Derry City & Strabane District Council and Donegal County Council

NORTH-WEST REGIONAL ENERGY STRATEGY

Final Report

70054180
MAY 2020

PUBLIC

Comhairle Contae Dhún na nGall
Donegal County Council

Derry City & Strabane District Council
Comhairle Chathair Dhoire & Cheantar an tSratha Báin
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Derry City & Strabane District Council and Donegal County Council

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ABBREVIATIONS

Abbreviation	Definition
CD	County Donegal
DCSDC	Derry City and Strabane District Council
DCS	Derry City and Strabane
DCC	Donegal County Council
EV	Electric Vehicles
PV	Photovoltaics
DSO	Distribution System Operator
DNO	Distribution Network Operator
DG	Distributed Generation
LCT	Low Carbon Technologies
LCE	Low Carbon Economy
CHP	Combined Heat and Power
DH	District Heating
HP	Heat Pump
NIE	Northern Ireland Electricity (Networks)
ESB	Electricity Supply Board (Networks)
ROI	Republic of Ireland
NI	Northern Ireland
UK	United Kingdom
AI	Artificial Intelligence
IPCC	Intergovernmental Panel on Climate Change

EXECUTIVE SUMMARY

This report contains the North-West Regional Energy Strategy for Derry City & Strabane District Council (DCSDC) and Donegal County Council (DCC).

All information is correct at the time of writing and any assumptions or predictions made have been done so with reference to credible sources.

Derry City & Strabane District Council (DCSDC) and Donegal County Council (DCC) both recognise the need to transition towards a smart, low carbon economy which can deliver sustainable prosperity for individuals, communities, businesses and the local environment within the North-West Region. To fulfil this goal, both councils have collaborated, with the support of WSP, to define a clear and structured North-West Regional Energy Strategy as one combined region.

This strategy supports the increasing global consensus arising from the IPCC's 2018 report that identifies the urgent need to accelerate decarbonisation objectives and has been aligned with "Net Zero" emissions targets. Importantly, the UK Parliamentary Climate Change Committee (CCC) in its recent report recommends that local authorities must be proactive and pursue strategies that are designed to eliminate carbon emissions within their regions given the specific nature of their individual energy system.

This report therefore aims to provide a strategic rationale and direction for the North West region to achieve its vision for a Net Zero emissions Energy sector by 2045. The Roadmap contained herein proposes a strategy that can deliver real reductions in annual carbon emissions, whilst encouraging the growth of a low carbon economy, improving the security of supply and minimising the environmental impact of all future activities.

This strategy recommends a Whole Energy System approach and provides a holistic view on the consumption and management of energy throughout the region. A wide variety of local measures have been recommended as potential opportunities to encourage the adoption of renewable Low Carbon Technologies (LCTs) both for the consumption and generation of energy within the North-West Region.

It is important that the North-West Region has a very clear plan on how it should become carbon neutral given the specific characteristics and requirements of the area. This plan should coordinate all energy vectors together to optimise energy consumption across the North-West Region and minimise both Greenhouse Gas (GHG) emissions and customer bills whilst minimising cost and maximising opportunity for all who live and work within the area.

Through the acceleration of this transition, the North-West Region is presented with a huge opportunity in becoming a proactive "prosumer" in the energy market and contributing towards future balancing markets both with the electricity transmission and distribution networks, as well as the gas networks. The area intends to build a template to demonstrate how local authorities can intelligently decarbonise to meet binding emission targets whilst encouraging sustainable economic growth.

Both Councils have a history of driving energy conservation throughout their organisations, and through the ongoing delivery of this strategy, wish to remain a driving force for innovation in the region. They will bring together the strands necessary within their own organisations, working with the private sector stakeholders and academia to deliver the objectives as set out within the report.

It is recommended that the **North West Regional Energy Hub** project body is established, closely following the excellent examples set out in Section 7 of the report in both Ireland and England.

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1

INTRODUCTION

1 INTRODUCTION

This report aims to evaluate the energy opportunities and local measures that are available to both councils within the North-West Region to encourage the growth of a sustainable low carbon economy. To do this, a clear strategy and roadmap has been developed which shows the local measures that can be taken to decarbonise the Region by 2045.

1.1 A LOW CARBON FUTURE ENABLED LOCALLY

The evidence in support of climate change is well documented; 17 of the 18 warmest years on record have occurred within the 21st century and the last 3 decades have each been warmer than the last [1]. The Intergovernmental Panel on Climate Change (IPCC) have concluded that the scientific evidence for human influence on a warming climate is indisputable [2].

Action is required to secure a sustainable future for generations to come and local authorities have an important and critical role to play. Climate change is a global challenge but beneath this, local regions must have clear strategies in place to ensure the causes of global warming are addressed.

The UK Climate Change Committee (CCC) has recommended in their recent report that the Government should “set and vigorously pursue” more ambitious targets to reduce Greenhouse Gas (GHG) emissions to 'net-zero' by 2050 [3]. Importantly the CCC warned that achieving such objectives required that “clear, stable and well-designed policies to reduce emissions further are introduced across the economy without delay”.

The Irish Government published their own Climate Action plan on 18th June ensuring Ireland achieved a Net Zero emissions target by 2050 [4]. This is in addition to supporting the wider EU Government’s recently stated intentions for a 2050 net zero target that would be binding for all member states.

This need to address climate change has given rise to a Low Carbon Economy which is already having a positive effect on the wider economy. In 2016, the industry turnover in Northern Ireland reached almost £1 billion, supporting 5000 jobs and 4000 businesses [5]. As well as addressing climate change and creating a low carbon future, energy security and cost can also be addressed. Implementing innovative solutions including LCTs can not only prevent this energy price increasing for consumers but can help decrease its overall cost.

As the global energy transition is founded upon exploiting distributed sustainable energy sources, it is individual regions that are best placed to drive emission reductions, based upon their detailed understanding of the local demands, challenges and opportunities. A central pillar of the UK’s Industrial strategy is to transition the energy supply value chain from reliance upon centralised fossil fuel generation to one built upon distributed energy sources managed within local Whole Energy Systems.

Derry City & Strabane District Council (DCSDC) and Donegal County Council (DCC) have therefore joined forces to build a co-ordinated Regional Energy Strategy for the North-West Region. Their approach is to take a leading role and facilitate local and regional stakeholders towards a decentralised smart energy system designed to meet the regional energy needs and facilitate achieving a Regional goal of net zero emissions by 2045.

This report takes a strategic view of all sources of energy consumed across the North-West Region. This includes energy generated for power, transport, heating, waste and water management, that are supplied by various sources such as electricity, gas, fuel oil, and petrol /diesel etc. Each source of energy consumed

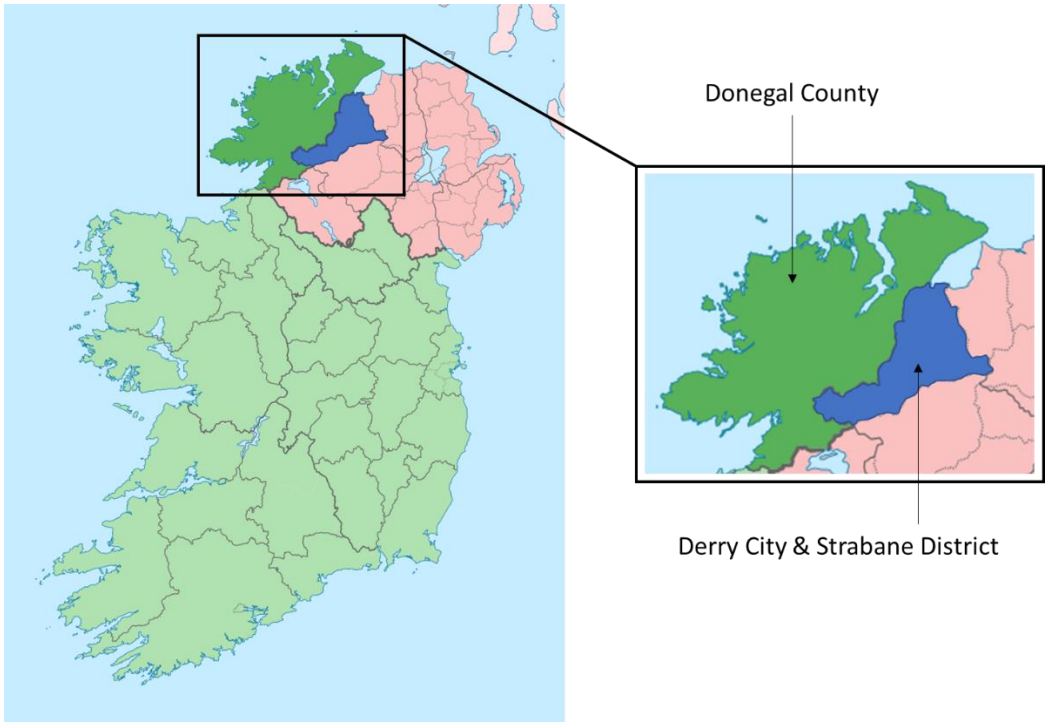
within the region contributes towards annual carbon emissions and it is therefore imperative to take a Whole Energy System view which incorporates all sources of energy production and consumption.

1.2 LOCATION OF REGION

The two areas that are referred to in this report are County Donegal (CD), located in the northern part of the Republic of Ireland (ROI), and Derry City and Strabane (DCS) district, located in the north-western part of Northern Ireland (NI).

Figure 1-1 shows a map highlighting both areas [6]. Throughout this report, the term 'North-West Region' is used to describe both regions. Unless otherwise specified, this report considers a single overall strategy that applies to both regions.

Figure 1-1 - Location of Donegal County and Derry City & Strabane District



1.3 VISION FOR DERRY CITY & STRABANE (DCS) & COUNTY DONEGAL (CD)

This report intends to encourage a holistic view of the energy system within the North-West Region by coordinating multiple energy vectors together in order to optimise energy consumption across the area by both minimising greenhouse gas emissions and reducing customer bills. The North-West Region will thereby aim to become a leader in achieving national and international climate change targets and set long term goals to become a "Net Zero Carbon Region" by 2045.

In doing so it is important that the North-West Region maintains a sustainable, secure and affordable energy system for all citizens' whilst also maximising the area's opportunities for economic growth. This Report therefore makes recommendations for sustainable economic growth across the North-West Region whilst minimising the environmental impact to realise the low carbon society which is so critical for our future.

1.4 ENERGY POLICIES

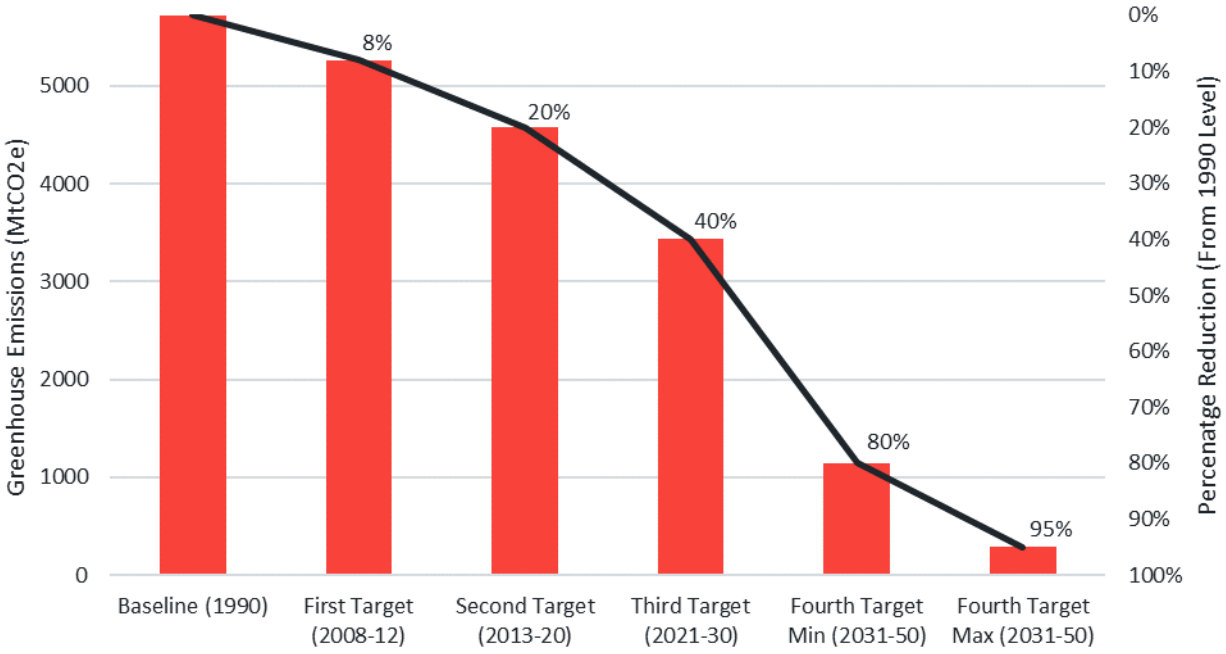
1.4.1 EUROPEAN UNION

The EU has implemented various policies and strategies to ensure that member states can provide secure, affordable and sustainable energy to their citizens as described below. Several reduction targets have been set for three different time periods as highlighted in Figure 1-2.

- By 2020, the EU aims to reduce its greenhouse gas emissions by at least 20% of 1990 levels, increase the share of renewable energy to at least 20% of consumption, and achieve energy savings of 20% or more [7]. Furthermore, all EU countries must also achieve a 10% share of renewable energy in their transport sector.
- By 2030, the EU aims to reduce its greenhouse gas emissions by at least 40% of 1990 levels, increase the share of renewable energy to at 27% consumption, improve energy efficiency by at least 26% (indicative target, to be reviewed by 2020), and support the completion of the internal energy market by achieving an interconnection target of 15% [8].
- By 2050, the EU aims to reduce its greenhouse gas emission by 80-95% of 1990 levels, forming the long-term goal of significant emission reduction [9].

Following the IPCC report published in 2018 [10], the EU are presently considering a redefinition of their emissions reduction targets based upon achieving net zero by 2050.

Figure 1-2 - EU Greenhouse Emissions Reduction Targets



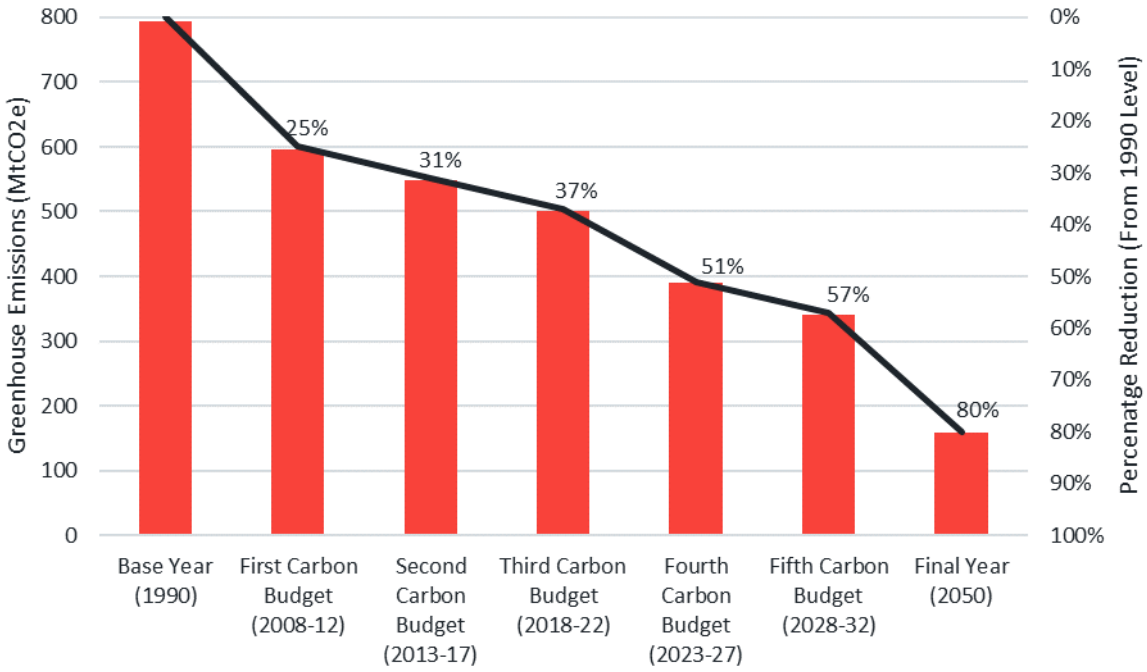
The EU plans to meet these targets by accelerating investment into efficient buildings, products and transport, building a pan-European energy market through the construction of network infrastructure, protecting consumer rights in the energy sector and pursuing good relations with the EU's external suppliers of energy and energy transit countries.

1.4.2 UK ENERGY STRATEGY

In 2017, The Clean Growth Strategy [11] was published to describe how the UK will meet its ambitious carbon reduction targets as set out in the Climate Change Act of 2008 [12]. The UK has a target to reduce its annual emissions by 80% of 1990 levels by 2050 as shown in Figure 1-3.

However, in May 2019 the CCC published its “Net Zero” report which recommends that the UK should aim to reduce GHG emissions to 'net-zero' by 2050, ending the UK's contribution to global warming within 30 years [3].

Figure 1-3 - UK Carbon Budgets and 2050 Target



The key policies and proposals within the UK Government’s Clean Growth Strategy provides a view on how these targets can be met and focusses on the following areas:

- Accelerating clean growth
- Improving business and industry efficiency
- Improving our homes
- Accelerating the shift to low carbon transport
- Delivering clean, smart, flexible power
- Enhancing the benefits and value of our natural resources
- Leading the public sector
- Government leadership in driving clean growth

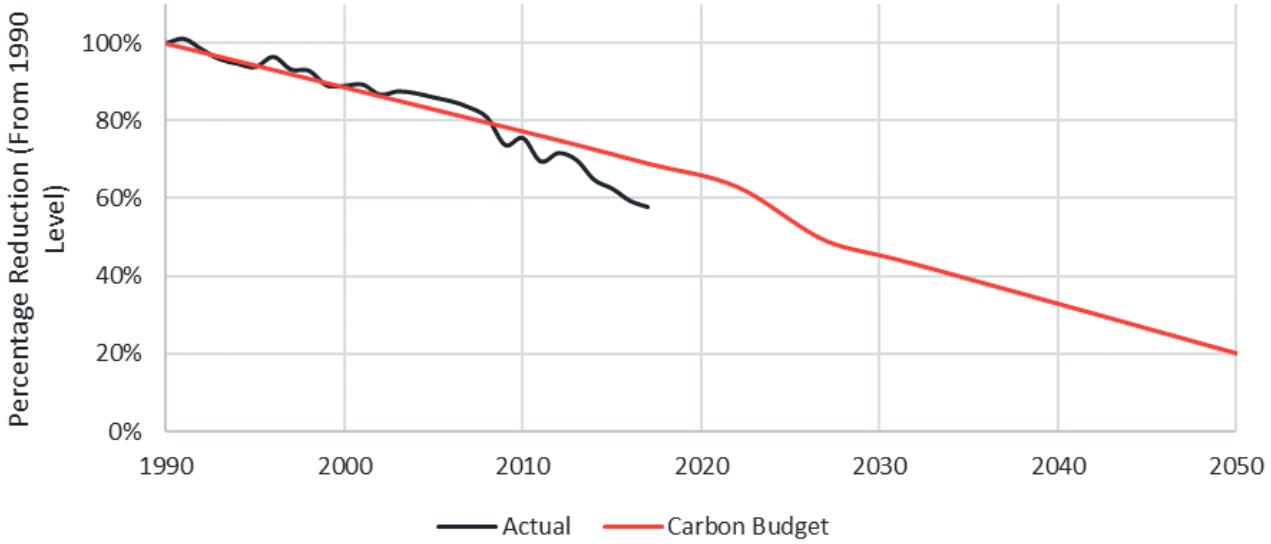
Figure 1-4 shows the actual percentage reductions of greenhouse emissions compared to the carbon budget targets [13]. UK emissions were 43% below 1990 levels in 2017. The first carbon budget (2008-12) has been

met and the UK is currently on track to outperform the second (2013-17) and third (2018-22) carbon budgets, but is not on track to meet the fourth, which covers the period 2023-27.

Meeting future carbon budgets and the UK's present 2050 target to reduce emissions by at least 80% of 1990 levels will require reducing domestic emissions by at least 3% per year. This will require existing progress to be supplemented by more challenging measures [3]. This could however require a further redefinition of budgets if the UK Government legislates for a "Net Zero" target by 2050.

In Northern Ireland (NI), total energy demand is expected to remain relatively flat within the range of a 2% reduction by 2030 to a 15% increase in the high scenario. Renewable energy sources currently make up 30% of this demand which is expected to grow through developments in both onshore wind and solar photovoltaic generation [14]. Gas (55%) and Coal (15%) currently make up the majority of the remaining 70%.

Figure 1-4 - UK Reduction in Greenhouse Emissions Comparison (Actual vs Carbon Budget Values)



1.4.3 REPUBLIC OF IRELAND ENERGY STRATEGY

The Republic of Ireland (ROI) has also set its own strategy to tackle energy and greenhouse emissions. In 2015, the Department of Communications, Energy & Natural Resources released 'Ireland's Transition to a Low Carbon Energy Future' [15] which set out Irelands energy strategy from 2015 to 2030.

In June, the Department of Communications, Climate Action & Environment released the 'Climate Action Plan 2019', which re-evaluated the emissions targets set previously [4]. The government has now stated that it "will support the ambition emerging within the European Union to achieve a net zero target by 2050" and have "sought a pathway to 2030 which would be consistent with a net zero target by 2050". Some of the key measures to help create a framework and support change include:

- Consistent development of a Green Procurement Strategy
- Targets of 50% Energy Efficiency and 30% greenhouse gas emissions reduction
- A trajectory for the price of carbon to create incentives which help avoid locking in carbon intensive technologies
- The realisation of the principle underpinning Project Ireland 2040 for compact, connected, and sustainable development; and

- Competitive funding rounds to promote research and innovation to meet the climate challenge

Figure 1-5 shows Ireland's emission targets.

Figure 1-5 - Republic of Ireland Greenhouse Emissions Reduction Targets

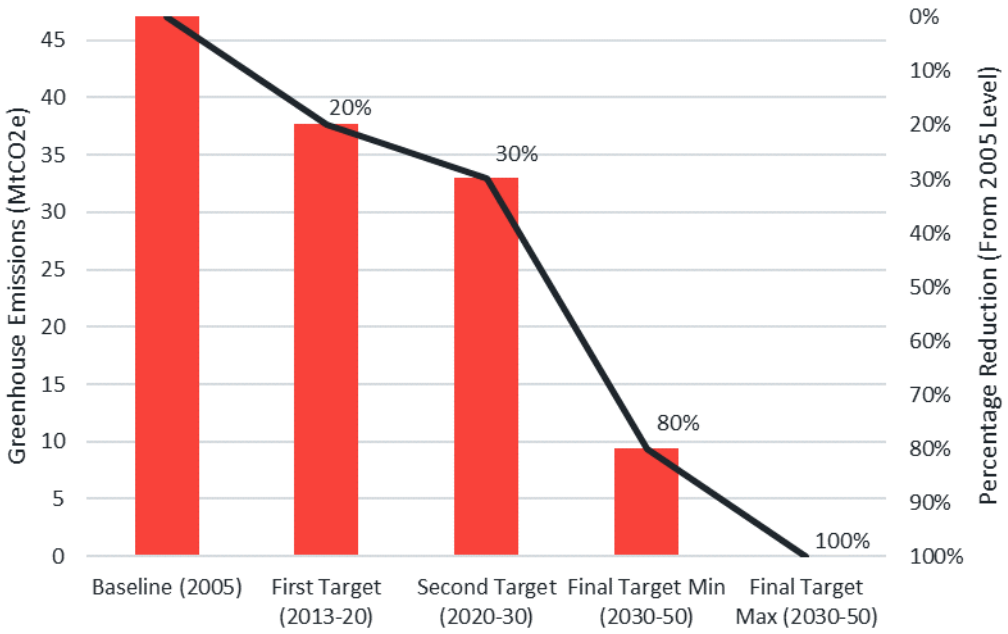
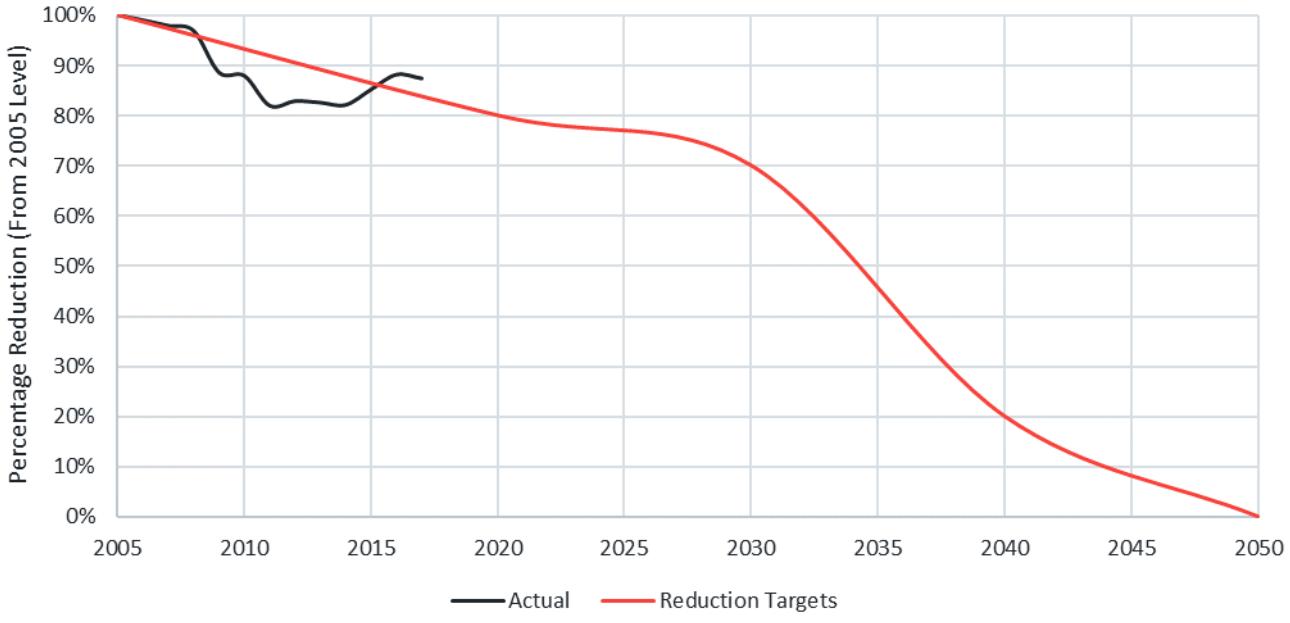


Figure 1-6 shows Irelands actual greenhouse emissions compared with the targets set-out [16]. As of 2014, Ireland has managed to meet 8.6% for the total renewable energy sources making up final energy consumption and was almost halfway (at 8-9%) of achieving its goal of a 20% improvement in energy efficiency.

