NETWORKS

ELECTRIFICATION OF HEAT AND TRANSPORT STRATEGY

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CONTENTS

01. INTRODUCTION

Climate change and a transition to low carbon energy use and generation are the key drivers for much of the development of energy policy across the globe. The objective of the 2015 United Nations Paris Agreement is to set the world on a path that ensures that temperatures stay less than 2°C above pre-industrial levels and aspires to limit the increase to 1.5°C [1].

Ireland will contribute to this agreement via the Nationally Determined Commitment tabled by the EU in March 2015 on behalf of Member States, which commits to at least a 40% reduction in EU-wide emissions by 2030 (compared to 1990 levels); this is based on reductions in the Emissions Trading System (ETS) and non-ETS sectors of 43% and 30% respectively. This is likely to be superseded by new targets as part of the European Green Deal, in which the Commission proposed in September 2020 to raise the 2030 overall greenhouse gas emission reduction target, including emissions and removals, to at least 55% compared to 1990 [2].

In 2019, to enable the EU deliver on the commitments laid out in the Paris Agreement, the EU completed a comprehensive update of its energy policy framework, to facilitate the transition to a low carbon, renewables-based economy. This framework is known as the Clean Energy Package [3]. This introduced several requirements that support the uptake of electric heat and transport, including electric vehicle charging capability in buildings and the development of zero-energy buildings that require low carbon heating.

In response to these legislative and policy drivers countries are themselves making unprecedented moves to enable decarbonisation and adopt sustainable technologies. For example Norway, UK and Ireland have announced that they will no longer sell petrol or diesel cars by 2030. Further public information in relation to the environment has been expanded through various awareness raising programmes. In 2020, the coalition government committed, as part of its final programme for government, to an average 7% per annum reduction in overall greenhouse gas emissions from 2021 to 2030 (a 51% reduction over the decade) and to achieving net zero emissions in Ireland by 2050 [4].

Ireland's Climate Action Plan, released in 2019, and the National Energy & Climate Plan, released in 2020, have set challenging targets for uptake of electric vehicles and residential electric heating sources out to 2030 [5 6]. The Government plan has targets for 936,000 electric vehicles and 600,000 residential premises to be equipped with electric heating sources, including heat pumps, by 2030.

Q1 STAKEHOLDER QUESTION

The path to achieving the targets set out in the Climate Action Plan in the next decade is uncertain, with different views on potential electrified heat and transport uptake curves between now and 2030. ESB Networks is assuming an uptake scenario for 2025 that would see 181,500 electric vehicles on Irish roads and 350,000 heat pumps in Irish homes by 2025 and is planning accordingly. Do you think these are realistic assumptions to plan to? Is there evidence to support alternative uptake scenarios?

Achieving these targets will contribute significantly to delivering Ireland's decarbonisation objectives. This transformation will require the distribution system to transfer significantly more energy, making this system central to enabling the decarbonisation of the Irish energy system. There is significant capacity in the existing infrastructure however in some areas of the network, additional capability in the distribution system will be required where significant clusters of electric vehicles and heat pumps emerge.

ESB Networks recognises the pivotal role that the electrification of heat and transport can make to lowering Ireland's greenhouse gas emissions and achieving our targets for decarbonisation of the Irish economy for 2030 and beyond towards net zero. The distribution system will be the critical link between customers electric vehicles and heat pumps and the zero carbon, renewables-based generation that will power them into the future. Therefore, we believe that it is essential that the distribution system will not be, in any way, an impediment and should instead be a key enabler of customer adoption of electric vehicles and heat pumps. This electrification strategy outlines our level of ambition in facilitating the electrification of heat and transport and clarifies what our position and objectives are across a range of customer, technical, commercial and educational areas.

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02. ABOUT ESB NETWORKS AND ELECTRIFICATION

Ireland's electricity network was first established in 1927 in conjunction with the building of the Shannon hydroelectric electricity scheme. Development of the electricity infrastructure has been a key part of Ireland's transition from a largely agrarian economy to one of the most modern economies in the world.

This infrastructure is again central to the next transition to a low carbon economy enabling the decarbonisation of electricity generation, including microgeneration, and the electrification of the heat and transport sectors through technologies such as heat pumps and electric vehicles.

The distribution system enables the flow of electricity from generators connected to the transmission and distribution system to over 2.3 million customers. It comprises networks operating at 110kV in the Dublin area, and nationwide the networks operating at 38kV, 20kV and 10kV and low voltage (LV) which is the voltage which is supplied to domestic customers. ESB Networks is the Distribution System Operator (DSO) in Ireland and has responsibility for the operation, planning and optimal development of the distribution system.

As the numbers of electric vehicles on Irish roads and heat pumps in Irish homes increase as we move through this decade, it will be the distribution system will provide

