

A nighttime photograph of a city skyline, likely Dublin, Ireland, featuring a prominent domed building on the left and a modern skyscraper on the right. A yellow semi-transparent box is overlaid on the lower-left portion of the image, containing white text. The background shows city lights, a bridge with a blurred light trail, and a parking area with cars in the foreground.

Tomorrow's Energy
Scenarios 2017
Locations Consultation
Planning our Energy Future

The EirGrid logo consists of the word "EIRGRID" in a bold, black, sans-serif font. To the right of the text is a stylized graphic element: a semi-circular shape with a grid pattern of intersecting lines, resembling a globe or a power grid.

EIRGRID

The current. The future.

Disclaimer

EirGrid has followed accepted industry practice in the collection and analysis of data available. While all reasonable care has been taken in the preparation of this data, EirGrid is not responsible for any loss that may be attributed to the use of this information. Prior to taking business decisions, interested parties are advised to seek separate and independent opinion in relation to the matters covered by this document and should not rely solely upon data and information contained herein. Information in this document does not amount to a recommendation in respect of any possible investment. This document does not purport to contain all the information that a prospective investor or participant in the Single Electricity Market may need.

For queries relating to this document please contact: scenarios@eirgrid.com

COPYRIGHT NOTICE

All rights reserved. This entire publication is subject to the laws of copyright. This publication may not be reproduced or transmitted in any form or by any means, electronic or manual, including photocopying without the prior written permission of the Transmission System Operator.

©EirGrid Plc. 2018

The Oval, 160 Shelbourne Road, Ballsbridge, Dublin 4, D04 FW28, Ireland.

Table of contents

Document structure	4
Glossary of terms	5
Executive summary	6
1. Introduction	8
1.1. Tomorrow’s Energy Scenarios 2017	8
1.2. Locations consultation	8
1.3. Our scenario development cycle	8
1.4. Continuing the conversation	9
2. Focus areas	12
2.1. Introduction	12
2.2. Technologies driving future change	12
2.3. Timeframe	12
2.4. Ireland’s regions	13
2.5. Information sources	14
3. Electricity demand	15
3.1. Data centres	15
3.2. Electric vehicles	18
3.3. Heat pumps	20
4. Electricity supply	22
4.1. Onshore wind	22
4.2. Offshore wind	25
4.3. Solar PV	26
4.4. Fossil fuel generation	28
5. Electricity storage and interconnection	30
5.1. Electricity storage	30
5.2. Interconnection	32
6. Continuing the conversation	33
Appendix 1 – Demand data	34
Appendix 2 – Generation data	35
References	36

Document structure

This document contains a glossary of terms section, an executive summary, six main chapters and appendices. The structure of the document is as follows:

The **Glossary of terms** explains some technical terms used in the document.

The **Executive summary** gives an overview of the main highlights of the document and summarises our future locations.

Chapter 1 describes the stories behind the four scenarios, introduces the locations consultation and explains its purpose in the context of the scenario development cycle.

Chapter 2 introduces some of the focus areas of the locations consultation and discusses where key information is sourced from and how it is presented.

Chapter 3 focuses on the future locations of the technologies which make up electricity demand and explains how these locations have been determined.

Chapter 4 focuses on the future locations of the technologies which make up electricity supply and explains how these locations have been determined.

Chapter 5 focuses on the future locations of the technologies which make up electricity storage and interconnection and explains how these locations have been determined.

Chapter 6 describes EirGrid's commitment to stakeholder engagement and explains how you can provide us with feedback on the locations consultation.

Glossary of terms

Capacity factor

The ratio of a generator's actual power output over a period of time, to its potential output, if it were possible for it to operate at full capacity continuously over the same period of time.

Combined Cycle Gas Turbine (CCGT)

A collection of gas turbine(s) and steam unit(s); waste heat from the gas turbine(s) is passed through a heat recovery boiler to generate steam for the steam turbine(s).

Demand

The amount of electrical power that is consumed by a customer, typically measured in megawatts (MW), in a general sense, the amount of power that must be transported from connected generation stations to meet all customers' electricity requirements.

EirGrid

EirGrid plc is the state-owned company established to take on the role and responsibilities of Transmission System Operator in Ireland as well as market operator of the wholesale trading system.

Electric vehicle

A vehicle driven by an electric motor that is powered by a battery. The battery is typically charged by plugging into the low voltage electricity distribution system.

Embedded generation

Refers to generation that is connected to the distribution system or at a customer's site.

European Union (EU)

A political and economic union of 28 member states that are located in Europe.

Greenhouse gas

A gas in the atmosphere that absorbs and emits radiation within the thermal infrared range.

Heat pump

A device that provides heat energy from a source of heat to a destination called a 'heat sink'.

Interconnector

The tie line, facilities and equipment that connect the transmission system of one independently supplied transmission system to that of another.

Maximum export capacity

The maximum export value, measured in megawatts, provided in accordance with a generator's connection agreement. The maximum export capacity is a contract value which the generator chooses as its maximum output.

Megavolt Ampere (MVA)

1,000,000 volt amperes, a unit of apparent power.

Megawatt (MW)

1,000,000 watts, a unit of active power.

Megawatt hour (MWh)

1,000,000 watts hours, a unit of energy.

Open Cycle Gas Turbine (OCGT)

A type of electricity generator that combines gas and compressed air in a combustion chamber to drive a turbine.

Peak demand

The maximum electricity demand in any one fiscal year. Peak demand typically occurs at around 5:30pm on a week day between November and February. Different definitions of peak demand are used for different purposes.

Single electricity market

The single electricity market is the wholesale electricity market operating in Ireland and Northern Ireland.

Solar Photovoltaic (PV)

Solar PV technologies produce electrical energy from solar radiation directly by converting light to electricity.

Transmission system

The transmission system is a meshed network of high-voltage lines and cables (400 kV, 275 kV, 220 kV and 110 kV) for the transmission of bulk electricity supply around Ireland and Northern Ireland.

Transmission system operator

In the electrical power business, a transmission system operator is the licensed entity that is responsible for transmitting electrical power from generation plants to regional or distribution operators.

Executive summary

Introduction

At EirGrid, one of our roles is to plan the development of the electricity transmission system to meet the future needs of society. Key to this process is considering a range of possible ways that energy usage may change in the period from 2017 out to 2040. We call this scenario planning.

In 2017 we introduced scenario planning into our grid development process as a way of ensuring the electricity grid continues to support Ireland's economic growth and expanding population in the face of an uncertain future.

We developed a set of four scenarios outlining four possible futures for the supply and consumption of electricity out to 2040. Our scenarios are:

- **Steady Evolution**
- **Low Carbon Living**
- **Slow Change**
- **Consumer Action**

We will not be revising our scenarios as part of this locations consultation. We will consult with our stakeholders as part of the next scenarios review in Spring 2019.

Locations consultation

This document, titled *Tomorrow's Energy Scenarios 2017 Locations Consultation*, proposes assumptions about where various demand and generation technologies may connect in the future. Modelling future locations in this way enables us to identify potential areas of stress on the network requiring further investigation.

As part of this consultation we are seeking feedback on the methods and assumptions used to determine our future locations.

We have used Ireland's regions to present our locations in a concise and consistent way. We have taken electricity demand, electricity supply, electricity storage and interconnection figures presented in Tomorrow's Energy Scenarios 2017 and disaggregated these by region.

The consultation will remain open until 11 May 2018. We look forward to receiving feedback on our future locations.

Electricity demand

Understanding the future locations of electricity demand is an important step in ensuring that the transmission system of tomorrow can support this growth.

There is approximately 250 MVA [EirGrid (2018)] of data centre capacity installed in Ireland at present. Data centres account for over 75 percent of new electricity demand growth in our scenarios. Future data centre locations have been assumed primarily based on connection offers and enquiries, however, other supplementary information sources have also influenced locations in some scenarios.

Dublin has become a hub for data centre development to date. Other locations in Ireland, such as Cork, Limerick and Galway are expected to experience some growth in data centre development. Relatively small levels of data

centre demand growth outside of Dublin are forecast in 2030 for our **Low Carbon Living** and **Consumer Action** scenario.

This growth is expected to be driven by increased investment in regional infrastructure supported by the *National Planning Framework* (NPF) [Government of Ireland (2018)] and changes in consumer behaviour.

Electricity demand for electric vehicles is expected to be more heavily concentrated in urban areas. This is because urban areas are more densely populated resulting in higher volumes of electric vehicles charging via the electricity distribution system.

Higher concentrations of heat pump demand are also assumed for urban areas due to higher proportions of new housing stock expected in these regions. A review of plans for strategic development zones has underpinned this approach as the majority of new housing is planned for urban areas.

Electricity supply

Grid connection applications received are central to our assumptions for future renewable energy technologies such as onshore wind, offshore wind and solar PV capacities. This information source is a strong indicator of future connection locations. We have also used government policy publications and regulatory guidelines to assess the likelihood of connections occurring for each of our scenarios.

The government has undertaken consultations

on the *Renewable Electricity Support Scheme (RESS)*, the *Renewable Electricity Policy and Development Framework (REPDF)* and the NPF. The outcomes of these consultation processes may impact on the future locations of renewable energy developments. Our scenarios align with various energy policy proposals as a means of preparing for changes to current connection patterns.

There is currently 3,200 MW¹ of onshore wind generation capacity in Ireland with the vast majority situated on the south, west and north coasts reflecting the high availability of wind resource in these areas.

Our **Steady Evolution** and **Slow Change** scenarios assume that future onshore wind connections will follow a similar pattern to those observed in recent times. Our **Low Carbon Living** scenario considers a different development pattern reflecting a plan led approach to future wind energy development. It assumes that government energy policy developments and changes to planning guidelines lead to a broader spread of onshore wind development.

Our **Consumer Action** scenario aligns with increased community participation in onshore wind projects. This community participation is assumed to be supported by the government's future RESS, and is reflected by the assumed regional distribution of future onshore wind capacity.

EirGrid has received a number of applications from offshore wind farms seeking connection to the transmission system. These

applications form the basis for assumed future locations with the majority on the east coast of Ireland.

The assumed future locations of large scale solar PV generation capacities are also influenced by connection applications. Rates of uptake of rooftop solar PV, or micro generators, affect the future locations of small scale solar PV capacity. We have assumed that the mix of large and small scale generators and the associated rates of connection vary depending on the scenario.

Low Carbon Living accounts for the highest levels of large scale solar PV generation predominantly based in southern regions of Ireland where sun exposure is highest. **Consumer Action** assumes the highest levels of rooftop solar PV which will be most concentrated in urban areas.

The amount of energy produced by fossil fuel generators in Ireland is expected to reduce in the future [EirGrid (2017b)]. Assumptions relating to the future locations of fossil fuel generators were formed during 2017 based on information provided by our stakeholders as part of the Tomorrow's Energy Scenarios 2017 consultative process. A number of existing fossil fuel generators are expected to re-power to gas or biomass and other generators will close.

Electricity storage and interconnection

New energy storage locations are expected in the future, primarily as a result of battery energy storage systems connecting to the transmission and distribution systems. Locations of future battery energy storage connections are scenario dependant and have been primarily based on connection applications received by EirGrid and ESB Networks.

Ireland is currently interconnected with Great Britain through the East West Interconnector and to Northern Ireland via a 275 kV double circuit line. Further interconnection with Northern Ireland is planned with the high voltage alternating current North South Interconnector planned to be completed in 2020. This project will increase the total transfer capacity between Ireland and Northern Ireland to 1,100 MW.

The expected quantity of High Voltage Direct Current (HVDC) interconnections by 2030 varies from one to three depending on the scenario. **Low Carbon Living** assumes the highest level of HVDC interconnection by 2030 including the existing East West Interconnector, the proposed Celtic Interconnector and further interconnection with Great Britain connecting in the South-East region. However, **Slow Change** assumes that East West Interconnector is the only interconnector location in Ireland by 2030.

¹ As of, January 2018

1. Introduction

1.1. Tomorrow's Energy Scenarios 2017

EirGrid is responsible for the ongoing development of the transmission system so that it continues to meet the needs of electricity consumers into the future. As the licensed transmission system operator we are required to facilitate the connection of authorised electricity suppliers to the transmission system and to ensure that all reasonable demands for electricity are met. The factors that influence the future usage of the transmission system are changing and becoming more varied. The level of uncertainty of each of these factors can be high.

The electricity industry is undergoing change driven by the adoption of new technologies and by new consumer behaviours. In 2017 we introduced scenario planning as a way of developing the transmission system so that it continues to support Ireland's economic growth and expanding population in the face of an uncertain future.

We published *Tomorrow's Energy Scenarios 2017* [EirGrid (2017b)] – a document outlining four possible futures for the supply and consumption of electricity in Ireland out to 2040. Our stakeholders were central to the scenario development process and engaged with us at every step.

We talked with a wide range of stakeholders and the public to identify the factors that may influence the future use of the grid. The factors of most significance are listed below:

- Energy and climate change policies,
- Economic developments,
- Technology evolution and adaptation, and
- Other national and international influences.

Tomorrow's Energy Scenarios 2017 brought together a wide range of factors that may shape the future electricity sector into a set of four discrete scenarios. Reflecting on these scenarios, and the process of developing them, provides context for our locations consultation.

Our final scenarios are described in Figure 2.

1.2. Locations consultation

During the *Tomorrow's Energy Scenarios 2017* consultation, many respondents requested more information on the locations assumed for different electricity generation and demand technologies. This document, titled *Tomorrow's Energy Scenarios 2017 Locations Consultation*, responds to these requests.