Figure 1-6 - Republic of Ireland Reduction in Greenhouse Emissions (Actual vs Target)



Accelerated development is needed in the country if they plan to meet published targets particularly if energy demand continues to increase. It is estimated that electricity demand in Ireland could grow by 57% in the next 10 years [17]. The Sustainable Energy Authority of Ireland proposed a number of areas to focus on. These include:

- Upgrade homes and businesses to make them more energy efficient (Grant schemes have been applied to more than 25,000 homes/businesses in 2014).
- Increase the total wind generation capacity
- Increase supply of biofuels to be blended with fossil fuels for transport
- Policy incentives to accelerate adoption of electric vehicles (private and commercial)
- Encouraging the installation of renewable heat options, such as biomass boilers, solar thermal and biomass CHP system, in homes and businesses.

2

EXISTING ENERGY SYSTEM

2 EXISTING ENERGY SYSTEM

This section of the report describes the existing energy system within the North-West Region, detailing the generation and demand/consumption. This will form the basis and starting point of any future plans for the region to become carbon neutral.

2.1 REGIONAL GENERATION MIX

The North-West Region contains a variety of different generation sources. As with most other regions in ROI and NI, the major generating sources are fossil fuel based.

Wind energy, however, plays a significant role in generation. The area is located in a region where speed and consistency is very favourable and allows for effective use of the wind resource. In 2010, Count Donegal was producing approximately 15% of electricity from renewable sources, according to The Donegal Local Economic & Community Plan 2016-2022 [18]. Of the 1,803 MW of power produced by wind farms in Ireland, 279.65 MW (15.5%) was generated in County Donegal from a total of 28 wind farms. Within DCS, there are 97 renewable sites across the district, as of the end of 2016, with a combined capacity of 304 MW and generation of 714,676 MWh, which accounted for 31% of the total renewable generation of Northern Ireland.

Over the years, the North-West Region has seen greater development in energy generation from wind technology. The County Donegal Development Plan 2018 – 2024 released in June 2018 [20] mentions its significant wind energy outputs compared to other counties in ROI and, as a result, is now an energy exporter, despite the limited available grid electricity infrastructure. Future developments are also planned for County Donegal which will increase the installed capacity. Within DCS, as of 2017, there are 17 windfarms which have received planning permission, which would account for 305.6 MW of additional generation, with a further 6 proposals under consideration and 1 under appeal.

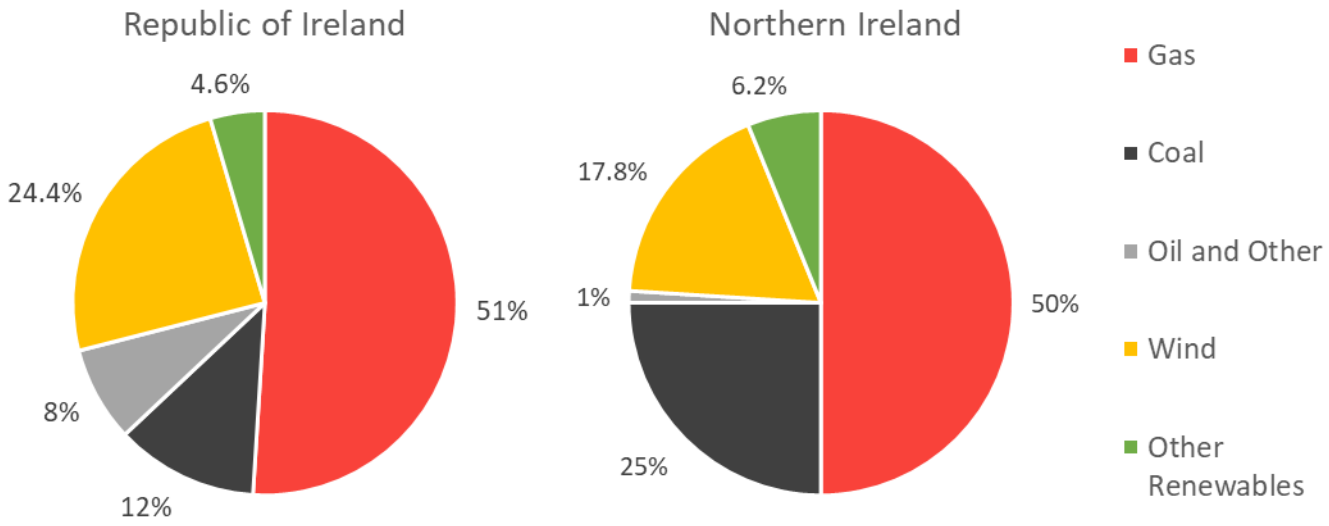
Another key generation source in Donegal County is hydro power, with several sites in operation through the area.

National Comparison

For both the ROI and NI, the majority of generation comes from fossil fuel, with natural gas providing the largest proportion. This is highlighted in Figure 2-1 which shows the electricity generation proportion for ROI in 2017 [24] and NI in 2016 [25].

The total generation of electricity from renewable sources in NI in 2016 was 2,324.7 GWh, accounting for 24% of the total electricity generation. The majority of this generation was from wind at 74%. However, with the increasing development of Photo Voltaic (PV) technology, Solar PV is likely to have a greater overall uptake. Similarly, 29% of electricity generation within the Republic of Ireland was from renewable sources, the majority of which being wind energy.

Figure 2-1 - Proportion of Electricity Generation in the Republic of Ireland and Northern Ireland



2.2 REGIONAL ENERGY CONSUMPTION AND DEMAND

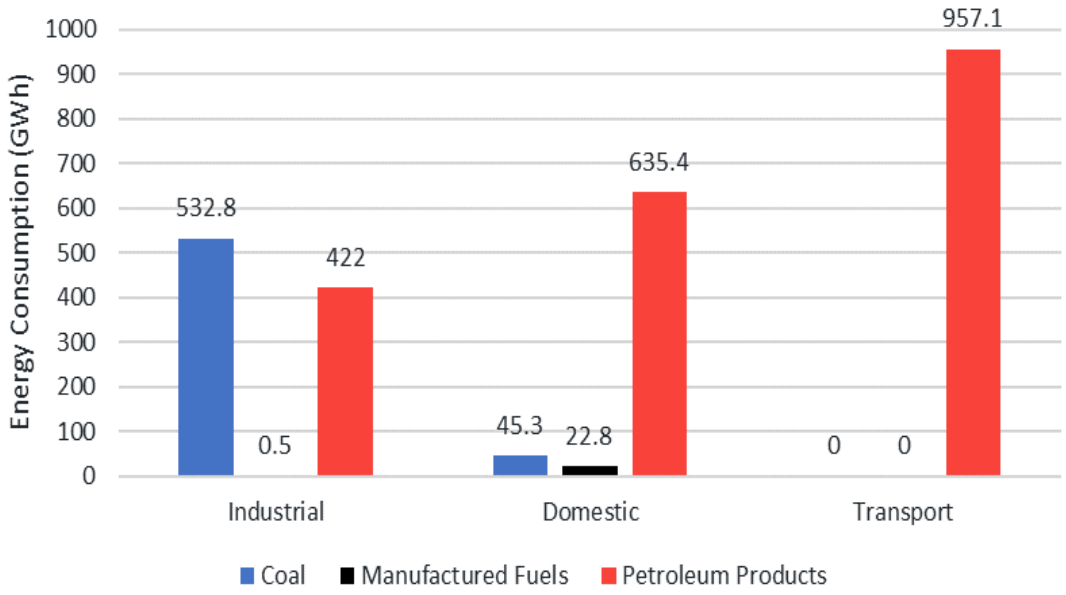
2.2.1 GENERAL OVERVIEW

Figure 2-2 shows the final energy consumption for DCS for each fuel type and sector in 2015 [25]. This energy consumption was 2,816.4 GWh and accounted for 8% of NI's total. The coal consumption within the district accounts for 16.7% of NI's total coal consumption whereas manufactured fuels and petroleum products accounted for only 8.3% and 7.3% of NI's total respectively. Coal consumption in the industrial sector accounted for 92% of total coal consumption within the district. The overall energy consumption of coal however was significantly less than that of petroleum products with, unsurprisingly, petroleum products contributing to 90% of total consumption in domestic use and 100% of total consumption in transport use.

For DC, the total business energy consumption was 814.1 GWh [26]. Compared with ROI's total business energy consumption of 156,093 GWh, DC's business energy use accounts for only 0.5% of the national consumption. Furthermore, DC's total business energy use has reduced by 30.7% since 2009. Data relating to other energy uses and their fuel types for County Donegal was not available at the time of writing this report.

The exact quantity of energy consumed within the North-West Region is not known however an attempt to quantify the total energy consumed has been highlighted within the Regional Energy Carbon Assessment tool which is detailed in Section 4 of the report.

Figure 2-2 - Derry City & Strabane Energy Consumption by Fuel Type and Sector



2.2.2 DOMESTIC ENERGY CONSUMPTION

2.2.2.1 Electricity Use

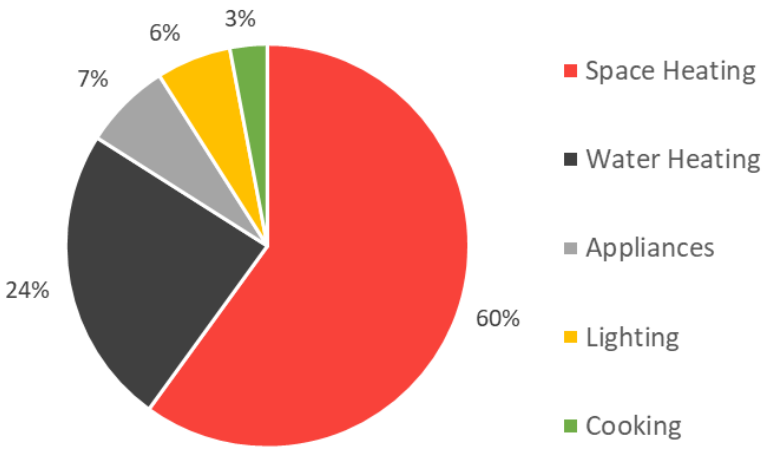
The total electricity consumption in DCS in 2015-16 was 644,797 MWh, with 214,728 MWh from domestic sources and 430,069 MWh from non-domestic sources [25]. This total consumption accounted for 8.5% of NI's total electricity consumption.

The average consumption per meter for domestic use in DCS was 3,400 kWh. Comparing this value with the NI averages of 3,600 kWh shows that the DCS district is lower than that of the national average. Furthermore, based upon the last Energy in Northern Ireland report published in 2016, shows that domestic electricity consumption fell by 9.1% in DCS from 2013-14 to 2015-16. This is a greater reduction in domestic electricity consumption then the NI average of 6.1%.

2.2.2.2 Domestic Heating

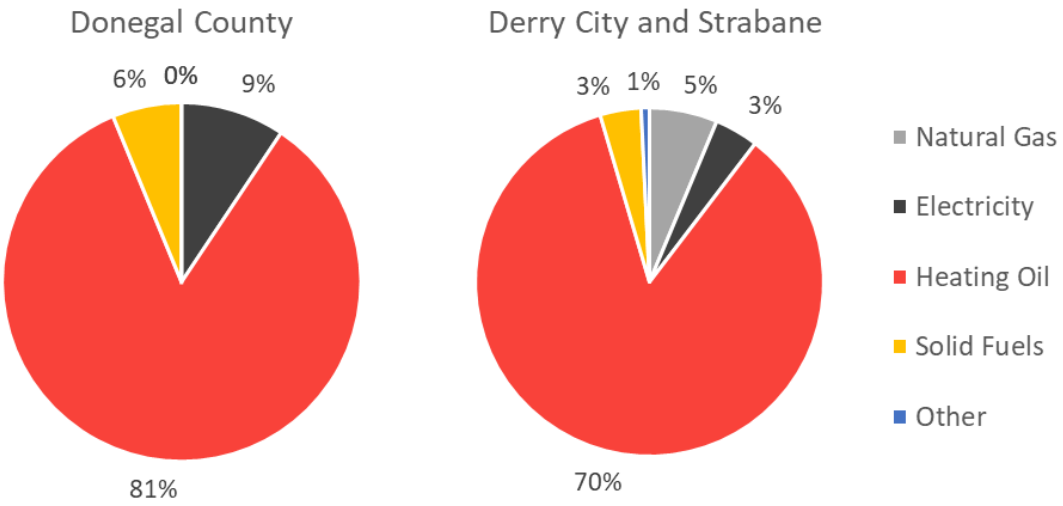
Heating is the major contributor to the total domestic energy use of the North-West Region. This is highlighted in Figure 2-3 which shows a general breakdown of how energy is used in a domestic premise. Furthermore, of all heating requirements, domestic heating within DCS accounted for 70.6% of the total heating demand at 983,363 MWh [27].

Figure 2-3 - Proportion of Energy Use within Domestic Premise



The largest domestic energy demand is space heating. Figure 2-4 shows the proportion of fuel types for main space heating of domestic premises in County Donegal and DCS [26]. The North-West Region has a very heavy reliance on fuel oil for heating. There are a number of reasons for this, with the major reason being a lack of connections to the gas network, with no gas network available within County Donegal.

Figure 2-4 - Proportion of Main Space Heating Fuel for the North-West Region



2.2.3 TRANSPORT

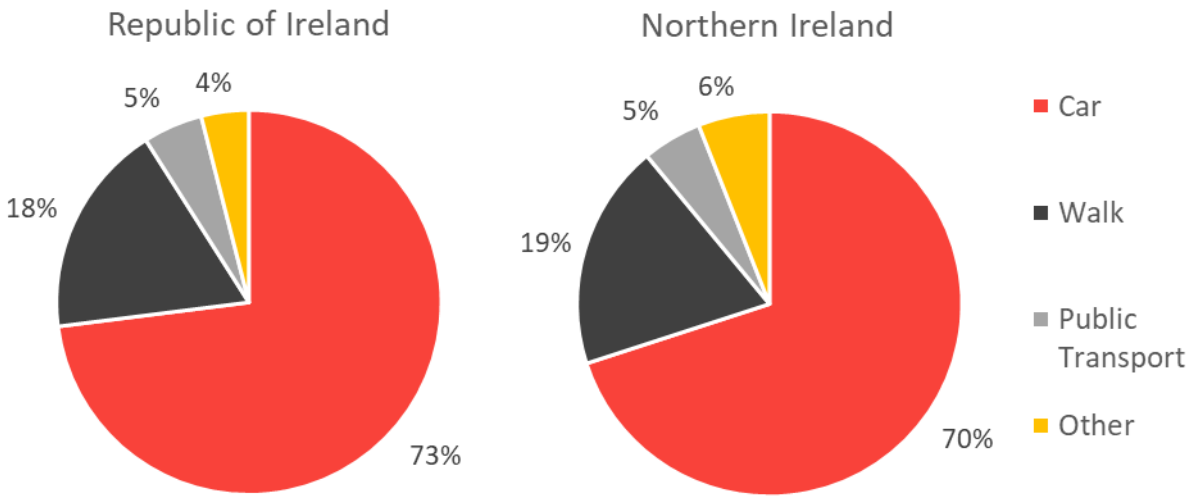
2.2.3.1 Statistics

Both the ROI and NI see similar trends for transport use. Figure 2-5 shows the results for transport use in each country [28] [29].

The majority of transport used within both countries is associated with car use. The main reason for this is a lack of public transport infrastructure, both past and present, leading to most individuals using cars for commuting. NI has seen a recent investment of £1.1 billion into public transport but this has not altered the publics transport means [30].

A survey performed by the Consumer Council [31] looked at public perceptions of public transport in NI. The main findings showed that 55% of all respondents use at least one form of public transport. 30% of these stated that public transport was the only form of transport available to them. Meanwhile, 47% of respondents who use public transport and have a car, choose to use public transport as it is more convenient that using a motor vehicle.

Figure 2-5 - Proportion of Transport Used for Making Journeys



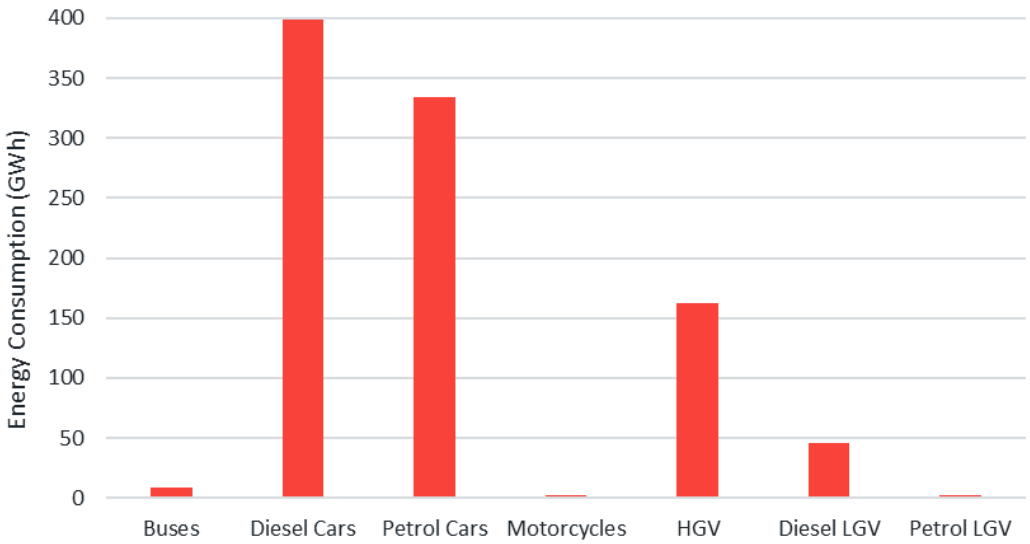
2.2.3.2 Energy Use

Figure 2-6 shows the road transport energy consumption for DCS [25]. The total energy consumption by transport in 2015 was 95.43 GWh, where 78% of this energy was consumed by personal transport use (buses, diesel cars, petrol cars, motorcycles) and 22% consumed by freight transport (HGV, diesel LDV, petrol LGV). DCS's transport energy consumption only accounts for 6.6% of NI's total transport energy consumption.

The results show that the majority of energy consumption comes from cars for personal use. This trend correlates with the statistics of transport use for NI. These results only show road transport however and do not detail information about rail, air and water travel.

No energy consumption data was available for County Donegal. However, the *North-West Carbon Baseline Report* has established an estimate of the carbon emissions arising from transport within the North West. The report estimates that transport is responsible for approximately 1,500 $ktCO_2eq$ each year within the North West.

Figure 2-6 - Proportion of Transport Energy Consumption for Derry City & Strabane



2.2.4 INDUSTRY AND COMMERCIAL

2.2.4.1 Statistics

Figure 2-7 highlights the percentage of total employment in each broad sector in County Donegal and State for 2016 [32]. These results show the total number of individuals employed but does not show the number of businesses operating and the proportion of market share for businesses in the region. Although agriculture, forestry and fishing make up approximately 5.8% of the workforce in Donegal, it is one of the largest forms of industry in the area.

Figure 2-7 - Percentage of Total Employment in Each Broad Sector in Donegal County and State

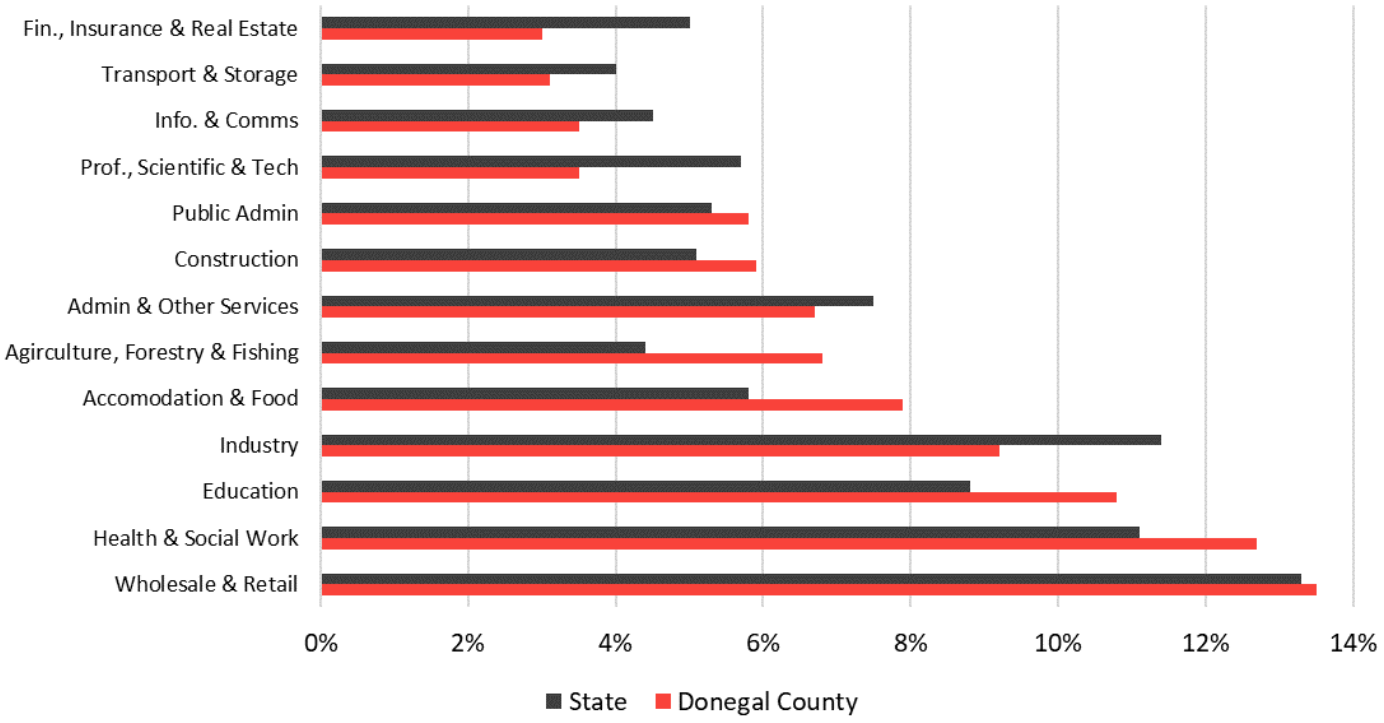


Figure 2-8 highlights the percentage of VAT and/or PAYE registered businesses operating in DCS compared with those operating in NI for 2018 [33]. The results show that County Donegal has nearly identical business proportions as the national proportions. Agriculture, Forestry and Fishing make up nearly 25% of total businesses operating.

Figure 2-8 - Percentage of VAT and/or PAYE Registered Businesses Operating in Derry City and Strabane and Northern Ireland by Broad Industry Group

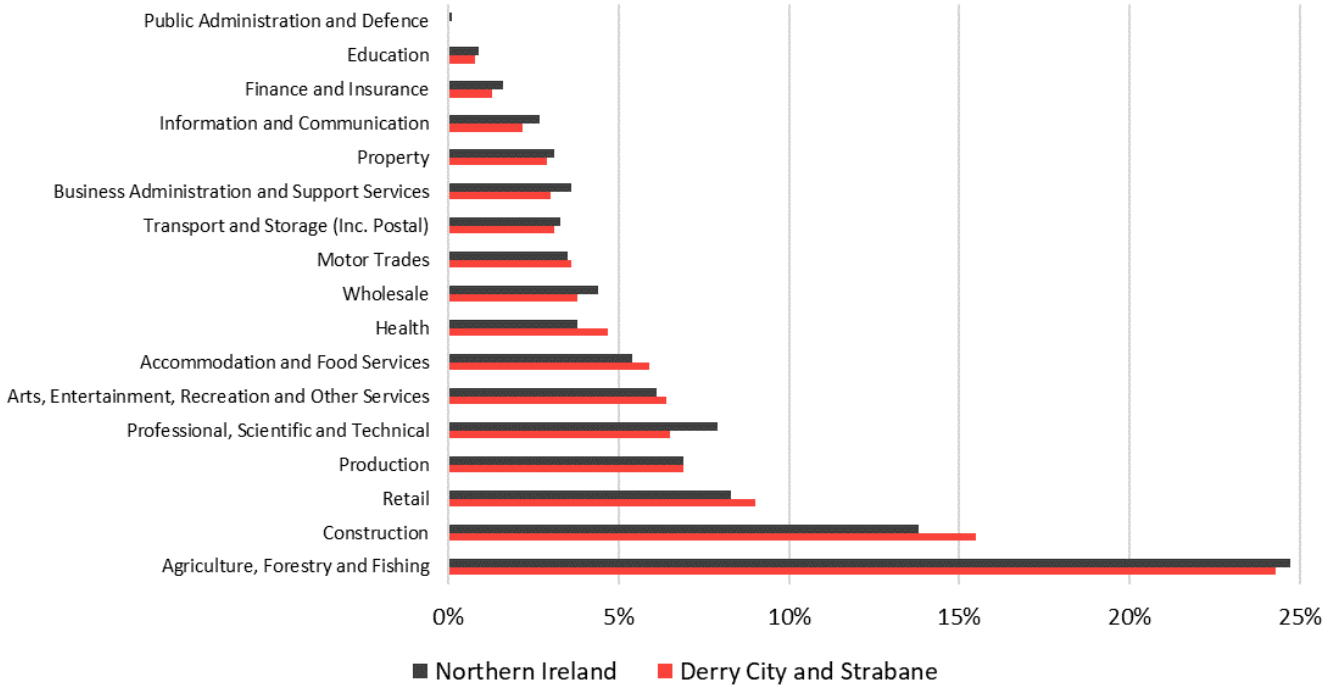
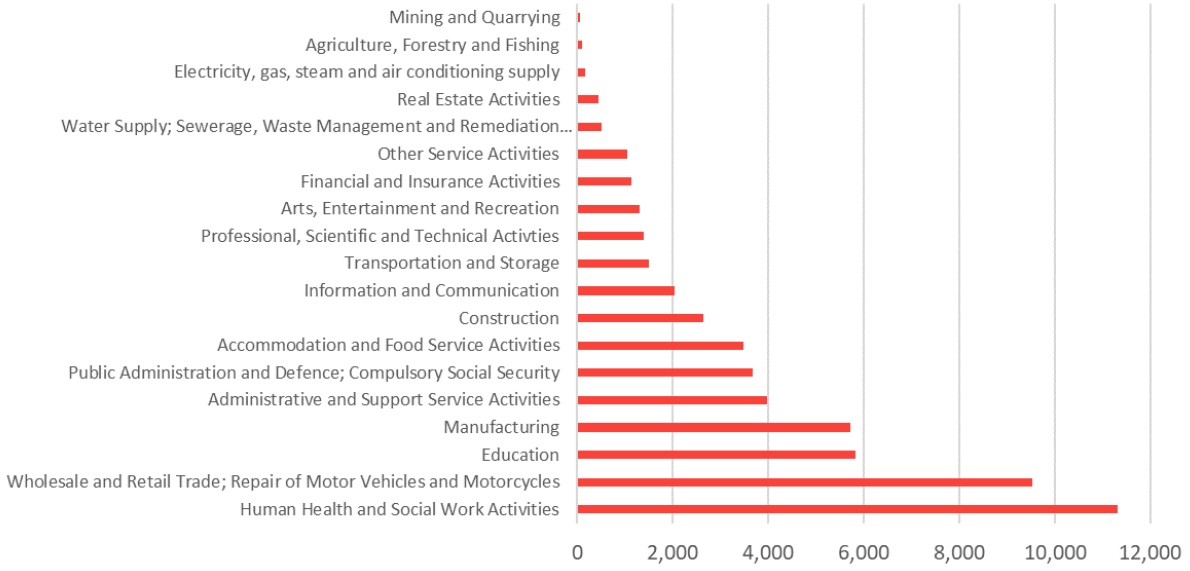


Figure 2-9 shows the number of employee jobs within each sector for DCS. This trend is similar to that of County Donegal, with health and social work, wholesale and retail trade, and education providing the majority of jobs within the North-West region.