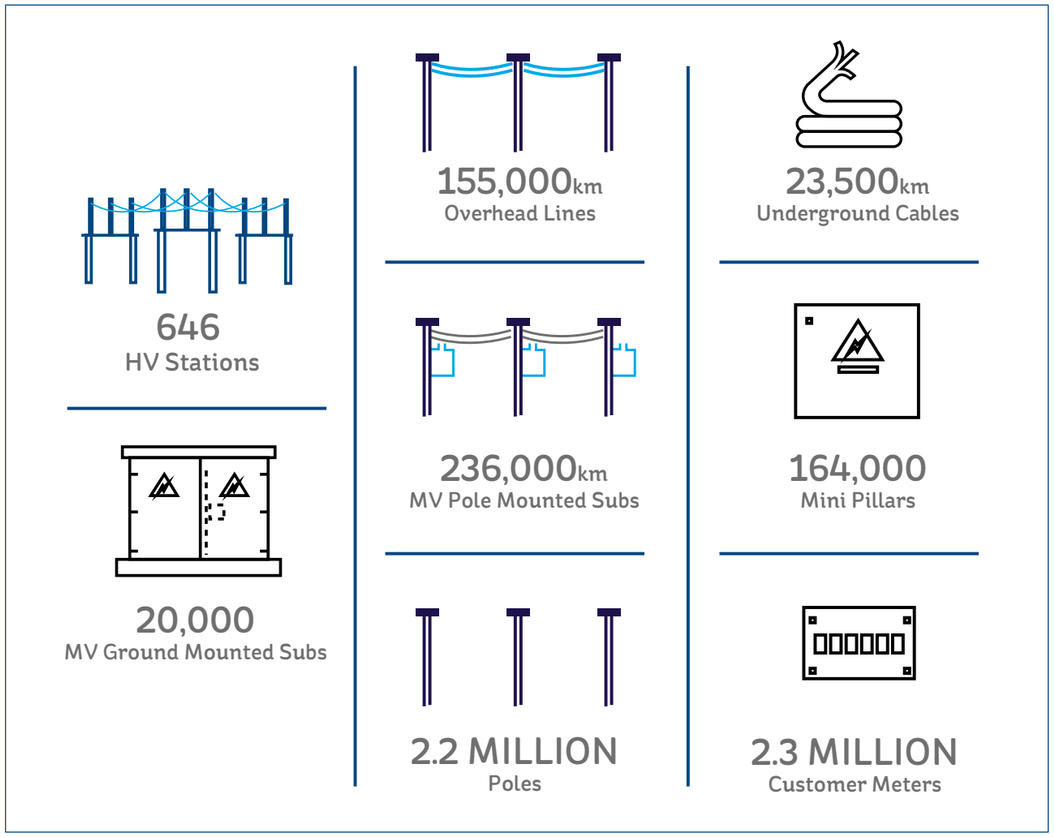


Figure 1 Summary of distribution system assets

low carbon electricity to power the electric vehicle charge points and heat pumps installed in customers' homes and businesses in Ireland. This means that ESB Networks, as the DSO, will need to continue the economic development of the distribution system and also ensure that our interfaces and engagements with our customers are as clear and as simple as possible to facilitate their adoption of these low carbon technologies.

WHAT WE HAVE ACHIEVED – RESEARCH AND INNOVATION IN ELECTRIFICATION

Since 2011 we have been working on several research and innovation projects which have delivered significant learning and support to the electrified heat and transport sector.

We have had a roadmap within our innovation strategy dedicated to solving the challenges associated with the electrification of heat and transport. These activities are now part of our new Climate Action and Future Customer innovation roadmaps[7] which encompass innovations relating to enabling the electrification of heat and transport, and innovations that will be needed to facilitate customers who wish to use the flexibility of electric vehicles and electrified heat to actively participate in the operation of the electrical system.

Over the period 2011 – 2015, ESB Networks delivered a large-scale pilot, Preparation for EV's On The Distribution System, led by the Commission for Energy Regulation (CER), to investigate electric vehicles and electric vehicle charging infrastructure and assess the impact that the electrification of transport will have on the electricity network. This vital, cross sectoral work was delivered with partners from the electricity, telecommunications, IT and electric vehicle industry, and with academic institutions, across Ireland and Europe [8,9]. This project delivered key insights into the challenges associated with the wide-scale deployment of electric vehicles including the impact on the distribution network. Furthermore, the pilot delivered the initial tranche of public electric vehicle charge infrastructure in Ireland, much of which is still in use today.

We are partners on the International Energy Research Centre (IERC) led Superhomes I and Superhomes II project along with three other Irish based consortium partners. The project is investigating how source heat pumps operate in newly retrofitted homes in Ireland. Working with the consortium partners and partners on the SEAI funded Exploration of Air Source Heat Pumps for Ireland's Residential Heating Needs we combined this data with heat pump performance metrics in order to inform an understanding of their real-world performance and the impact they have on the distribution system [10].

In addition to the role of electric vehicles and heat pumps in decarbonising the domestic heat and transport sectors, it is acknowledged that they have the potential to provide decarbonised flexibility that would enable the integration of greater quantities of renewable generation and enable Ireland to achieve the target of 70% of electricity generation coming from renewable sources by 2020. Furthermore, electrified heat and transport-based flexibility may also have a role in supporting the operation of the distribution system. In the EU Horizon 2020 funded RESERVE and Real Value project, we worked with other consortium partners to develop solutions that could enable 100% renewable generation on the electricity system. As part of the RESERVE project we investigated the operation of Vehicle-to-Grid (V2G) systems and piloted the country's first V2G charge point. The project also trialled the use of heat pumps in educational environments. In the Real Value project, controllable electric heating was investigated to provide Demand-Side Response (DSR) by installing over 1,000 Smart Electric Thermal Storage (SETS) units in homes in Ireland, Germany and Latvia as part of this trial.

Limerick City and County Council (LCCC) have been awarded Lighthouse City status as part of the +CityxChange EU Horizon 2020 project. Pilots of a Positive Energy Block (PEB) and a Community Grid will be carried out as part of this project to investigate how these concepts could enable the integration of large quantities of low carbon generation in urban areas. Heat pumps generating space and water heating, electric vehicles using smart charging and V2G technology will be an integral part of these pilots, providing valuable insights into how these technologies and concepts could operate collaboratively within future smart cities.

