arrigaline Tidy Towns
SUSTAINABLE ENERGY COMMUNITY

Carrigaline Energy Masterplan

June 2023






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CARRIGALINE ENERGY MASTER PLAN

June 2023

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Contents

****Please be aware that supporting Annexes B, C , D and E will be issued separately to this document****

Chairpersons Address

In January 2021, the Carrigaline Tidy Towns Sustainable Energy Community (SEC), a voluntary group, was established under the aegis of Carrigaline Tidy Towns. The SEC is part of a twenty-six counties network. The network is coordinated by the Sustainable Energy Authority of Ireland (SEAI), with the aim of encouraging and supporting the involvement of communities in the transition to a low-carbon future. SEAI offers guidance and mentoring as well as providing access to grant support.

Our Vision

To create a vibrant energy-efficient community that is aware of the current, and future needs of Carrigaline, and to reduce our Carbon Footprint which will result in energy savings for all in our community. Carrigaline SEC, decided as a first step to develop an energy master plan for Carrigaline.

The master plan:

1. Quantifies the current energy status of our community as a baseline of electrical, thermal and transport energy demand.
2. Identifies any existing renewable energy sources within the community.
3. Includes a Register of Opportunities - a list of potential projects for energy efficiency and renewable energy.
4. Outlines suitable projects for the first three years and sets energy reduction targets against the baseline figures

This plan was developed over a period from Jan 2021 to June 2023. On behalf of the committee, I would like to thank Plan Energy who drafted and produced the report in consultation with the SEC. We would also like to thank SEAI who grant-funded the plan and mentored the SEC, SECAD for their advice, support and funding for our graphics, and Design Republic for the graphic designs used in our media presentations and community surveys. A special thanks to the SEC committee for all their hard work over the past 31 months.

It is with great pleasure that we present the Energy Master Plan for the town of Carrigaline to those living in the area. While we realise the Plan, is only the first step on a long road, we hope it ignites the spark to transform our vision into a reality.

Liam Doyle
Chairperson Carrigaline Tidy Towns SEC

Carrigaline profile

Carrigaline is the largest town in County Cork, situated on the river Owenabue, approximately 13 kilometres south of Cork city, 8 km from the Port of Cork and 10km from Cork Airport. It forms part of the Carrigaline Municipal District (MD) which also includes a number of other settlements and a rural hinterland to the west and the south of Cork city. Carrigaline town represents approximately 45% of the population of the MD.

The town sits at the head of the Owenabue Estuary which forms part of Cork Harbour. The fast-expanding town offers a very comprehensive range of services and facilities. The location adjacent to designated scenic landscape, and to Cork Harbour is such that it provides an opportunity to create a high-quality living environment.

Carrigaline in the 17th century was a small village built around the last bridge over the Owenabue River before the river widens to the sea. It stayed that way for 300 years or so; growing slowly, fed by farming and a couple of notable local industries including Carrigaline Pottery. Everything changed at the start of the 1970s, when Carrigaline was earmarked by the County Council as a future satellite town for the growing Cork city. Several new housing developments were constructed over the following decades as new residents and city commuters poured in.

But Carrigaline prides itself on having kept some of its 'small village' feel – a town with a strong identity and sense of belonging. Like many other towns adjacent to large cities in Ireland, Carrigaline has a relatively large population. It is estimated that the population today (March 2023) is approximately 20,000 to be confirmed by the 2022 Census.

A lot of this population increase can be attributed to the fact that Carrigaline is situated close to major employment centres – Cork City, Ringaskiddy and the Port of Cork. Industries such as Janssen Sciences (Centocor), Thermo Fisher Scientific (GlaxoSmithKline), Hovione, Novartis, Pfizer and Bio Marin, all operatE in the pharmaceutical hub of Ringaskiddy. In addition, the National Maritime College of Ireland and UCC's Maritime Research Centre (Wave Energy) are also based in Ringaskiddy, with the Irish Naval Service based on the nearby island of Haulbowline, which is connected to Ringaskiddy by a bridge. All these sites attract a significant number of commuters from Carrigaline.

Carrigaline itself also has major employers such as PepsiCo, Munter, Kerry Foods and Good Fish. In addition, Carrigaline has a Hotel, the Carrigaline Court Hotel and Leisure Centre, which services not only holiday traffic but also the large business traffic to Ringaskiddy. Carrigaline is also well served with three major Supermarkets and a fourth in build phase, which serve all the shopping needs of Carrigaline and its hinterland. Dairygold Co-op Superstores provides DIY, household goods, fuel and agricultural supplies.

Past population increases have led to the development of significant transport infrastructure. The N28 from the Bloomfield interchange to Ringaskiddy is currently being rerouted and upgraded to a dual carriageway to serve Carrigaline, industry in the Lower Harbour, and the Port of Cork. Future plans include, cycle and walking development under the Carrigaline Transportation and Public Realm Enhancement Plan (Transport in Carrigaline is considered in greater detail in later sections of this report).

With the popularity and growth of Carrigaline, its town centre encapsulates all that makes an ideal location for future development, mixed use activities and town centre living. Cork County Council has signalled support for the primacy of the town centre, encouraging a mix of uses to facilitate sustainable transportation, as well as encouraging a greater focus on town centre living and placemaking. Over the next decade there will be a need to provide for mixed use town centre activities in line with national, regional and local planning policy for this strategically located town.

According to the 2022 – 2028 Cork County Development Plan, the strategic aim is for Carrigaline to "consolidate the rapid growth of recent years broadly within the town's existing development boundary, protecting its important green belt setting while maintaining its distinctiveness …. and increase active and sustainable travel movements in the town". The Plan further states that "future growth will occur within the existing development boundary and will primarily focus upon the redevelopment and rebalancing of the Town Centre".

The Carrigaline area is blessed with natural beauty because of its geographic location at the Head of the Owenabue Estuary, which is of considerable scenic beauty, with much of it proposed as a Natural Heritage Area. Furthermore, Currabinny Forest Trail is just a short distance east of Carrigaline and represents one of many scenic walks in the area.

The natural landscape that surrounds Carrigaline has also helped boost its agriculture sector. The area known for its fertile lands and favourable climate, making it an ideal location for agriculture. The agriculture sector in Carrigaline is diverse, with farmers cultivating a variety of crops and raising livestock. The area is particularly well-suited for dairy farming, with many dairy farms producing high-quality milk for the local market and beyond. Overall, agriculture plays an important role in the local economy and is a source of pride for the community, who are committed to sustainable and ethical farming practices.

Carrigaline has a long history of generating renewable power which were closely intertwined with its strong history of mills in the town. In fact, in 1928 Hodder W.B. Roberts founded the Carrigaline pottery factory at the site of the Upper mill. The first task carried out was the refurbishment of the mill and this included the installation of a 50-horsepower turbine, which was powered by a millstream built in 1825. As part of the Energy Master Plan and future developments it's hoped that Carrigalines' renewable energy generation will continue to form part of the town's character.

Glossary of Terms

Although all efforts have been made to keep the language in this report non-technical, through the use of infographics and normal language it is not always possible. In order to mitigate against this, we have provided a glossary of key terms used through-out this report and an explanation of their meaning. An additional excellent resource for understanding all terminology around energy and environment is https://climatejargonbuster.ie/Energy Efficiency

Energy Efficiency - It is energy efficient when we use less energy to achieve the same result.

Register of Opportunities (RoO) - The Register of Opportunities is a list of projects or opportunities within your community which if executed will result in energy efficiency and a reduction in energy use and the associated CO_2 output.

Kilowatt hours (kWh) - One kilowatt-hour is equivalent to 1000 watts of energy used for 1 hour. For example, a 100-watt lightbulb switched on for 10 hours uses one kWh of electricity.

Thermal Energy - Defined as energy used to generate heat. This commonly refers to the energy used to heat homes by burning oil, timber peat or using electricity in heat pumps.

Energy Savings - Energy in whatever format it is being consumed usually costs money (€). By reducing the amount of energy consumed you are also reducing the cost associated with providing that energy.

Building Energy Rating (BER) - BER stands for Building Energy Rating. A BER certificate shows you the energy performance of your home. It is a good indicator of how much you will spend on energy (like heat and light) and how much CO_2 you will release to heat your home to a comfortable level.

The BER rating goes from A to G. A-rated homes are the most energy efficient, comfortable and typically have the lowest energy bills. G-rated homes are the least energy efficient and require a lot of energy to heat the home.

Renewable Energy - Renewable energy comes from renewable resources like wind energy, solar energy, or biomass.
These resources can regenerate naturally, and we can use them repeatedly without reducing their supply.

Carbon Dioxide/ CO_2 - Carbon dioxide is a powerful greenhouse gas. It is naturally part of the air we breathe. However, human activities like burning of fossil fuels and deforestation have led to an increase in CO_2 in the air that contributes to climate change.

Carbon Footprint - Carbon footprint measures the carbon emissions linked to a particular activity or product. It includes emissions involved in all stages of making and using a product or carrying out an activity. The lower the carbon footprint the less that a product or activity contributes to climate change.

Renewable Electricity Support Scheme (RESS) - This Government scheme provides financial support to renewable electricity projects in Ireland to help us achieve our renewable electricity goals. It also aims to increase community participation in, and ownership of, renewable electricity projects. It aims to make sure electricity consumers get value for money and to improve security of our electricity supply.

Thermal Energy - Defined as energy used to generate heat. This commonly refers to the energy used to heat homes by burning oil, timber peat or using electricity in heat pumps.

Sustainable Energy Community (SEC) - An SEC is a community in which everyone works together to develop a sustainable energy system. To do so, they aim as far as possible to be energy efficient, to use renewable energy where feasible and to develop decentralised energy supplies.

Units
Throughout this report we present energy use and energy production, in kilowatt or megawatt hours per annum (KWh/yr) and (MWh/yr). These units of measurement are used regardless of the fuel used. As a reference point, a typical house consumes approximately 22MWh per annum. We also present carbon emissions in tonnes or kg of CO_2/annum. Energy costs are presented in euro spent on energy per annum.

Energy Credits - Projects that generate verifiable energy saving credits, can be sold to energy suppliers and obligated parties. The obligated Energy Suppliers then apply the energy savings towards their yearly targets, reducing overall energy consumption and carbon emissions.

For a more detailed explanation please see:
https://www.seai.ie/business-and-public-sector/business-grants-and-supports/energy-efficiency-obligation-scheme/

Small Area Plans - Small Areas are areas of population generally comprising between 80 and 120 dwellings created by The National Institute of Regional and Spatial Analysis (NIRSA) on behalf of the Ordnance Survey Ireland (OSi) in consultation with CSO. Small Areas were designed as the lowest level of geography for the compilation of statistics in line with data protection and generally comprise either complete or part of townlands or neighborhoods. There is a constraint on Small Areas that they must nest within Electoral Division boundaries.

Shallow Fabric Retrofit
Basic measures such as better air tightness, cavity and loft insulation, cylinder insulation, LED lights and wood stove

Medium (boiler) Retrofit
“Shallow fabric” plus External Wall Insulation, boiler, controls, new door, double glazing

Medium (Heat pump) Retrofit
“Shallow fabric” plus External Wall Insulation, heat pump, controls, new door, double glazing

Deep (Heat Pump) Retrofit
Medium (Heat Pump)” plus triple glazing, sloping ceiling internal insulation, demand control ventilation, Photovoltaic (PV) system

Ireland's Climate Action Plan 2021

- The Climate Action Plan (CAP) is a roadmap developed by the Government for taking decisive action to reduce Ireland's emissions by 51% of 2018's totals by 2030, and net zero by 2050. This is done by sector with a clear goal set out for each sector. Table 1 shows the mandated emissions reductions for each sector to achieve the target.

- The statutory national climate objective and 2030 targets are aligned with Ireland's obligations under the Paris Agreement and with the European Union's objective to reduce GHG emissions by at least 55% by 2030 (compared to 1990 levels) and to achieve climate neutrality in the European Union by 2050.

- Targets for each sector of the economy will be updated annually to ensure alignment with the governments' legally binding economy-wide carbon budgets and sectoral ceilings.

- Whilst all the sectors referenced in Table 1 are relevant for the Carrigaline EMP, of particular importance are the Transport, Agriculture and Building sectors.