Figure 2-9 - Number of Employee Jobs for DCS by Sector



2.2.4.2 Energy use

As mentioned in previous sections, the total energy consumption for the industrial sector of DCS in 2015 was 955.3 GWh whereas in 2016, the total business energy consumption for County Donegal was 814.1 GWh.

While the definitions between 'business' and 'industry' are most likely different, as both counties fall within different national legislation, it still provides an estimated comparison between the counties.

The total non-domestic electricity consumption for DCS in 2015-16 was 430.1 GWh which was 50% higher than the domestic electricity consumption [25]. Furthermore, the average consumption per meter for non-domestic use was 82.2 MWh. The *North-West Carbon Baseline Report* estimates that the non-domestic electricity consumption for County Donegal was 541 GWh.

2.2.5 PUBLIC LIGHTING

The roll out of LED street lighting leads to a significant reduction in energy and maintenance costs. It also has a measurable environmental impact due to the reduction in energy consumption. Both councils have established LED roll out plans to replace the older generation lamps which are inefficient and require replacement on a frequent basis.

In County Donegal there are approximately 17,500 street lights. To date approximately 20% of these have been replaced with efficient LEDs. Currently, the lights work on a dusk till dawn timer. The billing of the street lighting network is unmetered and bills are based on estimations of energy consumption.

There are opportunities to increase the accuracy of these energy bills if a centralised management system is adopted to intelligently control the LED light infrastructure. Intelligent street lighting also provides the opportunity to take advantage of real time data bringing the following benefits:

- Dimming, on/off programming and motion activation can increase cost savings over simple LED lighting
- Manual brightening of lighting when required from a control centre
- Street disturbances can be monitored using noise detection and CCTV
- Electric Vehicle chargers can be integrated into street lightning columns
- Movement sensors allow monitoring of footfall and traffic flow to aid in local planning
- Air pollution monitoring can be integrated into the street lighting network allowing high pollution zones to be targeted
- WiFi services can be integrated for use by vital city services and citizens

2.3 OTHER ITEMS

2.3.1 AIR QUALITY

Air quality is assessed based on the level of pollutants found within local air samples. Because of its effects on individual health and direct links to GHG emissions, it's an important aspect to both monitor and address.

The Clean Air for Europe (CAFÉ) directive was introduced within the EU on the 21st May 2008 and provided countries with an updated and integrated approach to monitoring, assessment and management of air quality [34]. Countries are split into zones based on population density and assessment techniques are applied for each type of zone. Limit values are set for each pollutant where no pollutant concentration should exceed. Upper and lower assessment thresholds are also set for each pollutant and used solely in the determination of the level of monitoring needed for that pollutant in a particular zone.

For County Donegal, the air quality index values in both Letterkenny and Buncrana are 2 whereas the rural parts of the county have an index value of 3 [35]. These are both considered 'good' values with respect to

the index chart, however they are not the most optimal value. More detailed information can be found in the additional appendices document. Real time air quality monitoring stations are in place in Letterkenny, Buncrana and Malin Head. These monitoring stations have recently recorded spikes in particulate matter which have arisen since the coal burning season has restarted. As such, it is important that both local authorities keep a track of the index value to identify spikes and take action to prevent this where possible.

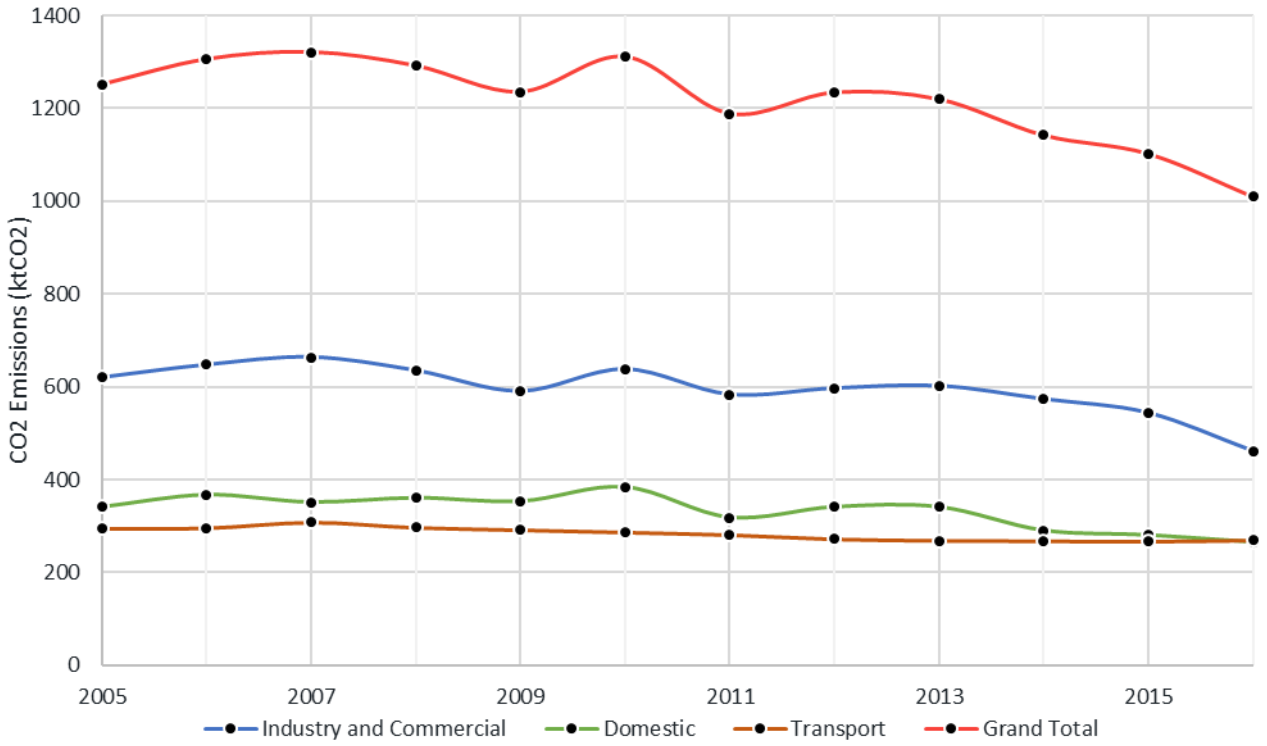
For DCS, a similar index scaling was used, with both Strabane and Derry City having an index value of 2, highlighting them as 'good' [36]. An index value could not be obtained for the rural parts of the district. More detailed information can be found in the additional appendices document.

2.3.2 CARBON MANAGEMENT

Both County Donegal and DCS are involved in the North-West Greenway Network project with one of its objectives to reduce CO_2 emissions entering the atmosphere by over 300 carbon tonnes per annum by 2023 [37] [38].

Figure 2-10 shows the annual CO_2 emission estimates for DCS between 2005 and 2016 with regards to different sectors [39]. The results show that over the years, the total CO_2 emissions from DCS have reduced. This reduction has been largely influenced by a reduction in industry and commercial CO_2 emissions. This provides a rough guide to how CO_2 emissions have changed within the North-West Region over the years. A more comprehensive estimation of the current CO_2 emissions produced within the North-West Region is detailed further in Section 4.

Figure 2-10 - Annual CO_2 Emission Estimates for DCS between 2005 and 2016



3

EXISTING UTILITY SECTOR

3 EXISTING UTILITY SECTOR

This section of the report provides an overview of the key Utilities that operate within the North-West Region and a description of their role in enabling the vision and strategy for both councils.

3.1 ELECTRICTY NETWORKS

There are two Distribution Network Operators (DNOs) that are responsible for distributing electricity in the Region. In NI, the local DNO is known as Northern Ireland Electricity (NIE) Networks whilst in the ROI, Electricity Supply Board (ESB) Networks own and operate the Distribution network. The primary role of both is to reliably and safely deliver electricity to both domestic and commercial customers throughout the Region.

Both DNOs will have a crucial role to enable the transition to a low carbon energy system for the North-West Region and as such are important Stakeholders for the North-West Regional Energy Strategy. This will continue to be the case as the electrification of both heat and transport accelerates as consumers move away from fossil fuelled energy sources.

Both network operators are critical stakeholders for the North-West Regional Energy Strategy and will have an important role to play to ensure the objectives of the strategy are met. For example, it is important that network capacity is available within the North-West Region for the connection of new Low Carbon Technologies (LCTs), such as Heat Pumps and Electric Vehicles. Not only must capacity be available, it must be provided in an affordable, timely, and innovative manner to minimise the impact on electricity bills. The following subsections describe the potential impact that various LCTs may have on the electricity network and the impact on cost for network customers.

3.1.1 ELECTRIFICATION OF HEAT (IMPACT OF HEAT PUMPS)

Nearly half the energy in the UK is used for heating [40]. Heat Pumps (HPs) are an efficient and cost-effective electrical alternative to fossil fuelled heat sources which have an important role to play in reducing the carbon emissions associated with heating. There are two main types of HP available referred to as Air Source HPs or Ground Source HPs.

The technology is now well developed and can supply low-cost, efficient and carbon-free heat for residential, commercial and industrial applications. However, the introduction of Heat Pumps will introduce an additional loading to electricity network which is not currently accounted for. If HPs are adopted on mass, there is a need to better understand the impact of the technology on the electricity network and the associated costs.

Heat pumps will introduce an additional loading to the network which have a very different load curve and impact to that of normal home appliances. Several studies have concluded that the accumulation of heat pumps can create harmful harmonic currents onto local networks and lead to harmonic voltage distortions which exceed network planning standings. For example, a study from Queen's University in Belfast [41] concluded that an example network could accommodate a 20% customer penetration of heat pumps under the worst-case scenario before constraints were reached. Furthermore, a study by UK Power Networks suggested that the cost to reinforce the LV network could increase by a factor of four due to the projected uptake of EVs and HPs.

Therefore, to facilitate the cost-effective adoption of Heat Pumps, Network Operators must develop new load profiles to better understand future load growth and its impact on network capacity to inform the future investments required to safely accommodate the technology.

3.1.2 ELECTRIFICATION OF TRANSPORT (IMPACT OF EV'S)

As with HPs, the transition towards low carbon transport and Electric Vehicles (EVs) is expected to add significant loading to electricity distribution networks. This impact will be felt most strongly across the Low Voltage (LV) network which directly supply domestic network customers. If smart solutions are not deployed to intelligently coordinate EV charging, then significant reinforcement may be required at the expense of electricity network customers throughout the Region.

A study carried out by UK Power Networks concluded that a large number of EVs would materially increase the number of voltage violations across the LV network [42]. In the London Power Networks (LPN) network area alone this was projected to lead to additional reinforcement spend of £42m (NPV) to accommodate the additional EV demand.

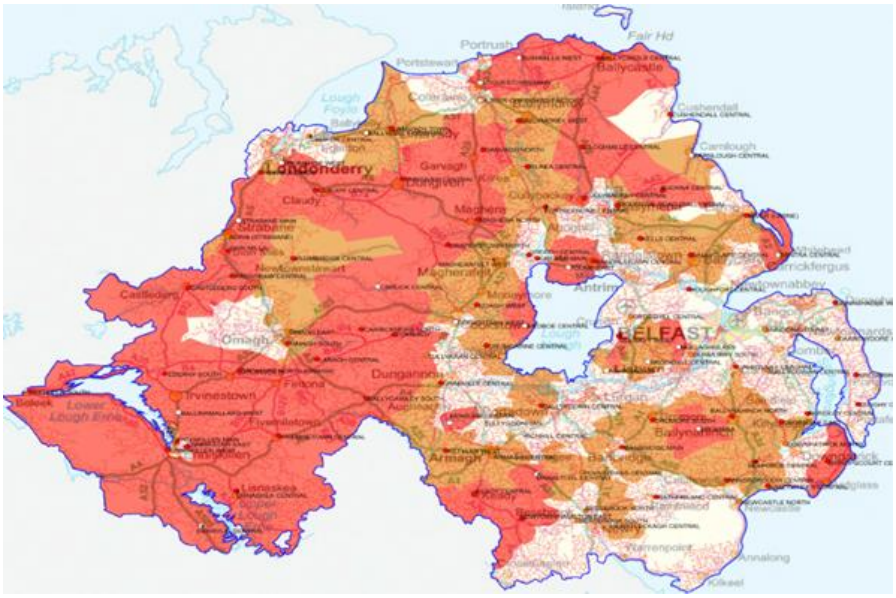
Currently, there is only a small number of EVs registered in the North-West Region. However, this number is expected to grow exponentially as the central government encourages the use of greener, more sustainable transport solutions and car manufacturers improve the performance and cost competitiveness of their EV portfolios.

The growth in EV numbers must also be matched by the growth in charging points, both private and public, to ensure adequate infrastructure is in place across the North-West Region. It is important that the roll-out and connection of EV charging points is planned in coordination with both DNOs in the region to ensure the enabling infrastructure is connected in a timely and cost-effective manner.

3.1.3 IMPACT OF RENEWABLE GENERATION

It is vital that low carbon generation is encouraged and connected to the electricity network, both to reduce carbon emissions and to increase security of supply in the North-West Region. Figure 3-1 below shows a heat map for Northern Ireland which shows constrained areas of network in red [43]. As seen there is currently little network capacity freely available within the region without additional network reinforcement to add additional capacity.

Figure 3-1 - Electricty Network Heat Map for Northern Ireland



The connection of wind farms is often constrained by various technical factors including thermal capacity, voltage limits and network harmonics. Given that the network capacity is near its limits, the cost associated

with building new wind farms must factor in the expense of network reinforcement or pursue innovations which reduce the cost associated with connecting to the network. Active Network Management (ANM) is an alternative method of connecting generation to the network without paying for wider network reinforcement. It is important that both network operators in the North-West Region are encouraged to make innovative technologies, such as ANM, available to remove economic barriers to new developments and to maximise the potential for renewable generation in the area. There are several political and environmental constraints that may block the development of renewable infrastructure in NI. Therefore, it is important that the technical constraints are minimised by Network Operators to encourage the future development of renewable technologies.

3.1.4 OFF GRID NETWORKS – MICROGRIDS

Microgrids are another form of smart system which could potentially bring benefits to the North-West Region if deployed. A microgrid can be described as a small network of electricity users connected to a local source of generation that can function independently from the central national electricity network.

Intelligent microgrids have been used around the world when connection to the main network is too expensive or not technically feasible. They can allow a greater penetration of renewables to be integrated within an area if balanced properly and deployed alongside battery storage.

In the future, independent microgrids could play an important role in maintaining energy supply security by helping to fill demand gaps created by storms or blackouts which have impacted the centralised national grid.

For this reason, the North-West Region should investigate opportunities to build and operate microgrids where connection and reinforcement to the existing network is not technically or commercially feasible. This investigation should be carried out in collaboration with DNOs and Independent Distribution Network Operators (iDNOs).

3.2 HEAT NETWORKS

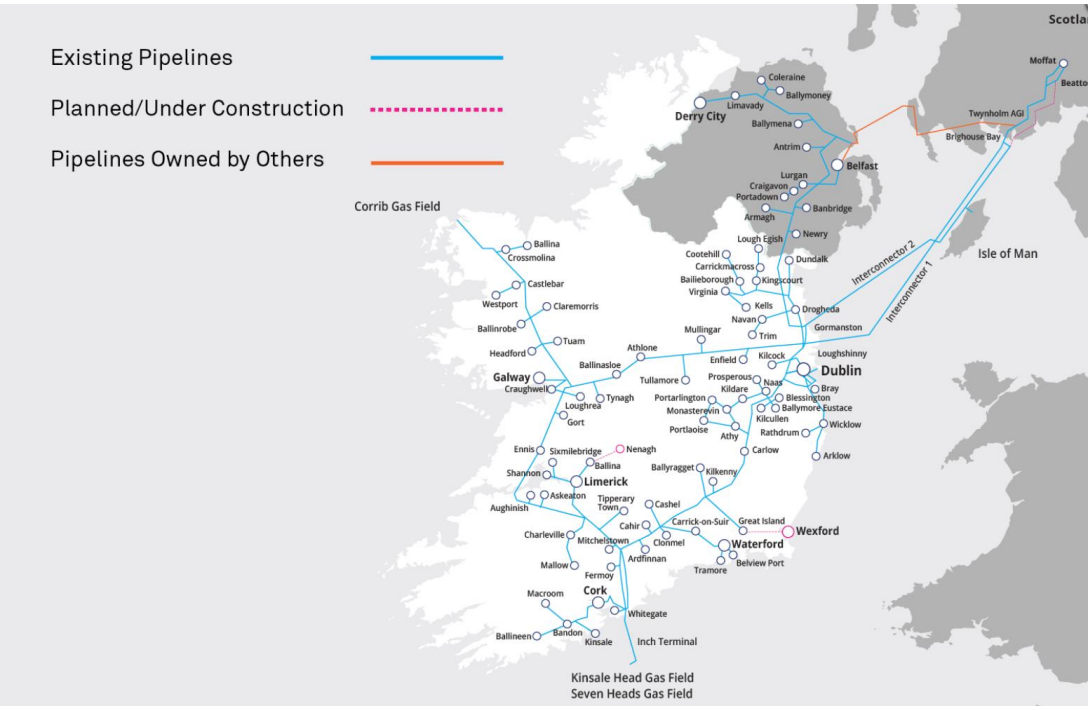
Both within the North-West Region and throughout the rest of the UK and Ireland, domestic and commercial heating makes up a large percentage of the carbon emissions each year. Consequently, it is important that low carbon and efficient heating solutions are pursued and encouraged within the Regional Energy Strategy.

Unfortunately, most of the North-West Region does not currently have access to the natural gas grid and many households and businesses rely upon fuel oil for heating. Not only is this expensive but also releases high levels of GHG's into the atmosphere.

3.2.1 NATURAL GAS

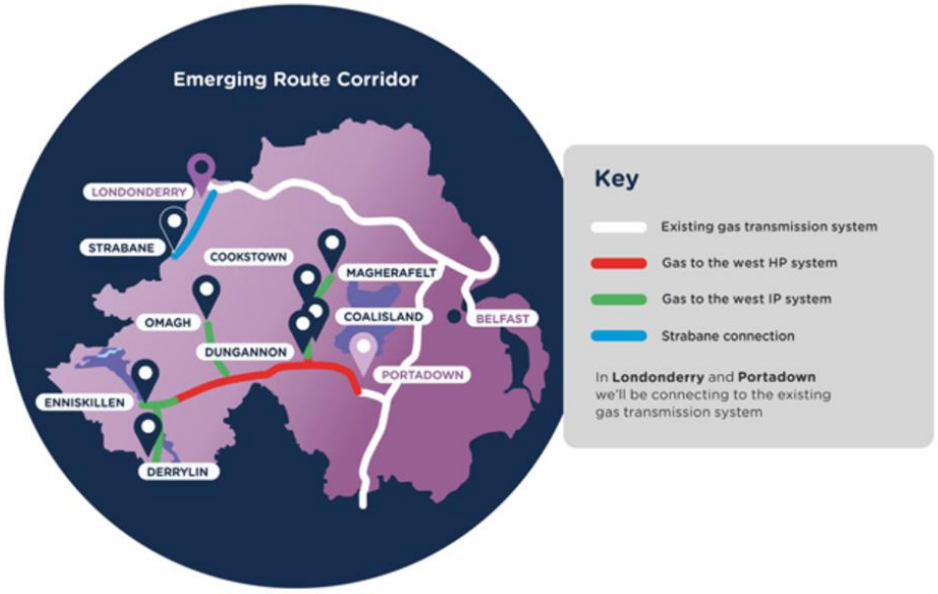
The transmission and distribution gas network is owned, operated and maintained by Gas Networks Ireland (GNI). GNI connects all customers to the network regardless of which natural gas supply company the customer chooses. Figure 3-2 shows the gas transmission network in the island of Ireland and the interconnectors and gas fields which supply the gas to the network [44]. The gas for NI is currently imported from the Moffat gas field in Scotland. The Moffat field is connected to the island by three separate subsea interconnector pipes, two entering the south and one to the north.

Figure 3-2 - Irish gas transmission network



None of County Donegal has no access to the gas grid and relies entirely on fuel oil. However, some areas within the DCS council area have access to a new gas network recently constructed under the "Gas to the West" project which intended to bring natural gas to approximately 40,000 additional households through the west of NI. This new supply of natural gas is shown in Figure 3-3 below [45].

Figure 3-3 - Map of New Gas Network Connections



However, relying upon Natural Gas for heating brings concerns regarding future energy security and independence for the region. Importing most of the gas from outside the country leaves the North-West Region vulnerable to fluctuations in availability and price. Therefore, it is important to investigate alternative sources of heating which leave the Region less at risk to factors out with its control.

3.2.2 FUEL / HEATING OIL

As seen in Figure 5-2 a large percentage of the region is not serviced by the gas network. For this reason, most households and businesses rely on heating oil for their heating and hot water. Unlike natural gas, heating oil is transported to consumers via road and then stored in oil tanks for use within oil boilers. Two types of oil are used known as gas oil or kerosene, the latter being preferred as a lighter, and cleaner fuel.

The price of fuel oil can fluctuate and leave vulnerable customers in a very difficult position, particularly those living in fuel poverty. Between April 2016 and October 2018, the price of heating oil increased from 30p a litre to 54p a litre demonstrating the volatility in price over a relatively short period of time [46]. This uncertainty is a genuine concern for the Region and can cause serious financial strain to those living on a lower income. Bryson Energy offer oil clubs to help reduce the price for vulnerable consumers by buying in bulk but this does not alleviate the risk of increasing prices caused by a number of external factors including weather, global production and politics.

As with natural gas, oil also poses an environmental impact which must be addressed. There are significant carbon emissions rises from the transportation and use of heating oil and the storage of oil can lead to local environmental damage when tanks are poorly maintained and leaks occur.

3.2.3 LOW CARBON ALTERNATIVES

As discussed both natural gas and heating oil contribute significantly towards the carbon emissions associated with heating in the North-West Region. As such, it is important that the energy strategy for the region considers the adoption of low carbon alternatives which both reduce the long term environmental impact and cost of heating homes. A number of potential alternatives are described below:

Renewable Gas

In 2017, a report published by SEAI estimated that up to 28% of Ireland's gas demand could be met by indigenous renewable gas which can be produced in anaerobic digesters from farm waste, sewage sludge and grass [47]. This gas would be considered carbon neutral and could be injected directly into the gas network and used within existing gas boilers.

Hydrogen

Hydrogen gas is a high potential, low carbon and dense source of energy which produces no carbon emissions when it is burned. It has been estimated that heat emission in the UK would be reduced by approximately 73% if the entire gas network was converted to hydrogen [48]. Fortunately, Ireland possesses a relatively new and reliable gas network which is ideal for transporting hydrogen gas. Importantly, hydrogen gas could also be much less disruptive and cheaper for those already connected to the gas network than converting the current housing stock to electricity. In addition, it could be used both for heating and as an alternative fuel for transport.

Heat Pumps

As discussed in Section 4.2.4, heat pumps are an important strategic technology which provides a low carbon alternative to gas and heating oil. As heat pumps use electricity from the Distribution Network, the green credentials of heat pumps rely in part upon the generation mix which feeds the grid. However, as more renewable generation comes online, the carbon emissions associated with heat pumps will fall. Local carbon emissions are also reduced to zero improving the air quality surrounding people's homes. In the ROI there are currently government grants worth €3,500 to encourage the uptake of the technology as a replacement for the fossil fuelled equivalents.

District Heating Schemes

District heating is another high potential solution which can be assessed on a case by case basis for local communities and businesses. District hearting uses a network of insulated pipes to transport hot water to consumers where individual heating solutions are considered more expensive. The hot water is generated on a single site and feeds all consumers connected to the scheme. The generation source can vary but low carbon renewable generation can be used that would otherwise not be economic or practical including heat pumps, fuel cells, and geothermal energy.

Liquefied Natural Gas (LNG)

LNG is a natural gas, often methane, which is converted to liquid to reduce the cost of storage and transportation. This allows the fuel to be transported across the world and sold to customers far away from the original gas field. After delivery, LNG can be converted back to a gas and injected into the natural gas network. Any potential LNG project could provide the Region with access to the growing global LNG trade and reduce reliance on the natural gas fields currently used. However, LNG is still considered to be a fossil fuel and release carbon emissions when burnt. Therefore, any future use of LNG must fairly balance the benefits of improved energy security and lower prices, with the associated environmental impact and carbon emissions.

3.3 WATER NETWORKS

Irish Water are the national water utility in the ROI, whilst Northern Ireland Water provide the water and sewerage services for NI. In Donegal, DCC act on Irish Waters behalf and are responsible for the maintenance and operation of the network throughout the Donegal region.

As a large consumer of energy, the Water Networks across the North-West Region have an opportunity to reduce both their annual energy bill and carbon footprint. Consequently, it is important that these opportunities are investigated as part of the North-West Regional Energy Strategy

Opportunities to reduce environmental footprint

- It is recommended that both water utilities within the North-West Region look at opportunities to install local green generation at their pumping sites to reduce their consumption of electricity. This could both reduce the cost to operate the water network and reduce the carbon emissions associated with their energy use.
- A high percentage (approx. 50%) of the water delivered to customers is lost through leaks in the water network through ageing or damaged pipework [49]. These losses require more energy, and hence carbon emissions, to be used at pumping stations to maintain the water pressure on the network. Therefore, it is important that leaks are addressed and minimised wherever possible.

  Currently, Irish Water operates a Leakage Reduction Programme which aims to reduce leakage across the country by fixing and replacing ageing and leaking pipes [50]. The programme is investing up to 500 million over 4 years to reduce leakage.

- Pump sizes should be reviewed and where possible oversized pumps should be replaced for smaller pumps to minimise energy consumption within pump stations.