The locations consultation presents assumptions on the geographic locations of the generation and demand technologies outlined in *Tomorrow's Energy Scenarios*

2017. Towards the end of 2017 we held a number of meetings with government departments, energy regulators and industry bodies in which we reviewed our location based assumptions and methods.

These stakeholders provided information and constructive feedback. We have used this feedback to refine the assumptions and methods used to determine our initial locations. We are now seeking your input to validate the assumed locations of the future transmission system.

1.3 Our scenario development cycle

We take a cyclic approach to scenario development. Involving our stakeholders in the development cycle is key to ensuring continuous improvement of our scenarios.

Figure 1 illustrates the consultation milestones and publications as part of the current scenario development cycle.

This locations consultation is phase three of the current development cycle. Feedback received as part of this consultation will be used to develop the final *Tomorrow's Energy Scenarios 2017 Locations Report*, which will be published in Spring 2018. This report will detail finalised assumptions and methods relating to our future locations.

With the final assumptions, we will conduct a technical assessment using Tomorrow's Energy Scenarios. This will be achieved by performing a number of different power system studies for each scenario out to 2040.

These studies will help us identify any future needs on the transmission system brought about by changes in electricity generation, electricity demand, electricity storage or interconnection. These results will be presented in *Tomorrow's Energy Scenarios 2017 System Needs Assessment* report which will be published towards the end of 2018. This report will conclude the current scenario development cycle.

Our scenarios and their portfolios will be not be revised as part of this locations consultation. However, our scenario development cycle will begin again in Spring 2019. We

will streamline our Tomorrow's Energy Scenarios development in 2019 by consolidating our consultation on scenarios and locations into phase one of the development cycle. We will engage with our stakeholders throughout our Tomorrow's Energy Scenarios 2019 scenario development process.

1.4. Continuing the conversation

We are committed to involving our stakeholders in how we plan the future transmission system. This is reflected in our Grid Development Strategy called *Have Your Say* [EirGrid (2016)], which outlines a six step process for developing the grid. One of the statements in this strategy is that: *'inclusive consultation with local communities and stakeholders will be central to our approach'*.

We are now seeking contributions to help us further improve our locations. We will be accepting input and feedback on *Tomorrow's Energy Scenarios 2017 Locations Consultation* until 11 May 2018.

For more information on how you can engage with us please refer to Section 6, or visit our [website](#) for further information on *Tomorrow's Energy Scenarios 2017 Locations Consultation*.

Alternatively, please email us your views on *Tomorrow's Energy Scenarios 2017 Locations Consultation* to scenarios@eirgrid.com, and one of our team will be in touch.

We look forward to receiving your feedback and using it to improve our future locations.

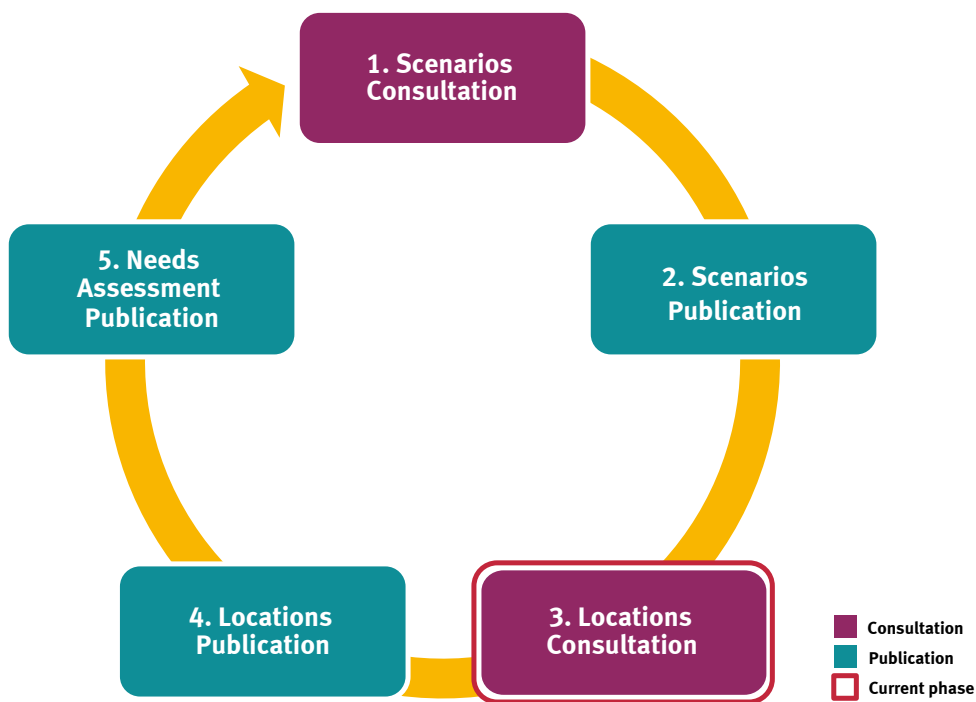


Figure 1 – Scenario development cycle

Steady Evolution

Renewable electricity generation maintains a steady pace of growth. This is due to steady improvements in the economy, and in the technologies which generate electricity. New household technologies help to make electricity consumers more energy aware. This increases energy efficiency in homes and businesses. Over time, electricity consumers gradually begin to make greater use of electric vehicles and heat pumps. This means that, over time, electricity powers a larger proportion of transportation and heating.



Onshore wind generation increases to approximately 5,200 MW by 2030



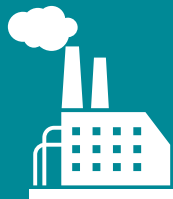
Ireland's 2030 emissions targets are met

New 700 MW interconnector to Europe is in place by 2025



Low Carbon Living

The economy enjoys high economic growth. This encourages the creation and rollout of new technologies for low carbon electricity generation. There is strong public demand to reduce greenhouse gas emissions. In addition to high carbon prices and incentives for renewables, this creates a high level of renewable generation on the grid. This clean energy then combines with improvements to broadband and transport to drive growth in large data centres.



Coal generation is repowered to Gas and Peat generation is repowered to Biomass by 2025

The total demand for electricity increases by 53% by 2030 compared to today



Data Centre connections reach 1950 MVA in 2030 - most of these are based in Dublin

Figure 2 – Tomorrow's Energy Scenarios

Slow Change

The economy experiences very slow growth. Investment in new renewable generation is only in established, low risk technologies. Due to poor economic growth, new technologies that could increase the use of renewable generation at household and large scale levels are not adopted. Overall there is little change in the way electricity is generated when compared to today. Domestic consumers and commercial users are also avoiding risk and uncertainty. The only source of demand growth is the connection of new data centres but the level of investment slows down significantly after 2025.

Fossil fuel generation capacity remains over 5,000 MW by 2030



The total demand for electricity increases by 22% by 2030 compared to today

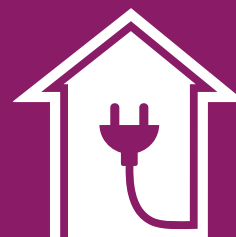
Ireland's 2030 emissions targets are missed



Consumer Action

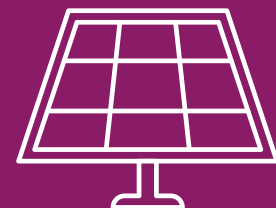
A strong economy leads to high levels of consumer spending ability. The public want to reduce greenhouse gas emissions. Electricity consumers enthusiastically limit their energy use and generate their own energy. This results in a large number of community led energy projects and a rapid adoption of electric vehicles and heat pumps in the home.

There are almost 560,000 electric vehicles on the road by 2030



17% of residential houses are heated through heat pumps by 2030

Household batteries and Solar PV help to increase self-consumption of electricity



2. Focus areas

2.1. Introduction

To assist with presenting the information in this consultation in a concise way we have focused on certain aspects of Tomorrow's Energy Scenarios 2017. This approach enables a deeper examination of the assumptions and methodologies used to determine our future locations.

2.2. Technologies driving future change

In this document we consider generation, demand and interconnection and storage developments whose locations, either individually or in aggregate, can have a significant influence on the future usage of the transmission system.

Data centres, electric vehicles and heat pumps account for the majority of future electricity demand growth as described in *Tomorrow's Energy Scenarios 2017* and each technology is given a section in this document. Assessments of generation developments have focussed on the potential locations of offshore wind, onshore wind, solar PV and fossil fuel generation technologies. Ireland's transmission system is expected to have more interconnection with other countries in future along with an increase in levels of electricity storage and both of these are also examined.

These technologies will influence Ireland's future transmission system and therefore it is important that our assumptions are validated. We have outlined the assumptions used to determine future locations for these technologies and welcome your feedback as part of this consultation.

2.3. Timeframe

Tomorrow's Energy Scenarios 2017 presented demand, generation and interconnection information for four different time periods; 2020, 2025, 2030 and 2040. However, this document concentrates on 2030 and uses this year to demonstrate our approach to determining locations for all Tomorrow's Energy Scenarios study years. The 2030 information is sometimes compared against current data as a way of gauging levels of change for different technologies.

We have selected 2030 because it is an important year for a number of reasons. The level of certainty of the future energy system decreases over time. To account for this we consider more scenarios the further into the future we look. This is the first year that all four of our scenarios are used.

Further, 2030 is relevant in terms of energy policy as performance against EU emission targets will be assessed in 2030. The government's *Energy White Paper* [Department of Communications, Energy & Natural Resources (2015)] set out a framework to help guide energy policy in Ireland out to 2030, highlighting 2030 as a 'milestone' in Ireland's journey towards a low carbon future.

Finally, 2030 is important from a grid development perspective as system needs that require grid reinforcements to be in place by 2030 may need to begin to develop solutions in the short term. Costs and benefits associated with potential grid development projects can be quantified with confidence within this 10 – 15 year planning horizon.

2.4. Ireland's regions

EirGrid uses regions to plan the development of the transmission system in Ireland as described in the *Transmission Development Plan 2015-2025* [EirGrid (2015)]. These regions, known as Nomenclature of Territorial Units for Statistics (NUTS) 3 regions [Ordnance Survey Ireland (2017)], have been in use in Ireland since 1994 and comprise the eight regional authorities established under the local government act, 1991.

NUTS 3 regions are also used by government agencies in Ireland, including IDA Ireland and the Central Statistics Office. The eight regions are illustrated in Figure 3. These regions will be used within this report to disaggregate information presented at a national level in *Tomorrow's Energy Scenarios 2017*.



Figure 3 – Ireland's regions

2.5. Information sources

Our assumptions for future locations of electricity supply, generation and storage and interconnection are underpinned by a number of sources of information. These have been identified through comparison with our peers, consultation with our stakeholders during the scenario development phase and through research of available internal and external information sources. We have explained the role of these information sources in forming our future locations in sections 3, 4 and 5 of this document. Some of the key sources are listed below.

- Transmission and distribution grid connection applications
- Electrical load data at transmission substations
- Renewable Electricity Support Scheme (RESS) consultation
- Ireland's National Planning Framework (NPF)
- County development plans and energy strategies
- Interconnector project plans
- Population growth projections
- Government energy policy development and energy position papers
- Energy asset owner plans and statements
- Transmission system operator plans in other jurisdictions

We have used this information and our experience as the transmission system operator to develop what we believe to be the most credible locations for future electricity generation, demand and storage and interconnectors in Ireland. In 2017 we held a number of meetings with government departments, energy regulators and relevant industry bodies in which we reviewed our location based assumptions and methods.

These stakeholders provided information and constructive feedback which we have used to refine the assumptions and methods initially used to determine our future locations.

3. Electricity demand

3.1. Data centres

Ireland supports a growing digital economy and is recognised as a “Digital Gateway to Europe” for many US based companies [Host in Ireland (2017)]. Ireland’s attractiveness as a destination for digital infrastructure investment can be attributed, in part, to the availability of skilled English speaking workers, fibre connectivity, power availability and reliability of the electricity network.

There is approximately 250 MVA of data centre capacity installed in Ireland at present. These large facilities house computer servers used to store and process data and require uninterrupted supply of electricity to ensure data is secure. The Irish Government has recently signalled an intention to include data centres in the Strategic Infrastructure Act [eISB (2006)]. This measure is expected to streamline the future development of new data centre facilities. Data centres account for over 75 percent of new electricity demand growth in our scenarios.

Data centre developers assess the suitability of potential locations in Ireland against a number of key criteria including the availability of the five P’s: People, Policy, Pedigree, Power and Pipes [Host in Ireland (2017)]. EirGrid is currently processing multiple data centre connection enquiries indicating that suitable development sites are available in a number of locations. Current forecasts suggest data centre capacity will marginally exceed 1,400 MVA by 2026 [EirGrid (2017a)].

Connection offers and enquiries form the basis for the assumed future locations of data centres. However, other supplementary information sources have also influenced locations in some scenarios.

Dublin has become a hub for data centre development and is recognised as a destination possessing all the required attributes. Other locations in Ireland, such as Cork, are developing these attributes [Host in Ireland (2017)] and are starting to experience growth in data centre development. The Government’s NPF [Government of Ireland (2018)] supports ambitious growth and introduces a strategy to increase investment in regional infrastructure.

Future data centre locations are primarily based on connection offers and enquiries. Some of our scenarios forecast data centre capacities in 2030 and 2040 in excess of our data centre demand forecast of 1,400 MVA. Locations for the balance of capacity above 1,400 MVA are based on the assumed data centre investment patterns associated with each scenario.

Slow Change and **Steady Evolution** forecast data centre capacity in 2030 of 850 MVA and 1,100 MVA respectively which are both lower than 1,400 MVA. Regional data centre investment patterns are not expected to deviate from current trends with assumed locations for these scenarios in 2030 solely based on the connection offers and material enquiries.