- One of the standout targets for the Electricity sector which is particularly relevant for the Carrigaline SEC is the target of increasing the amount of electricity generated by renewable sources to 80%. SEC's can play their part through small-scale renewable energy generation in the community as will be discussed later in the report.

Table 1 – Summary of the sectoral targets in the 2021 Climate Action Plan

Sector	Reduction	2018 *	2030 ceiling *
Electricity	75%	10.5 MtCO2eq	3 MtCO2eq
Transport	50%	12 MtCO2eq	6 MtCO2eq
Buildings (Commercial and Public)	45%	2 MtCO2eq	1 MtCO2eq
Buildings (Residential)	40%	7 MtCO2eq	4 MtCO2eq
Industry	35%	7 MtCO2eq	4 MtCO2eq
Agriculture	25%	23 MtCO2eq	17.25 MtCO2eq
Other**	50%	2 MtCO2eq	1 MtCO2eq

- Regarding transport, the expectation is that Electric Vehicles will cover 40% of car journeys by 2030. Conversely, public and active transport services will receive heavy investment, enabling an additional 500,000 daily journeys.

Introduction to the Energy Master Plan

To assist in achieving the Carrigaline Sustainable Energy Community's goals, an Energy Master Plan study has been conducted. This Energy Master Plan (EMP) has been funded by SEAI to assist in developing and refining short, medium and long-term plans for the Carrigaline Sustainable Energy Community.

The Master Plan aims to help communities understand their current energy usage and carbon footprint so that they can understand where they currently are, thereby allowing them to set reduction targets for the future.

The information gathered and tools developed to review projects will help the SEC strive toward being an exemplar model in the transition to a low carbon community.

The Energy Master Plan is based on a mixture of desktop research utilising publicly available information sets from a range of sources CSO, SEAI, POWSCAR, CIBSE, Pobal, County Council, etc.

Using modelling tools and methodologies developed inhouse by Plan Energy Consulting, the Energy Master Plan will also capture the energy consumption, emissions and spend within the community.

The EMP consists of three separate documents:

- The EMP report (this document)
- A Register of Opportunities document
- A document detailing home energy audits and non-domestic property audits

The EMP report begins with a sectoral energy breakdown that will give a broad overview of each sector's (Residential, Non-Residential, Transport, Agriculture) energy consumption, energy cost and contribution to CO_2 emissions in the Carrigaline SEC, followed by a brief discussion on how the SEC compares to national averages.

These sections form the basis of the recommendations and options supplied for a transition to renewable energy sources in each of the sectors as well as opportunities for energy reduction and increased efficiency within the Register of Opportunities document (in Annex D).

The EMP will identify the potential for the implementation of sustainable transport models such as electric vehicle (EV) charging infrastructure, alongside renewable energy generation possibilities from many varying sources such as wind, solar etc.

Reviewing the natural resources available to the community, high level analysis is provided on various renewable energy technologies that the community could further pursue. A wide range of natural resources are often within a community's grasp, however the understanding of how to progress from a concept through to reality can be an enormous barrier.

This EMP outlines the processes required by the SEC to quantify what these resources can offer, alongside how renewable projects can transition from an idea to a system that is owned by the community, contributing to the sustainable, decarbonisation of the area.

The report concludes with an Action Plan, Sustainable Energy Roadmap and Register of Opportunities section, which the community can use as a benchmarking tool, as they seek to become more energy efficient and reduce their carbon footprint over the next decade.

The final document is a collection of case studies, showing how various buildings in the Carrigaline SEC, both domestic and non-domestic, could be upgraded to a higher BER and decrease their energy efficiency. It begins by analysing a selection of the most common house types in Carrigaline and identifying various measures that homeowners could use to improve their homes energy efficiency and displaying these according to the amount of work a homeowner could feasibly carry out on their property.

It then details the findings from two non-domestic audits that were carried out on a community building and dairy farm in the SEC, complete with energy analysis and recommendations of how to reduce the respective cost and consumption moving forward.

Perhaps the primary benefit of the EMP is that it increases awareness in energy efficiency across the community.

This process begins through the interactive community survey issued, meetings with the SEC committee, energy audits of public buildings and finally the launch of the report at its conclusion. This report includes recommendations, demonstrating examples of what the community can do to change behaviour and increase the understanding of climate action and how those involved can contribute toward this shared objective of reducing their impact on the environment. The EMP covers 54 Small Area Plans [1] which are defined by the Central Statistics Office (CSO) and are shown below in Figure 1.

Figure 1 - The image depicts the area covered by Carrigaline SEC. This was generated using the Small Areas as defined by the Central Statistics Office (CSO SAPMAP 2016).

[1]Small Areas are areas of population generally comprising between 80 and 120 dwellings created by The National Institute of Regional and Spatial Analysis (NIRSA) on behalf of the Ordnance Survey Ireland (OSi) in consultation with CSO.

Executive Summary

The table below provides a holistic overview of the energy consumption, emissions and cost associated with Carrigaline SEC.

Table 2 – SEC Total Energy, CO_2 and Cost Analysis

					
	ELECTRICITY	**FOSSIL FUELS**	**TRANSPORT**	**AGRICULTURE**	**TOTAL**
ENERGY MWh	72,770	115,078	68,148	342	256,338
CO_2 EMISSIONS tCO_2	26,282	24,152	17,177	6,225	73,836
TOTAL ENERGY COST	€11,863,428	€14,172,000	€13,762,823	€131,402	€39,929,653

Apart from Agriculture, all of the data on this page was calculated using data from Central Statistics Office 2016 Census of Ireland (CSO, 2016), whilst the emissions and Energy Cost were calculated using SEAI Domestic and Commercial Fuel Cost Comparison (SEAI, 2022).

Due to the sparseness of publicly available Agricultural data, the EMP relied on data supplied by Carrigaline SEC. It was decided that it would be sensible to concentrate on the Energy consumption on Dairy farms as their energy profile far outweighs that of a cattle and/or tillage farm and the exact breakdown of meat and tillage farms is unknown. Data supplied by the SEC was supported by data from Teagasc (2018). Its comparatively low figure will be clarified later in the document on page 61.

The EMP breaks down the energy consumption and fuel mix within the community's catchment area into 4 key sectors consisting of:

1) Residential
2) Non-Residential (Building stock that is not classified as a home, e.g., Commercial, community or industrial buildings
3) Transport
4) Agriculture (Dairy farms only)

The sectoral baseline energy usage analysis, which will be discussed in more detail in later sections, is summarised in Table 3 in the form of an energy balance for the whole catchment area. This provides a full picture of how much energy is used in each sector, which helps identify and prioritise areas for action by the Carrigaline SEC.

Table 3 – Sectoral percentage energy consumption

Carrigaline SEC Primary Energy Baseline (MWh)				
Sector	**Electricity**	**Fossil Fuel**	**Renewable**	**Total** (MW)
Residential	54,072	78,628	473	133,172
Non-residential	18,697	36,450		55,147
Transport	109	68,039	4,715	72,863
Agriculture	342			342
Total Energy	73,220	183,117	5,188	261,524

Our analysis of the energy consumption within the catchment area has identified that 50.9% of the energy demand relates to the residential sector, 21.1% in the non-residential sector, approximately 27.9% in the Transport sector and 0.1% in the Agriculture sector.

Residential sector

Background

The Residential sector is one of the largest emitting sectors in Ireland, accounting for 29% of CO_2 emissions and roughly a quarter of the energy used in Ireland as per 2020 estimates from SEAI. Therefore, if communities want to make progress towards individual targets, as well as contributing to the national target of reducing all CO_2 emissions 51% by 2030, it is vital this sector is given particular focus.

Whilst energy usage from the residential sector has increased by almost 19% from 2014 to 2020, emissions only subsequently increased by 1%. These figures have been attributed to higher household incomes and expenditure which led to higher energy usage but have been balanced out by improvements in energy efficiency as a result of updated building regulations and homeowners increasingly more willing to invest in fabric upgrades within their homes.

The momentum within the country has been to ensure that as many homes as possible upgrade their homes insulation ahead of 2030, with the Irish Government setting the ambitious target of 'retrofitting' [2] 500,000 homes to a B2 Building Energy Rating (BER) by 2030. By retrofitting homes in a manner that focuses on enhancing their insulation, homeowners don't have to use as much energy on space heating within their home, which will naturally lead to emission reductions within the residential sector.

The residential section of this report will seek to analyse what retrofit measures may be suitable for properties in the Carrigaline SEC based upon housing age, occupancy, ownership and type. Furthermore, the fuels used to heat homes within the Carrigaline SEC are analysed for their emissions in tonnes of CO_2 equivalent.

The fuel mix can have a significant impact on the carbon footprint of a SEC as each fuel type has its own associated CO_2 output. For example, coal and oil produce approximately 0.4kg and 0.3kg of CO_2 respectively, for every kilowatt hour of energy delivered, compared to just over 0.2kg for natural gas.

The BER is based upon the provision of space heating, water heating for domestic purposes, ventilation, and lighting. The BER does not include what are called point load consumption such as plugged-in electrical appliances [3]. A breakdown of the communities BER ratings per Small Area Plan is provided, which helps identify those sectors of the community that require more investment to improve their BER. Given that a BER is a reflection of a home's energy efficiency, a lower BER implies that homeowners are using more fuel to heat their homes. Given the continued rise in energy costs, a strong BER can alleviate homeowners from fuel poverty and prevent others from going into it.

[2] A process where you look at the house's overall energy efficiency and use a combination of measures to improve it.

[3] An excellent reference which provides a breakdown of all energy used in the home is the "SEAI Energy in the Residential Sector 2018" Report - https://www.seai.ie/publications/Energy-in-the-Residential-Sector-2018-Final.pdf.

Method

An analysis of the residential housing stock in the catchment area of Carrigaline SEC has been carried out based on Central Statistics Office (CSO) data and the Eircode database provided by ESRI.

The residential housing stock is based on a baseline year of 2016 and a breakdown of the number of residential units which are vacant or classified as holiday homes is derived from the Eircode Database which is based on a baseline year of 2022. Statistics for residential heating are based on national averages against primary heating type. This allows for comparison against future census data.

The SEAI Building Energy Rating (BER) Map shown in Figure 8 displays colour coded 'Small Areas' of the Carrigaline SEC. The colour of a given small area represents the median BER of dwellings in that small area. The map only contains BER Information at the Small Area level for dwellings that have had a BER completed.

The medians were derived from all geo-located dwellings with a BER in that particular Small Area. For example, Small Areas that are green represent areas with a 'good' median BER. Small Areas with dwellings that have a poor median BER are either red or purple.

SEAI's corresponding prices and emission factors as of 2022 were applied to calculate the total spend and CO_2 emissions for various sources of energy and heating.

Results and Analysis

Housing Ownership

Within the catchment area approximately 76.3% of the housing is owner occupied. With a 27.5% outright ownership, this can imply a greater appetite to engage in home retrofits as the occupiers are the decision makers in relation to energy upgrades and have a clear incentive to upgrade.

Equally, for rental properties, it is in landowners' best interests to upgrade the homes they own with retrofit measures in line with the projected minimum BER increases for rental properties that the Government are rumoured to be implementing from 2025.

However, given that landlords themselves will not reap the benefits of a warmer home and cheaper energy bills, a strong strategy of engagement and encouragement will be required for landlords until obligatory measures come into effect.

Table 4 – Percentage of homes owned outright by owner (CSO, 2016)

Occupancy type	No. of homes	% of homes
Owned with mortgage or loan	2628	48.8%
Owned outright	1481	27.5%
Rented from private landlord	850	15.8%
Rented from Local Authority	276	5.1%
Rented from voluntary/co-operative housing body	37	0.7%
Occupied free of rent	48	0.9%
Not stated	70	1.3%
Total	**5390**	**100%**

Housing Type

A very significant percentage of the housing stock in the catchment is classified as individual houses consisting of detached, semi-detached, terrace housing with a small percentage classified as flats or apartments. Flats and apartments mainly consist of smaller developments or over the shop dwellings. This again is a positive sign for Carrigaline SEC, as the options for retrofitting a home increase with detached, semi-detached and terraced housing as there is less chance of interfering with other properties.