4

REGIONAL ENERGY CARBON ASSESSMENT

4 REGIONAL ENERGY CARBON ASSESSMENT

4.1 INTRODUCTION

An assessment of the carbon impact in the North-West Region was conducted as part of the Regional Energy Strategy. The assessment consisted of two parts;

1) **A Carbon Baseline for the North-West:** Quantification the carbon impact of the current energy system within the Region. This exercise allows the Region to track its annual greenhouse gas emissions and set informed reduction targets to meet the 2045 "Net Zero" target.
2) **A carbon assessment of potential local carbon reduction initiatives**: The assessment aimed to inform the selection of future investments made to accelerate the decarbonisation of the region. A tool was created which allows the carbon impact of the "local measures" to be quantified and compared against the carbon baseline.

The first part of the assessment was completed within an Excel based carbon calculation engine. The tool calculates the CO_2 emissions based on energy usage in kWh and categorises the contribution by sector and fuel source to enhance visibility of key carbon contributors.

The second Excel tool allows the impact of the local measures to be quantified across the five key areas of interest; Renewable Generation, Low Carbon transport, Low Carbon Heating and Energy Efficiency. The target sectors have differing methodologies to quantify the total carbon savings, therefore requiring various data inputs specific to the individual carbon saving initiative. When complete, the result provides evidence to support future investment in low carbon energy initiatives which will have the most significant impact and support the decarbonisation of the region.

Emission Factors

Several emission factors were used within the calculation to convert energy used into a quantity of CO_2eq. These emission factors were obtained from the Department for Business, Energy & Industrial Strategy [51] and were in respect to different fuel types for both general consumption and transport.

Given that emission factors provide detail on the estimated levels of CO_2 emissions for every kWh of energy used, or for every km travelled for transport, it was important to consider the fuel source used by each sector included within the study.

Emission factors in regions are widely reported on an annual basis providing substantial historic data to utilise forecasting techniques in the calculation of future emission factors. This assessment has evaluated the difference in emission factors for all fuel and transport types, with a focus on the difference between 2018 and 2019 recordings.

4.2 ASSESSMENT TOOL METHODOLOGIES

4.2.1 CARBON EMISSION BASELINE CALCULATIONS

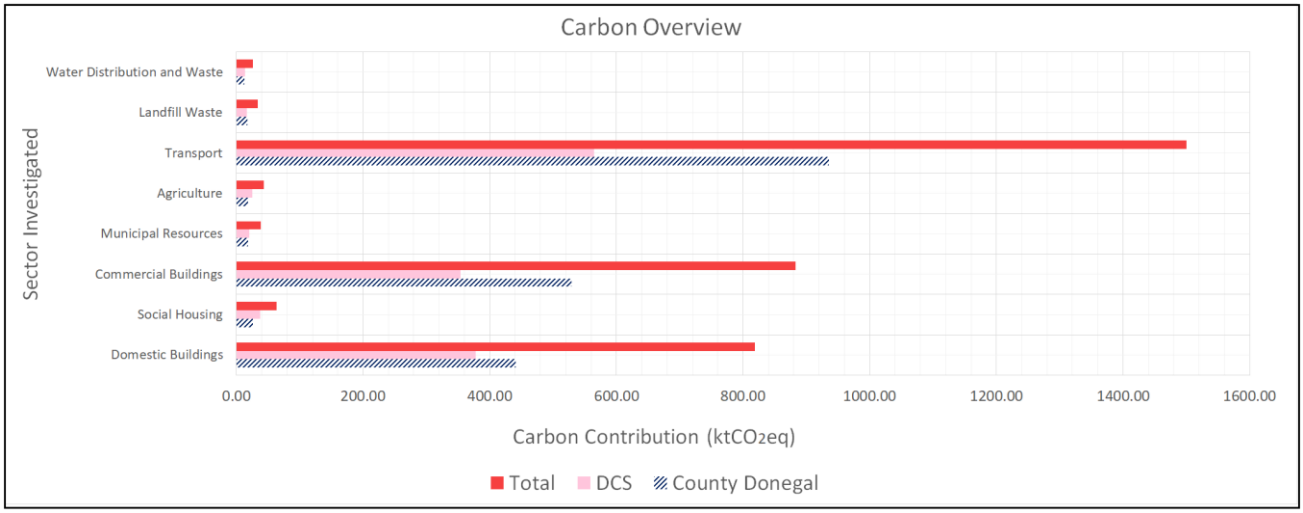
The Excel based carbon calculation engine provides an emission profile that can be used to inform future carbon reduction targets for the Region. The tool calculates the carbon profile across several categories or sectors, and considers the variables and drivers specific to each to calculate a CO_2 output. The key carbon contributors are identified below, with a summary of the calculation methodology listed:

- Domestic and Social Dwellings:
  - ***Inputs:*** *Total number of dwellings by category, construction year, and dwelling type. The total floor area of the dwellings. The total energy consumption for space and water heating, by consumed energy and energy source (electricity, oil, gas, or other).*
  - ***Output:*** *The CO_2 contribution of each energy source and dwelling type.*
- Commercial Buildings:
  - ***Inputs:*** *The type of business, floor area, total energy consumption, breakdown of energy used by fuel type.*
  - ***Additional Process:*** *where total energy consumption is not available, the energy use is calculated from data tables, based on type of business and floor area.*
  - ***Output:*** *Total CO_2 contribution of each business category (Education, Offices, Healthcare, Industrial use, retail, etc.).*
- Transport:
  - ***Inputs:*** *Total number of vehicles by use, type, and fuel source. The annual mileage of the vehicles, and the CO_2/mile factor based on vehicle type and fuel source.*
  - ***Output:*** *Total CO_2 contribution of each vehicle type.*
- Municipal Resources:
  - ***Inputs:*** *Total energy consumed by fuel type and category (Electricity, Thermal, Transport).*
  - ***Output:*** *CO_2 contribution of Buildings, Street Lighting, Transport, and Thermal, by fuel type.*
- Agricultural Operation:
  - ***Inputs:*** *Total farmed area, crops grown by type and land area, number of livestock by type (Cows, Sheep, Poultry, Horses, Pigs).*
  - ***Additional Process:*** *The energy consumption is calculated using data tables and conversions based on the area of farmed land and the number of livestock by category.*
  - ***Output:*** *Total energy consumed by fuel type.*
- Landfill sites:
  - ***Inputs:*** *Greenhouse gas emissions from the environmental reports for each registered site in the council authority area.*
  - ***Output:*** CO_2 equivalent contribution for all greenhouse gasses produced at the sites.
- Water Treatment sites:
  - ***Inputs:*** *Number of water treatment sites in the area, type of site, and energy consumed.*
  - ***Outputs:*** CO_2 produced I for types of water category (Distribution, Waste, and Other).
- Electricity Distribution:
  - *This is considered throughout the Excel tool, using conversion factors that adjust the energy consumed by a site or process from total consumed energy, to total energy required to deliver at source. This accounts for system losses at a distribution scale.*

Carbon Baseline Results:

The total carbon baseline across all sectors for the North-West region was calculated to be **3,407 ktCO2eq** (kilo tonnes of CO_2 equivalent), of which **1,998 ktCO2eq** is attributable to County Donegal, and **1,409 ktCO2eq** to DCS. The carbon associated to each sector disseminated by Figure 4-1.

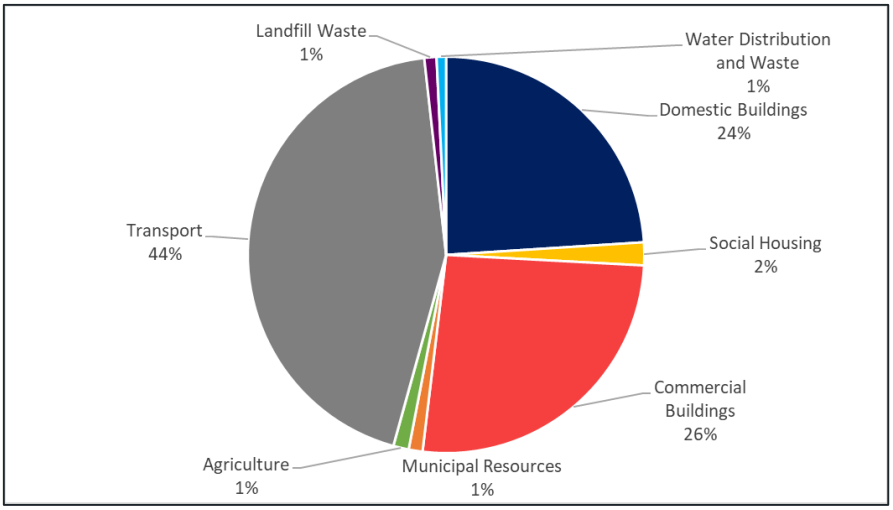
Figure 4-1 – North-West Region Carbon Baseline



Three main sectors; Transport, Commercial Buildings, and Private Domestic Buildings, have significant contribution to the carbon baseline making up 94 % of the total baseline (44%, 26%, and 24% for transport, commercial and domestic buildings respectively). This highlights the key focus areas for DCC and DCSDC authorities to target when developing low carbon initiatives.

For the transport output of the carbon baseline study, an increase of 66 % can be observed for County Donegal when compared to DCS. This can be attributed to the increased number of Heavy Goods Vehicles (HGVs) registered in the Donegal County – total of 12,454 more HGVs in County Donegal (449.6 ktCO2eq per year). Another large discrepancy between regions is the commercial buildings sector, with a difference of 162.3 ktCO2eq annually. This could be attributed to the data available for both regions as in County Donegal although the size of the dataset was extensive it was however vague in the detail provided. Similarly, the DCS dataset was vague and required approximations to be made for the floor areas.

Figure 4-2 – Total Segmented Breakdown



4.2.2 CARBON EMISSION SAVINGS CALCULATIONS

A unique methodology was developed for each of the four target sectors, to better quantify the impact of specific policies and actions taken to lower carbon emissions. The following expands the methodologies:

Renewable Generation & Energy Storage

Quantifying the impact of this sector provided the breadth required in the investigation to inform strategies that could displace the use of CO_2 emissions from conventional generation sources by integrating renewable generation and energy storage technologies. The assessment considered four different renewable technologies which could have a significant impact: Wind, Hydro, Solar (Rooftop) and Solar Farms.

The carbon reduction targets for associated technologies informed the calculation of annual generation for each renewable source. The emission factor associated with the type of electricity generation was then used to calculate the quantity of CO_2 emissions to present the total carbon savings, therefore quantifying the impact of implementing the studied renewable generation source.

Low Carbon Transport

Five distinct outputs of low carbon transport were evaluated through the assessment methodology:

- Increased uptake of hybrid and plug-in electric vehicles. *This measure looks to replace traditional fossil fuel based vehicles into hybrid/battery EVs to reduce CO_2 emissions.*
- Switching traditional fossil fuel based vehicles into hybrid/electric EVs.
- Investing in Greenways. *This initiative looks to decrease total car and bus usage facilitating the use of alternative transport modes (e.g. cycling, walking, etc.), and therefore reduce the average millage of all vehicles – limiting carbon emissions.*
- Increased Public Transport use. *Encouraging the use of public transport over private to reduce the average annual millage and limit carbon emissions.*
- Increased use of telecommuting. *An initiative that promotes individuals to work from home to reduce average annual millage of all vehicles.*

Real-world data influences each of the outputs, using reduction targets; For Output 1 – mix of internal combustion and electric vehicles, Output 2 to 4 – on year percentage reduction in average millage for each vehicle. The total CO_2 contributions can then be determined for each vehicle type to draw insightful conclusions regarding the total carbon savings from Low Carbon Transport.

Low Carbon Heating

This sector addresses the carbon impact of differing heating methods for both domestic and non-domestic buildings to establish mechanisms that drive sustainable reducing in CO_2 emissions to net zero for heating by introducing electrical heat pumps, biomass boilers and hydrogen. The assessment tool determines the total CO_2 emissions contributed by the different fuel sources to formulate a framework that facilitates growth in the proportion of low carbon heating.

The carbon assessment tool leverages user input data on total energy consumption and fuel type contribution, for domestic and non-domestic buildings. Reduction targets for each fuel type then direct the calculation of total annual heating consumption, and CO_2 emissions factors are used to quantify the total carbon savings from the implementation of a specific low carbon heating strategy.

Energy Efficiency

The assessment tool investigated the impact of Energy efficiency in two key areas:

- Improving Building Efficiency. *Looks to reduce the total energy consumption of domestic and non-domestic buildings by improving their overall efficiency.*
- Improving Lighting Efficiency. *This initiative targets the reduction of total energy used for lighting in domestic and non-domestic buildings, as well as street lighting by switching conventional lighting with LED bulbs.*

The number of buildings, light fittings, and other efficiency parameters are used to inform the assessment of CO_2 emissions in the region, using annual deployment and installation targets to determine the total 'lost' energy from poor heating efficiency, while also calculating the achievable reductions in energy consumption from lighting. Appropriate emission factors were then used to establish the potential carbon savings from the implementation of strategies that improve Energy Efficiency.

5

LOCAL CHALLENGES AND OPPORTUNITIES

5 LOCAL CHALLENGES AND OPPORTUNITIES

5.1 LOCAL CHALLENGES

To create an informed and effective Regional Energy Strategy that will deliver the vision for the Region it is important to carefully consider the specific challenges and constraints which the Region faces. The strategy has identified five key challenge areas as described below:

Social

A discussion of the potential positive and negative social impacts associated with the transition to a low carbon energy system.

Economic

The potential economic impact that may result from a change in regional energy strategy with a focus on local industry and employment.

Environmental

The environmental considerations which may prevent the development of low carbon energy infrastructure in the Region**.**

Technical

The specific technical challenges associated with the delivery of the regional energy strategy particularly the deployment of new low carbon technologies.

Development Policy

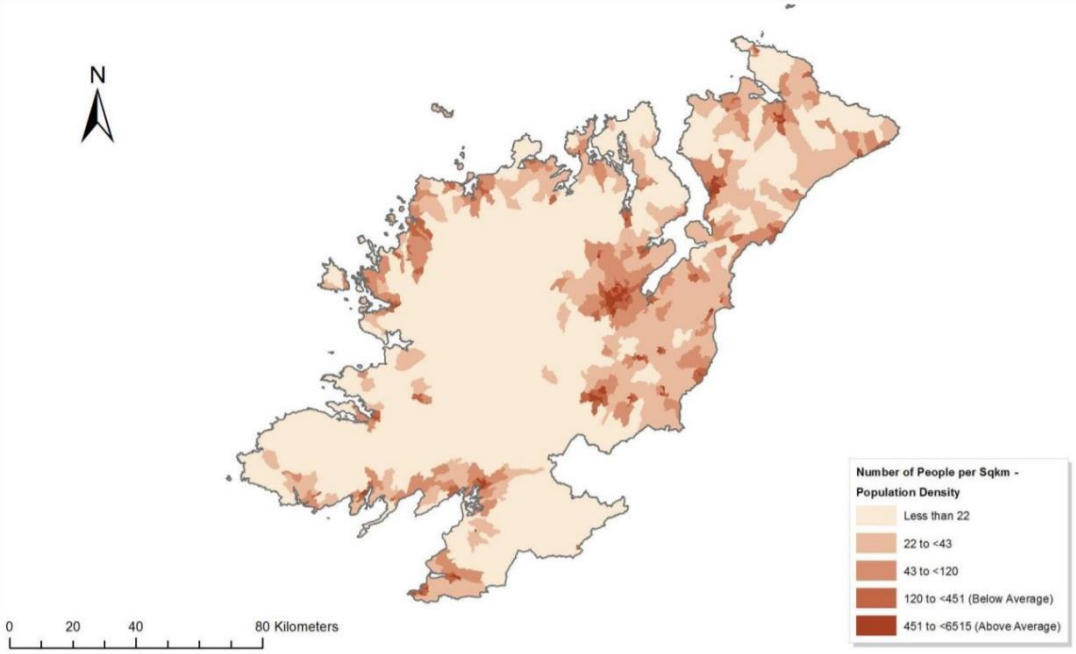
The policy developments which are required to enable the transition towards a low carbon economy within the North-West region.

5.1.1 SOCIAL FACTORS

5.1.1.1 Population Dispersion

County Donegal has a very dispersed population compared to most other counties in Ireland. In 2011, Donegal had a population density of 33.8 persons per square km [18] which was significantly lower than the state average of 67 persons per square km. The majority of the county is comprised of small towns with only 9 settlements falling into the aggregate urban area category of over 1,500 inhabitants. **Error! Reference source not found.** shows the population density for Donegal.

Figure 5-1 - Population Dispersion within Donegal County



The majority of the population is located within the east and northeast part of the county, with the highest density occurring in Letterkenny. The western and southern parts of the county show very low levels of density, with Donegal town showing the largest density in the southwest.

Because of the wide dispersion and low population density, Donegal has a weak overall urban structure meaning the access and provision of goods and services is limited. With respect to energy services such as electricity and heating fuel, and future developments and/or improvements of infrastructure are likely to be costly and difficult to implement.

The population density of DCS district was approximately 121.6 persons per square km [54] in 2011 which was marginally smaller than the state average of 131 person per square km. The density and dispersion in DCS do not pose as significant issues compared to Donegal County, with the vast majority of the population residing in Derry City and Strabane. However, there are some rural towns within this district.

5.1.1.2 Lack of Public Transport

There are a number of public transport services operating within the North-West Region that help connect the various settlements together. Within DCS, Ulsterbus is the main public transporter provider with various local and district wide services [54]. The company also provides dedicated routes between the district and various larger settlements e.g. Derry and Belfast and Derry and Dublin and services that connect Derry City and Strabane with Donegal County. Within County Donegal Bus Eireann and Local Link are the main public

transport providers with a large number of private companies offering scheduled bus services on a variety of routes also. Rail infrastructure does not have a large presence within the North-West Region, with the only rail connection in the region being a train service between Derry City and Belfast [54].

Although there is a presence of public transport in the North-West Region, it is minimal and fails to provide the needs for the vast majority of the population. This is highlighted within **Error! Reference source not found.** and **Error! Reference source not found.** which show the percentage proportion of transport use in County Donegal for 2011 [18] [63] and percentage proportion of transport use regarding journeys per person per year in DCS respectively [54].

Figure 5-2 - Percentage of Transport Use for County Donegal

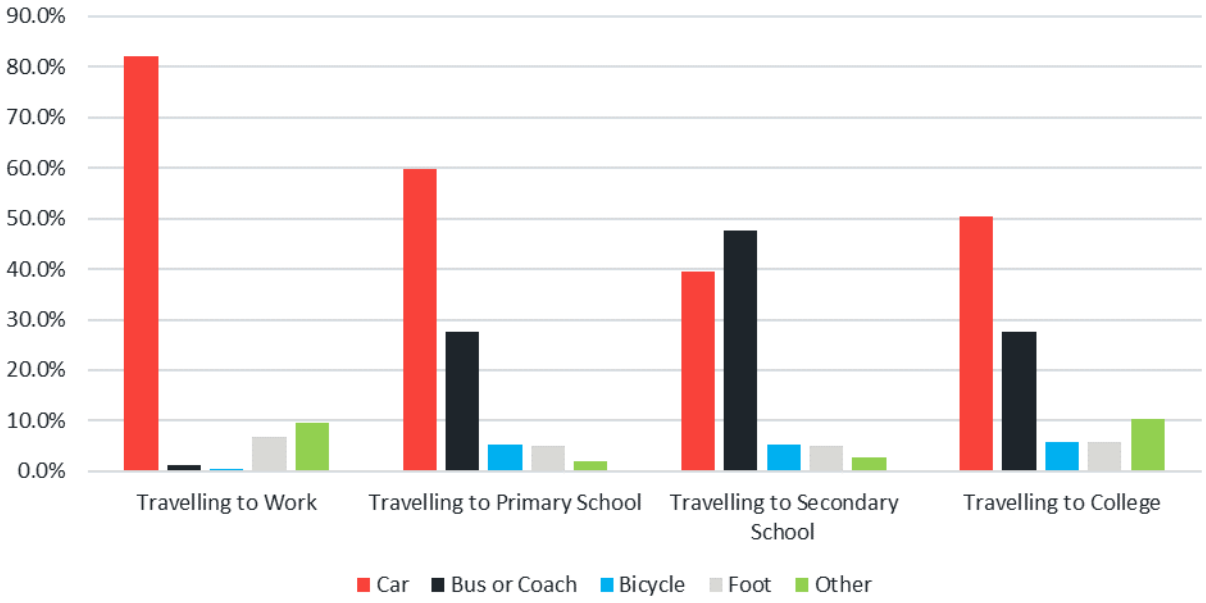
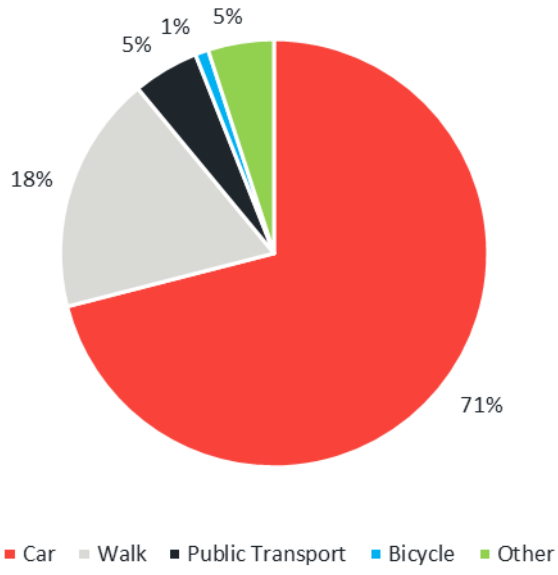


Figure 5-3 - Percentage of Transport Use for Derry City and Strabane District for 2013



For both districts, car use is the most popular form of travel, significantly outweighing the other forms of transport. Public transport makes up a very small percentage of total transport use with its most prominent use being for 'school runs' in more rural areas of County Donegal.

A survey conducted by TSNI for DCS asked participants how easy or difficult it would be to make the journey to work in some way without the use of a private car and found that 56% of people would find it quite difficult or very difficult [54]. Of those who it said it would be difficult, 64% stated that the journey was not possible on public transport (64%), followed by poor connection (25%) and too far/long of a journey (25%). The data and survey results regarding transport use show a significant issue with public transport and, although this survey does not include County Donegal, shows that the lack of public transport infrastructure is a large contributor to people not using public transport. Car use is therefore the only realistic way for most journeys and so total carbon emissions from transport will be greater as a result.

5.1.1.3 Heavy Reliance on Road Networks

There is a heavy reliance on roads and road based transport within the region. This reliance is even more prevalent within County Donegal as 100% of goods and people are transported by road and road freight and so forms the backbone of the entire county's economy [18]. Because of this, accessibility costs within County Donegal are among the highest in western Europe.

Error! Reference source not found. shows the overall map and road network of the North-West Region.

Figure 5-4 - Map and Road Network of the Region

Within DCS, there are key roads connecting the district to various parts of Ireland. The A6 links Derry to Belfast, the A5 links Derry to Dublin and the A2 links Derry to the North Coast of NI. There are also three major road links between Donegal and Derry City and Strabane; namely, the Buncrana Road (A2) and Letterkenny Road (A40) for links between Derry and Donegal County, and Lifford Bridge (A38) for connections between Strabane and Donegal County [54].

For DC, the N13 connects Derry with Letterkenny, the N14 connects Strabane and Letterkenny and the N15 connects Strabane with Donegal Town. The only major route between Donegal County and the rest of the ROI is the N15 from Lifford (near Strabane) and Sligo. For travelling within DC, the major road is the N56 which forms a circular route around the middle part of the county, connecting Letterkenny and Donegal Town, as well as a number of smaller settlements in the western part of the county.

Although there a number of major roads within the region, none of these roads are motor ways, with the majority being primary roads. The circular N56 road within County Donegal is only a national secondary road yet still serves a major path for many settlements within the county. Furthermore, the north-eastern region of DCC has no secondary roads, yet, when referring to Figure 4-2, this part of the county has a relatively significant proportion of the county's population. Coupling these problems with the regions heavy dependence on the road network for the delivery of goods and people means there is an inherent risk and challenge within the North-West Region. If further development occurs within the Region, then developments on the road network would be necessary.

5.1.1.4 Fuel Poverty

Fuel Poverty is a major concern within the North-West Region. The Public Health Agency classes fuel poverty as a situation where an occupant of a house has to spend more than 10% of their income on all household fuel use [64]. Another useful definition of fuel poverty was provided by Brophy et al [65] and classed it as "The inability to heat one's home to an adequate (safe and comfortable) standard owing primarily to low income and poor (energy inefficient) housing standards".

A report published by Unite in 2013 found that 19.5% of people living in County Donegal were affected by Fuel Poverty [66] and the Housing Executive released a report in 2016 which stated that 31% of all households in the DCS district were affected by Fuel Poverty [67]. These statistics show a huge problem within the North-West Region with regards to heating and energy.

There are three main factors that contribute and impact fuel poverty; household income, energy prices and domestic energy efficiencies within the home. For household income, people in fuel poverty would not want to spend money on fuel for heating as they would worry they could not afford the months fuel bill. In DC, the average disposable income per person (excluding rent) was €14,714 which is 22% less than the state average of €18,931 [68]. Energy prices also play a significant role in determining fuel poverty. This relates to the volatile nature of input prices determined largely on international markets. A consequence of this is that in addition to households that are currently fuel poor at any given time, a significant number of additional households may be vulnerable to becoming fuel poor as prices fluctuate. Additionally, a local problem arises between County Donegal and DCS due to differences in currency. Trading between these regions is subject to currency exchange rates which are volatile and cause some individuals to have to pay upfront.