Low Carbon Living and **Consumer Action** forecast data centre capacity in 2030 of 1,950 MVA and 1,675 MVA respectively. The assumed locations for capacities above the forecast 1,400 MVA have been determined based on the scenario storylines and the associated data centre investment locations.

The majority of future data centre capacity is expected in the Dublin region as reflected in connections offered and material enquiries received.

Slow Change forecasts 850 MVA of data centre capacity in 2030, all of which is assumed to locate in Dublin. Meanwhile, 1,030 MVA of data centre capacity in 2030 is assumed to be located in Dublin in our **Steady Evolution** scenario with the remaining 15 MVA and 60 MVA situated in the West and South-West regions respectively.

Low Carbon Living assumes the highest levels of data centre growth of all four scenarios. This scenario is associated with plan led development which is influenced by government initiatives delivered under the NPF. In this scenario the vast majority of data centres connect in the Dublin region (1,296 MVA), however, by 2030 infrastructure investment in regions outside of Dublin is expected to result in a wider spread of data centre facilities nationally.

Figure 4 illustrates the expected locations of data centre capacity by 2030 in **Low Carbon Living**.

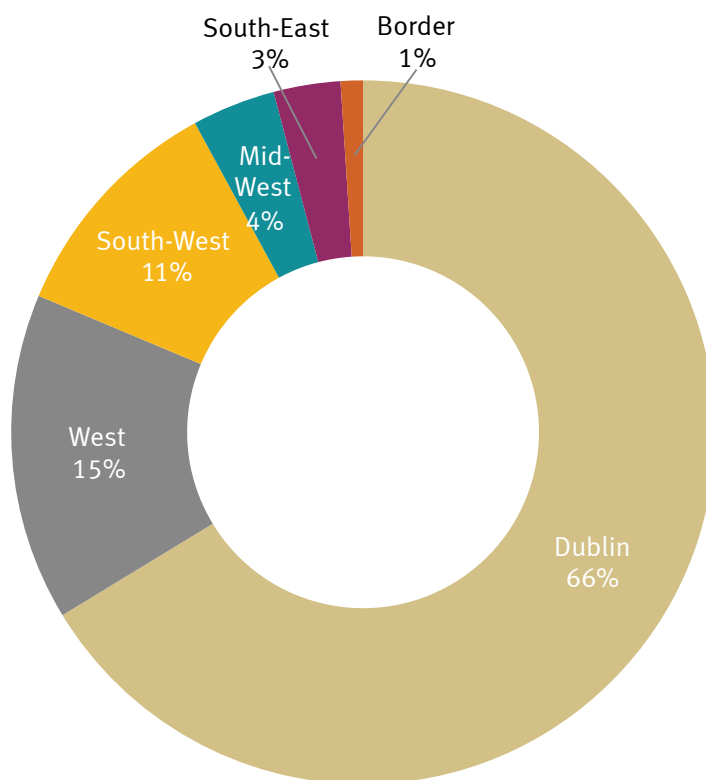


Figure 4 – Data centre capacity in 2030 by region, **Low Carbon Living**

High speed fibre optic networks support development of new data centre facilities. **Low Carbon Living** assumes that investment in fibre networks in the South-West, South-East, Mid-West, West and Border regions increases the likelihood of data centre development in these regions by 2030.

The majority of these regions are already serviced by the high speed fibre optic backbone network or will be serviced by a new line which will complete construction in 2019, as shown in Figure 5. These regions also account for Ireland’s submarine fibre cable landing points in counties Mayo, Cork, Wexford and Dublin [Telegeography (2018)] which may support expansion to current off-island fibre connectivity in the future.

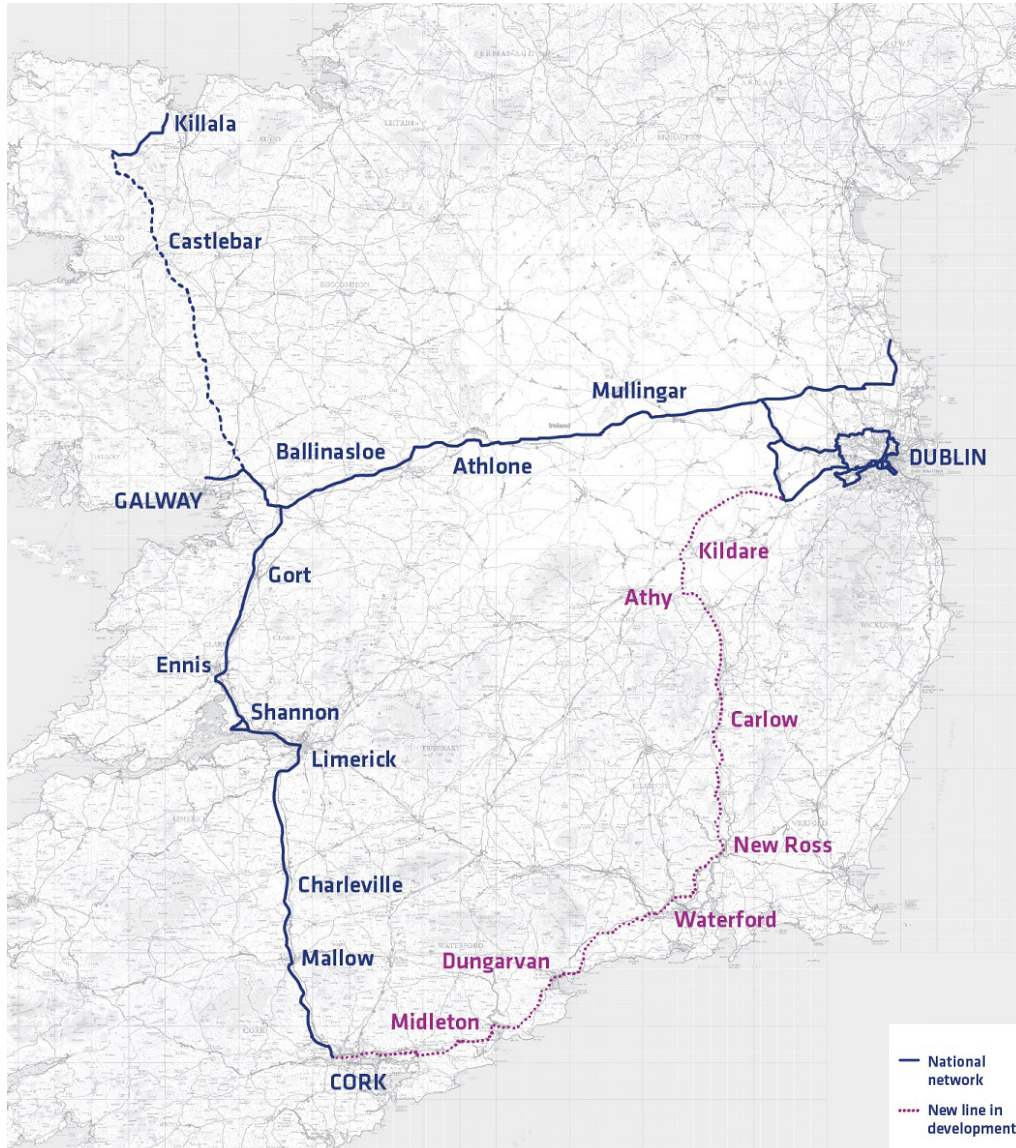


Figure 5 – National high speed fibre optic network [Aurora Telecom (2017)]

Consumer Action differs somewhat from our other scenarios in terms of the scale and types of data centres connecting to Ireland’s electricity infrastructure in the future. **Consumer Action** assumes that approximately seven percent of new data centre capacity in 2030 (105 MVA) will be small scale distributed data centres connected to the distribution electricity network in our cities.

Expansion of these small scale facilities, known as edge data centres, is reliant on the maturity of 5G communications networks in our cities and more widespread use of controllable smart devices in homes and businesses. Adoption of these technologies aligns with **Consumer Action** as electricity users proactively leverage smart devices to limit their energy use and reduce their carbon footprint. We have assumed that edge data centres will exist in the cities of Dublin, Cork, Galway and Limerick by 2030.

Consumer Action assumes the highest levels of data centre capacity in Dublin (1,358 MVA) by 2030 based primarily on connection offers and material enquiries. Growth is also forecast in the South-West, South-East and West regions due to a combination of large and small scale data centre developments in the three largest cities outside of Dublin.

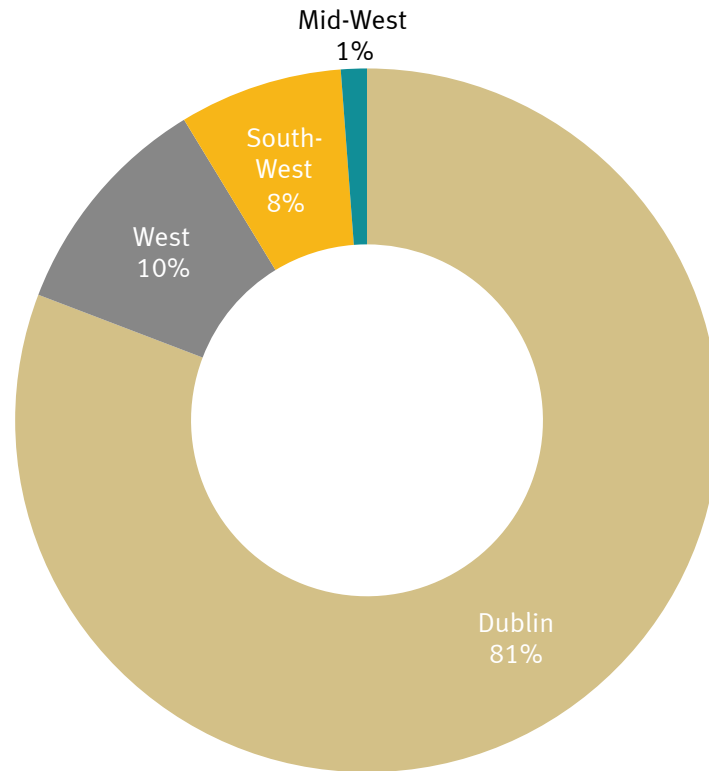


Figure 6 – Data centre capacity in 2030 by region, **Consumer Action**

3.2. Electric vehicles

Future electricity demand for electric vehicles will vary across the transmission system. This variation will depend on the points of the distribution network that the fleet of electric vehicles connect to for charging. It is expected the charging locations will be reflective of population densities with most charging occurring over night at the homes of electric vehicle owners.

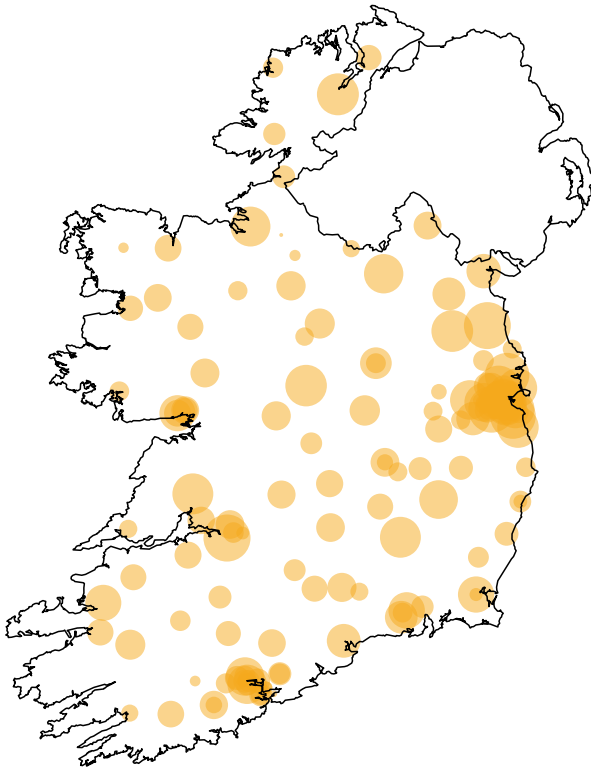
We have distributed future electricity demand for electric vehicle to transmission stations on a pro-rata basis based on distribution demand readings. These readings are taken as an approximation of the number of domestic consumers fed by each transmission station. We have discussed this approach with the distribution asset owner, ESB Networks. ESB Networks has endorsed the method and provided feedback on ways to refine future calculations of electric vehicle demand.

Figure 7 provides a spatial view of electric vehicle capacity in 2030. The regions with the highest population densities, such as Dublin, the South-West, the Mid-West and the Mid-East, are expected to account for the largest proportion of electric vehicle demand. These four regions make up just less than three quarters of the average demand across the four scenarios.