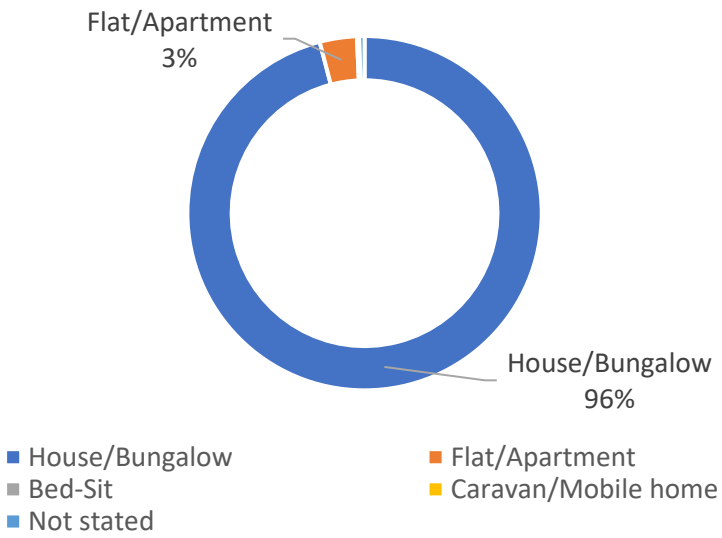


Figure 2 - Housing Stock percentage type - (CSO, 2016)

Housing Age

Within the catchment area there is a good mix of housing age types which will each require different energy efficiency measures to achieve a more energy efficient housing stock. As per Table 5 32.7% of Carrigaline's housing stock would be considered modern having been constructed after the year 2000, which indicates that measures such as cavity insulation improvements and attic insulation can be promoted.

Housing which was constructed prior to the introduction of the building regulations tended to be solid wall or hollow block construction which is unsuitable for cavity insulation due to the lack of a suitable cavity. These buildings tend to be more suited to internal or external insulation measures[4].

With 35.3% of dwellings having been constructed from pre 1919 – 1990, this strongly indicates that a very large number of homes will present opportunities to improve energy efficiency and reduce their energy requirements. However, the types of buildings within lower age bands present many challenges due to the historic construction methods applied from their era and the materials used, alongside the important significance associated with preserving the heritage of these homes.

[4] External Wall insulation involves fixing insulation materials such as mineral wool or expanded polystyrene slabs to the outer surface of the wall. The insulation is then covered with a special render to provide weather resistance. A steel or fiber-glass mesh is embedded in this render to provide strength and impact resistance.

Table 5 – Age profile of the Carrigaline SEC housing stock (CSO, 2016)

Period	No. of homes	% of homes
Pre 1919	57	1.1%
1919 - 1945	29	0.5%
1946 - 1960	85	1.6%
1961 - 1970	175	3.2%
1971 - 1980	879	16.3%
1981 - 1990	680	12.6%
1991 - 2000	1524	28.3%
2001 - 2010	1562	29.0%
2011 or later	199	3.7%
Not stated	200	3.7%
Total	**5390**	**100%**

Housing Fuel Mix

The residential fuel mix as illustrated on the following page in Table 6 provides a breakdown of the different types of fuel sources used in the community for the heating of residential properties. The CO_2 Emissions associated with Carrigaline SEC is linked to the type of fuel consumed within the community. Through using different fuel types, a community can significantly reduce the CO_2 footprint from the energy it consumes to heat its homes. The ideal situation for any community is to reduce the level of energy required to heat their homes through measures that enhance energy efficiency and to provide the remaining heat requirements from low or natural CO_2 producing fuel sources.

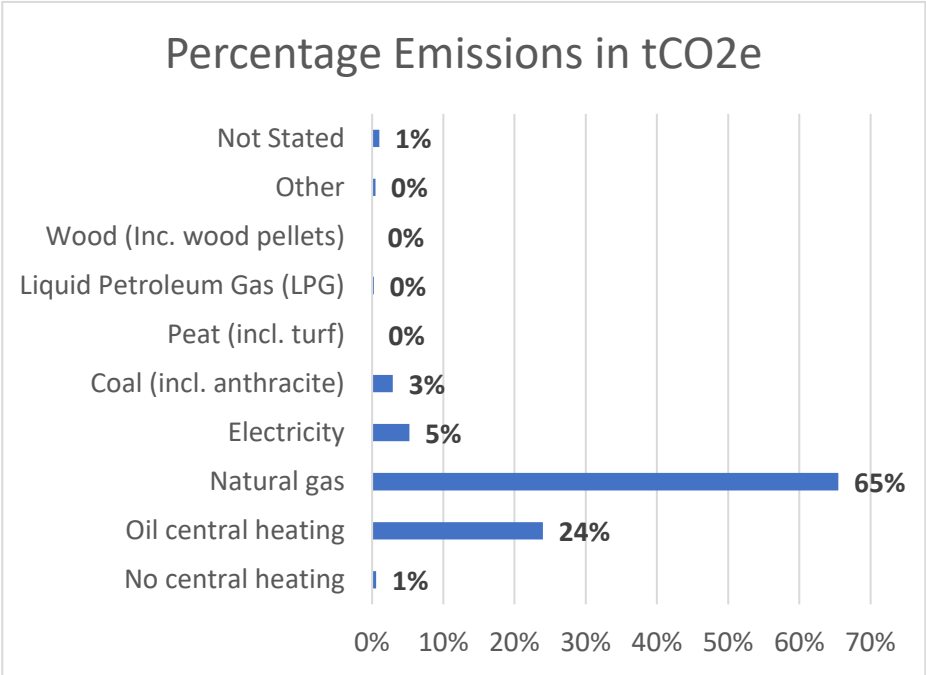


Figure 3 - Percentage emissions in tCO_2e (CSO, 2016; SEAI, 2022)

Within Carrigaline SEC, the main fuel types currently are oil and natural gas which make up 91.6% of the total thermal energy consumed. As per Figure 3, combined these two fuel types make up 89% of the CO_2 emissions from the Residential sector. Whilst these findings do raise cause for concern, it also demonstrates the huge level of potential for the community to significantly reduce its carbon footprint.

Table 6 - Residential Fuel Mix[5] (CSO, 2016; SEAI, 2022)

Heating Type	No. of Units	Fuel	% of Total Thermal Energy	Emissions tCO_2e
No central heating	26	Oil[6]	0.5%	95.3
Oil central heating	1082	Oil	20.1%	3964.7
Natural gas	3854	Natural Gas	71.5%	10820.3
Electricity	211	Electricity	3.9%	866.6
Coal (incl. anthracite)	102	Coal	1.9%	482.4
Peat (incl. turf)	2	Peat	0.0%	9.9
Liquid Petroleum Gas (LPG)	13	LPG	0.2%	41.4
Wood (Inc. wood pellets)	31	Wood Pellets	0.6%	0.0
Other	22	Other	0.4%	78.5
Not Stated	47	Other	0.9%	167.7
Totals	**5390**			**16,527**

The census poses a question around the primary heating source used by homeowners to heat their home, however this doesn't cover secondary and supplementary heating sources that many use for home heating. In addition to the Census data, an energy survey which gathered data from 441 respondents was carried out as part of the study fieldwork.

The home energy survey data shows that almost 67.3% of homes are heated in some way by natural gas and 22% by oil, which is roughly in line with the census data. What is perhaps more interesting for the community is the fact that electricity (3.9%), coal (1.9%) and timber (0.6%) which score so low on the census form, appear to be popular secondary fuel choices, with at least 30% of respondents using one of these fuel sources to heat their home.

These findings suggests that a sizeable proportion of homes within the community either have a wood burning or multi-fuel burning stove. Given the restrictions around the retail sale of turf which were introduced towards the end of 2022, it will be interesting for the SEC to revisit this a year or two further down the line.

Indeed, it is these homes that use coal and turf as a supplementary heating source that the SEC could try to target in an effort to reduce the carbon emissions produced by the community.

It's important to note that whilst the Census was filled in by all of the community, this survey was replied to by 441 individuals, with various response rates to the questions so it is not totally representative of the community. However, a question like this does reveal more about the SECs heating usage when placed alongside the Census results.

[5] Residential fuel mix is based on the primary heating source of the property and does not take into consideration secondary fuel sources as this information is not available within the CSO data.

[6] The fuel specified against no central heating is defined as 'Oil' which is in the mid-range between wood and coal. This is because this type of heating uses a variety of different fuel sources.

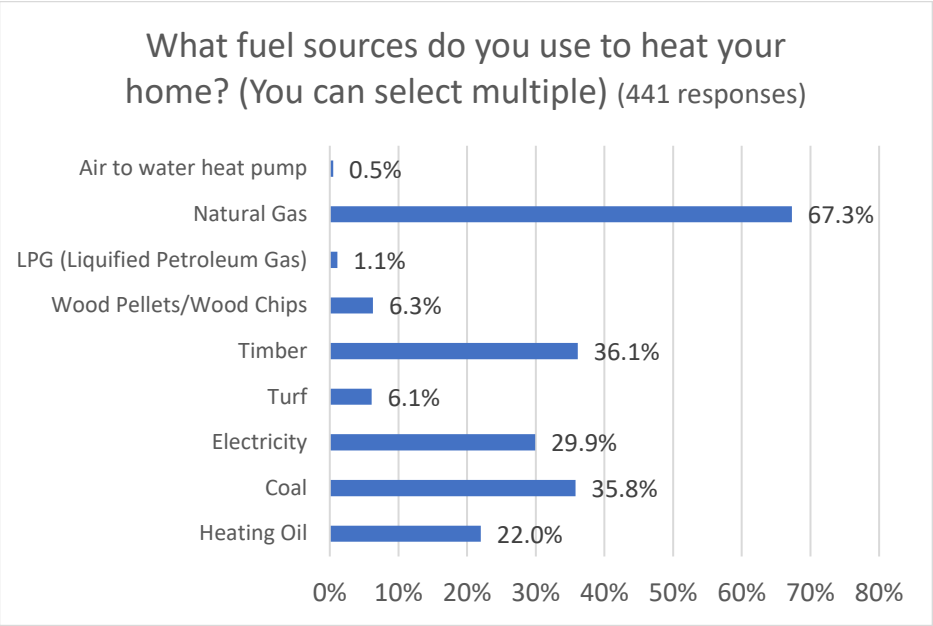


Figure 4 – SEC Energy Survey question asking respondents about the various sources they use to heat their home (Carrigaline SEC Home Energy Survey, 2022)

The survey also asked respondents to indicate if they used any renewable energy sources in their homes. 29.8% of individuals said they use a renewable energy source in their home. Solar Panels for heating came out on top with 10% of the share, with Solar Panels for electricity 2nd with a share of 7.9%. Meanwhile 6.9% of respondents said that they had an air source or ground source heat pump in their home. Interestingly, on the census only 3.9% of respondents indicated that electricity was their primary source of heating. Of course, Solar Panels for heating are likely to be used as a secondary source of heating, but there is a suggestion here that the amount of renewable heating has risen in the last 5 years.

Housing BER Coverage

An analysis of the Building Energy Rating (BER) of the current residential housing stock within the catchment area was carried out. The average BER rating has been determined, however this figure is based upon SEAIs BER database which was collected in 2022 and is compared against the 2016 CSO data on the number of houses in the Carrigaline SEC which have had BER's carried out on them and should be reviewed in that context.

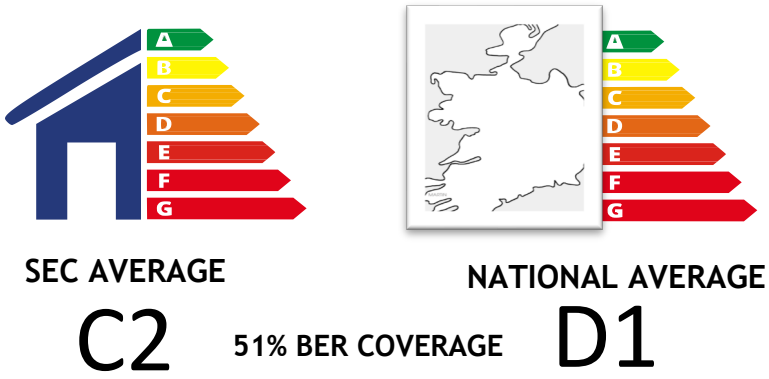


Figure 5 - Building Energy Rating information on catchment area [7] (SEAI, 2022)

Of the 5,390 homes registered within the Carrigaline SEC catchment area, a commendable 51% of these homes have Building Energy Rating certificates. The number of dwellings in Carrigaline with a BER of B or greater is identical to the national average (11%).