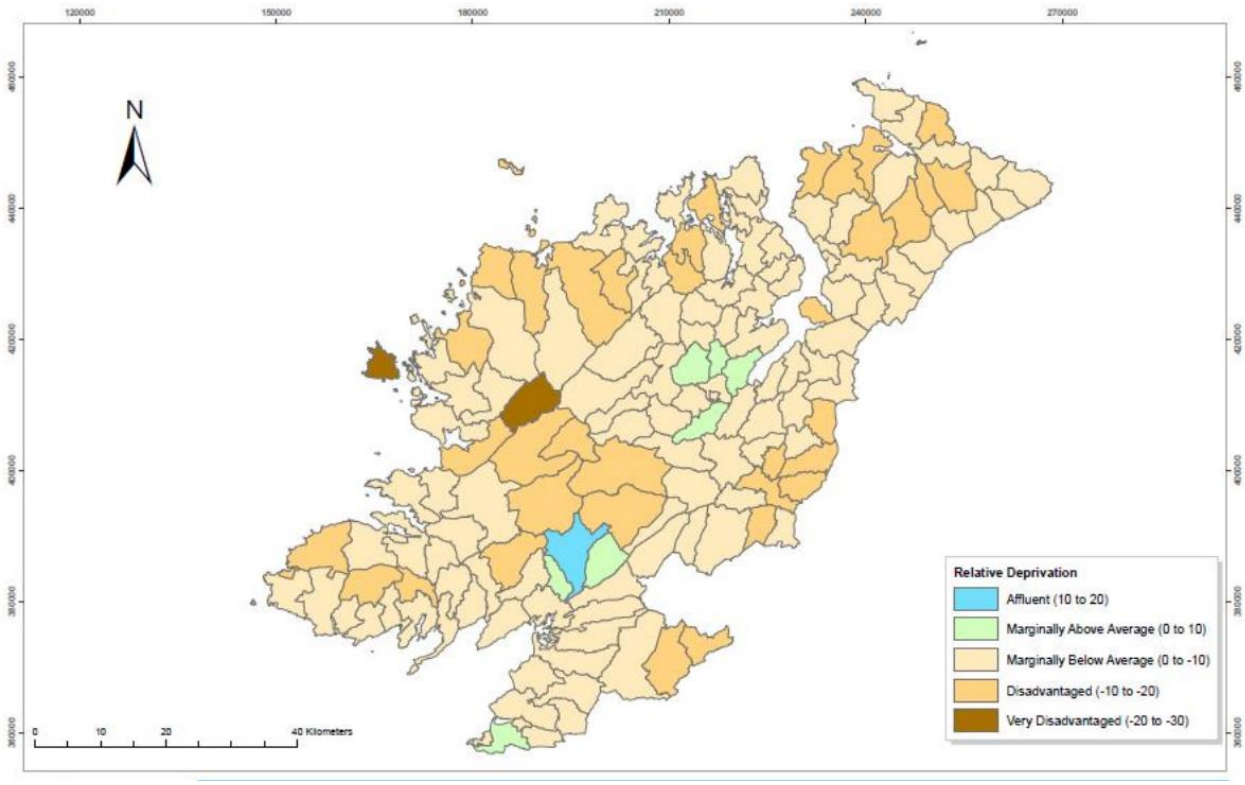
With the regions significant reliance on fuel oil for heating, Fuel Poverty becomes a major issue in many parts of the region. Some of the factors affecting fuel poverty are out of most people's control, but improvements in building efficiencies and reducing the dependency of fuel oil are ways to combat and decrease the rate of fuel poverty within the region.

5.1.1.5 Deprivation and Social Exclusion

Deprivation and social exclusion present challenges for both districts in the North-West Region. Deprivation refers to individuals lacking access to certain materials and benefits and can be separated into further segments including income, employment, health and disability, deprivation, education and skills, access to services, living environment and crime and disorder.

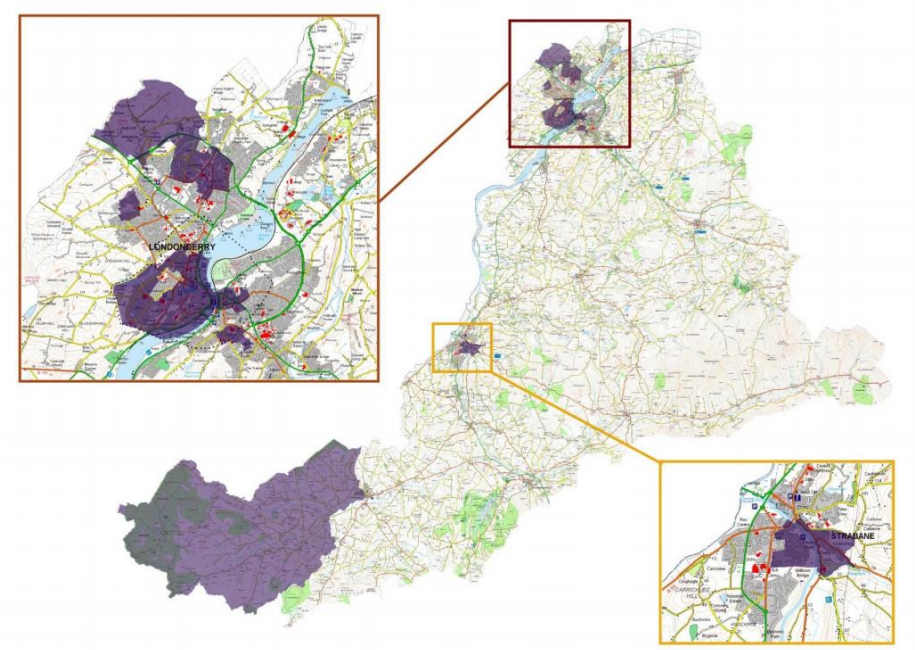
Error! Reference source not found. shows a map of the relative deprivation within County Donegal [18]. In 2011, the county was ranked as the second most deprived local authority area in the state with a score of -6.25 from the Haase Pratschke Relative Deprivation Score. Analysing the indicators associated with this found that low educational attainment (26.1%) and high male unemployment (31.4%) were the key contributors to this score. Looking closer at the relative scores within the county, 141 out 149 electrical divisions had scores that fell below the national average of +0.24 (103 were classed as 'marginally below average', 36 were classed as 'disadvantaged' and 2 as 'very' disadvantaged').

Figure 5-5 - Relative Deprivation of Donegal County



For DCS, the Multiple Deprivation Measure (MDM) was used to combine different deprivation domains to obtain a score. NI is split into 890 spatial areas known Super Output Areas (SOAs) with DCS containing 75 SOAs [69]. Of the 100 most deprived SOAs within NI, 20 of these SOAs are found in the DCS area (20% of the total). This equates to approximately 37,000 people which is 25% of the population of DCS. Furthermore, the most deprived SOA in NI is located in DCS (East Strabane). **Error! Reference source not found.** highlight where these 10 deprived areas are [69]. The reason for these high levels of deprivation can be attributed to employment, health and disability and education and skills deprivation.

Figure 5-6 - Location of Most Deprived Areas in DCS



Deprivation within the region can mean developments and investments for energy systems are harder to implement. However, they can also bring positives to the region with the potential increase of jobs being created and greater infrastructure for economic improvement.

5.1.1.6 Public Attitude Towards Electric Vehicles (EVs)

Despite the promising acceleration in the uptake of EVs within ROI and NI, public perception on the technology is still mostly negative. This presents a challenge in trying to encourage new drivers to switch from fossil fuel based cars to EVs.

iReach conducted a survey in 2018 to determine the Irish public's perception on EVs [70]. 63% of respondents who were planning on buying a new car in the next 24 months would purchase a petrol or diesel car whereas only 7% would buy a full electric car. When asked when they would consider purchasing a fully electric car in the future, 33% of respondents said never and only 2% said within the next 3 – 5 years. The top motivation for buying fully electric cars is its environmental sustainability (81% of respondents agree) followed by it being the smartest option for the next 5 to 10 years (74% of respondents agree). The top motivation from respondents though for the purchasing of both petrol and diesel cars was it being the most cost-effective option (44% and 81% of respondents agree).

The Department for Infrastructure conducted a survey looking at the public attitudes towards EVs in NI in 2015 [71]. The key findings from the survey showed that 94% of respondents were 'Not at all likely' to buy an electric car as their next vehicle. When asked what factors would discourage the purchase of an electric car, over half of respondents (53%) were discouraged by the 'need to recharge your vehicle' with a further 52% stating 'Vehicle range' and 46% stating 'Purchase Price'. The most popular factors that would encourage respondents to purchase an electric car were 'Low Running Costs' (39%), '£5,000 grant towards purchase of an Electric Vehicle' (33%), 'No Vehicle tax (30%), 'No carbon emissions' (25%) and 'No requirement to pay for petrol or diesel' (23%).

The overall uptake of EVs within the North-West Region could be at risk if public perceptions surrounding them persist.

5.1.1.7 Impact of Moving Away from Fuel Oil

A large percentage of the North-West Region has no access to the natural gas network and relies heavily on fuel oil as the primary source of fuel used within boilers for heating. This oil is imported into the region via road transport and as such is subject to varying prices, often at the expense of the poorest households within the Region. Furthermore, the process contributes towards annual GHG emissions creating a negative environmental impact.

As such, there is a need to adopt alternative heating solutions within the North-West Region which are both affordable and environmentally friendly. It is important that this transition is affordable for all residents within the Region and not only those who can afford the upfront expense associated with new heating systems. Any new solutions (such as Heat Pumps) must also deliver a long term financial saving to justify any subsidies and upfront investment, particularly in areas of social housing.

It is important that the right solutions are pursued within the North-West Region which can deliver long term financial and environmental benefits, whether that be CHP, district heating, heat pumps, hydrogen or biofuels. In reality a combination of all may be the optimal solution.

Substantial and long-lasting support may be required to ensure low income households adopt low carbon alternatives within a reasonable timeframe. Therefore, it is imperative that appropriate funding and financial incentives are considered when installing new heating systems to replace fuel oil as people may be left worse off, even if the price of fuel oil is high.

5.1.1.8 Unintended Consequences of Decarbonisation of the Region

Decarbonisation within the North-West Region may bring with it unintended consequences and these need to be properly managed. For example, upfront costs may be needed from people within the North-West Region to meet the objectives of decarbonising the area. These costs may include changing oil boilers to remove the need for fuel oil, adding building insulation to make homes more efficient and installing heat pumps as an alternative heating method.

The transition to a low carbon economy may also have an impact on local employment, particularly any industries supplying fossil fuels. Traditional fossil fuel industries may be put at risk as the region moves away from these types of fuel sources, putting jobs and businesses at risk. Places such as Coolkeeargh power station near Derry City may have their use decreased meaning individuals working there could be made redundant. This raises greater concern when taking into account the current high levels of unemployment within the Region.

Although these concerns need to be recognised and addressed, the long-term outcomes from decarbonisation will likely be a greater benefit overall. Low carbon economies bring with them sustainable prosperity for regions that implement them, creating jobs and providing a better standard of living. Increasing the level of renewable generation will bring jobs for locals in the form of developers, operators, maintenance workers etc. This is just one example of job creation that would likely occur as many more would likely be present with the Region.

5.1.1.9 Health Concerns

Within the North-West Region, there are people who may be more vulnerable to health-related issues from the lack of heating or poor insulation and energy efficiency within their homes. These may include the elderly and individuals with disabilities. It is important to address these concerns to ensure that the vulnerable population within the North-West Region have access to heating and ultimately avoid any damages to their

health. Poor building insulation and fuel oil prices are big contributors to poor health and so it's important that measures are put in place to protect vulnerable members of the region's population.

5.1.1.10 Social Housing Stock

Previous and future sections within this report have discussed how pivotal buildings will be play in the energy strategy as a way to reduce energy consumption and carbon emissions. Social housing within the North-West Region presents a huge opportunity for innovative development that would help in meeting the North-West Regions goals for its energy strategy.

Social housing would benefit greatly from having access to innovative energy solutions. These may include solar PV cells, low-carbon heating such as heat pumps and LED light installations. It is therefore imperative that the North-West Region invests in providing the social housing stock with these sorts of technologies, making them fit for purpose and future proof. If not properly addressed, social housing may fall behind in terms of technological advancement, leaving populations vulnerable in a low carbon economy.

5.1.2 ECONOMIC FACTORS

5.1.2.1 Energy Security

A very significant issue with the North-West Region, and the island or Ireland as a whole, is its energy security. Currently, Ireland is heavily reliant on fuel imports from other countries. In 2015, approximately 88% of energy came from imported sources which is an increase from 2014 at 84% [78]. Comparing this to the EU average of 50% import shows a stark contrast between Ireland and its neighbours. The main reason for such a need for import is the very low presence of fossil fuels. Although renewable energy is growing in Ireland, which provides greater energy security and reduces the reliance of imports, there is still a heavy dependence on fossil fuels.

Oil is Ireland's major import and accounted for 77% of the total energy import bill in 2013. The island is 100% dependent on imports for oil, with no oil fields present in the island. Coal production has reduced significantly in Ireland, with the majority being imported from countries like Colombia and Poland. Gas is the only fossil fuel that Ireland supplies a percentage of its needs. The Corrib and Inch gas fields supplied 54.5% and 5.9% of Irelands gas supply respectively in 2016. The rest was imported from the UK via Moffat in Scotland. Before 2014, 96% of the gas supply came from imports showing the large influence the Corrib and Inch gas fields have played. However, Corrib gas field is expected to be depleted around the end of the decade. With no new finds in Irish territories, the supply from Corrib gas field will have to be taken up again from import via the UK pipeline.

The ramifications for Ireland, and the North-West Region, is that the energy system as a whole is extremely vulnerable and has a low reliability. External situations and factors may affect the price and import of these fuels, and these will be almost completely out of Irelands control.

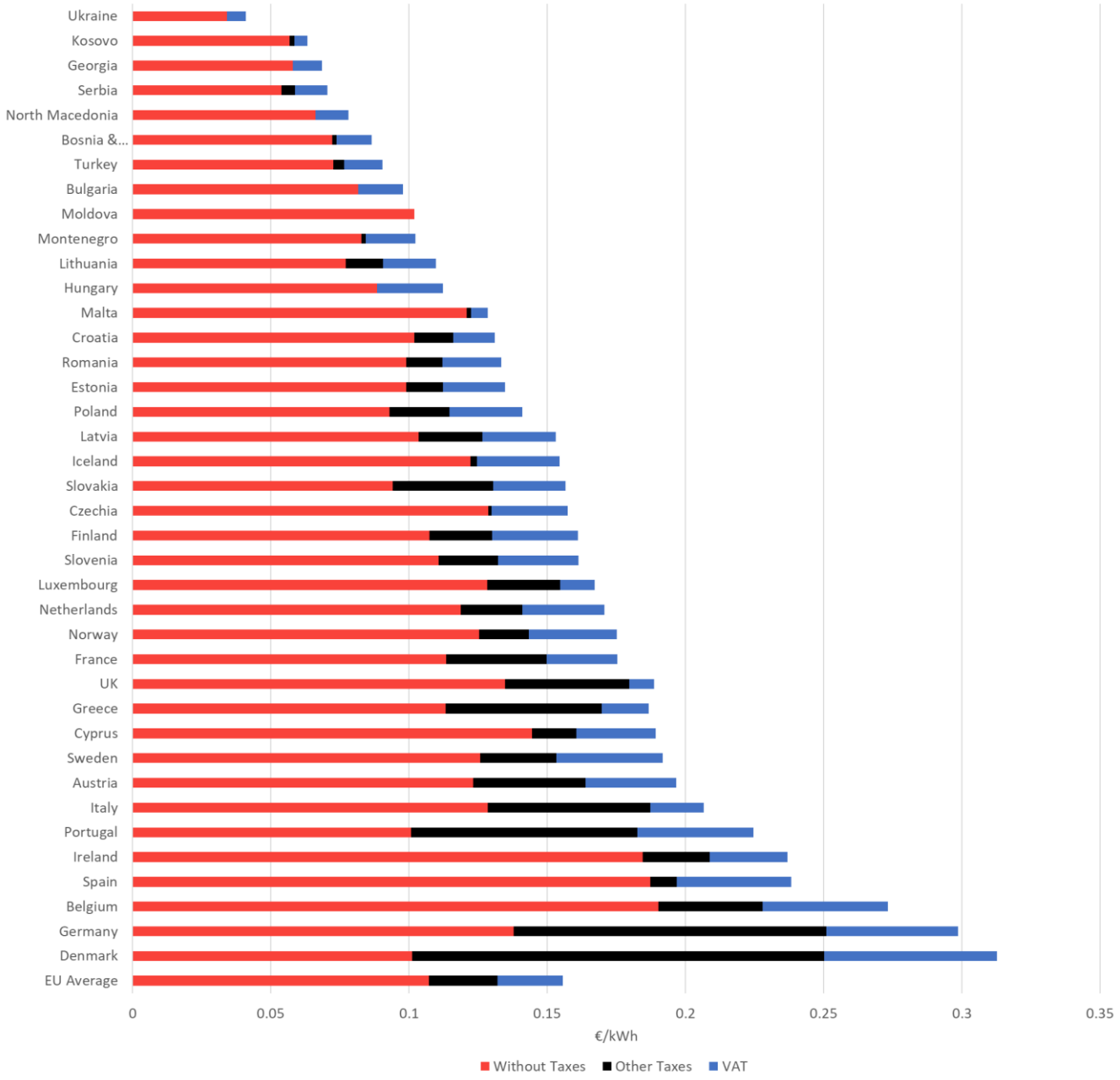
5.1.2.2 Price of Energy Sources

Due to Ireland's location within Europe, and its heavy reliance on fuel imports, the price of energy within the country is very high. **Error! Reference source not found.** shows the average domestic price per kWh of all EU countries for the first half of 2018 [79]. As can be seen in the results, Ireland has an average domestic energy price of 0.1846 €/kWh which is the fifth largest average energy bill out of EU countries. The EU average is only 0.1073 €/kWh, which is 42% lower than that of Ireland's average. This price is not hugely influence by VAT and other taxes, unlike Denmark and Germany, leading to the conclusion that the price must be largely influenced by the importation of fuel from outside the country.

The exact average domestic energy cost for NI is not known but the UK cost is 0.1347 €/kWh. Although this cost is still greater than the EU average, it is still far from the level of Ireland's cost. Furthermore, this cost encompasses the entirety of the UK, with Great Britain forming the majority of the population and energy use.

The root of this issues stems from the same problem as energy security; importing of fuel. Unless the total fuel import for the North-West Region, and Ireland, decreases, energy prices will continue to remain high and will likely increase in the future

Figure 5-7 - Average Domestic Energy Prices in €/kWh for EU Countries at the First Half of 2018



5.1.3 ENVIRONMENTAL FACTORS

5.1.3.1 Climate Change

Climate change has become more of a prevalent threat in recent years and some of its effects can directly or indirectly affect energy systems. These effects are not unique to any one part of the world and research at national levels has shown that changes in Ireland's climate are in line with global trends [58].

Extreme weather events have increased over the years as a result of climate change and are likely to carry on increasing in the next coming years. The events have a significant influence on the reliability and operation of the electrical network in particular. Some of these effects are described below [59] [60]:

- Higher temperatures and increased frequency of heat waves limits the power transfer capability of transmission lines, increasing energy losses.
- More intense winds can damage overhead lines causing them to break and/or shutdown all together.
- Greater rainfall can lead to flooding within substations posing a significant risk to substation equipment including transformers and switchgear.
- Increase in lightning strikes on or near overhead lines may cause a greater number of faults resulting in higher ratings of protection equipment needing to be installed.

Climate change also effects the wider energy system as whole including:

- Accelerating sea level rises may affect coastal generators resulting in more protection equipment needing to be installed or the generator having to shut down all together due to a major flood risk.
- Increase in droughts and reduced water supplies means a reduction in water required for cooling generators which creates a risk in its continued operation.
- Elevated water temperatures decrease the effectiveness of water cooling required in some generators causing a forced reduction in supply.

All of these effects have a direct influence on energy and electricity security – putting customers at risk of power outages. Within the North-West Region, the greatest effects most likely to be seen are an increase in annual rainfall and increase in wind speed and frequency [61].

5.1.3.2 Local Air Pollution

Air pollution is mainly caused from the burning of fossil fuels and can have devastating effects on personal health. This includes respiratory illness, cardiovascular damage, nervous system damage, fatigue and headaches, eye and throat irritation, and many more [62].

Within the region, air pollution is not a very significant issue, as discussed in Section 2.3.1. The entirety of the region is classed as 'good' which is at the higher end of the air quality chart. This means there is very little risk to human health. Although the air quality is currently at a good level, future developments in the area run the risk of increasing the air pollution levels. Care should be taken to ensure the air pollution levels do not worsen and that regular checks are made.

5.1.4 TECHNICAL FACTORS

5.1.4.1 Ageing Electrical Network

The electrical networks within the North-West Region carry the inherent risk from ageing assets. As electrical networks continue to get older, the assets age and the associated equipment deteriorate over time putting

safety and security of supply at risk. Equipment such as transformers, circuit breakers and switchgear have higher failure rates as they get older and also require more maintenance and inspection checks. The material within the equipment also wears down and may require costly replacement and inspections. For items such as cables and network lines, an increase in electricity demand from customers may mean an upgrade is required, as the current capacity of the cable/line is now inadequate for the level of demand required. Network upgrades and reinforcements will be essential in the future.

5.1.4.2 Increased Load Demand and Generation on Network

The electrical networks are currently under strain due to the increase in electricity demand and the greater uptake of renewable generation. These challenges need to be addressed as they are critical to ensuring a reliable supply of electricity for the North-West Region.

Over the years, electricity demand in the North-West Region has been increasing; a trend seen across ROI and NI. This increase in demand can be attributed to a number of reasons including population increase. The population of County Donegal in 2016 was estimated at 158,775 [20] and ambition for population growth highlighted in the Development Plan identifies the potential of reaching up to 200,000 people by 2038. This is an approximate increase of 25% to the total population within the county. Conversely, however, DCS have projected a decrease in population between 2016 and 2038, with the total population falling from 150,142 to 147,000 (2.1% decrease). Despite this decrease within the DCS District, population rise is projected to be significant over the entirety of the North-West Region. Increases in electricity demand in the Region have already been addressed by EirGrid, the Transmission System Operator (TSO) for ROI. The Donegal 110 kV project was a joint development between EirGrid and ESB Networks which upgraded large portions of the transmission network in County Donegal [72]. The project was to combat concerns of the quality of electricity supply in the region falling below acceptable standards due to significant electricity demand.

Another issue comes from connecting renewable generation as a Distribution Generator (DG). Connecting the DG will increase the overall loading on the line, and, unless the line/cable is of an adequate rating, it will not be able to handle the level of loading through it and be damaged. Furthermore, voltage rise is a common problem with DG's with some connections causing the line voltage to exceed its acceptable limits (Over 10%)

To combat these issues, network reinforcements would be required. These hold a number of challenges including being very disruptive, expensive and taking a lot of time to complete. Smart solutions are therefore needed to accommodate load and generation growth on the network

5.1.4.3 Lack of EV Infrastructure

The uptake of EVs is expected to increase rapidly over the coming years if carbon reduction targets are to be reached. To support and encourage this increase, the necessary charging points, both public and private, must be installed ahead of time. If charging infrastructure is not available within the North-West Region for both domestic and commercial travel it is unlikely that any low carbon transport targets will be met.

Currently, the EV infrastructure in the area is minimal. At the time of publishing, there is 19 public EV charging points across County Donegal [73] and 12 public EV charging points across DCS [74]. EV numbers within the region are expected to rise however if additional public charging points aren't installed to match the increase in EV uptake, there will be a reduction in overall EV use, slowing down the progression that EVs bring to the energy strategy.

5.1.4.4 Gas Network Coverage

As discussed in Section 5.2.1, most of the population within the North-West Region are not connected to the natural gas network. This brings with it a host of challenges and risks for people within the North-West Region.

Most people within the area rely on fuel oil for heating and hot water. This fuel is transported via the road network and there are no alternative means for transporting. Having such a heavy dependence on this transportation method means an inherent risk is present for fuel oil delivery and the overall security of supply.

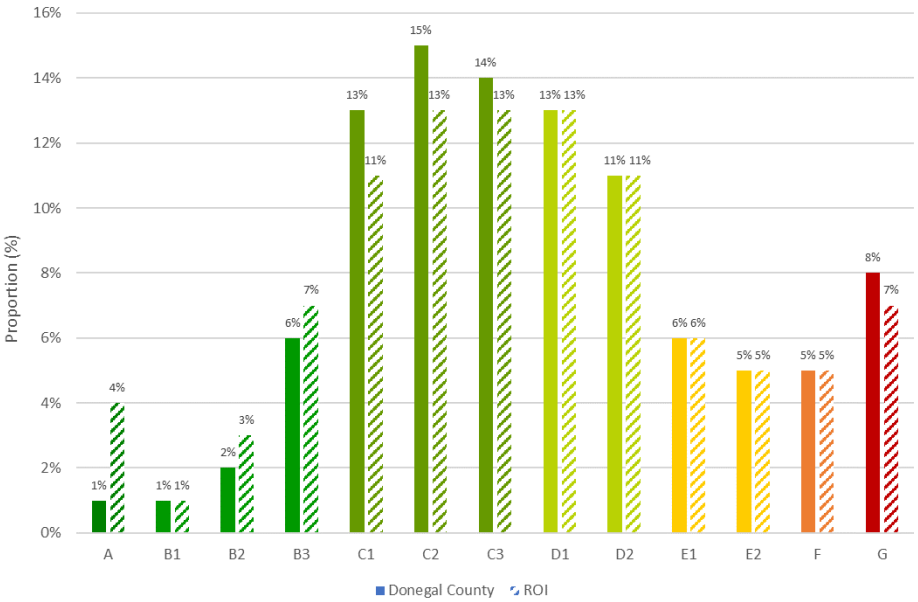
Another fuel source that is becoming more popular due to a lack of gas network coverage is electricity. Systems such as heat pumps can provide buildings with heating using electricity to power the technology. With this uptake in heat pumps however means an increase in electricity demand. This causes greater strain on the network and may mean that costly reinforcements are required.

5.1.4.5 Inefficient Buildings

Domestic buildings account for a significant proportion of total energy consumption and carbon emissions. Developments in domestic dwellings over the past number of years has led to more efficient buildings and hence resulting in less overall energy consumption. In both ROI and NI, all domestic buildings must have their energy efficiencies evaluated before being sold. In the ROI, this is done through a Building Energy Rating Certificate (BER) [75] and an Energy Performance Certificate (EPC) in NI [76]. Both of these evaluation methods use a scale from A to G, with A being the most efficient and G being the least efficient.

Error! Reference source not found. shows the domestic BER results for County Donegal and ROI for 2018 [77]. The results show that the majority of domestic homes in both County Donegal and ROI have a BER of C or D. Although this is not the least efficient rating, it is not very positive and shows that there is a lot of wasted energy from inefficient buildings. Furthermore, County Donegal has worse results than that of the ROI, by having fewer A and B rated buildings and more G rated buildings. There is huge potential to improve County Donegal s energy consumption by investing in the improvement of efficiency for domestic buildings within the area.

Figure 5-8 - Domestic Building Energy Rating (BER) Proportions for Donegal County and ROI



5.1.5 DEVELOPMENT POLICY

5.1.5.1 National Carbon Targets

Within the Region, there are two different national targets: One for ROI and one for NI. Both have the same target however with regards to renewable generation i.e. 40% of electricity generation is to be from renewable sources by 2020 [53] [54]. Furthermore, both countries have emission targets, which have been discussed previously.

The North-West Region is currently leading the way in terms of renewable energy, with it being one of the greatest contributors of renewable generation for the island of Ireland. This however may result in future pressures for the region to maintain this progress as it is viewed as a key area for both countries to meet their national targets.