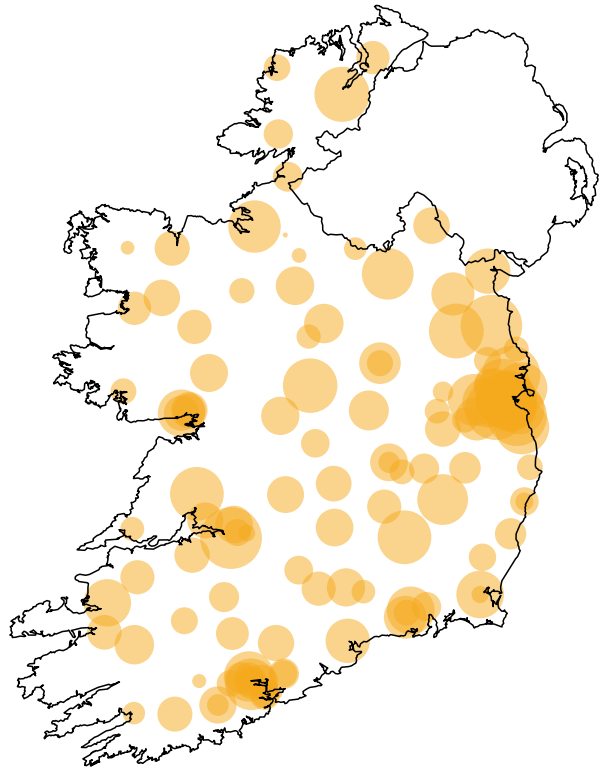
Figure 7 illustrates a clustering of future capacity around the major cities in these regions. This is most pronounced in **Consumer Action** which assumes there will be 560,000 electric vehicles on our roads in 2030 – the highest levels of all four scenarios. The largest electric vehicle electricity demand in 2030 is assumed to occur in Dublin. This region accounts for an average of 38 percent of electric vehicle demand.

Slow Change assumes the lowest levels of electric vehicle uptakes in all regions by 2030 resulting in an overall quantity of 309,000. **Low Carbon Living** and **Steady Evolution** assume the second and third highest numbers of electric vehicles in all regions by 2030 respectively.

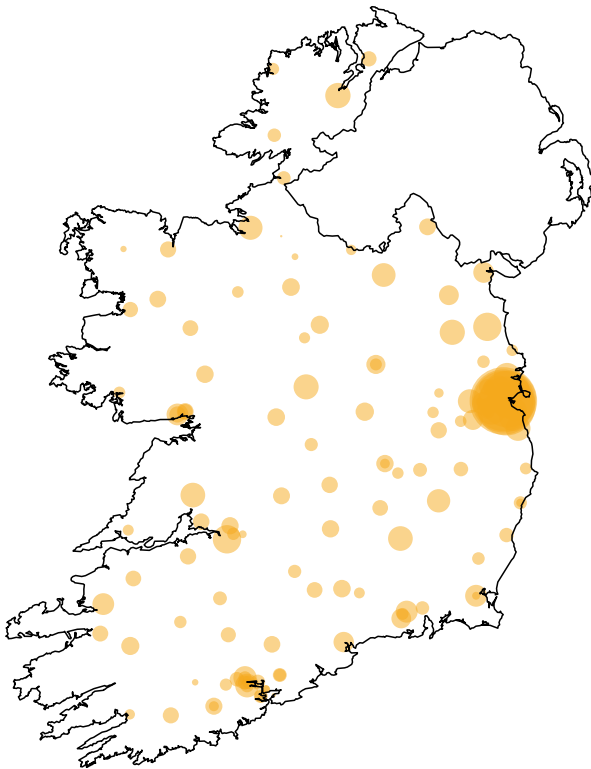
Steady Evolution



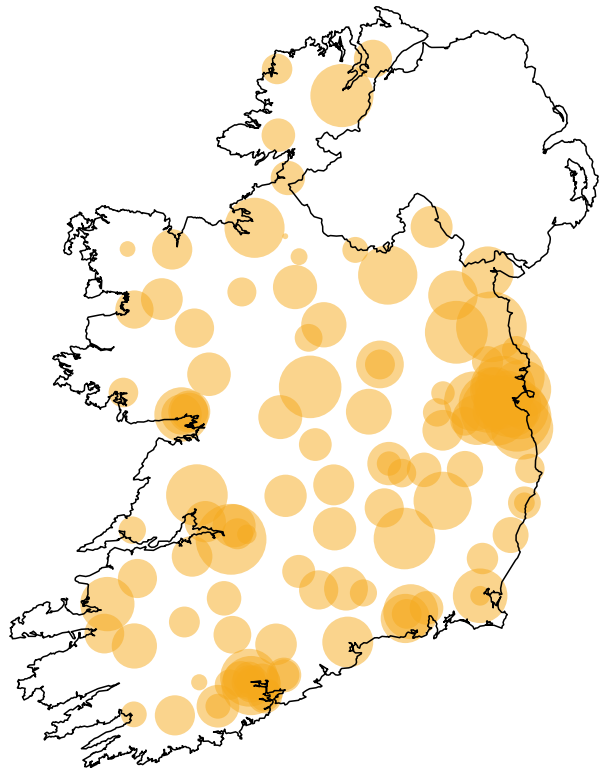
Low Carbon Living



Slow Change



Consumer Action



MW

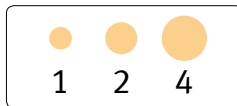


Figure 7 – Electric vehicle capacity in 2030 by transmission station

3.3. Heat pumps

Expectations for heat pump capacity growth are supported by the volume of new houses required to be built to meet Ireland’s growing population demands. Ireland’s population is expected to increase by 15% in 2030 [Central Statistics Office (2013a)]. Approximately 33% [PWC (2017)] of the housing stock in 2050 has not yet been built yet and it is expected that most new homes will be building energy rated ‘A’ homes with high quality insulation that will be heated using heat pumps.

Future growth of heat pump capacity is assumed to correlate with locations of new housing stock in areas zoned for future residential development. Land zoning [Department of Housing, Planning, and Local Government (2017)] conducted by the Government indicates that new housing development will be concentrated in urban centres.

We expect that 60 percent of all future heat pump demand will be fed from transmission stations situated in the urban centres and commuter areas of Dublin, Cork, Galway and Limerick. The commuter areas were assumed to be within a 50 kilometre radius of each city centre. The remaining 40 percent of heat pump capacity was assumed to be situated outside of these four major urban centres and commuter areas.

The heat pump capacity was then distributed across individual transmission stations on a pro-rata basis using distribution demand recorded at each station. The method used to allocate heat pump capacity to transmission stations is illustrated in Figure 8.

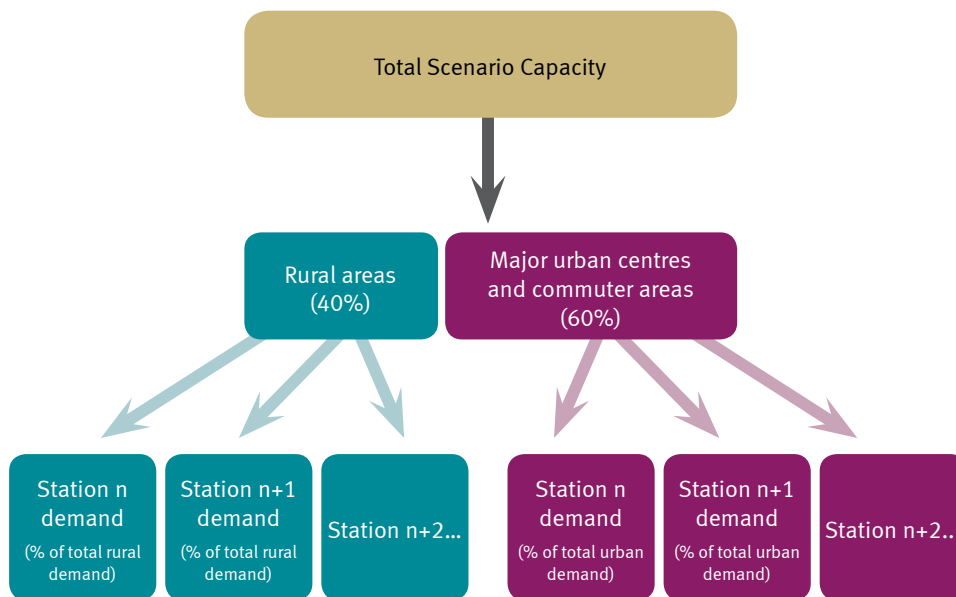


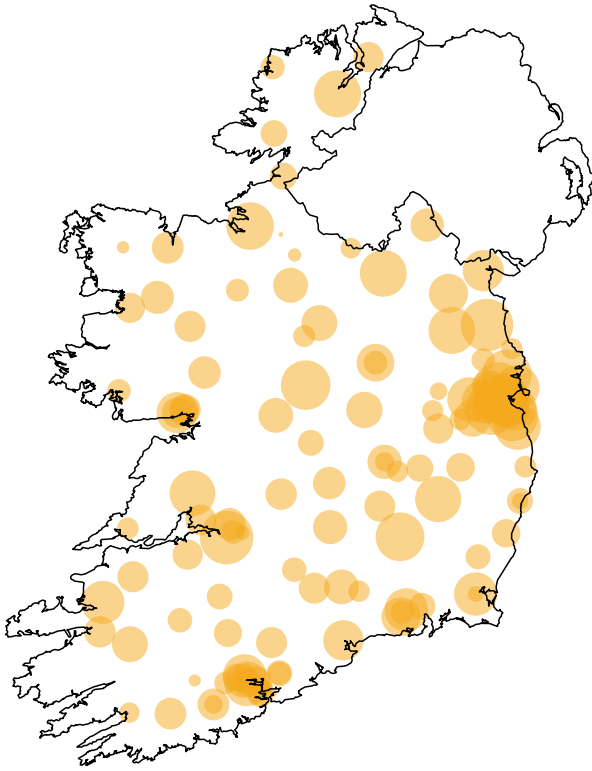
Figure 8 – Allocation of heat pump capacity to transmission stations

Figure 9 illustrates the assumed heat pump capacity in 2030. Dublin’s population is set to grow faster than any other region [Central Statistics Office (2013b)] which will drive the construction of new buildings that are heated using heat pumps. This explains the high concentration of heat pump capacity shown in Dublin.

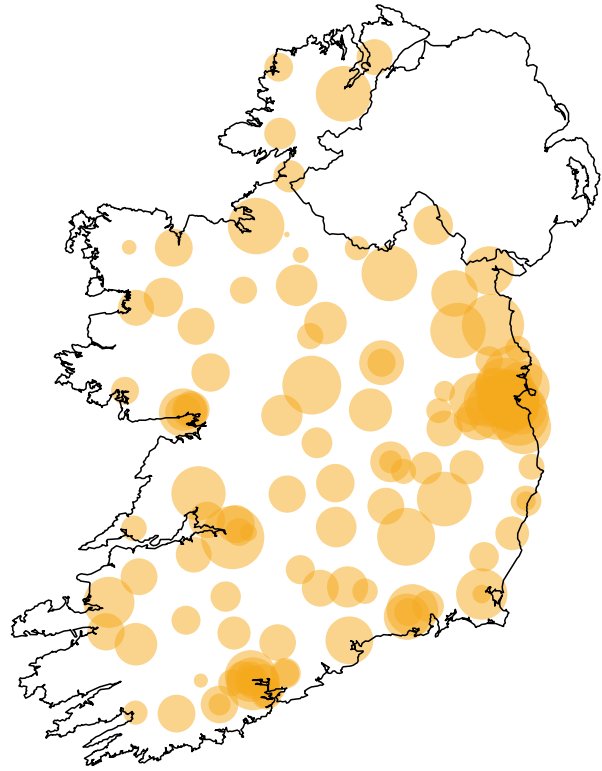
Other regions such as the South-West, Border and South-East are also expected to see increases in new housing stock by 2030. High concentrations of heat pump capacity are expected in towns and cities within these regions.

The highest levels of heat pump capacity growth are consistent with **Consumer Action** as individual electricity consumers seek to reduce their carbon emissions by electrifying the heating of their homes. **Consumer Action** includes the highest volumes of heat pumps across all eight regions followed by **Low Carbon Living**, **Steady Evolution** and **Slow Change**.

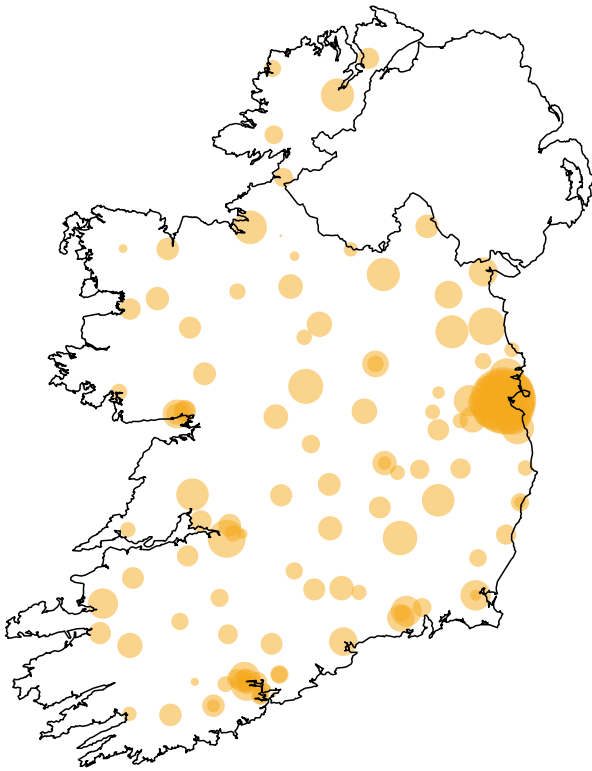
Steady Evolution



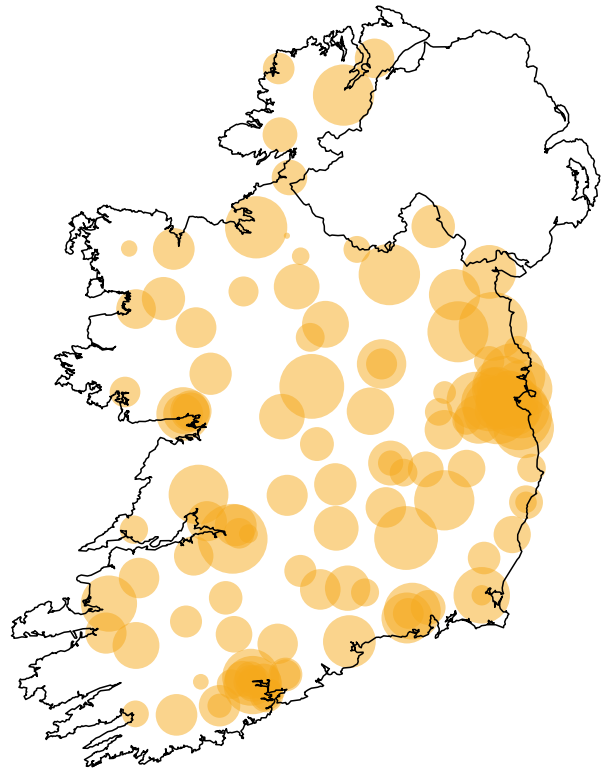
Low Carbon Living



Slow Change



Consumer Action



MW

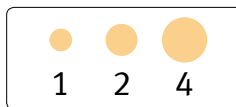


Figure 9 – Heat pump capacity in 2030 by transmission station

4. Electricity supply

4.1. Onshore wind

There is currently 3,200 MW² of onshore wind generation capacity connected in Ireland. Figure 10 displays existing onshore wind capacities by region. Ireland's wind resource availability is highest on the north, west and south coasts of Ireland. This is reflected in the location of existing capacity with the majority of wind farms situated in the regions on these coasts.