The Dingle Electrification Project is ESB Networks' flagship innovation project. The project is looking to evaluate the capability of behind the meter assets such as heat pumps, electric vehicles, direct water heating, solar photovoltaics, and energy storage to evaluate their impact on the distribution system and their capability to provide DSR. Clusters of heat pumps in the area are being monitored, using LV monitoring systems. During the project to investigate how customers use of electrical energy is changing as they electrify their heat requirements and evaluate the capability of these systems to improve our visibility of the LV network. We will also be carrying out a trial of electric vehicles to evaluate their impact on the distribution system.

These innovation projects and pilots fed into a broader project titled Planning Future LV Networks for Electrified Heat & Transport. This project evaluated our existing LV planning approaches and standards in the context of learnings from our innovation projects, international pilots and academia which evaluated the impacts of electric vehicles and heat pumps on the distribution system.

The key recommendation of this work was an increase to the After Diversity Maximum Demand (ADMD) that we use to design the LV networks to reflect the increased loads on the system as the penetration of electric vehicles and heat pumps increase. The ADMD can be thought of as the average peak load per customer and is a crucial metric in the design of LV networks here in Ireland and internationally. The ADMD in ESB Networks has been increased from 2.5kW to 5.5kW for the design of our networks, helping to future-proof the distribution system for changing customer behaviours.

This section has provided a summary of the research and innovation activity we have carried out over the past ten year. Our research and innovation has provided a solid foundation for our activities in supporting the electrification of heat and transport and is informing the development of this electrification strategy including the Forecast, Identify, Monitor, Smart Solutions and Strengthen Network (FIMSS) methodology detailed later in this document which is integral to our approach to developing a distribution system for the future.

03. THE ELECTRIFICATION CHALLENGE

BARRIERS TO UPTAKE OF ELECTRIC VEHICLES AND HEAT PUMPS

The electrification of heat and transport will have impacts that will go beyond those felt in the energy sector. To decarbonise the transport and heat sectors will require a paradigm shift in how society views and engages with these sectors.

Achieving this transition will require substantial cross-sectoral advances in policy, technology and industrial capability. In the short-term, several issues and barriers have been identified by customers and other stakeholders with respect to the uptake of electric vehicles and heat pumps. These include: [11] [12] [13]

- Concerns about the upfront cost of heat pumps and the cost of retrofitting existing properties so that they are appropriate for the installation of heat pumps
- Uncertainty about the performance of heat pumps
- Uneasiness about the availability of electric vehicles and their cost
- Anxiety about the range of electric vehicles and the perception that there is not enough reliable public electric vehicle charging infrastructure available [14]
- Concerns about the lifetime of the electric vehicle battery and the cost of its replacement
- Uncertainty about the interoperability between different charging service providers and ultimately a lack of choice of where to charge
- Concerns about the cost of connection to the distribution system, including third-party costs, for new electric vehicle charging infrastructure
- Worries about high residential electricity bills and reliance on electricity for energy, heat and transport
- Concerns about the disruption caused by installing an electric vehicle charge at home and difficulties accessing electric vehicle charging where a residence does not have access to a garage or dedicated parking space
- Costs and complexities associated with installing public charging infrastructure

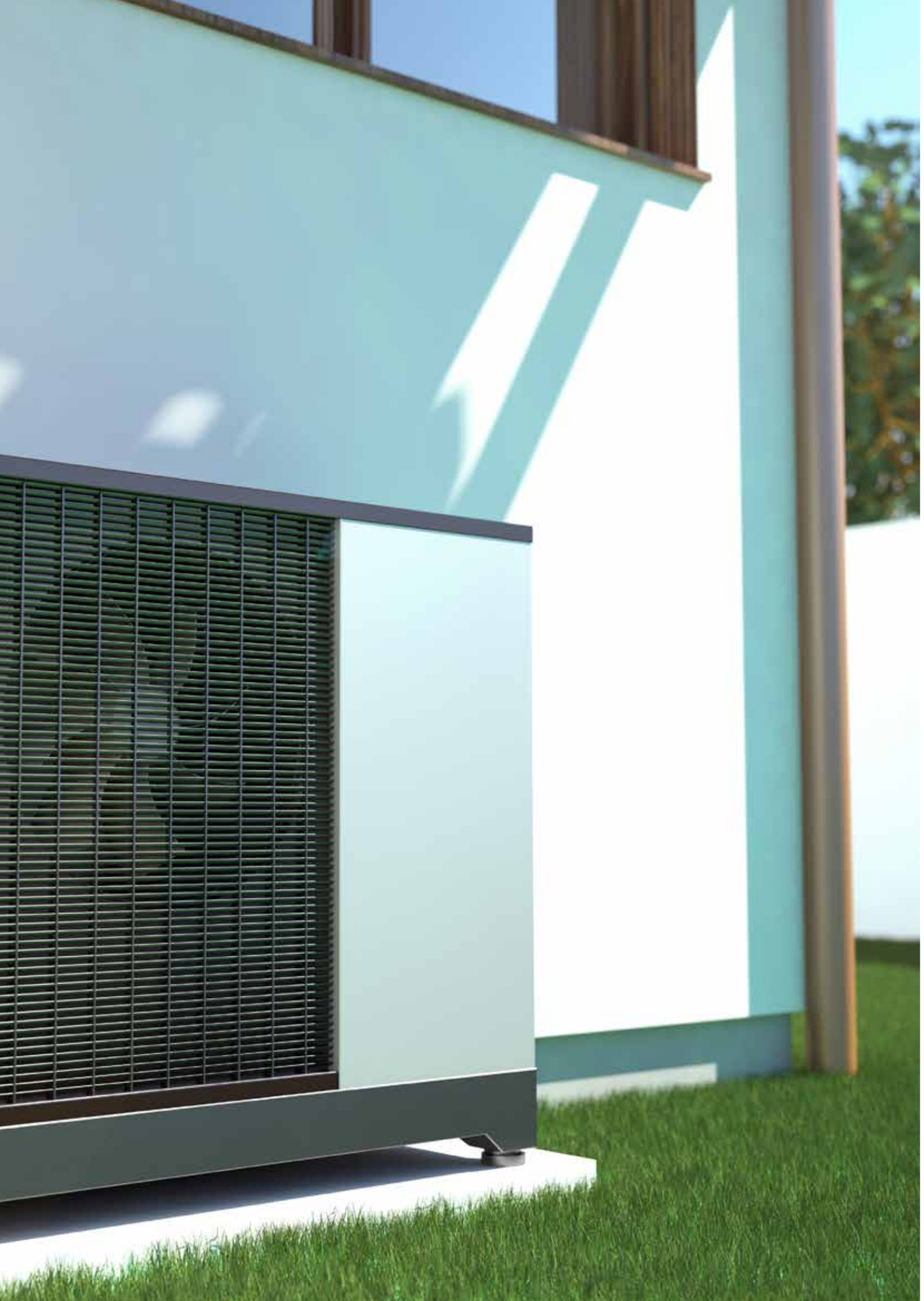
Many of these barriers are already being addressed by government, industry and advances in technology. Electric vehicle ranges are increasing as battery technology and vehicle design improves. Programmes to support the retrofitting of older properties and make them suitable for the installation of heat pumps are having an impact. Furthermore, the ongoing installation of reliable, publicly accessible charge points across the country, is providing potential electric vehicle buyers with the confidence that public charging will be available when and where it is needed. These developments are providing reassurance to customers, by visibly addressing their concerns in these areas and will in turn enable a faster and more predictable take up of electrified heat and transport.