[7] SEC average BER is based upon 51% of the building stock within the catchment area which currently has a BER, the average BER may be lower. Data comes from SEAI's BER database which was updated in 2022

When asked 'How efficient do you think your home is?' in the SEC survey, only 14.7% of respondents thought their home had poor or very poor efficiency, whilst 22.4% of respondents indicated that their home was very efficient or had excellent efficiency levels which is a positive indicator for the SEC going forward. The fact that 58.8% of respondents believed their home had average levels of efficiency is reflective of the SEC's overall average BER, which is identical to the national average.

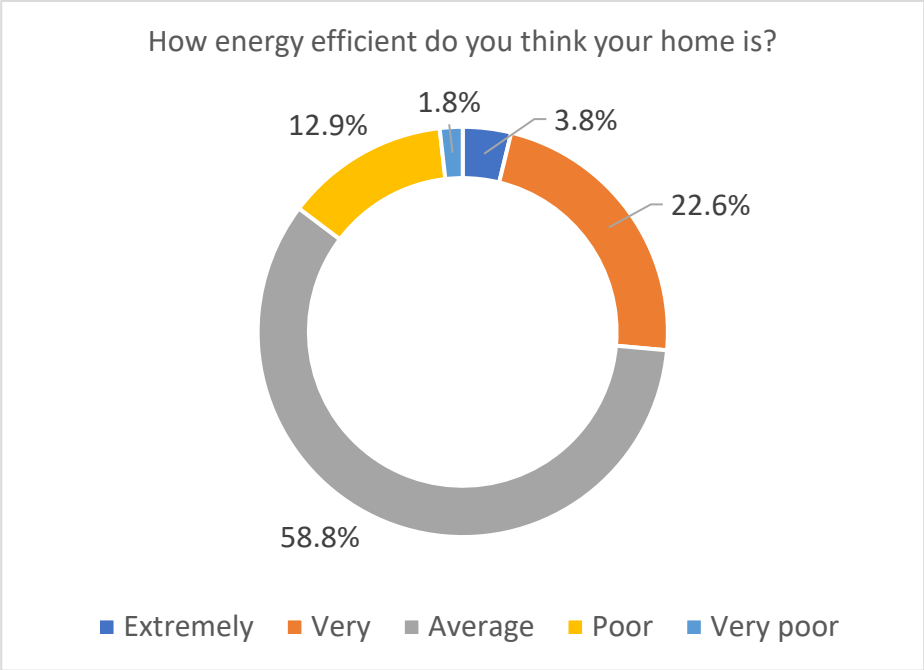


Figure 6 – SEC Survey results relating to how energy efficient respondents believe their home to be (441 responses) (Carrigaline SEC Home Energy Survey, 2022)

Whilst we do not have BER data for the entire housing stock for Carrigaline SEC, based on what we know about the housing stock in the SEC and by using a software package known as 'RetroKit', calculations can be made that estimate the BER for all of the homes in the catchment area. The chart below estimates that Building Energy Ratings for a large volume of Carrigaline SEC's residential building stock ranges from a C1 to an D2, 86% collectively, with such dwellings requiring between 150-300 kWh/m2/yr. of energy.[8]

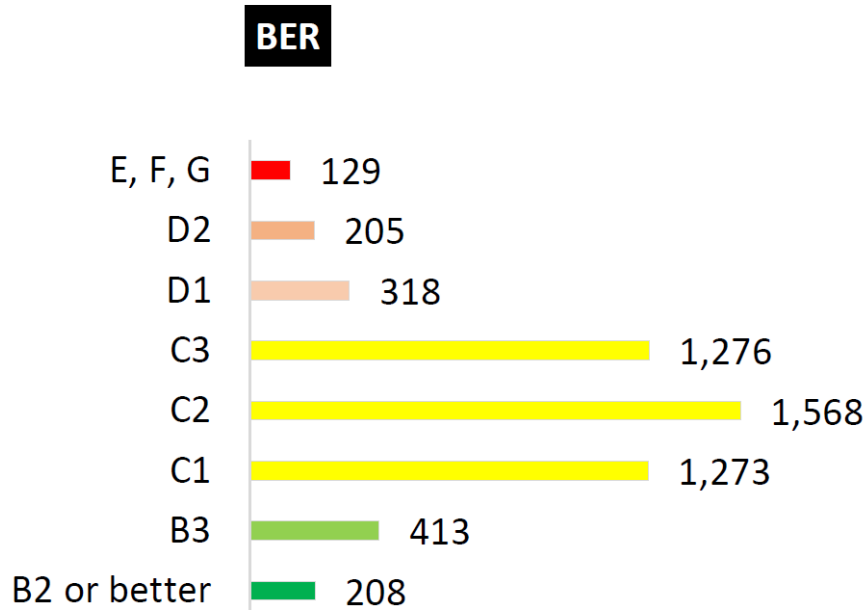


Figure 7 – Estimation of the BERs for all homes in Carrigaline SEC (RetroKit, 2022)

[8] A more detail analysis of BER data and actual performance was carried out by SEAI in the following research document 'Heating and Cooling in Ireland Today 2021'

This also estimates that 96% of the housing stock in the Carrigaline SEC are below the Irish Government's target BER B2. However, of that total, approximately 84% lies within a boundary of B3 – C3 which shows that a significant chunk of the housing stock can be brought up to this rating without deeply extensive retrofitting measures.
It's interesting for SECs to see how each subsection of their community fares in terms of BERs. This can reveal insights into fuel poverty and nudges decision makers towards those areas in need of most investment. The map below of the Carrigaline SEC illustrates the median BER's which have been recorded in each Small Area Plan.

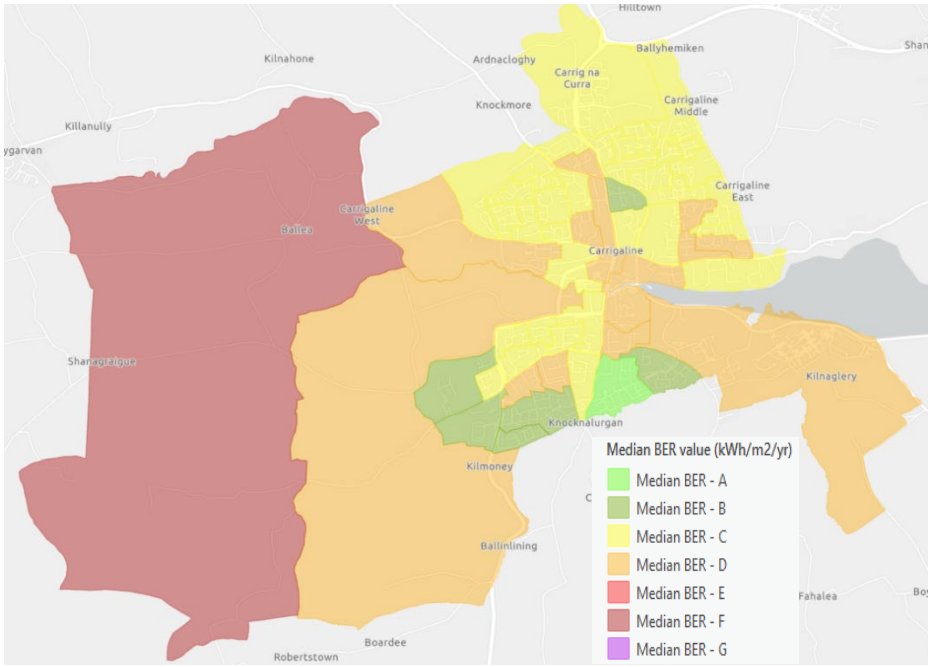


Figure 8 - Map of Median BER in SEC Catchment Area (SEAI, 2022)

It should be noted that this information is based on a limited number of BER data and is presented for illustrative purposes to allow for comparison in future reports.

Residential Energy Baseline

To calculate the residential sector's energy baseline, national residential data was obtained from the CSO's Small Area Population Statistics (SAPS) which lists the housing stock present in the area by house type and year of construction.

Table 7 - Residential Energy, CO_2 and Spend [9] (CSO, 2016)

	Electricity	Fossil Fuel	Renewable	Total
Total Primary Energy (kWh)	54,072,448	78,627,978	473,479	133,173,905
Total CO_2 (tonnes)	15,995	17,226	0	33,221
Total Spend (€)	€7,424,650	€8,886,798	€409,774	€16,721,222

For homeowners who wish to upgrade their BER's, The Sustainable Energy Authority of Ireland (SEAI) provides financial incentives to homeowners in the form of grants and supports, details of which can be found at the end of the report. It's important that homeowners are supported throughout the application process, so that they are investing in measures that are appropriate for their home.

[9] This table refers to the SEC's Total primary energy requirement (TPER). TPER is a measure of your energy consumption that also accounts for the energy that is consumed and/or lost beyond the boundary of the SEC, notably in generating and distributing the electricity that you use.

Whilst the costs of many of the retrofit measures associated with improving a home's energy efficiency may appear prohibitive on the surface for both lower income groups and landlords alike, SEAI's new 'National Retrofitting Scheme' [10] has meant home upgrades are more achievable for homeowners than ever before.

For example, homeowners can now avail of grants equivalent to 80% of the typical cost for attic and cavity wall insulation, with an upper limit of €2,500. These measures have been shown to improve energy efficiency significantly within typical Irish homes and should be an affordable measure for the majority of homeowners in Carrigaline SEC.

Furthermore, the Warmer Homes Scheme [11] offers free energy upgrades for eligible homeowners who are most at risk of energy poverty. A budget allocation of €148 million has been provided for the scheme in 2023. The scheme will target the least energy efficient properties, by prioritising homes that were built and occupied before 1993 and have a pre-works BER of E, F or G. Applications will also be accepted from qualifying homeowners who previously received supports under the scheme, but who could still benefit from even deeper measures.

Given that energy costs are expected to remain at the very least the same level in the coming years, if not increase further, it is vital that homeowners in lower income groups utilise these grant streams to protect themselves against falling into, or further into fuel poverty.

[10] https://www.gov.ie/en/press-release/government-launches-the-national-retrofitting-scheme/

[11] https://www.seai.ie/grants/home-energy-grants/free-upgrades-for-eligible-homes/

Retrokit

Background

The momentum within the country has been to upgrade the fabric of buildings so that heat pumps can be utilised as the primary heating source. However, in order for heat pumps to be a viable option, buildings need to be insulated to a level where they have a Heat Loss Indicator of 2.0 or less. SEAI define these dwellings as being 'heat pump ready' [12]. If properties are not insulated to an adequately high level, then this technology is not suitable as a primary heat source.

The government's climate action plan has set a BER of B2 as the target for the energy performance of retrofitted homes. This target is in line with current building regulations - 'Part L conservation of fuel and energy' [13], which specifies that buildings undergoing 'Major Renovations' [14] must achieve a BER B2 or a 'Cost Optimal' level of energy performance.

In order to accurately identify the fabric upgrades that need to be carried out to upgrade Carrigaline's residential housing stock to a BER rating of B2 (or better) and to achieve "heat pump readiness", a software package known as 'RetroKit' was employed.

Method

RetroKit is a decision-support tool developed by RetroKit Ltd. which compiles a wide range of data sources and applies analytics to establish the current energy performance of the housing stock in a community. It generates baseline data on energy performance of the housing stock in terms of energy use, expenditure, CO_2 emissions, BER rating and Heat Loss Indicator amongst many other variables.

RetroKit uses this data to develop and compare a range of retrofit scenarios:

1. Shallow fabric
2. Medium – (oil boiler)
3. Medium – (heat pump)
4. Deep Retrofit (heat pump)

The software conducts a cost/benefit analysis of each scenario in order to identify the optimum retrofit package for the community's housing stock and considers not only the technical factors, but also financial and environmental concerns.

[12] Heat Loss Indicator (HLI) value is the total heat loss per m2 of dwelling floor area. A minimum HLI of 2 Watts/Kelvin/m2 must be achieved to be suitable for a heat pump however in some cases, where upgrades may not be cost- optimal, a value of HLI up to 2.3 Watts/Kelvin/m2 can be accepted provided additional requirements are met

[13] https://assets.gov.ie/180475/e532a9c5-3ec6-4a4c-8309-02f8a653e2d8.pdf

[14] Major renovations refer to upgrades where more than 25% of the building envelope. Painting, re-plastering, rendering, re-slating, re-tiling, cavity wall insulation and insulation of ceiling are not considered major renovation works.