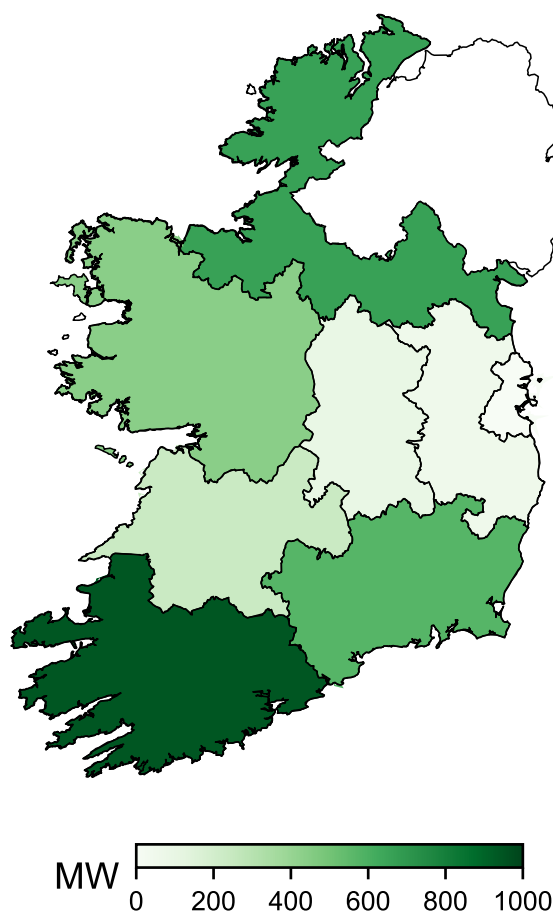


Figure 10 – Current onshore wind capacity by region

The pipeline of connection projects suggests that 1,100 MW of onshore wind generation capacity will connect to the electricity distribution and transmission networks in the coming years. This 1,100 MW of new capacity is made up of applications in advanced stages of the connections process with signed contracts and approved planning permission. Combining these new connections with existing connections provides locations for 4,300 MW [EirGrid (2017d)] [ESB Networks (2018)] of onshore wind generation².

Our scenarios forecast onshore wind capacities in excess of the 4,300 MW from 2025 onwards and so we must assume future generator locations based on best available information sources.

² As of, January 2018

Future locations of onshore wind generators are assumed predominantly based on generation connection applications [EirGrid (2017c)]. Connection applications include information about the proposed location, maximum export capacity and date of connection.

We have also used additional information sources, such as the government's NPF, proposed changes to wind energy guidelines [Department of Environment, Community and Local Government (2013)] and the RESS to determine the most likely onshore wind connection patterns for each of our scenarios. These information sources have been used to allocate capacities up to the capacity limit for each scenario.

Slow Change and **Steady Evolution** scenarios are closely aligned with an industry led approach to wind energy development. These scenarios both suggest a continuation of current connection patterns.

Slow Change and **Steady Evolution** forecast capacities of 4,640 MW and 5,140 MW in 2030. Capacities above 4,300 MW are made up of contracted connection applications only, with application connection dates used to determine the connection timing.

Low Carbon Living is associated with a shift towards a plan led approach to future wind energy development. As part of this scenario we assume that the government's NPF and the governments planned REPDF influence future patterns of wind energy development. Under this scenario investments are directed to sites deemed suitable for wind energy development under the new wind energy development guidelines.

Modelling performed by the Sustainable Energy Authority of Ireland (SEAI) indicates that there will be a limited number of sites suitable for development under the new guidelines. This will mean that regions, such as the South-West, may experience a deceleration in development due to the unavailability of suitable sites. However, other regions with a higher proportion of suitable sites may see an increase in wind energy development.

The government's NPF discusses an intention to explore the viability of state owned peatlands for renewable energy development. **Low Carbon Living** assumes that the relatively high availability of suitable sites in the West, Midland and Mid-East regions will result in connections in these areas. We also assume some repowering of existing wind farms that have reached end of life in the South-West, West, South-East and Border regions.

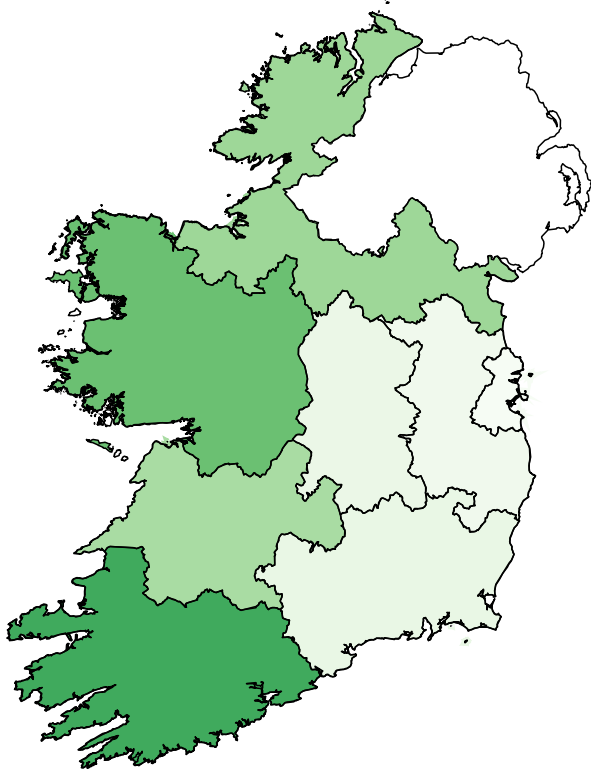
In 2017, the government engaged in a public consultation on the development and design of a new RESS. The RESS is intended to assist Ireland in meeting its 2020 renewable energy targets and 2030 energy ambitions by providing support for the development of renewable energy. Community ownership and participation is a key feature of the new RESS scheme. The public consultation set out options for the support of community participation in renewable electricity projects. Proactive involvement in renewable energy projects is consistent with **Consumer Action** as individuals, and groups, seek to reduce their carbon footprint.

Although the size and scale of future onshore wind generators are expected to remain mostly consistent with recent experience, **Consumer Action** assumes a small increase in the number of community led projects. This shift towards smaller scale distributed wind generation is expected in response to the new RESS. Community led projects are expected to be relatively small capacities, less than 30 MW, and will connect to the distribution electricity network.

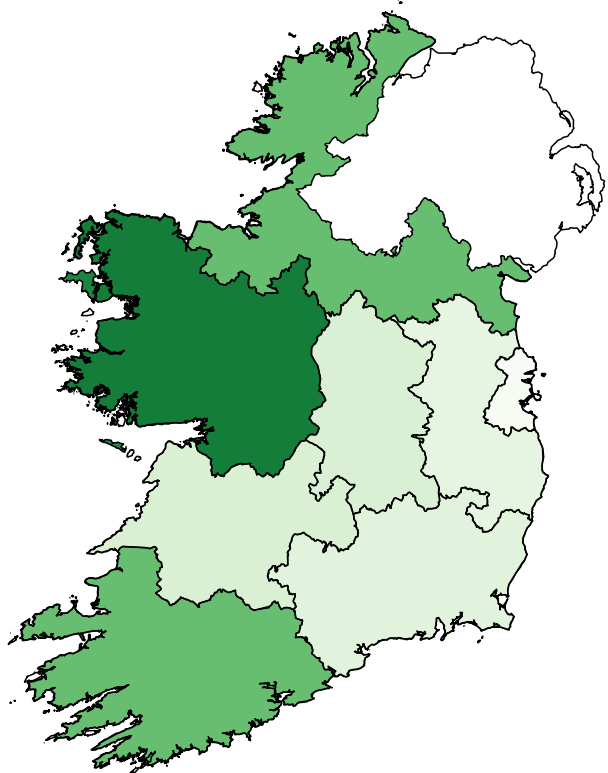
We have assumed that locations with existing applications, consistent with community led projects, are likely to connect as part of our **Consumer Action** scenario. This results in a more balanced regional spread of community led projects consistent with the SEAI's experience to date with projects of this nature.

Figure 11 provides a spatial view of assumed onshore wind capacity growth, from current levels, by 2030 for each of our scenarios. The magnitude and regional distribution of capacity growth varies across our regions depending on the scenario. **Steady Evolution** and **Slow Change** assume continued growth on the west coast, whilst **Consumer Action** and **Low Carbon Living** assume a more 'balanced' regional spread.

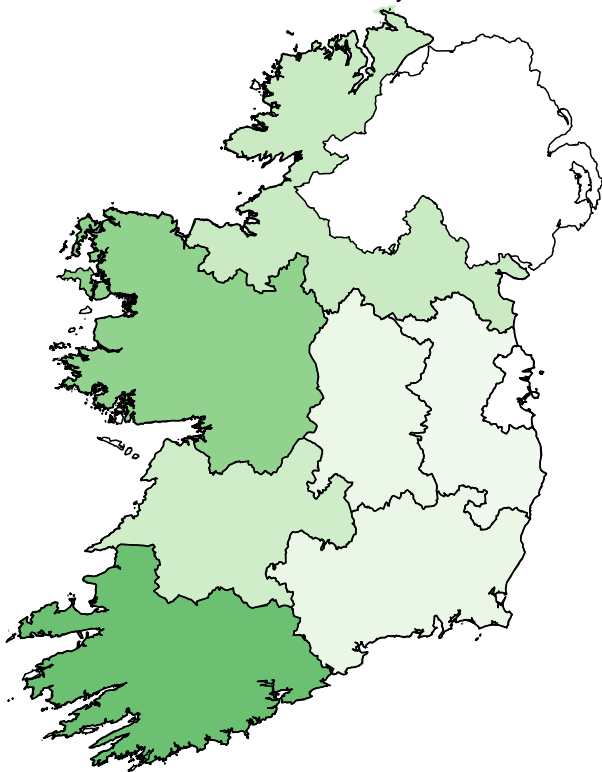
Steady Evolution



Low Carbon Living



Slow Change



Consumer Action

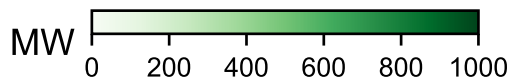
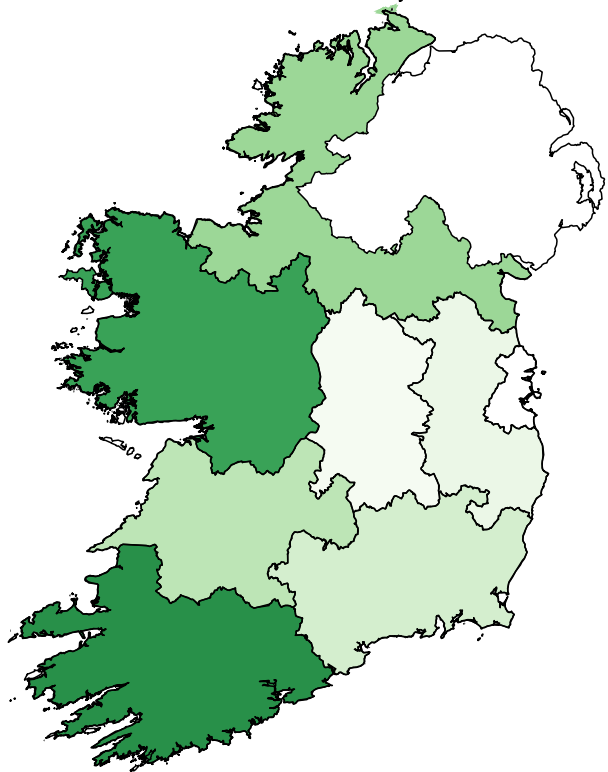


Figure 11 – Onshore wind capacity growth, from current levels, by 2030 by region

4.2. Offshore wind

We have received applications for offshore wind farms to connect to the transmission system. These applications provide the basis for assumed locations. Figure 12 displays offshore wind generation capacities in 2030 by region.