SECTORS OF ELECTRIFIED HEAT AND TRANSPORT

The electrification of heat and transport will have many impacts, not only on the distribution system but will have broader impacts on how we organise transport, build our buildings and engage with the energy system. Therefore, in order to comprehensively address the challenges, it is appropriate to identity discrete sectors to understand how we can facilitate their transition to electrified heat and transport.

Electrification of Transport

Among current permanent electric vehicle customers, international research has found that generally between 50-80% of all charging events occur at home [15]. In Norway, this percentage is even higher at over 90% and in the UK it was found that 72% of the energy used to charge electric vehicles came from home charge points. This reliance on domestic electric vehicle charging infrastructure has been shown to be dependent on factors such as access to garages or dedicated parking spaces allowing private electric vehicle infrastructure to be installed. It cannot be predicted with certainty whether these patterns of behaviour will continue or not, as factors including technological development, infrastructure availability, government policy and customer preference, may impact on how customers will charge their electric vehicles in the future.



ESB Networks was involved in the Low Emission Vehicle Task force, Working Group 2, chaired by the Department for Communications, Climate Action and Environment (D/CCAE). This group defined four broad types of electric vehicle charging [16] which we use to inform our four stakeholder sectors for electrified transport.

1. Domestic and Home – This refers to residential customers whose electric vehicle charging is done at home. Usually 7kW single-phase alternating current (AC) or less
2. Commercial and Location – This refers to stakeholders who are looking to provide electric vehicle charging at private commercial/communal premises with or without public access such as electric vehicle fleet operators. These chargers will typically have a capacity up to 22kW three-phase AC or less per charge point. This may include high power rapid charge points suitable for electric vehicles, particularly larger vehicles, with higher charge rate capabilities
3. Public On-Street – This refers to stakeholder who will be looking to provide electric vehicle charging in public areas with public access such as local authorities. These charge points will typically have a capacity up to 22kW three-phase AC or less per charge point
4. Rapid – This refers to stakeholders who wish to provide high power/fast charging with public access. It is envisaged that this will take place on private property with public access similar to a petrol forecourt. These charge-points currently have a capacity up to 350kW direct current (DC). This is expected to rise in the future as larger capacity batteries in electric vehicles become more common and as heavy goods vehicles and public transport (e.g. buses) also electrify

Q2 STAKEHOLDER QUESTION

How do you see charging evolving into the future e.g. do you see more charging taking place in public on-street/location/fast charging or will home charging remain the predominant approach to electric vehicle charging? ESB Networks is assuming that the energy used for charging their vehicles will be split as follows by 2025 between the sectors above.

> 80% Domestic/Home
> 10% Commercial and Location
> 5% Public on-Street
> 5% Rapid

Do you think this assumption is appropriate or do you have evidence to support an alternative assumption around the split of location of charging activities?

Electrification of Heat

From engaging with our stakeholders, we have identified five broad sectors to consider for our strategy

1. Domestic House– New Build: This refers to new build homes with heat pumps considered in the development of the building and network infrastructure from the outset
2. Domestic House – Existing: This refers to existing homes that may require a retrofit in order to install a heat pump
3. Apartment Blocks
4. Office Blocks
5. Industrial/commercial

Q3. STAKEHOLDER QUESTION

Is grouping customer buildings into these five sectors appropriate or does the diversity of challenges mean we should subdivide into more sectors to comprehensively address the challenges associated with electrified heat?

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04. VISION AND OBJECTIVES OF OUR ELECTRIFICATION STRATEGY

We believe that ESB Networks should take a proactive role in enabling the decarbonising heat and transport through electrification. Ireland already has one of the highest penetrations of renewable generation in the world and our distribution system has significant capability to connect large numbers of electric vehicles and heat pumps.

Thus, increasing the use of the distribution system to electrify heat and transport represents a tremendous opportunity to cost effectively decarbonise our transport systems and the heating of our homes and businesses.