Once baseline analysis is completed, to determine the energy usage of Carrigalines' housing stock, RetroKit runs a number of customised scenarios, based on the shallow, medium or deep fabric upgrade scenarios mentioned above, with associated upgrades to heating systems and renewable energy.

These scenarios are applied against the most common house types in the Carrigaline community in order to exemplify what fabric upgrades would take place in each typical home through a home energy upgrade plan.

Whilst the use of standard assumptions (e.g. fixed heating schedules and hot water usage) means that running costs and energy usage estimated by RetroKit will differ somewhat from actual data for specific dwellings, they provide a highly detailed representation of what the impact of a retrofit project would be for typical residencies in the Carrigaline community.

These home energy upgrade plans will help homeowners in the Carrigaline community understand how a house like theirs can be upgraded, the typical costs involved and include a breakdown of the revised BER rating, energy consumption, energy costs and payback period of the investment for the homeowner, along with many other variables for each scenario.

Measures are only applied by RetroKit where required and appropriate. This is done on a dwelling by dwelling basis. For example, for cavity wall insulation measures, RetroKit checks to see if the dwelling has a "cavity" wall and if the wall heat loss is high (and therefore worth insulating) before applying that measure.

RetroKit Scenario	Non-exhaustive summary of works
Shallow Fabric	Basic measures such as better air tightness, cavity and loft insulation, cylinder insulation, LED lights and wood stove
Medium (boiler)	"Shallow fabric" plus External Wall Insulation, boiler, controls, new door, double glazing
Medium (Heat pump)	"Shallow fabric" plus External Wall Insulation, heat pump, controls, new door, double glazing
Deep (Heat Pump)	Medium (Heat Pump)" plus triple glazing, sloping ceiling internal insulation, demand control ventilation, Photovoltaic (PV) system

The following pages outline the results of RetroKit's study on the Carrigaline SEC.

Results and Analysis

Heat Pump Readiness

'Heat Pump Readiness' refers to the likelihood of dwellings in the scenario having a suitably low heat loss indicator (2.0 or less, or below 2.3 in certain cases) so that a heat pump can perform effectively in the dwelling. A suitably low heat loss indicator is also needed if seeking grant funding for heat pumps. A dwelling should have additional fabric or airtightness measures applied if a heat pump is to be installed and if it isn't heat pump ready.

As per the Figure 9 below, 14% of residences in Carrigaline SEC are Heat Pump ready. However, this figure jumps to 54% under the 'Shallow fabric' scenario, meaning a significant proportion of homes in the community would only require a moderate amount of investment to be Heat Pump ready.

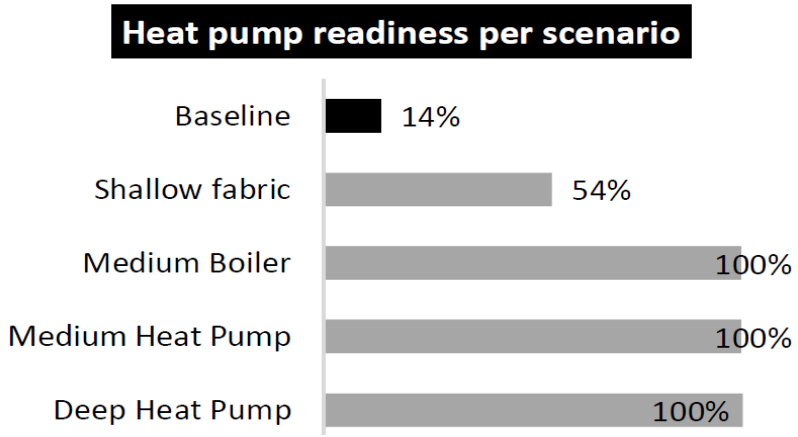


Figure 9 – Heat pump readiness under each RetroKit scenario for SEC. Please note Baseline conditions refer to today's conditions. (RetroKit, 2022)

Reduction in Final Energy Use

Reduction in final energy use shows how far 'energy usage' is reduced compared to the baseline if the upgrades associated with each scenario were implemented into every home in the Carrigaline SEC.

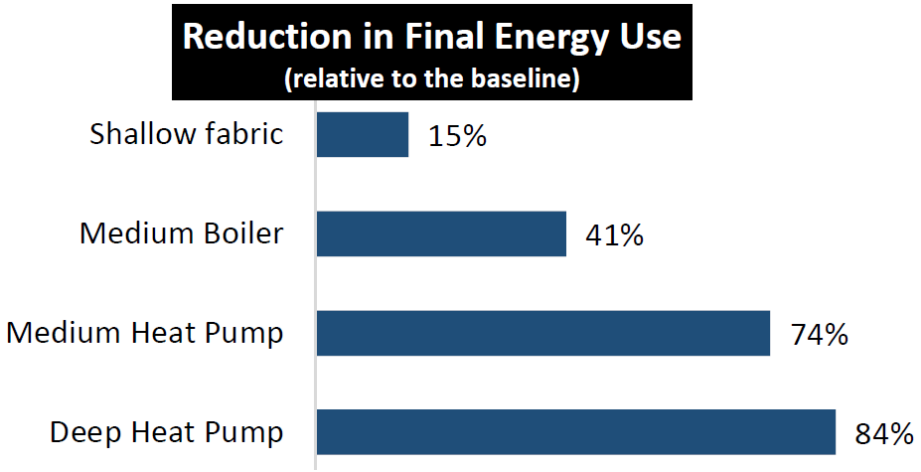


Figure 10 – Reduction in Final Energy Use compared to baseline data in the SEC (RetroKit, 2022)

As can be seen from Figure 10 above, significant reductions in energy use across the SEC can be achieved under the Medium (boiler) scenario, but particularly in the two Heat Pump scenarios. This is in alignment with the Irish Government's Climate Action Plan and the country's long-term goal of reaching net-zero emissions by 2050.

Total Annual Energy Savings

Naturally, reductions in energy usage will correspond to a decrease in energy costs for the community. The total annual energy savings graph evidences the fuel cost savings per scenario, broken down by the age bands of dwellings in the SEC. As the below graph shows, the Carrigaline SEC could save anywhere between €1.7 million - €5.2 million annually depending on which of the fabric upgrade scenarios were adopted by the community. Please note the cost savings associated with 2011-2021 homes are minimal (<€22k), therefore they are barely noticeable in the figure.

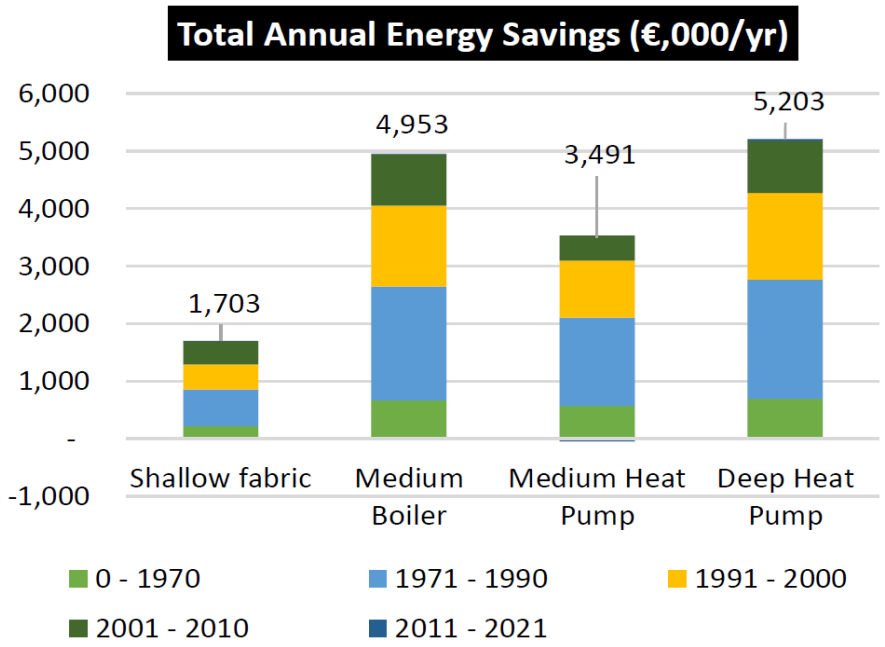


Figure 11 – Total Annual Energy Savings in millions of Euros per year versus baseline conditions if each scenario was adopted by the SEC. Please note Baseline conditions refer to today's energy prices (RetroKit, 2022)

Energy Cost per dwelling

On an individual homeowner level, the fuel costs arising from energy usage show significant reductions on an annual basis, with the potential to save almost €1000 annually if implementing upgrades in their home that align with the Deep (Heat Pump) scenario.

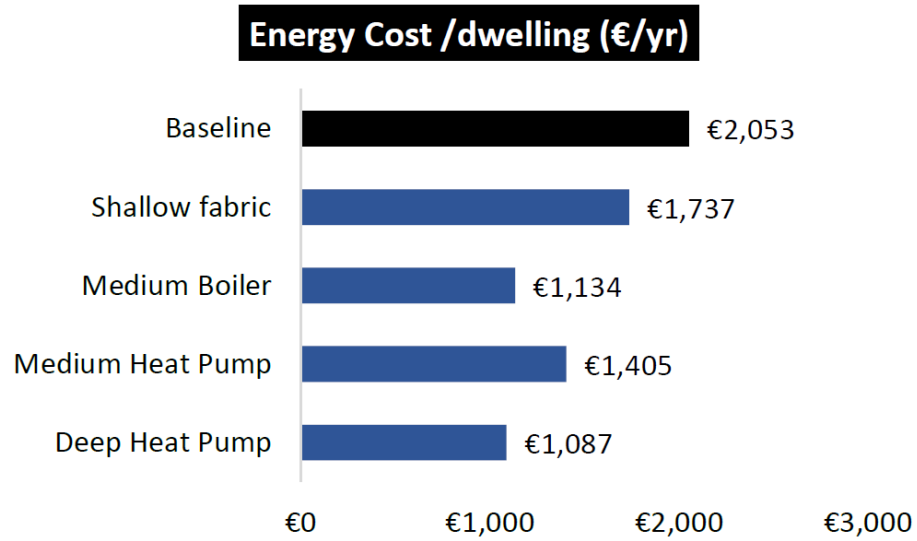


Figure 12 – The average annual energy cost per dwelling under each of the four scenarios (RetroKit, 2022)

As energy costs continue to rise, it is quite likely that the potential savings for both individual homeowners and the community as a whole would also increase under the four scenarios above. It would be hoped that this would create both a more environmentally and economically sustainable community.

RetroKit Case Studies

From the BER Research tool, RetroKit creates a set of "typical" archetype dwellings (up to 240 archetypes in total). The archetypes are classified based on 5 age bands, 4 dwelling types, 4 main space heating fuels and 3 main external wall types.

RetroKit then determines how many of each of the archetype dwellings are in the SEC. The CSO Small Area data is utilised to determine how many dwellings are in the study area as well as the percentage of these dwellings in each age band and fuel type.

As neither the CSO or BER small area data detail exactly how many dwellings are in each of the 240 archetypes, RetroKit uses the percentage of dwellings in each age band, each dwelling type, each fuel type and each wall type to determine the spread of dwellings across the 240 archetypes.

The software then deduces the most common property types in the community based on their percentage spread across the study area. This provides most homeowners across the community with a case study very similar to their own dwelling.

RetroKit select the archetypes for the case studies based on a number factors; age band, fuel type, wall type, house type and sample factor. This gives a fair spread of the different kinds of dwellings in the SEC area.

Table 8 – Carrigaline SEC RetroKit dwelling selection (RetroKit, 2022)

Age Band	Dwelling Type	Main fuel type	Main wall type
1991 - 2000	Semi-detached house	Gas or Liquid Petroleum Gas	Cavity
1971 - 1990	Semi-detached house	Gas or Liquid Petroleum Gas	Cavity
1991 - 2000	Detached house	Gas or Liquid Petroleum Gas	Cavity
1971 - 1990	Detached house	Heating Oil	Cavity
2001 - 2010	Terraced house	Gas or Liquid Petroleum Gas	Cavity
1971 - 1990	Semi-detached house	Gas or Liquid Petroleum Gas	Solid or hollow
<1971	Detached house	Heating oil	Solid or hollow

In the case of the Carrigaline SEC, seven common property types were selected. An example of one of these case studies is shown in the following pages, with the remainder contained within Annex B, a supplementary document to this report.