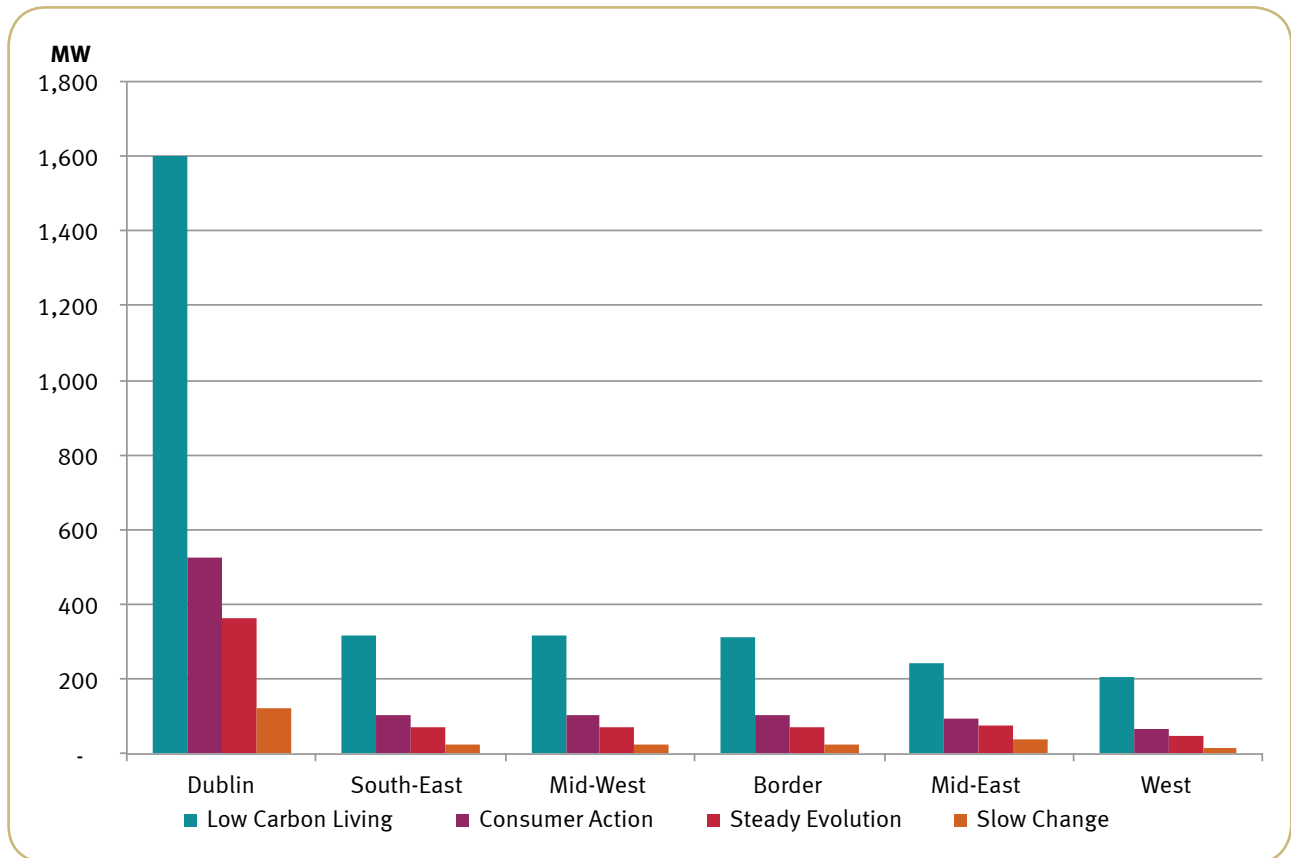


Figure 12 – Offshore wind capacity in 2030 by region

Shallow water depths and sheltered conditions in the Irish Sea make the east coast more favourable for wind farm development. This is reflected in connection applications with an average of 73 percent of offshore wind capacity seeking to connect on the east coast in 2030. There are a number of proposed wind farm developments at discrete locations off the coasts of Louth, Wicklow, Dublin and Wexford.

The highest levels of offshore wind generation are associated with **Low Carbon Living**. This scenario assumes that offshore wind technology may assist Ireland to meet its EU carbon emission targets and links offshore wind farm development in the Irish Sea with further interconnections to Great Britain. This scenario assumes an overall offshore wind capacity of 1,600 MW will connect in the Dublin area by 2030.

The remaining three scenarios also assume the majority of capacity growth to occur on the east coast, although, the magnitude of capacity growth is much lower.

4.3 Solar PV

Connection applications for solar PV generators are most frequent in southern regions of Ireland where sun exposure is highest resulting in greater solar PV generation capacity factors. Figure 14 demonstrates this with the highest assumed growth in capacities shown in the South-East, South-West, Mid-East and Midland regions. This is most pronounced in our **Low Carbon Living** scenario which assumes the largest levels of large scale connections to the transmission network.

Solar PV capacities were distributed across the transmission system in two ways depending on the scale of the generation. Large scale solar PV generators connected directly to the distribution or transmission systems were allocated to different regions in Ireland based on connection applications. Small scale solar PV generators located on domestic or commercial rooftops, also known as micro or embedded generators were distributed across the network based on distribution demand profiles.

The profile of regional capacities is different in our **Consumer Action** scenario, as shown in Figure 13 and 14. **Consumer Action** assumes the highest amount of rooftop solar PV or embedded generation. Although the expected capacities in the South-East, Mid-East and South-West are higher than other regions, the overall spread is flatter across the regions when compared to the three other scenarios. This is due to greater levels of roof-top solar PV up-take in our **Consumer Action** scenario leading to higher capacities in regions with dense populations such as Dublin, the South-East and the Mid-East.

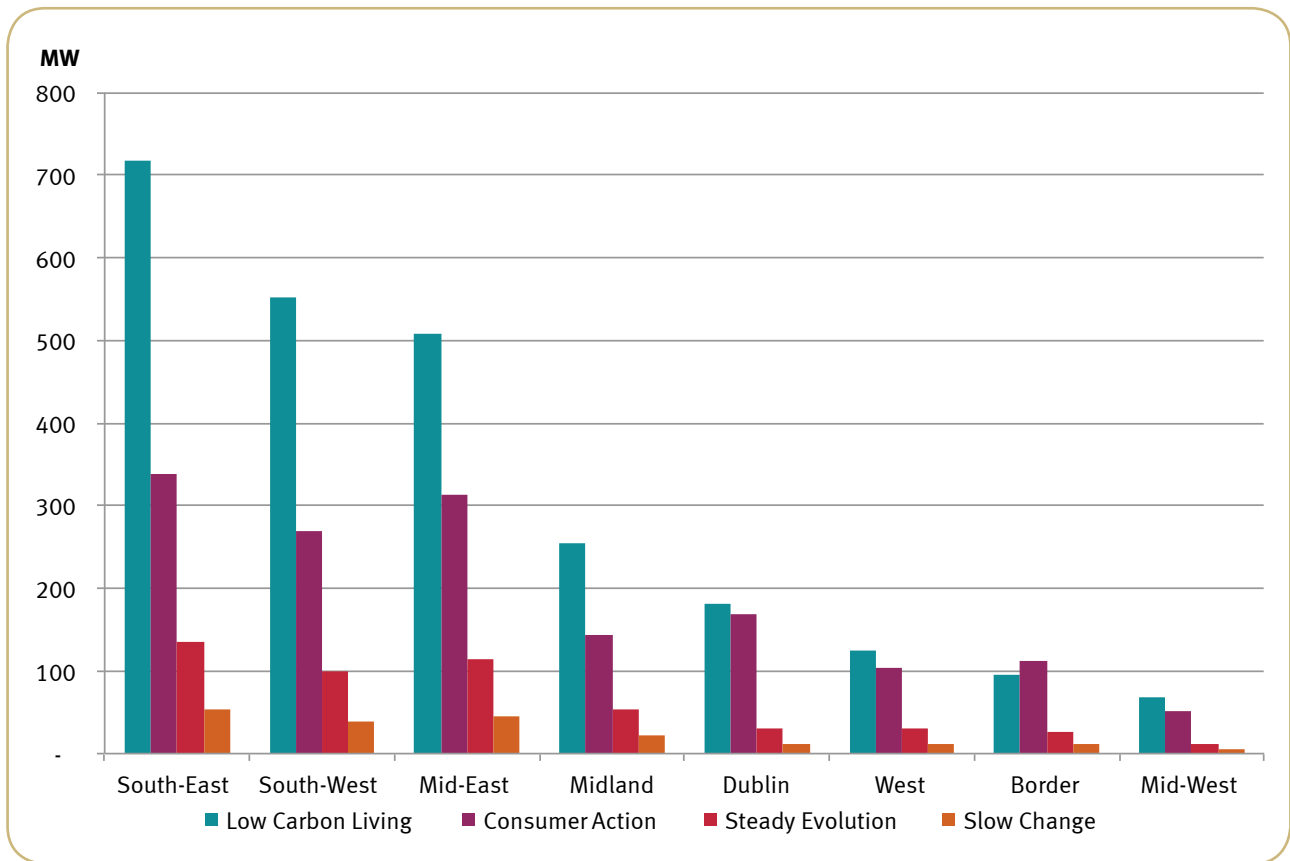
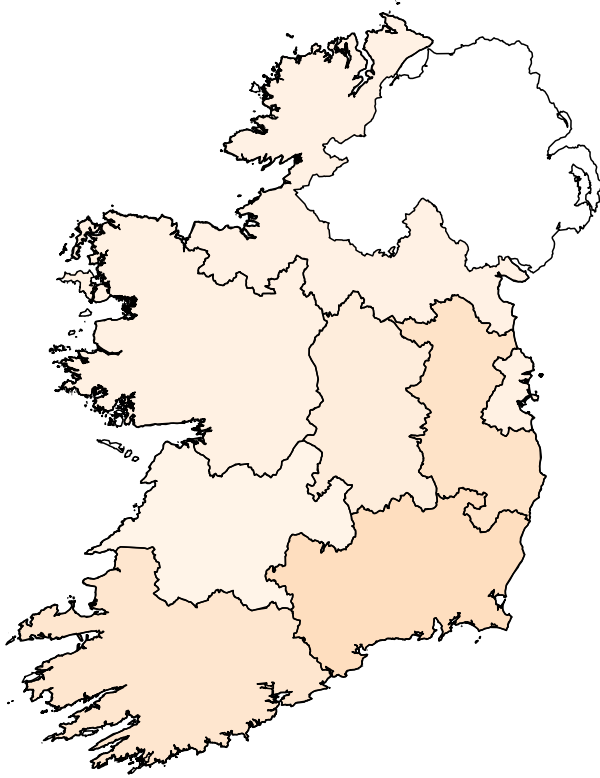
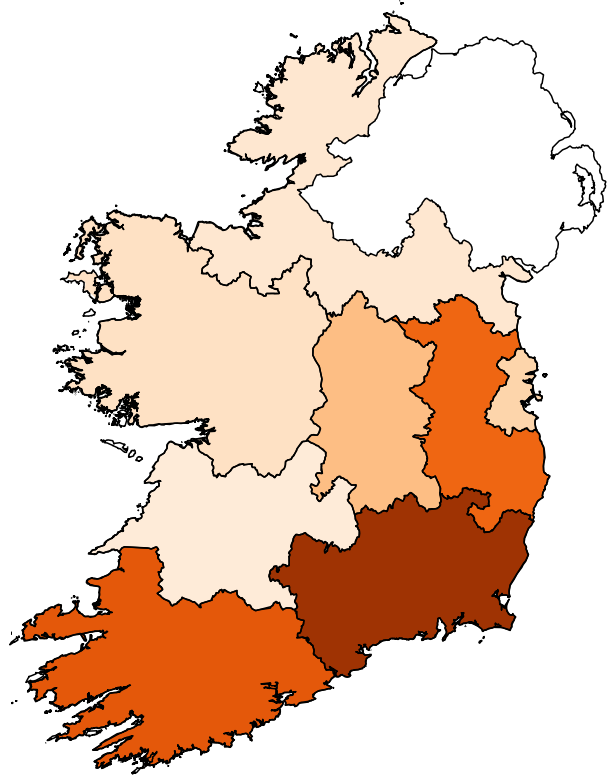