Our vision for our role in the electrification of heat and transport in Ireland and the core objectives of our electrification strategy have been designed to align with international and government policy outlined earlier. They address the key questions that need to be resolved to cost effectively develop a smart, sustainable distribution system that will enable our customers transition to electrified heat and transport

OUR VISION AND OBJECTIVES

TO FACILITATE OUR CUSTOMERS TO CONNECT UP TO 1,000,000 ELECTRIC VEHICLES AND UP TO 600,000 HEAT PUMPS ON THE DISTRIBUTION SYSTEM BY 2030

Supporting this vision are the core objectives of the electrification strategy

- Provide our customers and stakeholders with clear information and guidance in relation to the connection of electric vehicles and heat pumps to the distribution system
- Collaborate with our stakeholders to ensure a whole system approach is used to optimally develop heat, transport and energy infrastructure
- Ensure that the capability of the distribution system is expanded in a cost-effective manner using smart solutions and intelligent asset development as appropriate to meet the requirements of electrified heat and transport
- Leverage the possibilities offered by new innovative technologies and smart solutions, including smart customer propositions, big data, artificial intelligence and smart metering, to enable the transition to electrified heat and transport.
- Ensure that the additional capability of the distribution system is delivered in a timely manner.
- Ensure that the security and reliability of the distribution system is maintained and enhanced to match the expectations of customers who will increasingly rely on electricity

Q4. STAKEHOLDER QUESTION

Are these the appropriate objectives for our strategy? What could be added or maybe should be removed? Do you have a view on how we should prioritise these objectives?

05. OUR APPROACH

The distribution system in Ireland has provided a reliable, cost effective supply of electricity to all customers since its inception. Underpinning the planning, design and development of the system are robust models informed by data and measurements that have been gathered for almost 100 years.

The transition to electrified heat and transport necessitates both challenge and review of these models, particularly at the residential low voltage system level. Furthermore, the rate of uptake and the distribution of electric vehicles and heat pumps connecting across the distribution system is uncertain as we move from 2025 to 2030 and onward to a climate resilient and climate neutral economy by 2050. How we manage this uncertainty, continue to optimise our decision making for our customers, and facilitate our customers to transition to low carbon, electrified heat and transport, will be crucial to achieve our goals.

Our strategy to deliver our vision and core objectives, in this evolving environment is centred around three themes. These reflect the key areas that we need to deliver on to ensure that ESB Networks enables the electrification of heat and transport in this evolving environment.

The three themes within the strategy are summarised below

REMOVING POLICY BARRIERS

- Update relevant ESB Networks policies and standards to reflect the changes in the system arising from the electrification of heat and transport.
- Ensure that all external documents and guidance are clear and accessible to remove barriers for customers when adopting electrified heat and transport
- Support development of governmental, national body and local authority standards, policies and code of practice

ENGAGE, ENABLE AND EMPOWER OUR CUSTOMERS TO ELECTRIFY

- Supportive clear processes for electric vehicle and heat pumps customers
- Develop guides, online applications and tools that will enable customers to quickly and safely connect electric vehicles and heat pumps to the network
- Ensure we engage with our customers and stakeholders to collect and share the correct data and information

ENSURING NETWORK READINESS

- Improve and refine our forecasts for electrified heat and transport
- Use forecasts to proactively programme the development of the distribution system
- Expand the suite of smart solutions tool kit
- Develop new tools and procedures to enable the use of new innovative technologies and concepts

Q5. STAKEHOLDER QUESTION

Are these the correct themes on which to focus? What should be added or removed?

REMOVING POLICY BARRIERS

The convergence of the energy, transport and heat sectors, precipitated by the paradigm shift towards electrified heat and transport, requires a step change in collaboration and coordination between stakeholders in these sectors. To support these changes, we will support the development of governmental, national body and local authority standards, policies and codes of practice that will enable the electrification of heat and transport. Where appropriate and possible we will share our data and information to enable the best decisions and outcomes for all stakeholders.

Within ESB Networks, our policies and standards are being reviewed and where appropriate revised, to reflect the requirements of our stakeholders so that we deliver a distribution system that can support large numbers of electric vehicles, heat pumps, microgeneration and other low carbon technologies (LCTs). We will ensure that these policies, especially externally available policies, will be clear and accessible so our external stakeholders have clarity on what steps are required when connecting to the distribution system.

Already, we have introduced revised standards for the design of new LV networks, more than doubling the capacity in new build housing developments, to accommodate the requirements of future customers with respect to electrification [17] [18]. These design standard changes were informed by pilots, trials and research into electrified heat and transport within ESB Networks and in other jurisdictions and represents a significant future proofing of these networks for our customers.

ENGAGE, ENABLE AND EMPOWER OUR CUSTOMERS TO ELECTRIFY

We are putting customers at the centre of our electrification strategy. For each of the customer sectors, we are working on how we can best support them and offer choice where required. We will look to increase our engagement with customers and stakeholders to listen to their needs, collaborate on solutions and improve the overall customer experience. We also recognise that there is a need to better inform our customers about the wider energy industry, while learning from the heat and transport industry about the challenges and solutions of the electric transition.