The following pages contain an example of RetroKits housing upgrade plans below for a 1991 -2000 Semi-detached house. The report uses a colour coding scheme to rate the thermal performance of the home and its systems.

Red represents poor, orange adequate and green is good. This is similar to the colour coding in the new BER advisory report. This colour coding is used for baseline, (existing) performance of the dwelling and for each upgrade package.

Comfort is defined using the heat loss indicator, (HLI) which is a measure of how well insulated and draught free the building is. The comfort colour coding also gives an indication of heat pump readiness. Green is heat pump ready, orange is likely heat pump ready, and red is not heat pump ready.

Roofs, external walls, windows, doors and floors are colour coded based on thermal performance and derived from the u-value. [15] Draughts are colour coded on the rate of air leakage from the building as calculated in BERs.

Main heating, water heating and secondary heating are colour coded based on efficiency of the heat source.

Heating control is based on the space heating system control category as calculated in BERs, lighting is based on the percentage of low energy fittings and ventilation's rating is based on the type of ventilation system and number of open chimneys.

[15] The rate of transfer of heat through a structure (which can be a single material or a composite), divided by the difference in temperature across that structure. The units of measurement are W/m²K. The better-insulated a structure is, the lower the U-value will be.

Housing Upgrade Plan

Rural
Semi-d house
106m2
Built:1997
Gas or LPG

Your home energy upgrade will give you

More comfort | Money saved | Healthier home | Warmer home | Better for our planet

How you can achieve this

	Current	Shallow fabric	Medium boiler	Medium Heat Pump	Deep Heat Pump
BER	C2	C1	B2	B1	A2
Uplift					
Comfort Level					
Roof					
External Wall					
Windows					
Doors					
Floor					
Draughts					
Main Heating					
Water Heating					
Heating Controls					
Lighting					
Ventilation					

Powered by RetroKit

Your options to achieve a more comfortable home

Shallow fabric

BER:	Fuel Bills:	Environmental Impact:
C1	€-242/yr	-1164 kgs CO_2/yr

	Cost	Impact
Fit low energy lighting throughout property	€119	★ ☆ ☆
Top up attic insulation to 400mm	€1586	★ ★ ☆
Draught proofing - windows, doors and attic hatch	€362	★ ★ ★
Fit chimney draught excluder	€178	★ ★ ☆
Change open fire for high efficiency wood stove	€4052	★ ★ ★
Energy credits	€0	
Potential grants	€1300	
Total investment	€4998	

Powered by RetroKit Sustainable Energy Retrofit Planning Toolkit

Your options to achieve a more comfortable home

Medium boiler

BER:	Fuel Bills:	Environmental Impact:
B2	€-628/yr	-2095 kgs CO_2/yr

	Cost	Impact
400mm Attic Insulation on Ceiling	€3052	★ ☆ ☆
Deep Draught Proofing	€1429	★ ★ ☆
Replace Windows with Double Glazed	€6963	★ ★ ☆
Replace Door	€1983	★ ☆ ☆
Fit Mechanical Demand Control Ventilation	€4088	☆ ☆ ☆
New Condensing Gas System Boiler Including Controls	€3144	★ ★ ★
Fit Low Energy Lighting	€137	★ ☆ ☆
Change open fire for high efficiency wood stove	€4052	★ ★ ☆
Energy credits	€0	
Potential grants	€2000	
Total investment	€22851	

Powered by RetroKit Sustainable Energy Retrofit Planning Toolkit

Your options to achieve a more comfortable home

Medium Heat Pump

BER:	Fuel Bills:	Environmental Impact:
B1	€-381/yr	-2602 kgs CO_2/yr

	Cost	Impact
400mm Attic Insulation on Ceiling	€3052	★ ☆ ☆
Deep Draught Proofing	€1429	★ ☆ ☆
Replace Windows with Double Glazed	€6963	★ ☆ ☆
Replace Door	€1983	★ ☆ ☆
Fit Mechanical Demand Control Ventilation	€4088	☆ ☆ ☆
Air to Water Heat Pump, New Cylinder and Controls	€10131	★ ★ ★
Open Fire to Wood Fuel Stove	€4659	★ ☆ ☆
Change to Low Temperature Radiators	€4280	★ ☆ ☆
Fit Low Energy Lighting	€137	★ ☆ ☆
Energy credits	€0	
Potential grants	€18100	
Total investment	€18627	

Powered by RetroKit Sustainable Energy Retrofit Planning Toolkit

Your options to achieve a more comfortable home

Deep Heat Pump

BER:	Fuel Bills:	Environmental Impact:
A2	€-703/yr	-3379 kgs CO_2/yr

	Cost	Impact
400mm Attic Insulation on Ceiling	€3052	★ ☆ ☆
Deep Draught Proofing	€1429	★ ☆ ☆
Replace Windows with Triple Glazed	€8575	★ ☆ ☆
Replace Door	€1983	★ ☆ ☆
Fit Mechanical Ventilation with Heat Recovery	€6835	★ ☆ ☆
Air to Water Heat Pump, New Cylinder and Controls	€10131	★ ★ ★
Open Fire to Wood Fuel Stove	€4659	★ ☆ ☆
Change to Low Temperature Radiators	€4280	★ ☆ ☆
Fit Low Energy Lighting	€137	★ ☆ ☆
Install 2kWp Solar Panels	€6592	★ ☆ ☆
Energy credits	€0	
Potential grants	€19900	
Total investment	€27778	

Powered by RetroKit Sustainable Energy Retrofit Planning Toolkit

Home Upgrade Plan example – Further Commentary

The data used to calculate fuel costs, energy savings and emissions produced is based on SEAI data from June 2022. The costs of individual measures such as installing a new boiler were generated by RetroKits in-house Quantity Surveyor in June 2022.

The medium boiler and medium heat pump scenario have the same fabric and ventilation upgrades, the main difference being that the boiler scenario has a boiler for space and water heating and the heat pump scenario a heat pump. A heat pump is considerably more expensive than a new boiler, so the heat pump scenario will always be more expensive in terms of capital investment. As can be seen in the scenario comparison report, the medium heat pump results in greater CO_2 saving, energy use reduction and BER improvement than the medium boiler scenario, but it does result in higher fuel costs.

This is mainly due to the cost difference between mains gas (the main boiler heating fuel in this EMP) and electricity which the heat pump uses, electricity is almost 4 times as expensive based on SEAI published average energy costs from June 2022, which was used in this iteration of Retrokit. It's also worth noting that in the future, higher carbon taxes and reduced CO_2 content of electricity per kWh would reduce this gap (as the % of renewable electricity on the national grid ramps up in the coming years).

There is currently too much complexity to be able to model the effect that an increase in BER would have on a home's value and include the data in the Home Energy Assessment (HEA) reports (we don't know what's the house value to start with). However, according to ESRI (2012), each step up in BER grade increases the value of a property by 1.3%.

For example, bringing a D1 property with value of €300,000 to a B2 grade increases the value by approximately €20,000. More recent research from the Real Estate Alliance has shown that A & B rated homes are valued on average €36,000 more than those of a BER C rating and below [16].

The HEAs provided for Carrigaline show several scenarios from "shallow" through to deep retrofit. Within each scenario in each HEA, RetroKit have included the cost per individual measure and the impact of each measure if carried out on its own, relative to the other measures.

For example, typically, a lighting upgrade will have a very low cost but only achieve 1 "star" under impact, whereas a new main heat source will have relatively high cost but achieve three stars. By breaking down each individual measure in this way and categorising them as shallow & medium retrofit, the Home Upgrade Plans can be used as part of a long-term roadmap for home energy upgrades, as opposed to a big jump to a B2 BER.

[16] https://www.independent.ie/business/personal-finance/latest-news/energy-crisis-adds-60000-to-price-of-best-insulated-homes-42034823.html

Health and Social benefits of retrofitting

Creating an airtight, insulated home, retrofitting to a high standard and installing a decent cooling and ventilation system allows homeowners to maintain a regular, comfortable occupancy all year round. Considering that it has been estimated that we spend 90% of the time inside buildings, this counts for a lot. Homes are where we eat, sleep, spend time with families and friends, socialise and increasingly work. Therefore, being comfortable, happy, and able to function counts for a lot.

Energy efficiency retrofits in buildings create conditions that support improved occupant health and well-being, particularly among vulnerable groups. The potential benefits of energy efficiency measures include improved physical health such as reduced symptoms of respiratory and cardiovascular conditions, rheumatism, arthritis and allergies, as well as fewer injuries. In colder climates like Ireland's, energy efficiency improvements can lower rates of excess winter mortality.

From an Irish context, research from the International Energy Research Centre (IERC) at Tyndall National Institute has estimated that the increased health and wellbeing benefits associated with retrofitting homes could save the Irish economy up to €600 million annually, through gains in productivity and output, reduced sick leave and absenteeism, reduced burden on the healthcare and social welfare systems.

Annual savings on the reduction of hospital admissions alone, could be over €20m for the HSE, and over €2m to patients. The C40 Knowledge Hub references this as "housing as healthcare". They explain that improvements to our homes offer better living conditions and therefore reduce threats of respiratory disease. Optimum ventilation staves off damp and mould and a city's airborne pollution, leading to, for example, "a 2.5% decrease in asthma attacks".

Whilst this is a developing area in terms of research, recent evidence shows that chronic thermal discomfort and fuel poverty also have negative mental health impacts (anxiety, stress, and depression). This is because of the financial stress of coping with high energy bills and debt that is strongly associated with fuel poverty. Energy efficiency measures that improve the affordability of energy bills in low-income homes can have a measurable effect on improving mental well-being.

The gap to target

Currently there is a labour and skills shortage in the construction sector, which means that retrofit targets are unlikely to be achieved under current conditions. The Government have begun the process of establishing 'Retrofit Centres of Excellence' where trainees can come to learn the skills that will allow them to become employable within this sector. One of the four centres announced is to be based in Fermoy, Co. Cork as part of the Cork Education Training Board and is hoping to be set up in 2023. The SEC and wider Carrigaline committee should try to promote the courses and training offered at the ETB so that contractors based in their area have the appropriate skillset to carry out retrofits in their own communities.

Energy in Transport

Background

Transport in Ireland is currently deeply dependent on imported fossil fuels. Emissions from transport fuelled by fossil fuels were by far the largest source of energy-related CO_2 in 2020, as they were responsible for 40% of the total and it is the only sector where CO_2 emissions have grown since the end of the recession in 2012. Road transport specifically accounts for 96% of all greenhouse gases associated with transport, so a modal shift is critical.

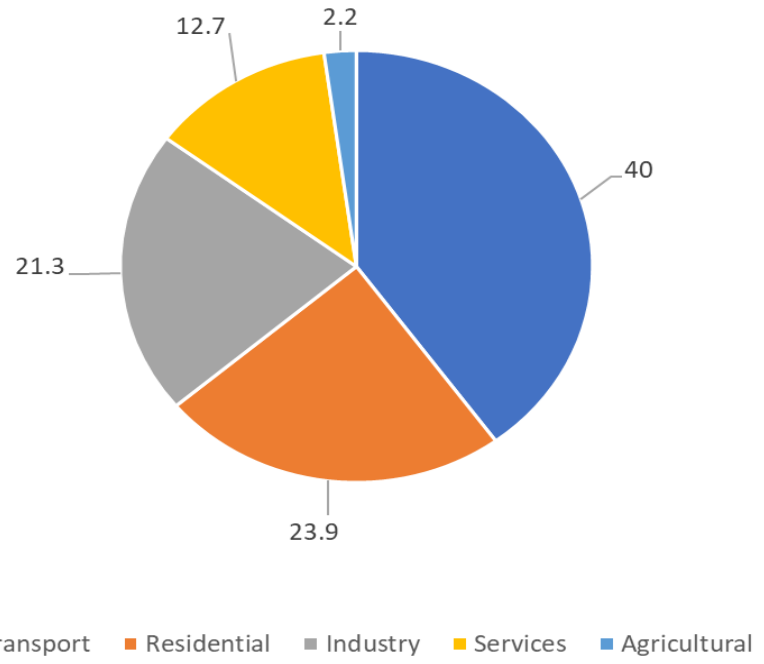


Figure 13 – Percentage share of Energy Related CO_2 by sector for 2020 in Ireland (SEAI, 2020)

Whilst it's important to note that Figure 13 doesn't account for overall greenhouse gas emissions for each sector, it is reflective of the work needed to reduce Transport emissions. The Climate Action Plan stipulates that there must be a 42-50% reduction in emissions from the transport sector by 2030 if Ireland is to meet its Climate targets.