5.1.5.2 Development Policy for Wind Farms

The North-West Region has potential for continued growth in the wind energy sector that would positively contribute to the renewable energy targets of both jurisdictions. In order to sustainably facilitate the future development of wind farms within the ROI, Draft Wind Energy Development Guidelines (Department of Housing Planning and Local Government) were published in December 2019. These guidelines set out how Development Plans must achieve a reasonable balance between responding to Government policy on renewable energy and enabling wind energy to be harnessed in a manner consistent with proper planning and sustainable development. It is in this context that DCC have begun the preparation of a revised Wind Energy Strategy that shall be incorporated into the Donegal County Development Plan 2018-2024 upon completion, and within Planning Policy Statement (PPS) 18, 'Renewable Energy' for DCSDC [56].

Although these documents differ from one another, as they are produced by different governments, they still provide similar considerations and recommendations for sustainable wind farm developments. These include, but are not limited to:

- Public safety, human health, or residential amenity;
- Visual amenity and landscape character;
- Biodiversity, nature conservation or built heritage interests;
- Direct and indirect effects on natural heritage;
- Environmental impacts including noise, shadow flicker, electromagnetic interference etc;
- Ground conditions;
- Adequacy of public and private access

Some of the principal planning considerations within the North-West Region relate to visual amenity, landscape character, biodiversity, nature conservation, human health and natural/built heritage. The Region has a landscape of outstanding quality valued as, inter alia, a significant tourism asset. According to a study by Failte Ireland in 2013 [57], 'The Beautiful Scenery' is the top reason for tourists choosing to holiday in Donegal/Silgo. In the same study, 'Natural Environment' scored highest in terms of their overall experience, while 80% of respondents gave the 'Beautiful Scenery/Countryside' as their reason for recommending the area.

Of note, certain provisions of the County Donegal Development Plan 2018-2024 (as originally adopted) (Section 6.5(c) & (f), Part B, Appendix 3 refer) relating to wind energy development, were ordered to be removed/deleted from the County Development Plan resulting from a Judicial Review.

5.2 OPPORTUNITIES

The strategy has highlighted five key opportunity areas for the Region to pursue. Each of these opportunity areas act as critical elements of the Regional Energy Strategy and if addressed will majorly contribute towards securing the low carbon and sustainable vision for the Region.

Smart Energy Management

The smart control and coordination of regional energy assets to minimise energy bills and unlock new revenue streams.

Renewable Generation & Energy Storage

Maximising the potential for green renewable generation throughout the Region efficiently coupled with energy storage technologies.

Low Carbon Transport

Delivering a low carbon transport system to reduce carbon emissions and improve air quality

Low Carbon Heating

Enabling the transition from fossil fuelled heating technologies to low carbon or emission free heating solutions.

Energy Efficiency

Increasing the efficiency of energy use across the Region to minimise consumption and reduce the associated carbon emissions.

5.2.1 SMART ENERGY MANAGEMENT

As energy consumers continue to adopt Low Carbon Technologies (LCTs) utilities must adapt to ensure that the various energy networks can maintain a reliable and cost-effective supply. For example, the electrification of heat and transport is expected to place a significant additional demand on electricity networks and lead to costly reinforcements at the expense of electricity consumers.

However, this need for expensive network investment also brings an important opportunity for energy users to build a closer and more interactive relationship with utilities by adopting various Smart solutions which can reduce the network's need for reinforcement. In return, energy users could see a reduction in their energy bills and unlock previously unavailable revenue streams from their various energy assets. The Smart technologies include:

Demand Side Response

Demand Side Response (DSR) is a technology that allows consumers to reduce, increase, or delay their energy use at times of peak demand in return for payment or in response to price signal which either increases or decreases energy tariffs. DSR will provide benefits for both consumers and network operators and may avoid the need to invest in new and expensive network and generation.

The National Infrastructure Commission (NIC) has estimated that consumers could benefit by up to £790 million if 5% of peak energy demand was met through DSR [80]. Furthermore, as the technology continues to develop, the potential benefits will continue to increase. DSR will allow large energy users such as local councils to aggregate demand across their portfolio of assets and offer any inherent flexibility to National Grid or the local Distribution System Operator (DSO) as a service.

If energy users possess the enabling energy assets, DSR can be used to maintain network stability by improving the balance between supply and demand. Energy storage devices are one such enabling asset which gives flexibility to energy users and allows consumers to generate and store their own energy. Consumers can then respond to DSR signals through a variety of means. For example, consumers with battery storage can; discharge back to the grid, charge at times of excess generation, or temporarily supply their own local energy needs and times of peak local demand.

Active Network Management

Active Network Management (ANM) is a technology which allows generators such as wind farms to quickly connect to areas of constrained network whilst avoiding the need for expensive reinforcement of the local electricity network. These reinforcement costs are often prohibitively expensive and prevent regions from realising the potential of their local wind resource. ANM technology provides a "non-firm" connection to the electricity network for generators. In cases of maximum generation and minimum demand when the capacity of the local network is reached, a signal is sent to the wind farms which have connected using ANM to reduce their output. This allows the network to remain within capacity during worse case operating conditions whilst facilitating the connection of renewable generation in areas that would otherwise not be financially feasible.

Regional Energy Management System

Various local authorities across the world have invested in local energy management systems to control and coordinate key infrastructure across their public areas. There is an opportunity to invest in such a system to control the critical public infrastructure in the region. Such a system would be a key enabler of a future digitally connected "Smart Region". Publicly owned assets such as LED street lighting, EV charging points, Security cameras, WiFi services can all be intelligently controlled to create a Smart Region which minimises energy use whenever possible.

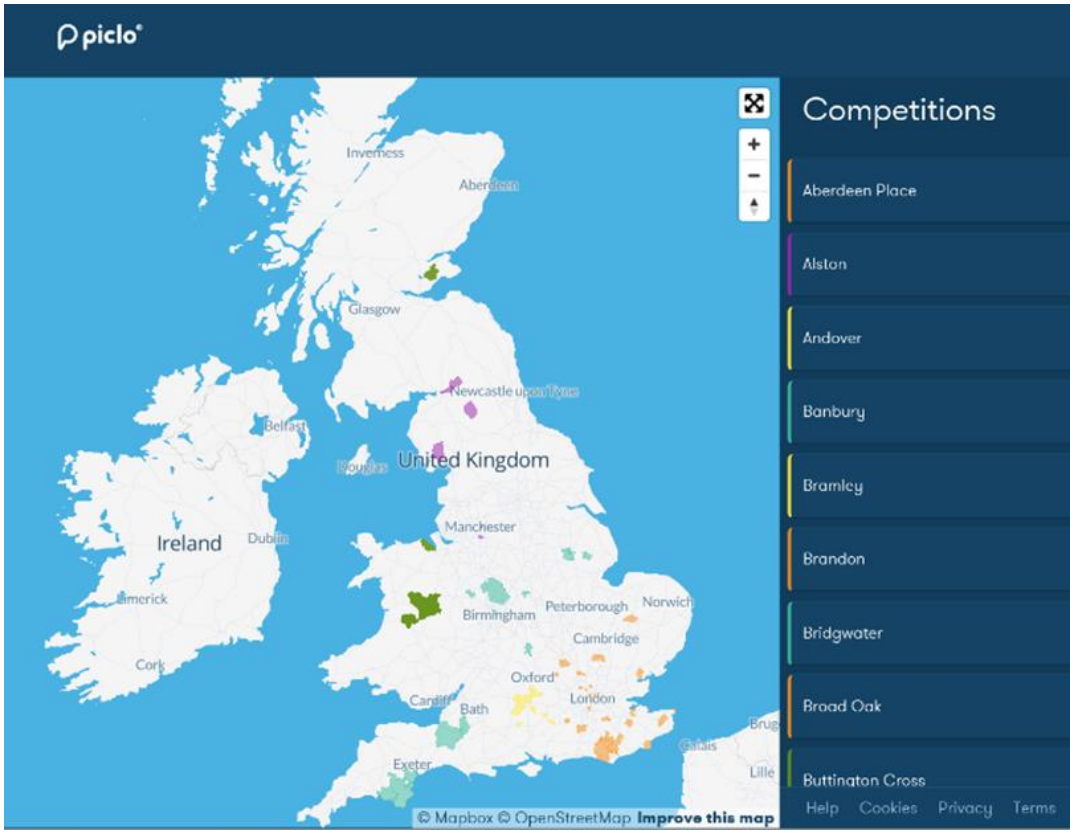
Distribution System Operator (DSO) Flexibility Markets

In Great Britain, Distribution System Operators (DSOs) are beginning to procure network flexibility services from "prosumers" that are connected to the distribution network. Currently, all 6 DNOs in Great Britain are taking part in flagship trail of an online bidding platform known as Piclo [81].

This online platform allows DSOs to post auctions or competitions for any flexibility services it requires for a specific network area. There are a variety of flexibility services that can be provided but simply put, these services are either an increase or decrease in consumption or generation depending on the needs of the network operator.

Aggregators or prosumers are then able to bid on each auction and are then paid by the DSO for the service they have agreed to provide. Figure 5-9 is an online map showing the live auctions which DSOs have already released to the public in Great Britain [81]. It is likely that auctions similar to these will become far more common, particularly as the need for network flexibility services increase alongside the uptake of Low Carbon Technologies (LCTs).

Figure 5-9 - Map of DSO Released Live Auctions



In March 2019, Scottish & Southern Energy Networks (SSEN) announced that they have agreed to procure flexibility and demand-side response services across its entire network, rather than just constrained areas [82]. To meet SSEN flexibility needs providers can be individuals, communities or aggregators and various assets types are able to provide services such as small-scale renewables, batteries, electric cars and load response. To start, SSEN have suggested a payment of £300/MWh for flexibility. Participating in these future markets is a key objective within this North-West Regional Energy Strategy.

5.2.2 RENEWABLE GENERATION & ENERGY STORAGE

The decarbonisation of the North-West Region will rely in part upon the generation mix which feeds the electricity network, particularly due to the electrification of both heat and transport sectors. Therefore, it is important that renewable generation grows within the North-West Region in a timely and affordable manner to reduce the greenhouse emissions associated with the consumption of energy. Modelling by the Committee on Climate Change shows that the power sector must be near zero carbon in 2050 if we are to meet our legislated emission reduction targets.

Investing in renewable technologies provides a great opportunity to develop a low carbon economy within the North-West Region that can support employment whilst improving future energy security. The following sections provides a summary of the technologies and opportunities which could accelerate the decarbonisation of the North-West Region and help build a strong and sustainable low carbon economy which can both reduce carbon emissions and provide substantial economic benefits. It is important that a coordinated view of renewable technologies is taken to deliver a reliable and affordable energy mix for the North-West Region.

Onshore Wind

Onshore Wind can form an important part of the future energy mix within the North-West Region. As the lowest cost renewable generation, onshore wind can play an important role in meeting binding EU emission targets. Missing these targets could result in significant penalties at the expense of consumers.

However, despite improvements in the cost of onshore wind (£/MWh) the number of new onshore wind developments within Donegal has fallen in recent years. This in part, is due to several political and environmental constraints which has prevented further developments.

As stated in Section 5.1.1.2, Draft Wind Energy Development Guidelines were published in the ROI in December 2019. Donegal County Council are now in the process of drafting a Variation to the County Donegal Development Plan 2018-2024 on this basis in order that the significant wind energy resource of the county can be harnessed through the sustainable development of wind farms. Within Derry City & Strabane, onshore wind has been an important contributor towards an increase in renewable generation. In fact, the Department of the Economy (DoE) reported that Derry & Strabane provided 31% (714 GWh) of all the renewable electricity generated within the North by itself (2325 GWh). This is a statistic to be proud of and where possible local authorities should continue to encourage the installation of new onshore wind developments.

Whilst the future deployment of onshore wind is not fully within the control of local authorities, the technology is an important source of low carbon energy which has massive potential to help decarbonise the Region. There is a variety of actions or local measures that can be taken locally to maximise the potential of onshore wind within the North-West Region. These are;

- GIS mapping of the region to better identify areas of possible future development.
- Encourage the replacement of ageing wind turbines for newer and more efficient models.
- Investigate the use of private wire and virtual private wire connections of onshore wind energy to large customers to increase the financial viability of new developments.
- Work with local government to clearly define the restrictions and constraints to future developments within the region balancing the need to produce green energy locally with other considerations such as maintaining tourism within the area.

Solar Power

Solar Power or Photovoltaics (PV) has become a mature renewable technology which has consistently fallen in price over the years having benefitted from government subsidies and feed-in tariffs which has provided a source of additional income for owners. Solar panels use the energy from the sun to generate electricity without producing any harmful carbon emissions.

Moving forward, PV is well aligned with the objectives of the Regional Energy Strategy and can bring both a new source of revenue for residents whilst contributing towards a reduction in greenhouse emissions. For this reason, local authorities should continue to encourage the adoption of solar panels throughout the North-West Region, particularly as the loading on the electricity network increases with the electrification of heat and transport. Vulnerable residents or those on low income should be prioritised where possible by targeting social housing within the North-West Region. As discussed below, there is also opportunity to pair solar energy with battery storage in the future to increase the financial feasibility of new installations as feed-in tariffs and subsidies are reduced.

The current uptake of PV panels in ROI has been limited due to issues with the feed in tariff. However, the Climate Action Plan has a specific target to address this in the future.

Both DCC & DCSDC can play an important role through direct investments within their own assets such as car parks and council buildings, or by supporting and encouraging the roll-out within the private sector. The following opportunities should be considered within the North-West Regional Energy Strategy with regards to solar power:

- Create a GIS map of the region identifying all opportunities to roll-out solar panels.
- Work with local housing authorities and agencies to encourage the community funded rollout of solar panel on social housing stock within the region.
- Encourage all new housing developments to include solar energy within the initial construction where appropriate.
- Target council owned car parks – co-ordinated with EV charging stations
- Invest in solar microgrids for council owned landfill sites to generate income and reduce emissions
- Encourage water companies to install PV and batteries at pumping station

Energy Storage

Energy Storage is a high potential area for development which could allow more renewable generation to connect to the electricity network than would otherwise be technically and commercially feasible. There are various forms of energy storage all of which may play an important role within the wider energy mix.

Battery Storage has the potential to act as a short-term buffer when supply does not match demand and can reduce peak loadings that the network may not be capable of accommodating. It also has the potential to reduce system constraints and provide valuable balancing services for the national electricity network.

Furthermore, storage can be used alongside new or existing wind or solar developments to increase the revenue and profitability of renewable energy generation. Co-locating storage can allow excess generation to be captured and used later when demand is high. This reduces lost revenue caused when supply exceeds demand. For example, often wind speeds are highest at night time when demand is low. Storage would allow this excess generation to be stored and used during the day to meet peak demand.

The performance and cost of batteries is also improving year on year due to a massive increase in global battery R&D mainly driven by uptake of electric vehicles. This is leading to the development of high potential new technologies such as Solid-State Batteries with high energy densities and charging rates.

Therefore, storage should be viewed as an enabling technology which can help to accelerate the uptake of renewable generation within the North-West Region, particularly if cost and performance continues to improve. It is recommended that the following opportunities be investigated as part of the North-West Regional Energy Strategy:

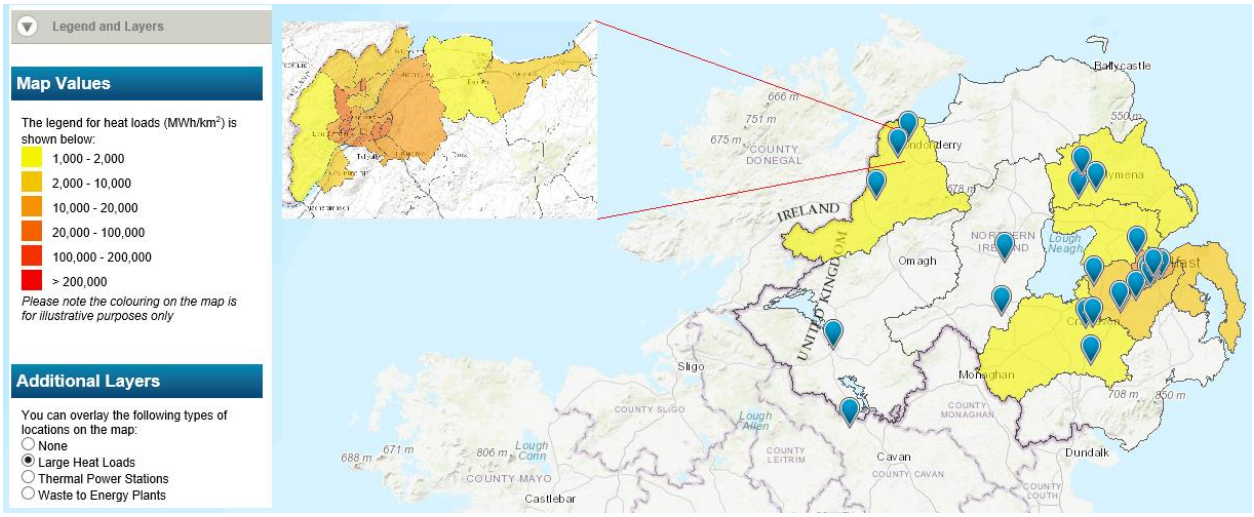
- Co-locate storage with renewable generation to maximise revenue
- Facilitate time of use energy tariffs to incentivise
- Encourage the use of batteries to provide balancing services to the electricity network.
- Plan all future energy developments within the Region with battery storage technology in mind where commercially viable.

Combined Heat & Power (CHP)

Combined Heat and Power (CHP) is another high potential technology which produces both electricity and heat in a single highly efficient process. It does this by capturing the usable heat produced whilst generating electricity and using this heat locally. Large scale power plants generally lose this useful heat to the environment as they are often built away from populated areas. This leads to low efficiencies and further losses when transporting power over large distances. Alternatively, CHP can deliver an efficiency of more than 80% depending on the type of fuel which is used, by producing and using both heat and power locally.

CHP can operate using a variety of fuels including fossil fuels such as natural gas, heating oil and coal, or renewable fuels such as biomass, biogas, and bioethanol. This provides flexibility allowing a fuel source to be used which is both low carbon and locally sourced. Furthermore, CHP is known is reduce carbon emissions by up to 30% when compared to separate means of generation such as a boiler and power station. It can also lead to cost savings of up to 20% [83]. The technology is seen as an important part of a future low carbon energy mix and is supported by BEIS which has created a “CHP Focus” initiative to support the development of CHP in the UK alongside free tools which can be used as an indicative assessment and review of potential options for installing CHP on a particular site. There are also tools available to view existing CHP development within the UK as seen in Figure 5-10.

Figure 5-10 - Map Highlighting the Proportion of Heat Loads within NI and DCS



5.2.3 LOW CARBON TRANSPORT

Electric Vehicle (EV) Uptake

The uptake of electric transport across the North-West Region will contribute towards a reduction in carbon emissions and improve air quality. This is particularly important in more densely populated areas within the region. As such, it is important that a coordinated approach is taken to the rollout of EV charging infrastructure so critical stakeholders are aligned with a joint vision for the Region. It is also important to consider low carbon alternative fuels such as Hydrogen and Biodiesel, particularly for heavy goods vehicles.

In the Republic of Ireland, EVs are quickly becoming more popular. RTE reported that 811 EVs were sold in January 2019 which is a 680% increase from January 2018 and more than the whole of 2017 [84]. Currently, EVs make up only 2.6% of the market share as of January 2019 which is still significantly low compared to diesel and petrol cars at 49% and 40% respectively. However, this market share has grown quickly with it being less than 1% in January of last year. There are approximately 7,500 EV's on the road today in Ireland and the growth of EVs is expected to be exponential over the coming years [85]. This is helped in part by the government incentives introduced in 2018 which provides citizens with a grant of €5,000 and VRT relief of up to €5,000 when purchasing an EV [86]. There are approximately 750 public charging points across Ireland [87]. The Irish government set a target that all new cars sold in Ireland post-2030 will be zero emissions or zero emissions capable [88].

According to NIdirect [89], there are approximately 2000 EVs on the roads in Northern Ireland and 337 public charging points. Similarly, to the Republic of Ireland, EV purchases have increased significantly over the past years. In the UK, there are approximately 195,000 EVs since February 2019 according to Next Greencar [90]. This accounts for approximately 8% of the total market share and has also seen a rapid increase from previous years. The UK currently offers a grant worth £3,500 for purchasing of an EV however this grant does not now apply to hybrid vehicles and only refers to pure electric cars [91]. In July 2017, the UK announced that it will end the sale of all conventional petrol and diesel cars by 2040 [92].

Hydrogen Vehicle Uptake

Hydrogen is currently viewed as one of the main alternatives to fossil fuels when it comes to fuelling vehicles. Technology and infrastructure within this field is rapidly advancing and there have been many trials and schemes implemented across the world to determine how effective the fuel source could be for vehicles and creating a low carbon transport system. An example project is GenComm which is a €9.39 million project being funded by Interreg North-West Europe [93]. The project aims to validate hydrogen as a sustainable energy source for the 3-key energy uses: transport fuel, power and heat – through the development of 3 pilot plants – one of which being in Northern Ireland. Using wind energy, hydrogen will be produced through large electrolysers and then used as a fuel source for a number of hydrogen buses manufactured by Wrightbus. The project should help understand what infrastructure is needed to implement a hydrogen based transport system.

Hydrogen is also seen as a particularly effective alternative fuel source for heavy goods vehicles (HGVs) and long-haul vehicles (e.g. buses). The main reason for this is it has a longer range than traditional electric based vehicles. Hydrogen fuelling points would also only need to be placed in very specific areas. Despite this however, hydrogen can be effective in smaller sized vehicles and should not be disregarded in this sense. The infrastructure for this would need to be developed but the North-West Region could take results from the GenComm project to implement an area wide hydrogen transport scheme.

Development of Greenways

Greenways are seen as ways to reduce the impact transport has on a particular area. Transport consumes a large proportion of the North-West Region's total energy consumption and it also contributes a significant portion of its CO_2 emissions as well. Developing the use of greenways will reduce the total number of cars on the road which has the added benefit of reducing congestion in particular busy areas of the North-West Region, such as the road between Derry City and Strabane. Implementing these greenways can be done through the following methods:

- Improve the low carbon infrastructure
- Create a car sharing scheme. Incentivise and/or reward individuals who partake in the scheme
- Have a greater uptake of smaller low carbon transport technologies. For example, electric scooters and electric bikes

Overview

Going forward, it is recommended that the following opportunities are investigated to accelerate the adopted of low carbon transport throughout the North-West Region:

- Encourage and support the roll-out of low carbon charging and fuelling infrastructure across Region for EV and Hydrogen fuelled transport.
- Where feasible, convert all public services vehicles to run on low carbon gas or replace with electric vehicles.
- Implement an Ultra-Low Emission Zone in any Urban areas to encourage the adoption of green transport.
- Support the use of immediate alternatives to Diesel for fleets of heavy goods and refuse vehicles such as Compressed Natural Gas (CNG)
- Generate more local renewable power to decarbonise the electricity network which power any EVs
- Inject low carbon natural gas alternative such as Hydrogen or Biomethane into the gas grid.
- Carry out an assessment of the charging infrastructure required across the region to support a high uptake of EVs
- Provide financial and technical support to local communities and businesses to help with the installation of new charging infrastructure.
- Encourage and incentivise public transport such as buses to update fleets to low carbon equivalents (Fully electric, hybrid, hydrogen etc.)

5.2.4 LOW CARBON HEATING

The decarbonisation of heating is strategically critical if the North-West Region is to meet its wider decarbonisation targets. This is illustrated by the Climate Change Committee's claim that that 18% of UK heat will need to come from heat networks by 2050 if the UK is to meet its carbon targets cost effectively [94].

Whilst some areas within the North-West Region have access to the natural gas network most of the North-West Region rely upon Fuel Oil as the primary source of energy for space heating. Regardless, both fuel types are classified as fossil fuels and contribute towards annual greenhouse gas emissions and more environmentally friendly alternatives should be encourage across both residential and industrial sectors.

There are several viable alternatives that could act as replacements for the Oil and Gas heating currently used within the North-West Region. It is not fully clear which combination of these will work best at scale while keeping costs down but all will play an important role:

Heat Pumps: Heat Pumps connect to the low voltage electricity network to generate heat. The impact on carbon emissions depends on the decarbonisation of the electricity network. However, HPs do shift the location of emissions away from residential areas and will become more environmentally friendly as the wider electricity network is decarbonised.

District Heating: District heating is another high potential solution which can be assessed on a case by case basis for local communities and businesses. District hearting uses a network of insulated pipes to transport hot water to consumers where individual heating solutions are considered more expensive. The hot water is generated on a single site and feeds all consumers connected to the scheme. The generation source can vary but low carbon renewable generation can be used that would otherwise not be economic or practical including heat pumps, fuel cells, and geothermal energy.

Hydrogen Gas: Hydrogen gas is a high potential low carbon and dense source of energy which produces no carbon emissions when it is burned. It has been estimated that heat emission in the UK would be reduced by approximately 73% if the entire gas network was converted to hydrogen [48]. Importantly, hydrogen gas could also be much less disruptive and cheaper for those already connected to the gas network than converting the current housing stock to electricity.

Therefore, it is recommended that the following opportunities be assessed and investigated to help decarbonise domestic and commercial heating within the Region:

- Ensure long standing support and incentives are available for both domestic and industrial buildings to convert from Gas and Oil heating to electric Heat Pumps.
- Coordinate or combine heating incentives with wider energy efficiency incentives such as building insulation.
- Develop relationships with local developers to ensure opportunities to decarbonise the regions heating stock are not missed.
- Ensure planning consents for new developments include clauses to include low carbon heating solutions, particularly the use of heat networks in new build developments.
- Investigate the feasibility to generate Hydrogen locally and inject into the gas grid.
- Carry out a detailed assessment of the Region to identify opportunities for potential district heat networks.

- Convert off gas grid homes to biofuels such as locally produced wood chip to reduce carbon emissions and support the local economy
- Carry out detailed assessment for the potential of the Region to build a new economy around biofuels

5.2.5 ENERGY EFFICIENCY

Improving the energy efficiency of households and businesses throughout the North-West Region should be an important objective within the North-West Regional Energy Strategy. Doing so will bring wide societal benefits including a reduction in energy consumption, carbon emissions and heating bills, helping to protect vulnerable people from fuel poverty. In fact, the Building Research Establishment (BRE) has estimated that cold and damp homes significantly impact public health and cost the NHS approximately £760 million per year [95]. Furthermore, improving the efficiency of the average household from a Band E to Band C reduces energy costs by £650 per year [96].

For these reason, it is important that energy efficiency measures are taken to target both households and non-domestic sectors to improve energy efficiency in line with the Governments targets of 20% by 2030.

It is also important that any energy efficiency initiatives are coordinated or combined with low carbon heating incentives such as the deployment of District Heating schemes or Heat Pumps to maximise the performance of any low carbon heating solutions which are deployed.