Key objectives of this theme are:

- Supportive clear processes for those customers installing electric vehicle charge points and heat pumps to improve the overall customer experience with ESB Networks.
- We will develop guides, tool kits and online applications that will simplify engagement with ESB Networks when installing electric vehicle charge points and heat pumps in their homes and businesses.
- Data and digitalisation of process and interfaces between ESB Networks and our customers is becoming increasingly important to deliver the distribution system of the future. We will engage with our customers and stakeholders to collect and share useful, appropriate and legal data and information, for example information about heat pump installations, to inform cost-effective development of the distribution system, compliant with legislation, best practice and aligned with customer requirements. Furthermore, we will look to develop processes to share information, where appropriate, legal and useful, to enable other stakeholders to develop heat and transport infrastructures like on-street electric vehicle charge points.
- As part of the National Smart Metering Programme new smart meters will be installed in every home in Ireland. As well as providing more accurate information on energy usage and reducing the need for estimated bills, smart metering will also enable the provision of new smart products and services from electricity supply companies. These could provide significant value and advantages for customers including those who have electric vehicles and heat pumps installed in their homes. Furthermore, these new smart products and services could enable smart solutions to enable the development of the distribution system and support the operation of the transmission system. Research commissioned by ESB Networks indicated that these smart solutions could reduce the conventional investment in the LV network infrastructure by up 20% resulting in material savings for all our customers. This finding closely aligns with data from UK DNOs and the Energy Networks Association (ENA) in the UK. Therefore, we will engage and collaborate with electricity supply companies, customers and other stakeholders to evaluate and where appropriate support development of these products and services.
- We will review our connection agreements and terms and conditions to ensure their suitability for customers adopting electrified heat and transport. We will investigate the potential for new connection arrangements such as managed or timed connections, which are used in other jurisdictions, to provide additional capability to the distribution system.
- Timed connections limit the power supplied to a customer during particular periods of the day and could provide cost savings to customers who generally use their connection at certain times of day.
- In managed connections the limits are managed dynamically, or alternatively specific devices e.g. electric vehicle charging may be managed. This may occur only during periods when the system is very heavily loaded or under emergency conditions. These sorts of connections could provide costs savings to customers who are flexible about their energy consumption.
- These connections options have the potential to increase the utilisation of the distribution system and thus reduce the costs of operation and development of the system for all customers of the distribution system.

Q6. STAKEHOLDER QUESTION

What communications mechanisms and media are best suited to ensure electrification stakeholders are informed and educated on network aspects for the transition to electrified heat and transport?

Q7. STAKEHOLDER QUESTION

Customers who have low carbon technologies such as electric vehicles and/or heat pumps may look to participate actively in providing flexibility services to support the operation of the transmission and distribution systems. Such service provision was not considered in the design of the existing distribution network. Facilitating these services may require additional capability in the distribution system in certain areas and there are different views on how the costs of providing this additional capability (e.g. active system management, localised distribution reinforcement) should be recovered. Do you have views on how these associated costs should be recovered in a fair and equitable manner?

Q8. STAKEHOLDER QUESTION

Do ESB Networks need to provide customers with new innovative and alternative connection products such as timed and/or managed connections in addition to our existing connection agreements? Are there other approaches from other jurisdictions that could be applicable to the Irish distribution system?

ENSURING NETWORK READINESS

A key enabler of the transition to electrified heat and transport will be distribution system infrastructure itself. Within ESB Networks, we recognise the importance of proactively developing the distribution system, particularly the LV network, so that customers do not suffer from power quality, resilience and reliability issues as the load on the system increases due to the increased penetrations of electric vehicles and transport. This needs to be balanced with our responsibility to prudently invest in the network and avoid unnecessary development of infrastructure and stranded assets.

To enable consistent, robust decision making and programming and maximize the opportunities to reduce costs that support the electrification of heat and transport we have identified five phases of our approach to developing the distribution system. This proposed methodology is illustrated in Figure 2.

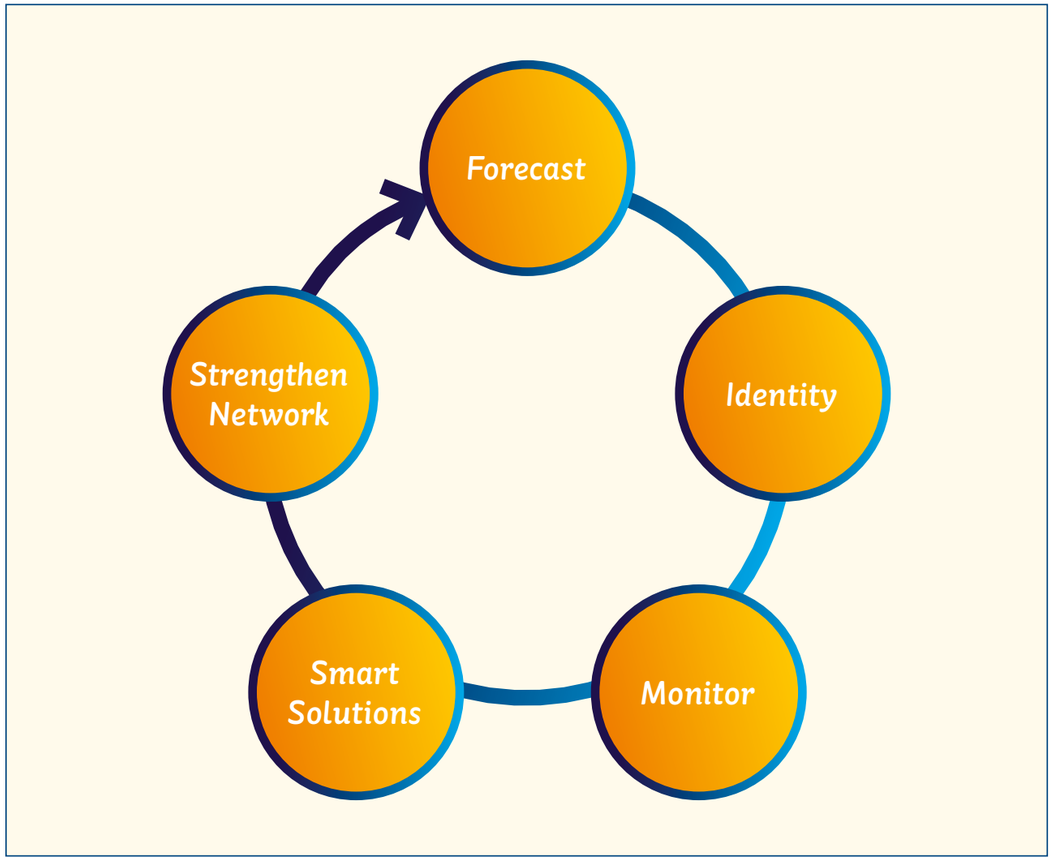


Figure 2 Forecast, identify, monitor, smart solutions and strengthen network (FIMMS)