Figure 13 – Solar PV capacity in 2030 by region

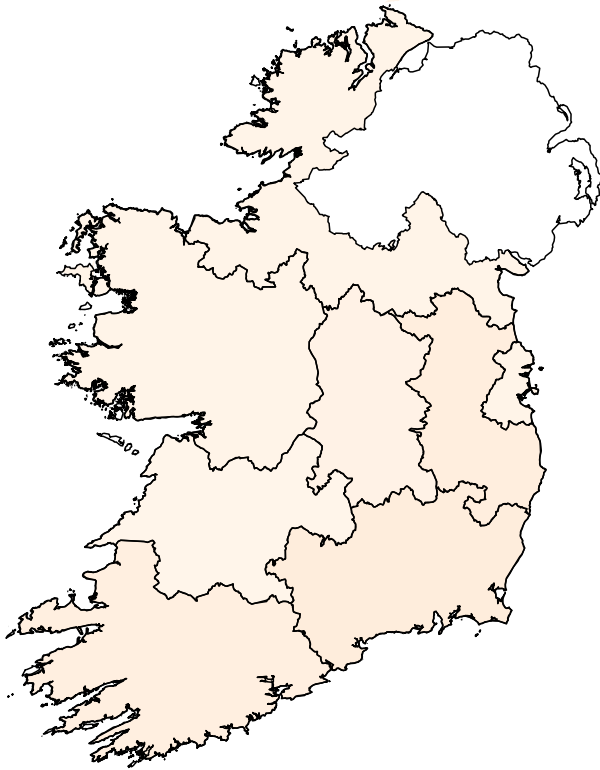
Steady Evolution



Low Carbon Living



Slow Change



Consumer Action

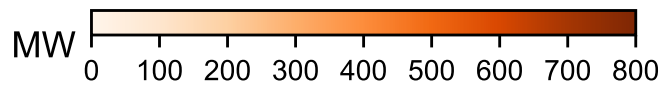
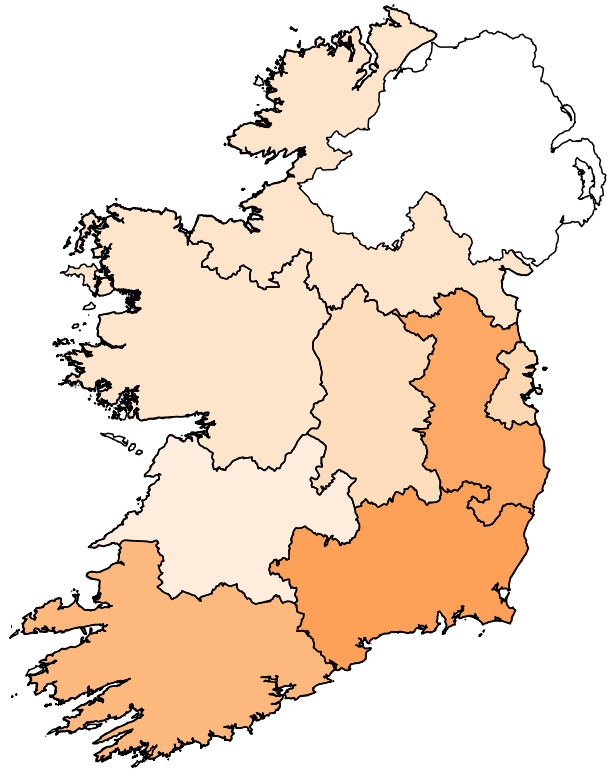


Figure 14 – Solar PV capacity growth, from current levels, by 2030 by region

4.4 Fossil fuel generation

Assumptions relating to the future locations of fossil fuel generators were formed based on information provided by stakeholders as part of the *Tomorrow's Energy Scenarios 2017* consultative process. Our stakeholders have suggested that peat and coal fired generation will cease completely by 2030 under all scenarios. **Low Carbon Living**, however, assumes removal of coal and peat generation will occur earlier by 2025. Removal of peat generation by 2025 is also assumed to occur in **Steady Evolution**.

There are currently three peat fired stations in Ireland situated at Edenderry, Lough Ree and West Offaly with a combined capacity of 311 MW. It is assumed that, by 2030, these stations will either repower with biomass or close depending on the scenario. Biomass is already in use at Edenderry which currently generates 35 MW of biomass energy by co-firing with peat.

Ireland's only coal-fired generation station, Moneypoint, in the Mid-West, is assumed to convert to gas between 2020 and 2030. This assumption aligns with Gas Networks Ireland's 2016 Network Development Plan [Gas Networks Ireland (2017)]. Distillate oil generation units at Edenderry, Tawnaghmore and Rhode may convert to gas in some scenarios by 2040 while heavy oil generators at Tarbert is assumed to be removed from service by 2025.

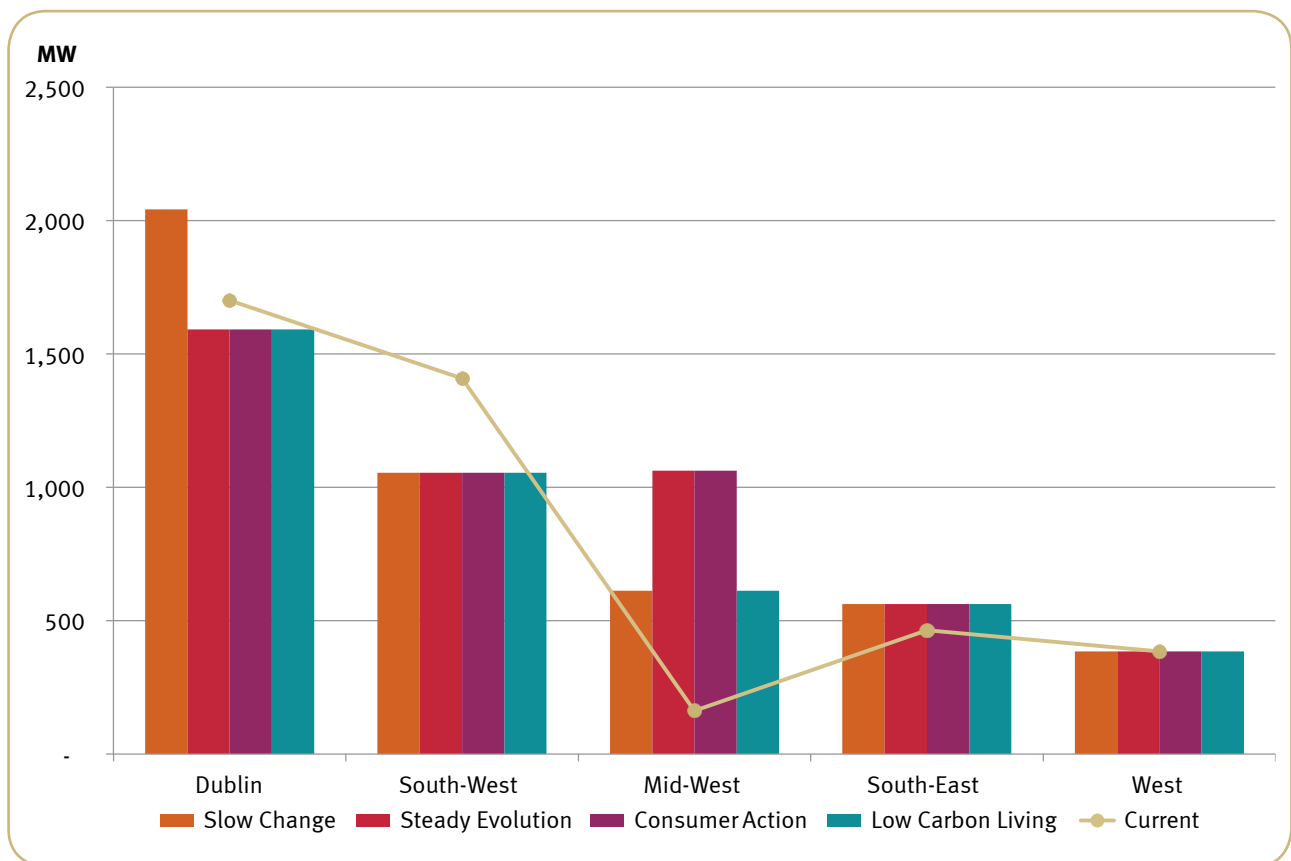


Figure 15 – Gas capacity in 2030 by region

The effect of gas repowering is demonstrated in Figure 15, which displays gas capacities today and in 2030 by region. We can see an increase in the Mid-West region due to gas repowering of Moneypoint. The South-West sees a reduction in gas capacity in 2030 compared to today as aged gas fired generators are removed from service.

Closure of a Open Cycle Gas Turbine (OCGT) unit is assumed [EirGrid, (2017a)] in the Dublin region for all scenarios by 2030. However, gas capacities are assumed to increase in the Dublin region, by 2030, in **Slow Change** due to comparatively lower levels of renewable generation on the transmission system.

Although some regions may experience decreases in gas capacity an overall net increase in gas capacity is assumed in Ireland by 2030.



5. Electricity storage and interconnection

5.1. Electricity storage

Ireland has traditionally used pumped hydro energy storage; however, battery energy storage and compressed air energy storage technologies are becoming more widely used in transmission systems around the world.

Ireland’s Turlough Hill station in Wicklow uses pumped hydro energy storage technology and has a maximum export capacity of 292 MW. A second pumped hydro energy storage facility is assumed to connect to the transmission system by 2030 as part of our **Low Carbon Living** scenario. This facility is expected to have a maximum export capacity of 360 MW and connect to the grid in the Midland region.

Large scale battery energy storage systems are assumed to have capacities of 10 MW or greater and are connected directly to transmission or distribution systems or installed within wind or solar PV farms. EirGrid has received applications for a number of large scale battery energy storage facilities to connect the transmission system. We have used these applications to determine our future battery energy storage locations. The upcoming DS3 volume capped procurement process may affect the future locations of battery energy storage, however, this is not reflected in our Tomorrow’s Energy Scenarios locations.

Figure 17 displays large scale battery energy storage capacities in 2030 by region. **Low Carbon Living** assumes significantly more capacity than the other three scenarios in all regions. For instance, capacities for **Low Carbon Living** are 24 times that of the **Slow Change** which assumes an overall capacity of 50 MW in 2030. This reflects the scale of renewable generation expected in the **Low Carbon Living** scenario compared to the other scenarios.

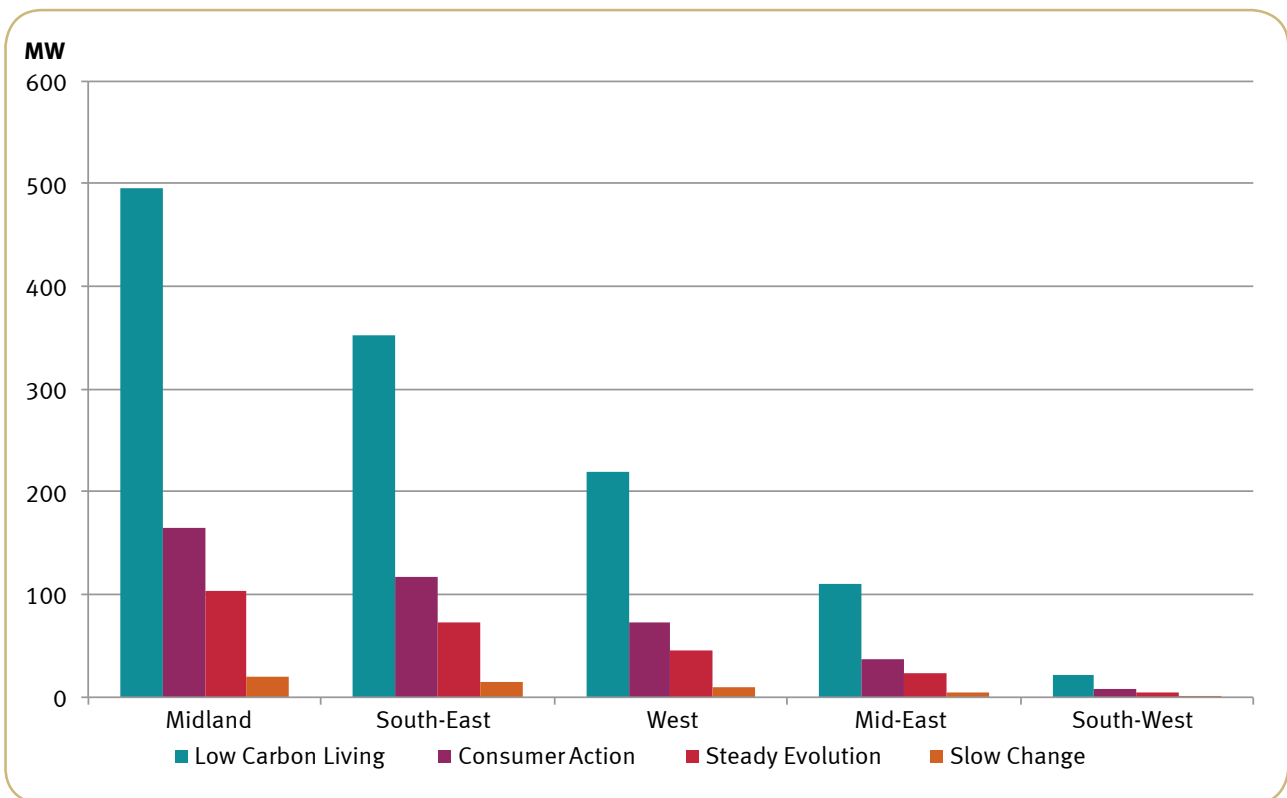


Figure 17 – Large scale battery storage capacity in 2030 by region

Our scenarios assume that less small scale battery storage capacity is expected to connect to the transmission system compared to large scale systems. Small scale batteries are considered to be domestic household batteries or battery banks with capacities less than 10 MW. We expect that these storage solutions will augment rooftop solar PV generators or small wind and solar PV farms connected to the distribution system.

It is assumed that small scale batteries will somewhat offset, at times, existing distribution load and so capacities have been allocated to transmission stations on a pro rata basis based on the recorded distribution load readings. This is illustrated in Figure 18 as the concentrations of small scale battery capacities in 2030 are highest in regions with high population densities and the largest proportions of distribution load.