There are several approaches that can be taken to improve energy efficiency throughout the Region but the following opportunities should be investigated:

- Identify and target homes within the Region which are known to have a low energy efficiency rating, particularly those on low annual income.
- Ensure financial and advisory support is available for those homes which are identified to adequately encourage the deployment of insulation and low carbon heating solutions as one heating system. A whole system approach should be taken so that each households heating performance is improved.
- Launch LED lightning support and advice for domestic and industrial buildings to reduce energy consumption associated with lighting. Continue the roll-out of LED lighting for Street lighting across the Region.
- Ensure any new developments are delivered in line with the latest quality and sustainability standards such as the BRE Home Quality Mark (HQM) in NI or the green building policy and regulation in Europe and Ireland.
- Ensure the level of support (both financial and advisory) is consistent across the Region where possible.
- Work with local businesses to identify opportunities within the Region to develop industrial heat recovery to provide low carbon heating or cooling for local residents through heat networks.

5.2.6 FUNDING AND INCENTIVES SCHEMES

Within the North-West Region there are several important incentive and grant schemes available which can help to facilitate the roadmap presented within this North-West Regional Energy Strategy. These incentive schemes make funds and advice available for both domestic households and commercial businesses to support a reduction in carbon emissions whilst minimising energy bills.

It is important the benefits that can be derived from these schemes be maximised whilst they are available to help ensure that the targets set out within this strategy are met. Below is a description of some of the key incentives that are currently available. However, it is vital that the strategy does not entirely rely upon central government incentive schemes. As such, both councils within the North-West Region will take strong leadership and drive the strategy forward by implementing their own incentive mechanisms wherever possible.

Climate Action Fund

The Climate Action Fund is one of four funds included within the Irish Government's National Development Plan (2018 – 2027), and is set up to address the issues within the Climate Action Plan . The fund is available for innovative interventions, will support innovation and capacity building towards development of climate change solutions, and generate wider socio-economic benefits, and €500M will be available to 2027. A call for expressions of interest was available earlier this year in order to provide input into the shape of the fund going forward. Donegal County Council submitted an outline proposal, making the funders aware of this strategy, and intend to submit a proposal when the second round of funding is made available later in the year.

Sustainable Energy Authority of Ireland (SEAI)

SEAI is Ireland's national sustainable energy authority. They work with households, businesses and communities to encourage a cleaner energy future and provide a wide range of support from grants to support the adoption of Heat Pumps to Lighting Support Scheme. In 2016 SEAI supported over €130 million in energy upgrades [97]. Below is a summary of the grants that SEAI currently make available which can provide significant support to the Donegal area.

- **Home Energy Grants:** A wide range of support for households including significant financial support for the adoption of Heat Pumps, Solar Electricity & Water Heating, Insulation, a Deep retrofit service to upgrade home energy efficiency to an A-rating.
- **Business Grants:** Several grants are available to support businesses of different sizes to meet energy saving targets. This includes support to carry out feasibility studies to develop the initial business cases for large energy efficiency projects, and
- **Electric Vehicle Grants:** A range of grants are available for private and commercial electric vehicles depending on the value of the vehicle. The maximum grant available is €5000
- **Community Grants:** Known as Better Energy Communities, SEAI assists energy efficiency community projects through capital funding, partnerships and technical support worth up to €28 million each year.
- **Research Funding:** SEAI invest in research, development and demonstration projects with the objective of stimulating the development of energy related products.

Bryson Energy

Bryson Energy [98] are a charitable group who act as Northern Irelands National Energy Agency and support energy users to reduce their costs and greenhouse emissions. They provide a number of services to support domestic households including general energy advice, home visits to vulnerable householders, education, benefit entitlement assessments, and Oil Buying Clubs

Invest NI

Invest Northern Ireland [99] provide Energy Efficiency and Renewable Energy advice for businesses throughout Northern Ireland. Their goal is to help NI businesses become more competitive through cost savings. A key element of this is reduction in energy costs. Invest NI offer the following support

- **Technical Consultancy Support** – up to 5 days free consultancy to produce technical audits and feasibility studies.
- **Resource Efficiency Capital Grant** – Grants of up to 40% of project costs (capped at £40k) to help with purchasing resource efficiency equipment to reduce water, waste and raw materials.
- **Resource matching through Industrial Symbiosis** - Support to help identify opportunities to turn unwanted materials of one business into a resource for another business.
- **Best practice guides and technical advice**

Action Renewables

Action Renewables [100] are a charitable body who represent the renewable energy sector in Northern Ireland. They host the Action Renewables Energy Association (AREA) which acts as the sole body representing the renewable energy sector in Northern Ireland. Its objective is to establish a secure renewable energy policy framework in Northern Ireland which will protect the existing renewable energy investments and support the development of the renewable energy sector.

NISEP

The Northern Ireland Sustainable Energy Programme (NISEP) [101] is an annual fund managed by the Utility Regulator which provides support towards energy efficiency interventions including insulations, LED lighting and heating upgrades for domestic and commercial customers.

Each year a funding window is opened to provide access to several schemes. The funding is collected from all electricity consumers through a Public Service Obligation (PSO). The majority of the funding awarded in the past has been used to support vulnerable customers in Northern Ireland. The next launch of the NISEP for 2019/2020 is yet to be announced.

Affordable Warmth Scheme

The Affordable Warmth Scheme [102] is a fund issued by the housing executive and managed by local authorities. The scheme supports low income and vulnerable energy users who have an annual income of below £20,000. This includes the replacement of loft and wall insulation, windows and wooden frames, and old or broken gas and oil boilers. The fund can provide up to £10,000 of support for each applicant.

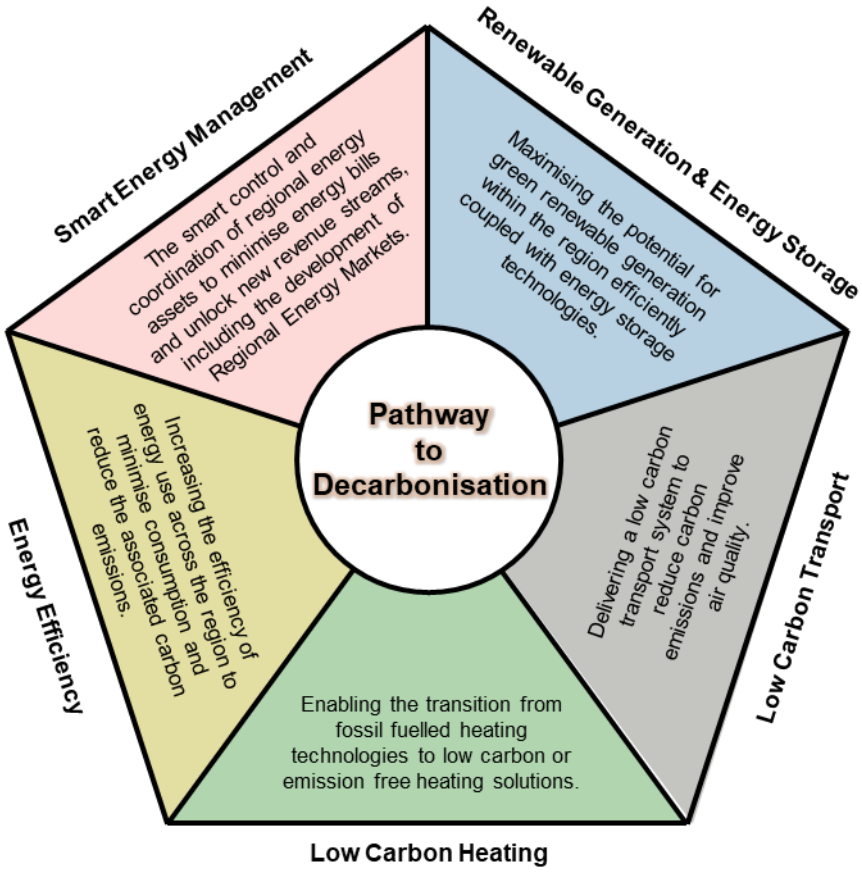
6

REGIONAL ENERGY STRATEGY & ROADMAP

6 REGIONAL ENERGY STRATEGY & ROADMAP

A Regional Energy Decarbonisation Roadmap has been developed based on the analysis of the North-West Region. The roadmap highlights five key areas of interest as listed below. However, the emphasis of this strategy is to create a pathway to a collaborative carbon neutral Whole Energy System which brings together multiple energy vectors within the region and provides a detailed view on the optimal future energy system for the region given the specific challenges and opportunities identified within this report. This is highlighted in Figure 6-1.

Figure 6-1 - Details on target energy sectors for the pathway to decarbonisation



These five Target Sectors have been explored and core paths have been developed for each which together form an effective strategy for the North-West Region to deliver on pre-set objectives. The Roadmap shows the intended progression for each area, indicating milestones that align with national energy targets and strategies. The Roadmap therefore addresses two strategic imperatives;

- Definition of a coordinated North-West Regional Energy Decarbonisation plan with a target of achieving net zero carbon emission by 2045;
- A high level Whole Energy System implementation plan to deliver key objectives;

A timeline with defined milestones that will deliver high level Regional Energy objectives.

	2020 – Short Term	2030 – Mid Term	2040 – Long Term	2050
	UK Fifth Carbon Budget; Ireland First Carbon Target; UK Fifth Carbon Budget	Ireland Second Carbon Target	Ireland Third Carbon Target; UK Final Carbon Budget	Ireland Final Carbon Target
1) Smart Energy Management The smart control and coordination of regional energy assets to minimise energy bills and unlock new revenue streams.	**Objectives:** •The North-West region has a clear view of the lowest cost and smart carbon neutral energy system and have implemented the first smallscale trial of the Smart Energy Management System • All assets / buildings with the potential for current and future flexibility with DSR ad ANM are identified. • The region has implemented its first microgrid as a cost effecitve alternative to conventional network connection.	**Obectives:** • The design and initial implementation of a regional wide Smart Energy Management System is completed. • Further bids are made on flexibility systems meaning DSR and ANM schemes will be wide spread and total energy cost is reduced. Large scale prosumers are actively traded low carbon energy between themselves across the region. • Microgrids have been installed as an alternative to network connections	**Objectives:** • A fully integrated and operational Smart Energy Management System that will include all public assets. • Consumer energy bills are significantly lower than 2020 prices through DSR and ANM schemes, • Microgrid developments are considered for all future developments. • Private and virtual private wire connections are common place connecting green generation to the region at low cost.	
2) Renewable Generation & Energy Storage Maximising the potential for green renewable generation throughout the Region efficiently coupled with energy storage technologies.	**Objectives:** • A GIS map of the region identifying all possible installation locations for renewable generation (rooftop solar, onshore wind) will be launched. • Restrictions surrounding future wind farm developments are removed where possible. • Locations are identified for the roll-out of solar technology for all private and publically owned buildings. • All future renewable development schemes consider battery storage as standard.	**Objectives:** • Northwest Region has become Ireland's major exporter of wind energy • Solar panels are common place on commercial and domestic buildings • Generation mix consists of different locally produced renewable energy • Battery storage schemes are common place (both domestic and commercial).	**Objectives:** • 100% of all of the Northwest Region's energy consumption comes from renewable source (power, heat and transport). • Energy will be generated from a mixture of sources however wind continues to be the main contributor. • Solar panels are installed on all buildings and commerical solar farms are commonplace. • Battery storage has become part of every renewable system and is used for time-of-use energy tariffs, creating additional revenue.	
3) Low Carbon Transport Delivering a low carbon transport system to reduce carbon emissions and improve air quality.	**Objectives:** • The charging infrastrucutre required for EV & Hyndrogen vehicles is indentified and optimal locations identified • Local incentives are in place for ultra low carbon transport. • The first Low Emission Zones (LEZ) has been implemented within Derry City, Strabane, Buncrana and Letterkenny. • Further Greenways are installed and a car sharing scheme is introduced to reduce congestion.	**Objectives:** • All petrol and diesel based vehicle sales are banned within the Northwest Region. • EVs are commonplace across the region with the charging infrastructure regularly upgraded. • Greenways continue to dominate the area with further incentives applied to reduce the number of cars on the road. • Hydrogen has become common place for long haul vehicles fueled from locally produced hydrogen.	**Objectives:** • All vehicles on the road within the Northwest Region are low carbon based (either EV or hydrogen). • The total number of cars on the road is reduced by 25% with more people using greenways, car sharing and public tranport. • EV infrastructure is fully operational and the network can handle 100% penetration of EVs (domestic & commercial). • Heavy penalties on all fossil fuel based vehicles has made low carbon transport significantly more economically viable.	
4) Low Carbon Heating Enabling the transition from fossil fuelled heating technologies to low carbon or emission free heating solutions.	**Objectives:** • The optimal heating systems have been identified for all buildings across the region (hydrogen, gas, electric) • Locally produced hydrogen gas is injected into the natural gas network • Sustainable Heat Pump incentives are in place and 50% of fuel oil boilers are replaced. • Biofules are being produced locally and acting as an alternative to heating oil in boilers.	**Objectives:** • 75% of heating systems within the Region are low carbon alternatives to gas and oil. • Up to 50% of the gas in the natural gas network is locally produced Hydrogen. • District heating schemes are installed taking advantage of waste industrial heat. • Heat pumps will be common place for all off-gas grid residents and businesses.	**Objectives:** • 100% phase out of all oil and natural gas based heating systems in domestic and commerical premises. • Northwest Region will have a localised hydrogen gas network that is produced locally and used for transport and heating. • All homes not part of gas network will have Heat Pumps as their primary source of heating. • A mature industry has grown for locally produced boifuels exporting across the country.	
5) Energy Efficiency Increasing the efficiency of energy use across the Region to minimise consumption and reduce the associated carbon emissions.	**Objectives:** • All buildings that need efficiency improvement are identified and sustinable incentives are in place. • An energy effiency incentive is combined with a heating incentive and all priority buildings are upgraded (worst performing buildings) • All fnew commercial and housing developments are built with an efficiency of at least Band B. • All lighting has been replaced with high efficiency LED lighting systems.	**Objectives:** • 75% of all commerical and domestic buildings have an efficiency rating of at least Band B. • All public and private lighting including street lighting has been changed to LED lighting. • Efficiency improvements have directly pushed down the total energy consumption within the Northwest Region.	**Objectives:** • 100% of all buildings in the Northwest Region will have an efficiency of at least Band B. • All homes and businesses will have LED lighting and standard filament lighting will be obsolete. • Energy consumption and consumer bills across the region has decreased substantially due to highly efficient public and private buildings	

6.1 SMART ENERGY MANAGEMENT

6.1.1 CREATE A DETAILED WHOLE ENERGY SYSTEM PLAN FOR THE REGION

To deliver a carbon neutral energy system for the region it is necessary to take a Whole Energy System approach. To do this a detailed techno commercial evaluation of the local energy system will take place to understand the options available and related costs to achieve a carbon neutral energy system. This multi-vector assessment will bring together electricity, gas, heating and transport to create a view of the optimal low carbon energy system for the region given the specific characteristic, opportunities and challenges of the energy system locally.

As part of this analysis it is proposed that DSCDC and DCC explore the design of a Regional Whole Energy Market (RWEM) with the aim of maximising the value of Regional energy resources and investments. This would employ digital platforms and management tools to enable a new generation of market aggregators and Virtual Power Plants (VPPs) across the region. This would in turn facilitate the end consumer being empowered with data to participate directly within the RWEM. Further investigation would be required to determine if these would be separate markets given that both NIE Networks and ESB Networks operate within the region.

6.1.2 SUPPORT DSO FLEXIBILITY THROUGH ANM AND DSR

An important element of any future RWEM will be the provision of demand and generation flexibility from “prosumers” to the local Distribution System Operator (DSO) as a service. The capability will allow energy users to unlock hidden revenue from their energy assets by responding to price signals and flexibility auctions set by the DSO. This will be achieved through the following processes:

- Identify assets/buildings with the potential for current and future flexibility
- Work with local DNOs (ESBN, NIEN), the utility regulator and system operator to understand how it can be implemented
- Work with aggregators to coordinate small energy users together
- Set up a team to bid on any tenders released for flexibility systems
    - Encourage time of use energy tariffs
    - Encourage V2G when penetration of EVs increases

6.1.3 PRIVATE WIRE AND VIRTUAL PRIVATE WIRE GENERATION CONNECTIONS

Private wire and virtual private wire connections can reduce the cost for new renewable generation to connect to the electricity network, whilst also reducing the cost for consumers. Private wire connections do not connect directly to the electricity distribution network but instead connect directly to a large energy user. This avoids the need to pay for network connection costs and charges. Instead the energy user has a direct commercial relationship in place with the generator which increases revenue for the generator and reducing cost for the consumer. The following processes will be undertaken:

- Identify all future and current large energy users that could have a dedicated generation connection through a private wire or virtual private wire connection.
- Put out tenders to encourage new renewable private wire energy developments where feasible.

- Build a council portfolio of Private and Virtual Private Wire Connections to encourage further developments with renewable generators whilst avoiding network costs and charges.

6.1.4 IMPLEMENT A REGIONAL SMART ENERGY MANAGEMENT SYSTEM

A Regional Smart Energy Management System involves combing key infrastructure to create a single management system that can help reduce total energy use. Within the Region, the councils could aggregate the different public assets to create a Regional Management System. The following tasks will be carried out to meet the objectives:

- Create a detailed business case which described the long-term benefits for the region by implementing a regional smart energy management system.
- Create a technical specification which identifies the key assets to be included and the basic functionality that is required. These could include LED public lighting, public EV charging points, CTV cameras, etc.
- Release tender and the technical specification and procure a supplier of the smart energy management system.
- Identify long term operation and maintenance resource requirements.

6.1.5 IDENTIFY OPPORTUNITIES FOR DEPLOYMENT OF MICROGRIDS AND COMMUNITY ENERGY SCHEMES

Microgrids are small networks of electricity users connected to local sources of generation and active demand management systems that can function independently from the central national electricity network. Microgrids could play an important role in maintaining energy supply security by helping to fill demand gaps created by storms or blackouts which have impacted the centralised national grid. In addition, Microgrid systems could offer the potential to reduce consumer energy costs and allow for the development of RWEM services as “prosumers” trade energy resources within a Microgrid system. For this reason, the North-West Region should investigate opportunities to build and operate microgrids by addressing the following activities.

- Identifying potential rural areas that could benefit from a microgrid installation
- Collaborate with DNOs and iDNOs to investigate the feasibility of the microgrid
- Create small trial sites using council owned buildings to test effectiveness
- Engage with microgeneration companies to create a mix of generation technologies

Community Energy schemes are likely to become more financially attractive as a result of the UK Government’s proposed introduction of new “Export Tariffs” to increase the number of small-scale generators without adding the cost of subsidies to energy bills.

6.1.6 IDENTIFY THE POTENTIAL OF ENERGY SERVICE COMPANIES (ESCOS)

In addition to the goals regarding decarbonisation of the regional energy system, there are additional socio-economic benefits to be realised. Although energy prices for consumers remain relatively high, many consumers do not switch to lower price offerings deals, even though these are available. As a result, Fuel poverty in the region remains high.

Many Local Authorities have therefore begun to explore the opportunity for creation of locally focused Energy Service Companies (ESCOs) to allow local consumers to benefit directly from local investments in renewable generation and demand management platforms. It is therefore recommended that the North-West investigate

the possibility of developing their own ESCO to reduce energy prices for consumers and encourage low carbon generation within the region.

6.2 RENEWABLE GENERATION AND ENERGY STORAGE

6.2.1 GIS MAPPING OF RENEWABLE ENERGY SOURCES

Create a GIS map of the region identifying all possible installation locations for renewable generation (rooftop solar, onshore wind). This will provide a clear view of the potential for further investment in renewable energy within the region and encourage developers and energy consumers to target these locations.

NIE are presently developing a “Heat Map” that projects future energy demand within the province and there may be an opportunity to build upon this application in order to cross reference areas that would benefit for deployment of Distributed Generation in order to build a Renewable Energy roll out plan.

6.2.2 INCREASE INSTALLED CAPACITY OF ONSHORE WIND

Onshore wind already accounts for an important percentage of the low carbon generation within the region. To further encourage the future deployment of new onshore wind and reduce the regions carbon emissions the following local measures will be undertaken:

- Assess opportunities to pair onshore wind with battery storage
- Investigate opportunities for Private and Virtual Private Wire connections to increase revenue for wind farms
- Create incentives for future planning to allow growth in existing wind developments
- Investigate the potential to incentivise the replacement of old wind turbines with higher performing newer models where possible

6.2.3 INCREASE THE PENETRATION OF ROOFTOP SOLAR

Solar technology is an effective way to increase the level of renewable generation installed within the region. The cost of the technology is reducing each year as the technology matures and performance increases. The following tasks will be undertaken to maximise the potential of rooftop solar within the area:

- Assess potential policy and incentive programmes that would facilitate community energy schemes to jointly fund solar projects for social housing and low-income areas.
- Assess and develop appropriate incentives for private housing and local businesses. Target council owned car parks for new installations and co-ordinate with EV charging stations
- Identify potential sites for solar microgrids; target rural areas that contain council buildings to create an independent microgrid system
- Help water companies to install PV and batteries at pumping station

6.2.4 ENCOURAGE USE OF BATTERY STORAGE

Battery storage is an effective solution when combined with renewable generation to overcome the difficulties associated with renewable generation and intermittency. It can also be used to enable flexibility services. The following local measures will be undertaken to increase the adoption of battery storage:

- Assess opportunities for co-location with renewable generation to maximise revenue and support Microgrid operation
- Facilitate time of use energy tariffs to bring in additional revenue from battery systems.

- Assess the feasibility of energy storage with all new developments (housing, commercial buildings, onshore wind etc.)

6.3 LOW CARBON TRANSPORT

6.3.1 FACILITATE THE UPTAKE OF LOW CARBON TRANSPORT

Low carbon transport is considered an important enabler of a future carbon neutral society. As such, it is important that the region is prepared for the uptake of electric and hydrogen vehicles and the necessary infrastructure is in place ahead of time. The following local measures will act as enablers for low carbon transport within the region:

- Enlist the services of transport planners to identify the number of charging points required within the region to facilitate future uptake scenarios
- Work with local businesses to install the appropriate charging infrastructure in place to adequately support the future penetration of electric vehicles
- Invest in EVs and hydrogen vehicles as replacements for the council's current fleet stock
- Incentivise / penalise private companies with large fleets to go electric / hydrogen based
- Public education programme for the benefits (financial & environmental) and performance of EVs to improve public perception.
- Combined LED lighting with EV charging points (Smart Management System)

6.3.2 IMPLEMENTATION OF LOW EMISSION ZONE(S)

Low Emission Zones (LEZ) have been used in many cities around the world to improve the air quality within densely populated areas. A LEZ within the region could incentivise more efficient low emission vehicles in key areas within the region. The following steps will be taken:

- Define areas and roads within the region that would benefit most from a LEZ.
- Follow European standards for low emissions vehicles
- Analyse and observe current Low Emissions Zones in other countries and councils
- Implement a phased rollout in selected towns (low emission, then ultra-low emission) increasing the compliance requirements over time
- Implement a daily charge for any vehicles that are non-compliant
- Provide free parking for low emission vehicles within towns and cities

6.3.3 ENCOURAGE USE OF HYDROGEN AS A FUEL FOR TRANSPORTATION

Hydrogen is a fast-developing alternative fuel source for long haul goods transportation where EV range or cost is prohibitive. The following local measures will be taken to increase the use of hydrogen for vehicles:

- Determine the most suitable long-haul transportation requirements (Buses, lorries etc.) that could switch to hydrogen.
- Define the fuelling infrastructure required in the region to support these vehicles.
- Provide incentives to companies who invest in hydrogen vehicles.

6.3.4 INVEST IN LOCAL GREENWAYS AND OTHER FORMS OF LOW CARBON TRANSPORT

Developing the use of greenways will reduce the total number of cars on the road which has the added benefit of reducing congestion in busy areas of the North-West Region, such as the road between Derry City and Strabane. Implementing these greenways will be done through the following methods:

- Improve the low carbon infrastructure
- Create a car sharing scheme. Incentivise and/or reward individuals who partake in the scheme
- Have a greater uptake of smaller low carbon transport technologies. For example, electric scooters and electric bikes

6.4 LOW CARBON HEATING

6.4.1 ROLL OUT AIR SOURCE AND GROUND SOURCE HEAT PUMPS (HP)

A large percentage of the region currently has no access to the natural gas grid. For those customers, Heat Pumps could provide a viable low carbon alternative to heating oil which is currently prevalent within the region. The following local measures could be taken to encourage the adoption of this technology:

- Create long term incentives to encourage the installation of HPs in homes
- Prioritise financial support for low income households and homes with poor energy efficiency.
- Identify areas to install smart control systems (perhaps network control)
- Co-ordinate with the roll-out of HPs with wider energy efficiency programmes
- Target homes off gas first
- Make tariffs cheaper than heating oil
- Penalise the use of fossil fuels

6.4.2 DEPLOYMENT OF DISTRICT HEATING SCHEMES

District heating schemes may also be a good solution to the current dependency of fuel oil for heating. The following local measures will be taken:

- Carry out assessment of towns and nearby businesses with waste heat to identify opportunities to build district heating schemes.
- Target off-gas grid homes first as alternative to heating oil.
- Work with local developers to identify opportunities for local heat networks.

6.4.3 LOCALLY PRODUCE HYDROGEN AND INJECT INTO NATURAL GAS NETWORK

The natural gas network in the region could be used to transport hydrogen gas in the future if a source of hydrogen becomes available. For consumers who currently have access to the network, converting to hydrogen may be a more cost-effective option that HPs or District Heating schemes. The following local measures will be taken:

- Assess opportunities for industrial electrolysis from excess renewable generation near gas network to locally produce hydrogen gas.
- Determine effective ways to store and transport any hydrogen that is produced
- Investigate natural gas network system as a means to inject and transport hydrogen
- Create incentive for generators that generate excess energy to use the excess energy to generate hydrogen (provide incentives / good buying rates)
- View Orkney as example of a practical application

6.4.4 LOCAL PRODUCTION AND USE OF BIOFUELS

Biofuels may also be a good way to replace the fuel oil used today and may increase the energy security within the region. This will be done using the following methods:

- Create a biomass supply chain in the region to support the local economy

- Convert fuel oil to locally produced wood chips
- Identify opportunities to invest in energy from waste developments (natural and industrial wastes)

6.5 ENERGY EFFICIENCY

6.5.1 UPGRADE ALL BUILDING EFFICIENCIES TO A MINIMUM OF BAND B

With a large proportion of energy consumption coming from heating buildings, an effective way to reduce total energy use and carbon emissions would be to better insulate the buildings. The following local measures will be taken to increase the adoption of this technology:

- Target homes built prior to 1992 with poor energy efficiency performance
- Also target industrial buildings and businesses
- Provide advice or financial support for the installation of cavity wall, loft insulation and double glazing
- Prioritise social housing stock and vulnerable fuel poor residents
- Introduce penalties for any industrial buildings not reaching efficiency targets
- Ensure new developments are built in-line with latest BRE energy efficiency standards

6.5.2 ENCOURAGE USE OF LED LIGHTING IN HOMES AND BUSINESSES

LED's are an affordable way to improve the efficiency of lighting in homes and business and can also reduce energy bills. To help in the implementation of this, the following will be undertaken:

- Provide local education on the carbon and financial benefits of LED lighting
- Provide free assessments for vulnerable residents to upgrade lighting

6.5.3 INCREASE THE PENETRATION ON LOW ENERGY LED STREET LIGHTING

Both local authorities within the region are rolling out LED street lighting. This will be continued and accelerated. It is also beneficial to pair LED lighting within the region with a smart energy management system to maximise savings and increase accuracy of billing and so this will also be undertaken.