1. FORECAST

The distribution network has considerable capacity to accommodate electrified heat and transport however there will be areas of the network which are already heavily loaded or where clusters of electric vehicles or heat pumps emerge that will require smart solutions or reinforcement. This is because the distribution system, and in particular the LV network, was not designed to cater for the larger loads associated with electrified heat and transport and microgeneration. Traditionally, there have been no requirements to monitor our MV/LV transformers and the LV network as robust models existed accurately to predict load on these systems. The electrification of heat and transport however means that these models will need to be updated.

To develop forecasting tools that will support our decision making going forward we are developing and refining forecast models to predict where the network may need support. Research and innovation projects including Preparation for EV's On The Distribution System, Superhomes 2.0, Winterpeak and Planning Future LV Networks for Electrified Heat & Transport, which have investigated the impacts of electric vehicles and heat pumps on the distribution system are key inputs into the development of our forecasts.

To develop the best forecasts we need data and collaboration with external stakeholders to support this development including SEAI and ESRI.

The datasets that will support the development of the forecast models may include:

- Domestic electricity revenue meter data
- SEAI grant data including electric charge point installations and heat pump installations
- CSO socio-demographic data
- Smart meter data
- Qualitative and quantitative data from academia
- Trials and pilot data from other jurisdictions
- Electric vehicle and heat pump sales data

2. IDENTIFY

Forecasting, local surveys and appropriate power system modelling will be used to identify which areas of the distribution system are likely to need support in terms of smart solutions and reinforcement to provide the quality of supply required by our customers.

Forecast data will be used in conjunction with power system modelling as appropriate to determine where constraints on the system are likely to occur. These power system models will be based on detailed models provided by LV mapping which is being piloted as part of the Dingle Electrification Project.

Local surveys will be used to validate the assumptions that informed the forecast loading on the infrastructure and assess the condition of the assets. This overall assessment informs where we deploy cost-effective LV monitoring.

3. MONITOR

Monitoring is used to validate that the areas of the network that have been identified will require support. A combination of the forecasting data, local surveys and data from monitoring will be used to confirm whether additional system capability is required, evaluate how much additional system capability is required and inform whether smart solutions or network reinforcement should be used to provide this additional system capability.

4. SMART SOLUTIONS

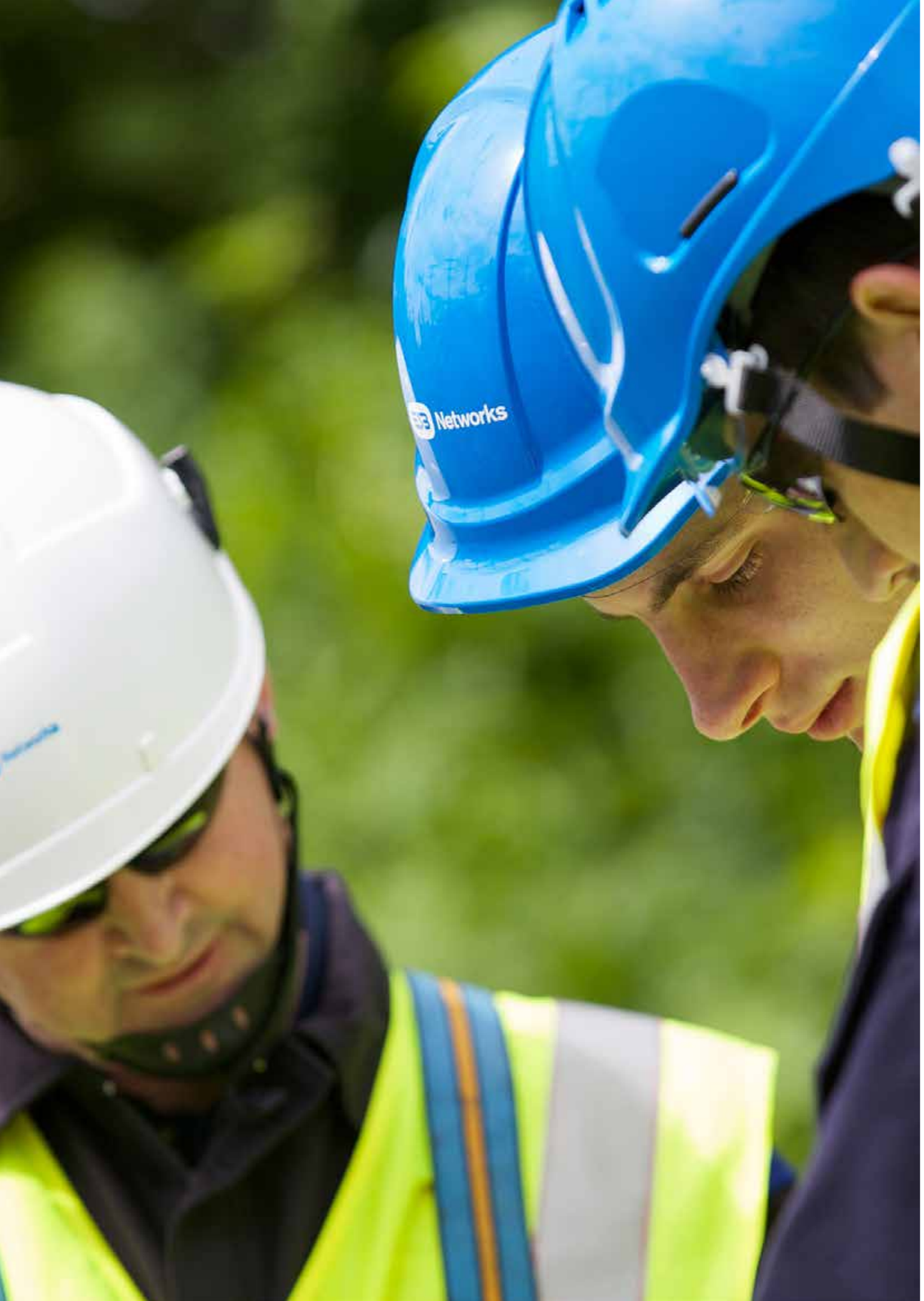
Where the combination of forecasting and monitoring validate the need for an intervention to augment the capability of the distribution system and to minimise cost and disruption, we will first look to smart solutions where they are practical and cost effective to provide additional capability. Our smart solutions tool kit will have options to help us maximise the use of the existing assets, manage uncertainty of uptake and provide support to the distribution system whilst we consider longer-term system impacts.

