and the minimisation of their impact on the local networks will be dependent on the technical integration capabilities of domestic charging with the wider electricity grid – all of which will be examined as part of this trial.

Additionally, some rebalancing of charger types or the integration of control technologies may be required, depending on consumer charging patterns. ESB Networks will manage and monitor such requirements as part of the trial programme which will be scoped in line with EV sales, ensuring that these needs are met in an informed and cost effective manner.

Customer Behavioural Trials

In order to assess the EV owners charging behaviour and needs, customers will be recruited to participate in the trial. In the first instance, there are approximately 350 privately owned EVs in the country. These customers will be asked to be part of the trial so that, as a group, their charging practises can be assessed. In addition, ESB Networks have 18 EVs that will be circulated to people on the trial for a number of months. Some charging behaviour information has already been built up using this fleet and it is expected that up to another 200 potential users will be accommodated in the next two years.

In order to get statistically valid samples, the ESB fleet will be deployed based on location, network condition, age profile and socio-economic grouping. It is also hoped that the private owners of EVs will also be spread across various ages and socioeconomic grouping, but this is yet to be confirmed. Particular information on commercial EV charging practices will also be collected. ESB have a number of fleet electric vehicles, as do other semi-state / commercial companies, who will also be asked to partake in the trial.

IT Systems & Market Facilitation

IT systems are required to support the physical charging infrastructure during the trial and to demonstrate how such a system may work in the future. ESB Networks is mindful of the requirement to ensure that any such systems are implemented, integrated and operated in the most cost efficient manner. Therefore it will be ensured that the system, with little effort, will be scalable and usable after the trial if it proves suitable. The long term cost effectiveness requires that they are designed and deployed in such a way as to minimise

any impact on existing market participants and structures, whilst facilitating full retail competition in terms of tariff offering, electricity sales and new product development. The IT system will be designed on this principal.

Current market structures are not designed to support the mobile electricity consumption characteristics of EV drivers. As such, the appropriate IT and associated systems are not in place at this time. It is clearly accepted that those market models eventually adopted is beyond the influence of the parties to this trial and will not be pre-empted by this system. However for the purposes of the trial period it is proposed to develop those technical solutions as would facilitate the Integrated Infrastructure Model as identified by Eurelectric, as it is an internationally accepted model anticipated to allow for full retail competition. It is not intended that the trial solutions set precedents for any other retail market areas.

Beyond the above, other IT systems modifications may be needed to facilitate the implementation and oversight of smart charging including further development of the existing network control and monitoring systems used by ESB Networks.

Technical Facilitation of Retail Competition

For any meaningful and informative trial, it is important that supplier consultation and involvement is maximised to identify likely tariff offerings and post-trial market structure as would be enabled by EV infrastructure. To this end, ESBN will develop and deploy trial systems capable of supporting retail competition for retail offerings whilst minimising any additional related IT investment costs on the part of suppliers or customers.

ESB Networks has already undertaken significant preparatory development of an industry model sufficient to support the trial and to meet the requirements of retail competition with minimal impact on existing industry participants systems from a technological perspective. Given the restricted timescales available, and the need to develop and deploy these systems in advance of the end of the trial, ESB Networks recognises the importance of CER support in securing industry participant buy-in for the proposed implementation of necessary systems and structures to support the trial.

Consumer and research or academic community involvement

To allow for field trials and deployments, and to gather information pertaining to charging characteristics based on a range of factors, a necessary part of the trial programme will be engagement with the general public. As stated above, the involvement of the research and academic community allows for a more informed analysis of those parameters in the area of customer interaction with EV systems as will have a bearing on the impact on electricity networks.

5. Project Finance & Cost Recovery

Trial Period and Costs

ESB Networks plan to complete the physical infrastructure and IT systems rollout by end 2013 with the trial period continuing through to Q1 2015. ESB Networks estimate the cost of the project would be of the order of €30.7M. This is an already reduced figure from the level that would have been required to deliver the full scope of the project. Significant efficiencies have already been achieved, for example, through collaboration IT element of the project. We expect further such savings and therefore the resultant reduction means that a final figure requested for regulatory approval is €25M.

Leveraging additional Funding Mechanisms

ESB Networks, as always, is fully conscious of the need to minimise the cost for the electricity customer. In keeping with our stated objective, we will continue to seek ways to reduce these costs through funding and contributions from interested third parties, with particular emphasis on securing EU grants applicable to this area. To aid the pursuit of such support, ESB Networks would propose to share the benefits of any such contributions secured. Other areas will be pursued including seeking assistance for specific host locations though either direct financial contributions or in kind.

Cost Recovery

To date ESB Networks has negotiated partial funding of the trial programme through the European Investment Bank (EIB). This arrangement is subject to a regulatory cost recovery mechanism being agreed with CER.

Following an evaluation of the pilot, the CER may determine the future use of the pilot infrastructure, while ensuring that ESB Networks investment is recognised.