7

ROLE OF INNOVATION

7 ROLE OF INNOVATION

To enable both the Strategy and Vision described within this report, the Region will have to engage with various innovations from across several sectors within the energy industry. The following subsections describe the innovation projects that both councils are currently engaged in and the wider industry innovations which could positively influence the Region and the strategy.

7.1 NATIONAL INNOVATION PROJECTS

This section details some of the national innovation projects that both the ROI and NI/UK are currently engaged in and how they may benefit the North-West Region's strategy and vision.

7.1.1 DERRY CITY AND STRABANE FUNDING DEAL

The DCS district is set to receive £50 million in funding to support innovation and the growth of the area's digital sector [103]. A further £55 million has also been allocated to the area with the aim of funding job creation and projects designed to tackle deprivation and develop young people's skills.

This is a significant sum of funding which will help the North-West Region reach its vision and strategy goals. Some of the funding has already been put towards projects including a new university medical education and innovation hub and proposals have been submitted that include the improvements to the areas digital connectivity, the creation of skills academies and the creation of a Centre for Industrial Digitisation, Robotics and Automation. It would be extremely beneficial if the North-West Region utilised some of this funding for innovative LCTs within the DCS area. This may include the trialling and installation of Heat Pumps and District Heating Schemes or improvements to EV infrastructure.

Although this does not affect all of the North-West Region, it would still provide significant benefits to the North-West Region as a whole and help set it up as a leader in innovative energy technologies and systems.

7.2 COUNCIL INNOVATION PROJECTS

This section provides a description of the various innovation projects that both council are currently engaged in and how these are aligned with the strategy and vision for the region:

- **SECURE –** Smarter Energy Communities
- **SmartRENEW –** Smarter Renewable Energy & Heating Management
- **SMARCTIC** – Smart Energy Management in Remote Areas
- **STARDUST** – Holistic and Integrated Urban Model for Smart Cities
- **CLIMATE –** Collaborative Learning Initiative Managing & Adapting to the Environment

This section provides a description of the various innovation projects that both council are currently engaged in and how these are aligned with the strategy and vision for the region:

- **SECURE –** Smarter Energy Communities in Northern & Arctic Regions

  SECURE is an interregional project funded under the Northern Periphery and Arctic Programme 2014 - 2020, with a budget of €1.8 million. It aims to foster energy-secure communities through the promotion of **energy efficiency solutions**. The main objective is to use **transnational**

cooperation to transfer and implement innovative energy solutions for improving energy efficiency and renewable sources in public housing, lighting and public buildings. Stakeholders will also study **effective technologies and good practice approaches** that promote the increased use of energy efficiency and renewable energy resources.

http://secure.interreg-npa.eu/

- **SmartRENEW –** Smarter Renewable Energy & Heating Management for Arctic and Northern Rural Territories

  SmartRENEW is a project funded under the Northern Periphery and Arctic Programme 2014 – 2020 with an allocated budget of €1.6 million. The aim of SMARTrenew is to transfer renewable energy and smart storage solutions to dispersed regions of the NPA. The primary objective of SmartRENEW is to utilise knowledge transfer from partners across the NPA region to improve efficiency and effectiveness of renewable energy sources and implement innovative and sustainable energy storage solutions.

  http://smartrenew.interreg-npa.eu/

- **SMARCTIC** – Smart Energy Management in Remote Northern, Peripheral and Arctic Regions

  Smart energy management in remote Northern, Peripheral and Arctic regions project aims to increase the use of energy efficiency and renewable energy solutions in housing and public infrastructures in remote, sparsely populated areas.

  We are six project partners and five associated partners from Europe and Atlantic Canada that are working together to:

  1. Provide a Smart Energy Management Model (SEMM) suitable for NPA communities.
  2. Build & test the effectiveness of new smart energy solutions.
  3. Increase NPA's communities' innovation capacity to deliver energy solutions.
  4. Disseminate findings outside of the partnership.

  http://smarctic.interreg-npa.eu/

- **STARDUST** – Holistic and Integrated Urban Model for Smart Cities

  STARDUST is an EU Horizon 2020 Smart Cities project, which brings together advanced European cities, thus forming into a constellation of "innovation islands" – exemplary models of smart, highly efficient, intelligent and citizen-oriented cities.

  Cities are highly complex systems. We have seen over the years the evolution of urbanization all over the world yet these cities lack the sustainability required to form a fruitful symbiosis with its citizens. Thus, we saw a rising number of urban challenges in these cities including atmospheric pollution, traffic congestion, fuel poverty, high energy consumption, digital gap and issues with regards to economic growth and job creation.

  Energy, mobility and information and communication technologies (ICT) have been identified recently as key elements in improving citizens' quality of life. In spite the positive outlook they provided, the "dumbing down attitude" of solving urban challenges failed to address the other issues interconnected to them. *Thus, a more holistic approach in the form of interdisciplinary solutions, both technical and non-technical, is needed to approach the said urban challenges predominant in many cities.*

In STARDUST, intelligent solutions for energy, mobility and ICT will be integrated in cities together with innovative business models, which will serve as blueprints for replication across Europe and abroad. These synergy of actions will transform cities into living labs, platforms where citizens and community engagement will become the driving elements to improve not only their way of life but also their local economies.

The project is fully aligned with the Clean Energy for All Europeans strategy and involve STARDUST's objective is to introduce low carbon, highly efficient, intelligent, and citizen oriented cities. This will be done by providing green technical solutions and innovative business models to address the urban challenges identified by the cities involved.

These challenges have got to do with the **environment, society, mobility, energy, economy and the cities' visibility**. To name a few examples are urban poverty, poor waste management, incremental air pollution and traffic congestion, lack of jobs, high energy cost and poor international recognition.

According to the challenges pointed out, selected targets are to be met by STARDUST. These include:

- Creating several ***"innovation islands", or urban incubators*** that demonstrate scalable, cost-effective and bankable urban scale solutions
- Creating ***smart ecosystems*** that makes use of the new economic paradigm in European cities that is based heavily on *eco-innovation, market competitiveness, low carbon usage, and promotion of a circular economy*
- Creating and deploying ***open city information platforms***, an ICT platform that allows both lighthouse and follower cities to engage actively with one another and to address effectively their issues with the technical partners
- Organizing and fostering the ***lighthouse cities' solutions***, which will be transferred and replicated to the **follower cities**

https://stardustproject.eu/

- **CLIMATE –** Collaborative Learning Initiative Managing & Adapting to the Environment

  The main project objective is *"Promote and improve climate change awareness in European peripheral rural communities through a knowledge based approach and community led sustainable resource planning that will mitigate against future climate impact and incorporating transnational collaboration through a best practice model which will improve preparedness for sustainable environmental management in future years".*

  Involved UK and Irish partners' will learn significantly from the climate adaptation expertise of Scandinavian & Faroes partners whilst UK and Irish partners' will share their knowledge & experience of effectively utilising a 'bottom-up' community led approach to achieving desired results.

  The project partners have come together to analyse and evaluate climate change issues and to use best practice models to develop a method for development of a Climate Adaptation Plan and Preparedness Scale matrix for local authorities. This project provides an opportunity for significant delivery of change on a transnational basis, the project will explore possibilities and practical solutions across the regions. This includes opportunities to explore what works in one region and how this can be transferred – particularly from a policy and implementation point of view.

The project will create new environmental management solutions such as a model for development of a Climate Adaptation Plan for local and central government that can be modified and adopted across the NPA region. The Preparedness Scale and Risk Register will also be innovative developments which will build on and adapt the baseline risk assessments carried out to date by Swedish municipalities.

http://climate.interreg-npa.eu/

Northern Ireland Dept. for the Economy

The Department for the Economy have just completed gathering evidence for their draft Energy Strategy for Northern Ireland, and hope to present this to a minister by the end of 2020. They suggest that it will only be achieved through collaboration and joined-up delivery across government departments, the energy sector and other key stakeholders such as local government, consumer representation bodies and academics. With this in mind Derry City and Strabane District Council provided a response to the Call for Evidence, setting out some ideas on how local government are already involved in the energy sector, and making them aware of their continued involvement through this North West Regional Energy Strategy in order to deliver local projects.

Ireland

Ireland has established its own national energy authority, the Sustainable Energy Authority of Ireland (SEAI). Funded through government, they work throughout Ireland with householders, business, communities and government to create a cleaner energy future. There are also various local energy agencies like Codema and Tipperary Energy Agency. Codema is the City of Dublin's Energy Management Agency, and is committed to leading Dublin's low-carbon transition towards 2030 and 2050. They are funded from, and act as the energy advisor to the four local authorities in Dublin, and support each council in leading and influencing this low-carbon transition by improving energy efficiency, incorporating renewable energy technologies and reducing their greenhouse gas emissions. Their mission is to accelerate Dublin's low-carbon transition through innovative, local-level energy and climate change policy, planning and projects, in order to mitigate the effects of climate change and improve the lives of citizens. They recently sourced funding from the initial round of the Climate Action Fund for the south Dublin district heating system.

Tipperary Energy agency is a similar body, a social enterprise, supporting Tipperary county as a whole to reduce energy demand, enabling people, communities and public sector to become more sustainable. They work in community energy, renewable energy, and energy management of buildings. They have helped the county on their way to achieve carbon reduction targets.

Great Britain

The Department of Business Energy and Industrial Strategy (BEIS) in London have recently established a new initiative to fund five Regional Energy Hubs throughout England. One of these, the Midlands Energy Hub, is managed by Nottingham City Council as part of its clean growth strategy. Its mission is to support the capacity of the local enterprise partnerships and local authorities to deliver local low carbon energy projects, reduce carbon, tackle fuel poverty, and create new green jobs.

North West Regional Energy Hub

With consideration of above, the councils are exploring various internal and external funding streams in order to kick start the process of delivering on the five key themes as detailed in the Roadmap, along with the Flowchart of Smart Energy System work streams as set out within the recommendation section of this report. We will therefore seek to coordinate each of the main areas of activity, and to develop each of the work streams as laid out within the Flowchart of the Smart Energy System.

Derry City and Strabane District Council in conjunction with Donegal County Council is considering a similar model to Codema in order to deliver this North West Regional Energy Strategy. The North West Regional Energy Hub will initially be funded by both councils, and both councils would retain overall governance responsible for this organisation.

7.3 OTHER INNOVATION TOPICS

It is important that the region stays up to date with the latest "State of the Art" and innovations in Energy as the North-West Regional Energy Strategy is implemented. There are many innovation projects and demonstrators around the world with the goal to reduce carbon emissions. This presents the Region with fast follower opportunities to implement the learnings and developments that arise from global innovation projects as they become available.

As an example, the RUGGEDISED project has brought together six European cities to accelerate a path towards a sustainable future by creating model urban areas [104]. The project is funded under the European Union's Horizon 2020 research and innovation programme and intends to partner with industry and academia to demonstrate how to combine ICT, e-mobility and energy solutions to design smart future cities.

In total, RUGGEDISED has funded 32 innovative projects in the cross-section of energy, transport and ICT as seen below.

Smart Thermal Grid:

- Geothermal heat/cold storage and heat pumps
- Geothermal heat/cold storage
- Thermal energy from waste water
- Surface water heat/cold collection
- Pavement heat/cold collector
- Peak load variation management
- Heat exchange/connection of buildings to district heating network
- Smart City connection to 100% renewable energy

Smart Electricity Grid and E-mobility:

- Smart charging parking lots
- EV-charging infrastructure hub
- Surplus power storage in EV charging hub

- Innovative connection to renewables and storage
- Intelligent LED street lights with integrated e-vehicle charging functionality
- Optimising the e-bus fleet
- Energy optimised electric BRT-station
- EV-charging hub battery storage in car parks
- RES generation and storage for mobility
- Optimisation of the integration of near-site RES
- Energy-efficient land use through flexible green parking

Energy Management and ICT:

- Energy management system
- 3D city operations model
- Long-range wireless network
- High performance servers to heat homes
- Smart waste management
- Intelligent building control and end user involvement
- Smart open-data city platform
- Smart open-data decision platform
- Efficient and intelligent street lighting
- Intelligent LED street lights with integrated e-vehicle charging functionality
- Implementation of energy demand management technology in a university campus
- Implementation of energy demand management technology in street lighting
- Implementation of energy demand management technology in domestic & non-domestic properties
- Development of an Energy Innovation Company to support and drive decarbonisation activity

8

CONCLUSIONS

8 CONCLUSIONS

Both Derry City & Strabane District Council (DCSDC) and Donegal County Council (DCC) have joined forces to build a sustainable and low carbon North-West Region which can encourage further economic growth whilst reducing the carbon emissions arising from the use of energy within the North-West Region.

This North-West Regional Energy Strategy has defined the current energy system within the region and potential opportunities that are available to help meet binding national and European carbon reduction targets. These opportunities have been mapped against five themed areas as described below.

A number of recommended immediate next steps have been proposed in order to provide a foundation for the creation of a Regional Whole Energy decarbonisation programme that is capable of realising the goal of Net Zero by 2045.

Smart Energy Management The smart control and coordination of regional energy assets to minimise energy bills and unlock new revenue streams.
Renewable Generation & Energy Storage Maximising the potential for green renewable generation throughout the Region efficiently coupled with energy storage technologies.
Low Carbon Transport Delivering a low carbon transport system to reduce carbon emissions and improve air quality.
Low Carbon Heating Enabling the transition from fossil fuelled heating technologies to low carbon or emission free heating solutions.
Energy Efficiency Increasing the efficiency of energy use within buildings across the Region to minimise consumption and reduce the associated carbon emissions.

It is clear from above that there is a considerable amount of work over many years requiring a coordinated effort in order to develop and deliver, the projects set out within the North West Regional Energy Strategy. We are aware that as we are consulting on this strategy, the NI Energy Strategy is also being developed, and the intention is that both strategies are finalised towards the end of 2020. In keeping with similar organisational arrangements in both Ireland and England, we are confident that a delivery body such as a Regional Energy hub would work well in the North West of Ireland.

9

RECOMMENDATIONS & NEXT STEPS

9 RECOMMENDATIONS & NEXT STEPS

The following steps are recommended as a short-term action plan to facilitate the implementation of the roadmap which is described within this strategy in Section 6. This includes a number of in-depth feasibility studies and analysis to be carried out on each of the potential local measures. This will allow the North-West Region to develop a clearer view on a Smart Energy System and quantify the business case associated with each potential initiative, including all costs and benefits.

The following subsections describe many recommended activities that should be carried out over the next 3-5 years to allow the Smart Energy System for the Region to be better defined and to ensure progress is made against the long-term roadmap.

9.1 THE NORTH-WEST SMART ENERGY SYSTEM (NWSES) STUDY

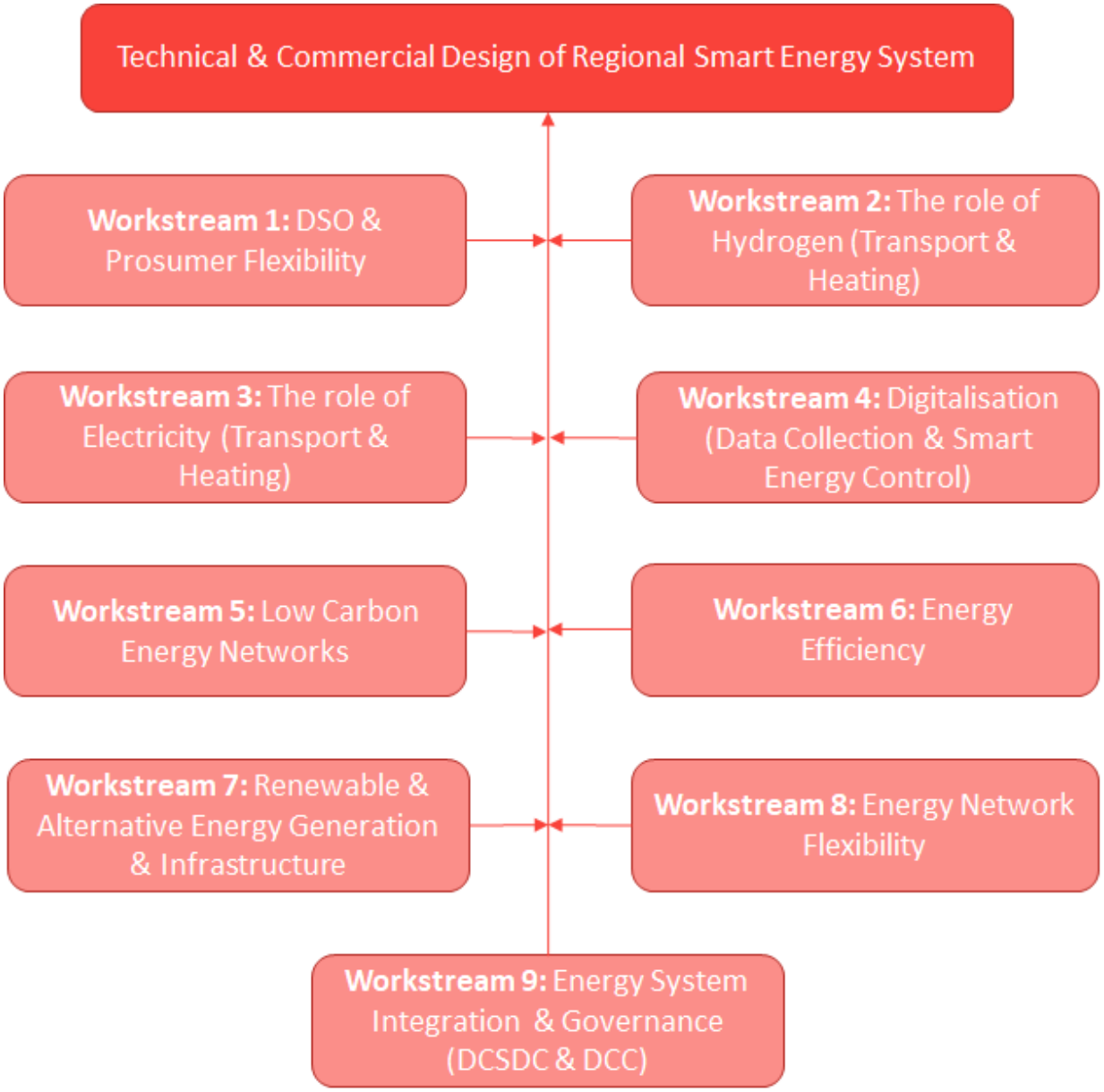
The NWSES study will deliver an optimal smart energy system design specifically for the North-West Region which is considered both low cost and will deliver a “Net Zero” Regional Whole Energy system by 2045. This will incorporate Heat, Transport and Power together as one multi vector energy system across the entire North-West Region.

This study will produce a detailed design for a smart “Net Zero” energy system for the North-West which views the multiple energy vectors as part of one interconnected energy system. A suite of Commercial mechanisms and tools should be designed which ensure that the desired future energy system is realised and binding carbon targets are reached ahead of time. Broadly speaking the following steps are recommended to allow a fit-for-purpose Smart Energy System for the North-West to be designed:

- Develop a Regional Spatial Energy Demand Analysis to map energy information for the Region and create respective geographic energy profiles for the commercial, residential and municipal sectors;
- Define and propose revolutionary market and business model options for the provision of cross boarder Smart Energy Systems;
- Develop selection criteria to assess the suitability of the market and business models;
- Investigate possible funding models and structures to finance the project. Ensure business model will attract finance and investment;
- Perform impact assessments to compare effects of business models on value chain for Whole Energy System. Develop financing proposals that share benefits and risks fairly between investors, consumers, utilities and authorities;
- Validate revenue streams and value proposition of the proposed business models. Recommend most appropriate model that aligns with strategic objectives of the North-West region;
- Develop detailed design for chosen business model and determine expected outcomes. Implement business model to build financial structure of project;
- Deliver a strong communication, engagement plan, recommend activities to achieve strategic objectives of the project and to share operations with projects in other localities.

Once this overarching view of the Smart Energy System of the future has been defined for the region the following technical and commercial Workstreams will further act to prove and demonstrate how the modelled energy system will operate both technically and commercially. This is shown in Figure 9-1.

Figure 9-1 - Flowchart of Smart Energy System workstreams



The high-level scope associated with each Workstream is further defined below. Please note, that the scope currently described is flexible and can be adapted with input from partners which form the consortium. The detailed scope and delivery plan for each workstream will be developed as part of the ISCF proposal.

Workstream 1 – DSO & Prosumer Flexibility

Possible Partners / Contributors: DNOs, Regulator, Aggregators, Domestic and Commercial Consumers; Local Authorities, Housing Association, University, consultancy support etc.

This Workstream will act to identify how consumers and prosumers of all sizes can act within a whole system energy market place for demand aggregation and flexibility services within the North-West. Specifically, it will identify how consumers of all sizes can be best represented within this new market place and how they can maximise future revenue streams from the wider value chain using their energy assets through demand side response, load management schemes and active network management.

Furthermore, the Workstream will follow industry best practice to define a market model for flexibility services that can be implemented within the region which considers existing regulation and identifies any changes which may be required to current regulations. This will involve close involvement from a broad range of industry stakeholders including DNOs (ESBN, NIEN), the regulators (CRU, UR), energy suppliers and consumers (domestic and commercial).

Workstream 2 - The Role of Hydrogen in Transport and Heating

Possible Partners / Contributors: Gas Network Operator, Energy Company with Hydrogen Experience, University, consultancy support etc.

This Workstream will identify all opportunities to produce Hydrogen gas locally to support the decarbonisation of both transport and heating. For heating, the workstream will identify where and how hydrogen gas can be injected into the local natural gas network and build guidance on what adaptions are required to natural gas heating systems to operate on hydrogen gas.

Similarly, this Workstream will build business models and a view of a future hydrogen supply chain within the reason to fuel low carbon hydrogen transport.

Workstream 3 – The role of Electricity in Transport and Heating

Possible Partners / Contributors: Local Authority**,** Housing Associations local businesses with fleets, ESBN, NIEN, consultancy support, EV charging point suppliers etc, Heating equipment suppliers

To meet Irish low carbon transport targets the charging infrastructure within the North-West region will need to be developed to facilitate the mass adopted of electric transportation of all types.

To achieve this goal, this Workstream will combine transport planning with an assessment of available network capacity within the region to identify and map the optimal locations for future installations of EV charging points (fast, rapid & ultra-rapid) to facilitate the adopted of electric cars (domestic, fleet vehicles, long haul etc).

The creation of business models and financial incentives will then be used to encourage investments in these charging point locations to ensure the required infrastructure is in place within a suitable timeframe.

The electrification of heat will place a significant additional load onto the LV network within the region if adopted on mass. To account for this, this Workstream will identify constraint areas across the electricity network within the region and identify the lowest cost alternative low carbon heating technologies or smart methods which can be used to accommodate this additional load at lowest cost to the consumer (hybrid heat pumps, flexible connections, voltage regulation devices etc.)

As an output, this Workstream will deliver a detailed Cost Benefit Analysis which identifies where the electrification of heat should be prioritised within the North-West and what support or incentives are required to quicken the deployment within the region.

Workstream 4 – Digitalisation (Data Collection & Smart Energy Control)

Possible Partners / Contributors: Local Authorities, Network Companies, Data Analytics, Machine Learning, Universities etc.

This workshop will design the digital architecture required by the cross boarder regional Smart Energy System. This will include a review of how Smart Meters can be best introduced within the region and how the data collected can be used to efficiently operate the Whole Energy System within the North-West across all energy vectors.

Workstream 5 - Low Carbon Energy Networks

Possible Partners / Contributors: Local Authorities, Housing Association, Consultancy Support, Universities etc.

District heating schemes have been proven as cost effective ways to provide low carbon heat to many households and commercial premises within one heating network. This Workstream will identify all opportunities to build low carbon heating networks within the North-West Region and build details business cases to justify their future deployment.

It will also investigate and demonstrate the ability to utilise any excess renewable generation (curtailed wind generation) within the region to produce low carbon hot water for heating. Opportunities to use excess use from industrial processes within the region will also be assessed to understand the scale of the opportunity.

Workstream 6 – Energy Efficiency

Possible Partners / Contributors: Local Authorities, Housing Associations, SEAI, Local Energy Efficiency SMEs, Consultancy Support.

A critical element of a Smart Energy System is ensuring the system is efficient. This is the case within domestic and commercial buildings across the North-West Region. Consequently, this work stream will design a detailed strategy for the North-West to increase its energy efficiency within both its existing buildings and future developments.

This workstream will design detailed commercial business models in collaboration within Workstream 5 to enable the most efficient smart regional heating system which minimises energy losses and consumers heating bills.

Workstream 7 – Renewable & Alternative Energy Generation Infrastructure

Possible Partners / Contributors: Local Authority, Consultancy Support, large energy consumers, University etc.

The high cost to connect to the electricity network and the limited network capacity can limit the financial viability of future connections of renewable generators such as wind farms. To account for this, new innovative connections are required which could lower the cost of connecting to the network.

Private wire and virtual private wire connections are examples of commercial innovation which could significantly lower the cost of building new wind farms within the region. This Workstream will look to identify opportunities within the region to match large energy consumers with new renewable generators through both private wire and virtual private wire connections and generate detailed business models which justify their future deployment.

Workstream 8 – Energy Network Flexibility: Flexibility between Gas and Electricity Networks

Possible Partners / Contributors: Gas Network Operator, DNOs, Consultancy support, University

Both the electricity and gas networks are major suppliers of energy for a vast range of purposes. Both networks operate under their own constraints. The purpose of this Workstream is to model specifically how the electricity and gas networks within the North-West can work together across both vectors to alleviate constraints and minimise the cost of providing low carbon energy to consumers within the region.

Workstream 9 – Energy System Integration & Governance (DCSDC & DCC)

Possible Partners / Contributors:

The purpose of this workstream is to identify the commercial and technical mechanisms that need to be designed, tested and implemented to create one coordinated Smart Energy System for the North-West which is applicable across the entire region. The workstream will demonstrate how a Smart Energy System can be efficiently implemented across a national boarder, in this case the border between DCS & County Donegal. It will also identify all opportunities for the whole energy systems across the entire North-West region to be coordinated and planned as a whole across all energy vectors and energy networks.

9.2 NEXT STEPS

As the workstreams outlined in this section begin to develop and grow, it is recommended that the Councils explore all avenues of funding in order to progress the establishment of the North West Regional Energy Hub.

Appendix A

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