By piloting and trialling new concepts and technologies as part of our innovation activities we will continue to develop our smart solutions tool kit to respond to the uptake of technologies such as electric vehicles and heat pumps in homes and businesses. These include: -

- Non-wires solutions/customer flexibility/DSR
- On-load tap-changing (OLTC) 1MVA MV/LV transformers
- Ester filled/higher capacity MV/LV transformers for both ground mounted and pole mounted applications
- Sidewalk MV/LV transformers
- Single-phase MV voltage regulators

5. STRENGTHEN NETWORK

Where smart solutions are not practical or cost effective, conventional reinforcement will provide better value for our customers, we will use conventional reinforcement. This will include the installation of new overhead line and underground cable infrastructure and installation of additional MV/LV substations.



LV READINESS PROJECT – DEVELOPING THE LV NETWORK FOR EXISTING DOMESTIC CUSTOMERS

We are already implementing this approach as part of our LV Readiness project which is looking to address the issues associated with the emergence of heat pumps and electric vehicles on the existing LV network. Key to this work is identifying the areas of the network that are likely to need support in the short term, using new models and forecasting, and use monitoring to validate these models and forecasts before we consider smart solutions on conventional reinforcement The key objectives of this project are as follows;

1. To develop an LV Network Investment tool which enables ESB Networks to proactively reinforce the LV network in advance of any power quality issues materialising due to the unprecedented increase in electrical load from home electric vehicle charging and heat pumps.
2. To ensure design standards for MV and LV network cater for wide-scale national customer adoption of electrified heat and transport. Our existing design standards will be revised to include the smart solutions as outlined above. Our design staff in ESB Networks will utilise new tools, so that the new smart solutions are adopted as business as usual.
3. To derive and assure efficient deliverability, so that the capacity exists in both our design and construction resourcing model, which ensures that reinforcement work on the LV network is carried out economically, efficiently, and to our Least Cost Technically Acceptable (LCTA) policy.

Q9. STAKEHOLDER QUESTION

To ensure that ESB Networks can prepare and adapt efficiently, do you think it should be mandatory for ESB Networks to be made aware when large new equipment such as heat pumps or electric vehicles are installed? How could this be best achieved?

Q10. STAKEHOLDER QUESTION

Can you think of other valuable third-party data sources we should include to inform our forecasting and improve investment decisions?

KEY COLLABORATIONS

The electrification of heat and transport will demand changes not only in the energy, heat and transport sectors but also across society. We will look to engage with individuals, companies and organisations that inform our objectives and support our efforts. We work in teams and collaborate across all our activities. From academia, local authorities, consumer groups to public sector organisations we have many examples of how working together delivers greater outputs.

Some useful collaboration include:

- EV Pilot – eCars, CRU, Electric Ireland
- Dingle Electrification Project – MaREI, Molteic (Dingle Creativity and Innovation Hub), and the Tipperary Energy Agency
- +CityXChange – 32 partners across Europe including Limerick City and County Council, Trondheim Municipality, IES and MPower
- RESERVE – : 10 Horizon 2020 Consortium Partners from across the EU
- LEV Task force – WG2 and WG3 – Including Local Authorities, D/HPLG, D/TTAS, D/CCAE, Gas Networks Ireland
- SuperHomes and Superhomes II – International Energy Research Centre (IERC), Tipperary Energy Agency (TEA), Limerick Institute of Technology, and Electric Ireland
- Exploration of Air Source Heat Pumps for Ireland's Residential Heating Need – UCD – SEAI funded
- Intelligent Secondary Substation Monitoring (Winterpeak) – LV Monitoring Original Equipment Manufacturers (OEMs)
- MV Customer Connection Standard Module - Electric Vehicle Charging Hubs in Urban Environment – Public Consultation

HAVE YOUR SAY

We are already busy in many parts of the business looking to facilitate the electrification of heat and transport. To enable this, we will look to embed a company-wide programme cutting across boundaries and business functions to reshape the way we do business around our customers' needs.

Electrified heat and transport impacts large swathes of our business, from our new connections team to the engineers who decide when and where we invest in our network, from the National Control Centre to the our Network Technicians and other key field staff who have always kept the lights on and who will now be a key enabler of the transition to low carbon heat and transport. Our Electrification strategy sets out how we are enabling this transition. We value all forms of feedback. Please help shape our business offerings by sending us your comments to:

innovationfeedback@esbnetworks.ie

We look forward to hearing from you!

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