In order to achieve these emission reductions, it's clear that a transition towards more sustainable forms of transport is required. To realise this transition, many forms of transport options must be maintained, planned, and provided for the region. This ranges from safe and accessible walking and cycle routes to appropriate public transport links serving the needs of the residents, to the implementation of appropriate infrastructure to support the electrification of private car and fleet vehicles.

The standout targets for the Transport sector as part of the Climate Action Plan are to:

- Provide an additional 500,000 daily public and active transport journeys
- Electrify 845,000 passenger cars
- Electrify mass transportation with up to 1,500 Electric Buses

This will necessitate a change in the traditional 'road hierarchy' which has dominated Irish roads for years, starting with active travel and then public transport being encourage over the private car.

Ireland's rapidly growing economy in recent years has brought with it urban sprawl and low-density development which has locked in unsustainable travel patterns and a reliance on private cars bringing with it entrenched behavioural patterns that will be a challenge to overcome.

However, the impact of the COVID-19 pandemic, with the introduction of travel restrictions and greater remote working practices, is estimated to have resulted in a reduction of approximately 16% of transport emissions (excluding aviation) in 2020 compared to 2019 levels. The pandemic has shown that large scale behaviour change is achievable and that new patterns of mobility and working can play a part in the transition to a more sustainable transport system.

Method

An analysis of the means of transport for workers and students as well as the transport fuel mix in the catchment area of Carrigaline SEC has been carried out based on data from the Central Statistics Office (CSO). SEAI's corresponding energy usage, prices and emission factors for various forms of transport as of 2022 were applied to calculate the total spend and CO_2 emissions for various sources of fuel for vehicles in the catchment area.

Results and Analysis

Commuting to work

Commuting to work by private car is the primary method of transport in the Carrigaline SEC with 81.7% of workers either driving or being driven by car.

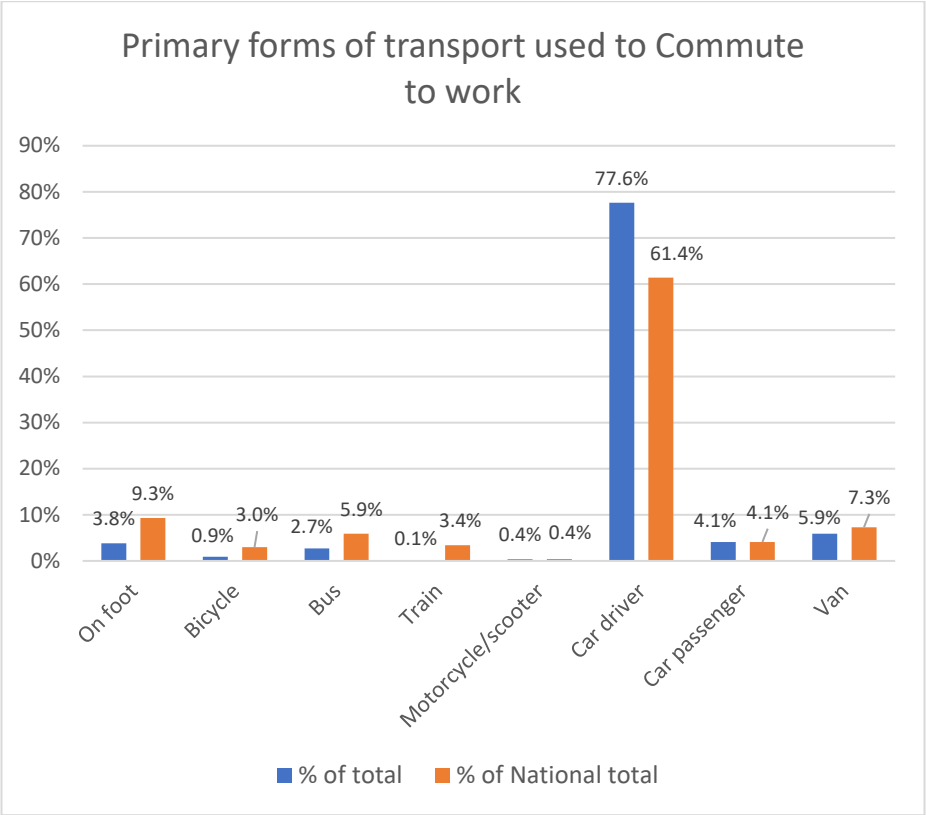


Figure 14 – Primary forms of transport used to commute to work (CSO, 2016)

According to the 2016 Census, Carrigaline lags behind national averages in public transport usage for commuting to work. To tackle these low levels and shift more commuters away from driving traditional fossil fueled cars, the SEC could try to encourage those commuters who travel within a 15km radius of the town to utilise the bus services to the surrounding area. However, one of the weaknesses of using Census data from 2016 is that it does not account for changes which have taken place in the interim.

For example, the introduction of Cork's first 24 hour bus, which runs services from Ovens to Carrigaline every 15 minutes between 6am and midnight on weekdays, with a 30/60 minute frequency between midnight and 6am. Data released by Bus Eireann [17] has indicated that there has been a significant uptake in passengers on the Cork network, largely on the 24 hour bus (220 route), however we cannot be sure if this has led to an increased uptake in Carrigaline until the census results are released later in 2023.

It's also pertinent to note that the 24 hour bus route, will be adapted to two separate 24 hour bus routes crossing the city. Route 1 will run east-west, from Ovens/Ballincollig through the city centre to Mahon (along the proposed route for a future Luas line), and Route 3A will run north-south through the city from Carrigaline to Hollyhill. This will result in a more direct bus journey for those residents travelling to the city or those destinations along the way than what they would've experienced previously on the single 24 hour bus.

Due to the developments that are planned by BusConnects as part of Cork Metropolitan Area Transport Strategy, Carrigaline will soon be positioned as a transport hub. With bus services to Cork City running at a frequency of every 10 minutes at peak time, this will in all likelihood increase the number of people who are using the bus for their educational, leisure and work commutes.

Unfortunately, for those residents commuting to other industrial hubs away from the city, such as Ringaskiddy, the new bus network planned in the Transport Strategy does not appear to have made improvements to the frequency of services.

Ringaskiddy is a pharmaceutical hub, with the likes of Centocor, GlaxoSmithKline, Hovione, Novartis, Pfizer, and Recordati all operating in the area. The National Maritime College of Ireland and UCC's Maritime Research Centre (Wave Energy) are also based in Ringaskiddy, with the Irish Naval Service based in the nearby Haulbowline. There are strong links between Carrigaline and Ringaskiddy due to the large number of people who live in Carrigaline and commute to Ringaskiddy, with the majority using their cars to do so despite the fact that the 225 bus line connects the Airport and Haulbowline via Carrigaline and Ringaskiddy.

Perhaps the lack of uptake in the bus service to Ringaskiddy could be related to the distance that it leaves users from the industrial areas, as it can take users up to a further half hour to walk from the bus stop to their workplace, which has led to commuters opting to travel by car. It has been noted in feedback from the SEC that this is a valuable service to the community and that enhancements to the service in the new Bus Connects Cork plans would have been welcomed, but the planned peak frequency of buses has remained at every 30 minutes.

Very few residents in the SEC use active transport for their commute to work, as the SEC sits well below the national average. This could be explained by Carrigaline sitting in the Cork commuter belt, which means active transport is not feasible for their commute. According to 2016 CSO Census data, Carrigaline has a job to resident ratio of 1:5. In other words, there are 1 job available for every 5 residents. In comparison to the Cork City and Suburbs area, which have a similarly calculated ratio of 1:2, Carrigaline has low employment availability which forces residents to travel distances for employment that are not well suited for active transport.

[17] https://buseireann.ie/bus_eireann_news.php?id=4587&month=Jan

Across the country, services such as Local Link operate successful services to isolated and vulnerable people within communities outside of the major urban centres, as well as offering an alternative means of transport within the region. Feedback from members of the SEC has indicated that there is currently a limited Local Link presence within the town, with two routes that only operate on Friday which is a surprise given its population.

Table 9 – LocalLink timetables for services that operate in Carrigaline (LocalLink, 2023)

Ringaskiddy to Carrigaline	
Stops	**Times**
Shanbally	09:50, 13:35
Ringaskiddy (Community Centre)	10:00, 13:25
Curraghbinny	10:15, 13:10
Carrigaline (Supervalu / PO)	10:25, 13:00
Minane Bridge to Carrigaline	
Stops	**Times**
Farranbrien	09:45, 14:20
Kiely's Cross	10:10, 13:55
Minane Bridge	10:15, 13:50
Upper Fountainstown	10:20, 13:45
Kilmoney	10:30, 13:35
Carrigaline (Supervalu / PO)	10:35, 13:30

The SEC could contact LocalLink and ask them to increase their services in the town if they can prove that the demand is there. Given that so many residents commute to Ringaskiddy for employment purposes, there is a strong case to add services that bring residents to and from Carrigaline on a daily basis.

Alternatively, the town would also be well suited to its own 'hop-on hop-off' style bus service to meet the needs of the SECs citizens who sit on the outskirts and suburbs of the town centre. This would be a significant addition to Carrigaline's transport offering as a regular local bus service would allow people to travel to school, shops, doctors, social settings and enable connections to Cork city and other public transport links without having to drive and find parking.

Depending on how a potential town bus service is implemented, it could make a huge impact on the transport emissions associated with the town. For example, Athlone's town bus service recently became Ireland's first all-electric bus service. The new fleet will reduce CO_2 emissions by 400,000kg annually and will deliver a quieter, cleaner bus service for the town and passengers.

The project, a €10 million investment by the NTA, is the first to launch under the government's Pathfinder Programme – a package of exemplar transport projects to be delivered by state agencies and local authorities around the country within the next three years. Whilst this particular funding stream has closed for now, the SEC should monitor its status to see if it re-opens, or similar funds become available so they can pursue a project similar to that in Athlone

It's also important to recognise that not all journeys are made for education or work purposes and that journeys for other purposes comprise a significant amount of transport emissions. As part of the Carrigaline Transportation and Public Realm Enhancement Plan (TPREP), a number of measures have been announced with the hope of improving pedestrian and cyclist access in the town centre.

These include the provision of widened and continuous footpaths, improved walking and cycle lanes, new lighting, street furniture, rain gardens and pavement along the Main Street. This will also include a bus-only lane southbound on Main Street between Church Road and Strand Road, a one-way southbound traffic flow on Church Hill and a one-way system westbound along Strand Road, from the entrance to the Library/Dunnes Stores towards Main Street.

Furthermore, there are also plans to have dedicated cycle facilities on both sides of Ballea Road between Cork Road and the Western Inner Relief Road as well as the removal of the existing roundabout at the Heron's Roundabout, which will be replaced by a signalised junction with dedicated pedestrian and cycle facilities. This is part of a wider plan to integrate the residential housing developments on the outskirts of the town centre with each other, as well as within the town centre and remove the barriers to active travel that have impacted on the uptake of active travel in the SEC. It is hoped that this phase of the plan will create a town centre accessible to pedestrians, cyclists and public transport users and one which is not congested by vehicular traffic.

This the planners hope, will make the town a more attractive, people friendly space would mean that more residents opt to cycle or walk into the town centre. However, the construction of these plans will not be complete for at least a few years and will take time to be embedded, so this will not be an overnight fix. These developments will be discussed in more detail later in the report.