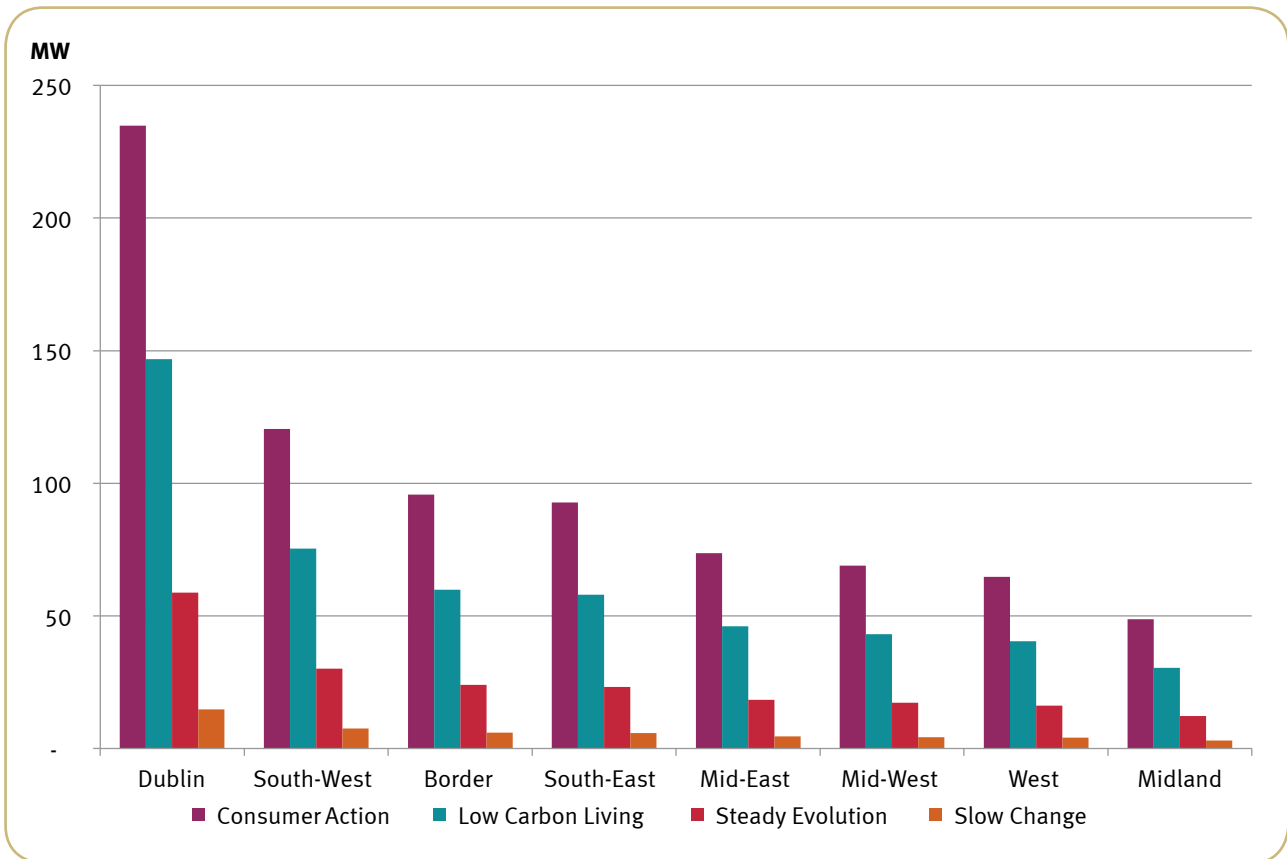


Figure 18 – Small scale battery storage capacity in 2030 by region

Small scale batteries are most prominent in **Consumer Action** as households seek to better utilise rooftop solar PV generators. Capacities are highest in all regions for this scenario, although, more sparsely populated regions are assumed to experience marginal growth in all scenarios. The Midlands region, for example, is expected to contain maximum capacities ranging between 49 MW and 3 MW under our **Consumer Action** and **Slow Change** scenarios respectively. This is because distribution load levels are relatively low in these regions suggesting that low growth of small scale battery capacities can be expected.

5.2. Interconnection

Ireland is currently interconnected with Great Britain through the East West Interconnector and to Northern Ireland via a 275 kV double circuit line. There are also two 110 kV tie lines between Northern Ireland and Ireland. However, these tie lines are not interconnectors as they do not, on their own, have sufficient power carrying capacity to securely hold the two transmission systems together.

The East West Interconnector uses HVDC technology and connects Deeside in Wales to the Woodland substation in Meath. The maximum transfer capacity of this interconnector is 500 MW. Further interconnection with Northern Ireland is planned with the high voltage alternating current North South Interconnector planned to be completed in 2020. This project will increase the total transfer capacity between Ireland and Northern Ireland to 1,100 MW.

Table 1 displays HVDC interconnector capacities in 2030 by region. The expected quantity of HVDC interconnections varies from one to three depending on the Scenario. **Slow Change** assumes that the East West Interconnector provides Ireland’s only HVDC transfer capacity in 2030 and that no further interconnectors have been commissioned. This is due to a lack of capital funding caused by unfavourable economic conditions. Under this scenario Ireland does not meet its EU interconnection targets.

Consumer Action and **Steady Evolution** assume that an additional interconnector is built in addition to the East West Interconnector. This second interconnector has a capacity of 700 MW and is assumed to connect the electricity transmission systems of Ireland and France. **Low Carbon Living** assumes the highest level of interconnector transfer capacity of all our scenarios by 2030. Strong economic growth and high levels of renewable generation result in the further interconnection with Great Britain. This additional interconnection is assumed to have a total transfer capacity of 750 MW with connection(s) to the Irish transmission grid in the South-East region. This would take Ireland’s total HVDC interconnector transfer capacity to 1,950 MW by 2030.

Region	Low Carbon Living	Consumer Action	Steady Evolution	Slow Change
Mid-East	500	500	500	500
South-West	700	700	700	
South-East	750			

Table 1 – HVDC Interconnection capacity (MW) in 2030 by region

6. Continuing the conversation

Our stakeholders are central to how we plan the future transmission system. We would like your feedback to assist us to prepare our final *Tomorrow's Energy Scenarios 2017 Locations Report*.

We will be accepting input and feedback on our future locations until 11 May 2018.

Please visit our webpage to get further information on our future locations and to complete our locations survey. You will also find details on our upcoming *Tomorrow's Energy Scenarios 2017 Locations Consultation* webinar.

Alternatively, please email us your views on *Tomorrow's Energy Scenarios 2017 Locations Consultation* to scenarios@eirgrid.com and one of our team will be in touch.

In particular, we would like your views on the following topics:

1. Do you feel this document has helped you better understand the possible future locations of Ireland's electricity infrastructure? If so, how?
2. Are there additional information sources which would help improve our future electricity demand locations?
3. Are there ways that we can improve our assumptions on future electricity demand locations? If so, how?
4. Are there additional information sources which would help improve our future electricity storage and interconnection locations?
5. Are there ways that we can improve our assumptions on future electricity supply locations? If so, how?
6. Are there additional information sources which would help improve our future electricity supply locations?
7. Are there ways that we can improve our assumptions on future electricity storage and interconnection locations? If so, how?
8. Are there any further details which you would like us to provide in our final *Tomorrow's Energy Scenarios 2017 Locations Report*?

We look forward to receiving your feedback on our future locations.

Feedback received on this consultation report will be used to develop the final *Tomorrow's Energy Scenarios 2017 Locations Report*, which will be published in Spring 2018. This report will detail finalised assumptions and methods relating to our future locations.

With the final assumptions, we will conduct a technical assessment using tomorrow's energy scenarios. This will be achieved by performing a number of different power system studies for each scenario out to 2040. These results will be presented in *Tomorrow's Energy Scenarios 2017 System Needs Assessment* report which will be published towards the end of 2018.

If you require any further information on Tomorrow's Energy Scenarios please email us at scenarios@eirgrid.com.

Appendix 1 – Demand data

Demand technology	Region	Steady Evolution	Low Carbon Living	Slow Change	Consumer Action
Data Centre (MVA)	Border	-	20	-	-
	Dublin	1,026	1,296	850	1,358
	Mid-West	-	74	-	19
	South-East	-	60	-	-
	South-West	60	209	-	124
	West	14	291	-	174
Data Centre Total (MVA)		1,100	1,950	850	1,675
Electric Vehicle (MW)	Border	27	46	10	61
	Dublin	66	114	24	150
	Mid-East	21	36	8	47
	Midland	14	24	5	31
	Mid-West	19	33	7	44
	South-East	26	45	9	59
	South-West	34	58	12	77
	West	18	31	6	41
Electric Vehicle Total (MW)		225	388	81	510
Heat Pump (MW)	Border	37	52	18	63
	Dublin	85	118	42	144
	Mid-East	27	37	13	45
	Midland	19	27	10	33
	Mid-West	25	35	13	43
	South-East	37	52	18	63
	South-West	45	63	22	76
	West	25	35	12	42
Heat Pump Total (MW)		299	420	150	509

Table 2 – Electricity demand in 2030 by region and technology

Appendix 2 – Generation data

Generation Technology	Region	Steady Evolution	Low Carbon Living	Slow Change	Consumer Action
Onshore Wind	Border	1,049	1,039	905	1,053
	Dublin	10	7	10	7
	Mid-East	109	132	109	150
	Midland	186	385	186	118
	Mid-West	589	384	451	521
	South-East	671	903	665	770
	South-West	1,564	1,440	1,458	1,666
	West	962	1,210	856	1,095
Onshore Wind Total		5,140	5,500	4,640	5,380
Offshore Wind	Border	70	311	23	102
	Dublin	363	1,601	121	525
	Mid-East	74	243	41	96
	Mid-West	72	319	24	104
	South-East	72	319	24	104
	West	49	207	17	69
	Offshore Wind Total		700	3,000	250
Solar PV	Border	27	95	11	112
	Dublin	30	181	12	168
	Mid-East	114	509	46	313
	Midland	53	255	21	143
	Mid-West	11	68	4	52
	South-East	135	717	54	339
	South-West	99	551	40	269
	West	31	124	12	104
Solar PV Total		500	2,500	200	1,500
Gas	Dublin	1,593	1,593	2,043	1,593
	Mid-West	1,062	612	612	1,062
	South-East	562	562	562	562
	South-West	1,055	1,055	1,055	1,055
	West	388	388	388	388
Gas Total		4,660	4,210	4,660	4,660
Large Scale Battery	Mid-East	23	110	5	37
	Midland	103	495	21	165
	South-East	73	352	15	117
	South-West	5	22	1	7
	West	46	221	8	74
Large Scale Battery Total		250	1200	50	400
Small Scale Battery	Border	24	60	6	96
	Dublin	59	147	15	235
	Mid-East	18	46	5	74
	Midland	12	30	3	49
	Mid-West	17	43	4	69
	South-East	23	58	6	93
	South-West	30	75	8	121
	West	17	41	3	63
Small Scale Battery Total		200	500	50	800

Table 3 – 2030 Electricity generation capacity (MW) in 2030 by region and technology

References

Aurora TELECOM. National Network. Aurora TELECOM. 2017. <https://www.auroratelecom.ie/network-maps/national-network/>.

Department of Communications, Climate Action and Environment. National Energy Efficiency Plan for Ireland #4 2017-2020. Department of Communications, Climate Action and Environment, 2017. <https://www.dccae.gov.ie/documents/NEEAP%204.pdf>

Department of Communications, Energy & Natural Resources. Ireland's Transition to a Low Carbon Energy Future. Department of Communications, Energy & Natural Resources, 2015.

Department of Communications, Energy and Natural Resources. Offshore Renewable Energy Development Plan. Department of Communications, Energy and Natural Resources, 2014.

Department of Housing, Planning & Local Government. myplan.ie. Ordnance Survey Ireland. 2017. <http://www.myplan.ie/webapp/>.

Department of the Environment, Community and Local Government, Proposed revisions to Wind Energy Development Guidelines 2006. Department of the Environment, Community and Local Government, 2013.

EirGrid. All Island Generation Capacity Statement 2017-2026. Dublin: Eirgrid, 2017a.

EirGrid. Connected and Contracted Generators - Ireland. EirGrid, 2017d. <http://www.eirgridgroup.com/customer-and-industry/general-customer-information/connected-and-contracted-generators/>.

EirGrid. Have Your Say. EirGrid, 2016.

EirGrid. Offer Process Transmission Connection Applicant List. EirGrid, 2017c.

EirGrid. Tomorrow's Energy Scenarios 2017. EirGrid, 2017b.

EirGrid. Transmission Development Plan 2015-2025. EirGrid, 2015.

electronic Irish Statute Book (eISB). "Planning and Development (Strategic Infrastructure) Act 2006." electronic Irish Statute Book (eISB), 2006. <http://www.irishstatutebook.ie/eli/2006/act/27/enacted/en/print.html>.

ESB Networks. Connected and Contracted Generators - Statistics. ESB Networks, 2018. <https://www.esbnetworks.ie/new-connections/generator-connections/generator-connection-statistics>.

Gas Networks Ireland. Network Development Plan 2017. Gas Networks Ireland, 2017.

Government of Ireland. Project Ireland 2040, National Planning Framework. Government of Ireland, 2018.

Host In Ireland. Ireland's Data Hosting Industry. Host In Ireland, 2017.

International Energy Agency. Renewables 2017. International Energy Agency, 2017. <https://www.iea.org/publications/renewables2017/#section-1-3>.

Ordnance Survey Ireland. NUTS3 Boundaries Ungeneralised - OSi National Statistical Boundaries. Ordnance Survey Ireland, 2017.

<https://data.gov.ie/dataset/nuts3-boundaries-ungeneralised-osi-national-statistical-boundaries>.

Central Statistics Office. Population and Labour Force Projections. Central Statistics Office, 2013a.

Central Statistics Office. Regional Population Projections. Central Statistics Office, 2013b.

PWC. Transitioning to a low carbon energy system. PWC, 2017.

TeleGeography. Submarine Cable Map. TeleGeography. 2018. <https://www.submarinemap.com/#/>.



The Oval, 160 Shelbourne Road, Ballsbridge, Dublin D04 FW28 • Telephone: 01 677 1700 • www.eirgrid.com



Printed on recycled paper