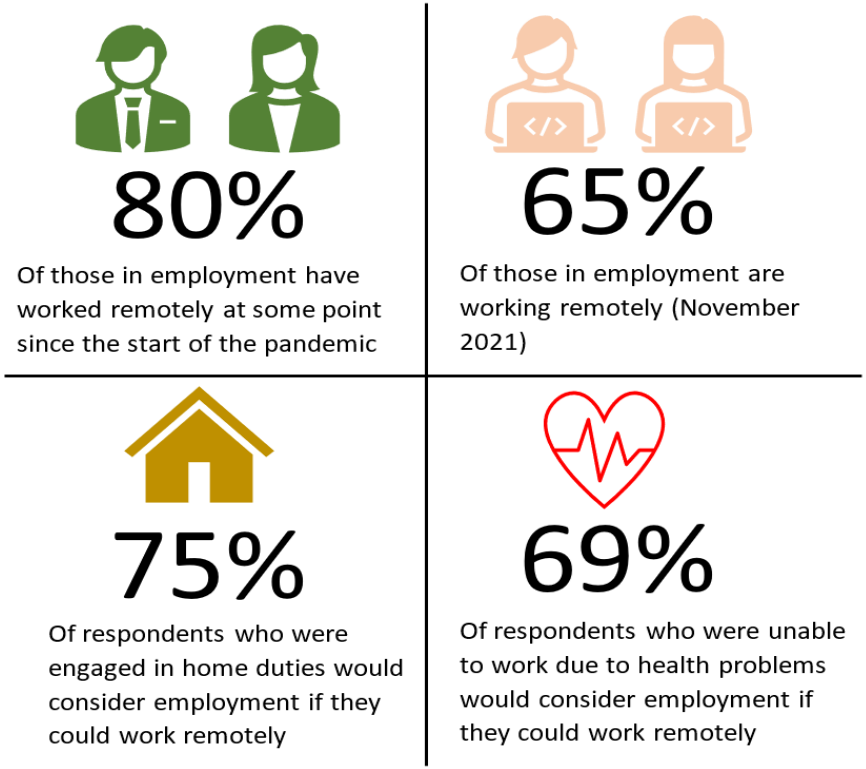
Reducing car journeys through remote working

The impact of COVID-19 on the nature of transport in Carrigaline cannot be understated and the profile will have changed significantly in the last two years, with a greater shift to home-based working and education, thus leading to a reduction in car usage. NUIG in conjunction with the Whitaker Institute [18] have released data from 8,428 respondents on their experience of Remote Working.
At the time of data collection (April 2022), 52% of respondents were working in a hybrid model (sometimes remotely, sometimes onsite), with 40% working fully remotely.

More than half (58%) of respondents said they had never worked remotely before the pandemic and almost all (95%) of respondents either agreed or strongly agreed that working remotely makes their life easier which suggests it will continue to be the norm for a significant amount of the population.

The recent enforced changes have created a national experiment in the concept of hybrid or remote working models which in many cases have been seen as being successful. Many office-based jobs can be based partly or on a full-time basis at home or within remote office hubs within the community. A reduction of 40% in work associated commutes could be achieved by working remotely 2 days a week, which would mean significant progress in reducing transport emissions by 42-50%.

[18] http://whitakerinstitute.ie/wp-content/uploads/2014/02/Remote-Working-Survey-Report-2022-final-updated.pdf



Compared to days when they are in their workplace, when those aged 45-54 years' work remotely:

Figure 15 – Results from the CSO 'Our Lives Online: Remote Work' survey from November 2021

Commuting to school or college

The outcome is similar for students commuting to primary, secondary and college education. Naturally we would expect the car to dominate the uptake for primary school children, so this slightly skews the results. However, there is still a lower usage of public transport amongst the student population in the community, with the SEC's usage over 33% lower than the national average. This could be a cause for concern but could also be viewed as a significant opportunity, as the community could try to address this by lobbying their local councilors and TDs if they can prove there is demand for the service.

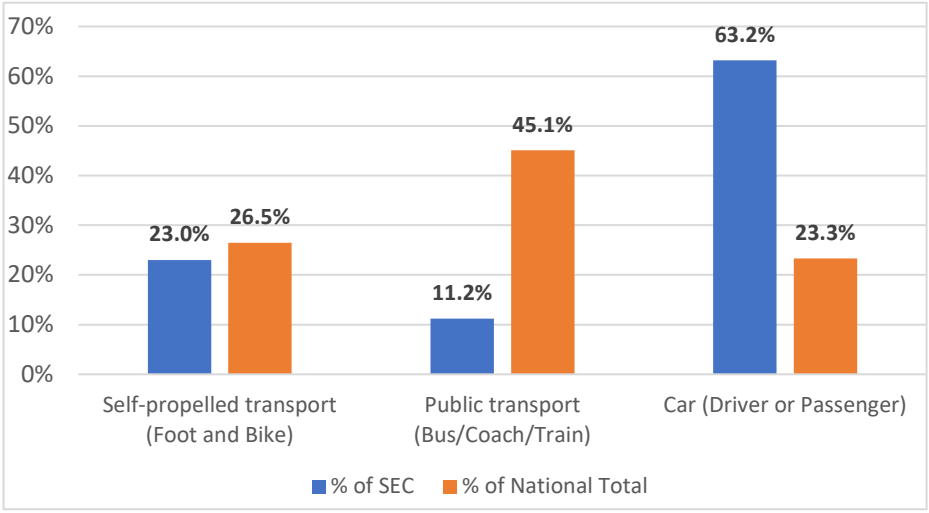


Figure 16 – Primary forms of transport for primary, secondary and college students (CSO,2016)

Carrigaline has a reasonable level of students who either walk or cycle to school, sitting just 3.5% below the national average. To increase this rate the SEC could look to seek funding or grants in order to improve the active travel infrastructure in their community so that walkways and cycle paths are safer for students.

For example, The Safe Routes to School (SRTS) Programme launched in March 2021 and was open to all schools in Ireland to apply for active travel funding and delivery. Over €15 million was provided in Round 1 of funding to accelerate the delivery of walking and cycling infrastructure on key access routes to schools and on school grounds.

Often times, one of parent's primary concerns about their children using active transport to go to school is their safety when going out alone. One way to combat this is through a 'Cycle Bus'. A Cycle Bus is where students cycle along a designated route to school with parents accompanying them.

Similar initiatives have popped up over the country, except rather than cycling, parents' guide children by foot in what is known as a 'Walking Bus' [19].

The improvements in active travel infrastructure that were outlined in the previously referenced Carrigaline Transportation and Public Realm Enhancement Plan should also provide safer routes for children attending schools in the Carrigaline town centre, particularly along those routes which have bollard separated cycle lanes. It remains to be seen how much of an impact these upgrades will make on active transport rates for students but an improvement in the cycling infrastructure should correspond to some kind of increase in its uptake.

[19] https://www.waterfordsportspartnership.ie/pdfs/walkingbusstartuppack.pdf

Energy consumption from transport

An analysis of transport related energy consumption was carried out for the Carrigaline SEC catchment area. The analysis was based upon a statistical analysis of vehicle ownership along with the types of vehicles used and their associated carbon emissions. [20] As already referenced, the Census data shows that the majority of commutes within the Carrigaline SEC catchment area are by car or van.

Table 10 – Means of commuting in the SEC (CSO,2016)

Commuting to work	No. of people	% of total
On foot	274	3.8%
Bicycle	65	0.9%
Bus	195	2.7%
Train	6	0.1%
Motorcycle/scooter	26	0.4%
Car driver	5535	77.6%
Car passenger	293	4.1%
Van	420	5.9%
Other	31	0.4%
Work from home	180	2.5%
Not stated	105	1.5%
Total	**7130**	**100%**

Based on the information on vehicle ownership within the catchment area, it is possible to calculate the energy consumption and carbon footprint for the transport sector. A national stock breakdown has been used to calculate energy consumption and emissions (56.9% diesel, 42.7% petrol, 0.4% Battery Electric Vehicle (BEV)) based on national average km travelled.

[20] The renewable portion of the fuels has been taken as follows: renewable content of electricity consumed (40% in 2020), 5% of petrol consumption and 7% of diesel consumption (as per the Biofuels Obligation Scheme).

Table 11 – Private Vehicle Transport Energy and CO_2 impacts (CSO,2016; CODEMA, 2019)

		National average annual km	kWh/km (TPER)	gCO_2/km
	Petrol	12,113	0.73	167
Car	**Diesel**	19,681	0.70	167
	BEV	12,958	0.38	65
Motorcycle		2,741	0.41	94
Van		19,787	1.01	243
Truck		44,671	3.47	832

Based on this information and values, a conservative estimate of energy used in transport is shown in Table 12 below.

Table 12 - SEC Transport Energy, CO_2 and Spend (CSO, 2016; SEAI, 2022)

	Electricity	Fossil Fuel	Renewable	Total
Total Primary Energy (kWh)	109,018	68,038,998	4,715,343	72,863,359
Total CO_2 (tonnes)	19	17,170	0	17,189
Total Spend (€)	€20,604	€13,742,218	€891,200	€14,654,022

Switch to electrical vehicles

An analysis of the impact of changing 20% of the existing private vehicle fleet to battery electric vehicles and reducing work-associated commutes by 20% through remote working is detailed in Table 13.

It indicates that a CO_2 reduction of 5,414 tonnes and a reduction in energy spend of approximately €4,308,240 per annum. These are savings which can be recirculated around in the local economy, creating a more economically sustainable community.

Table 13 - SEC Transport Energy, CO_2 and Spend with 20% Electric Vehicles and 20% decrease in work associated commuting (CSO, 2016; SEAI, 2022)

	Electricity	Fossil Fuel	Renewable	Total
Total Primary Energy (kWh)	5,450,912	43,057,531	3,306,647	51,815,090
Total CO_2 (tonnes)	932	10,843	0	11,775
Total Spend (€)	€1,030,222	€8,690,604	€624,956	€10,345,782

A significant increase in the availability of long-range electrical vehicles (EV) has made this mode of transport more suitable for rural environments. Electric vehicles will become the dominant mode of privately owner vehicles in the next 10-15 years. The key benefit for the user is the reduced operational costs associated with fuel to power the car. The following fuel costs for the EV are based upon home charging with night rate electricity in 2022.

Table 14 - Comparison of CO_2 impacts and fuel costs based on 250km per week (SEAI, 2022; Bonkers.com, 2022)

Vehicle	Weekly fuel cost	Weekly gCO_2
Electric e.g. Nissan LEAF	€9.84	13,800
Volkswagen Golf (Petrol)	€33.40	41,750
Volkswagen Golf (Diesel)	€35.51	28,000

The Carrigaline SEC should consider a public EV awareness event to promote the suitability of electrical vehicles for suburban environments. Whilst the one-off purchase cost can be more expensive than a fossil fueled car, electric vehicles are significantly cheaper to run, with SEAI reporting running costs for a diesel car as €1000 more expensive annually than an electric vehicle [21]. Households with 2 vehicles should consider purchasing a smaller electric vehicle alongside their first car for shorter journeys as a starting point on the route to electric vehicles.

SEAI provides a series of supports to incentivise the transition from fossil fuel-based vehicles towards electrical vehicles, details of which can be found in the Annex A at the end of the report.

However, it is acknowledged that it is still a significant outlay to purchase an EV and will be beyond many individuals' financial limits. Whilst we do anticipate the accelerated growth of a 'second-hand' market to grow in the next five years, in the short term the Carrigaline SEC should focus on implementing the 'Avoid-Shift-Improve' or ASI model for transport within the community. Until the cost of EVs comes down, it is important that communities embrace the ASI model and continue to use it even when the secondhand market for EVs begins to mature as EVs alone will not decarbonise the transport sector.

Table 15 – Avoid–Shift–Improve Transport model

Pillar	Description	Example
Avoid	Avoid or reduce travel or the need to travel	Transitioning to increased remote working. Walking or cycling where possible
Shift	Shift to more energy efficient modes	Using public transport such as bus services
Improve	Improve efficiency through vehicle technology	Moving towards electric vehicles

[21] https://www.seai.ie/technologies/electric-vehicles/compare-and-calculate/comparison-results/?vehicle1=8164927&vehicle2=7910676&vehicle3=4147520&vehicle4=4271646

Transitioning away from Cars

Car ownership

In order to meet the Transport reduction targets set by the Irish Government, the number of car journeys will need to decrease substantially. Naturally this means moving away from the traditional fossil fuelled car and towards alternative forms of transport that have a lower carbon intensity. Whilst EVs will undoubtably form part of the solution to reduce emissions from transport, other modes of transport will help to alleviate reliance on EVs.

Based on census data we know that there are 8,732 cars between the 11,542 people who are legally of age to drive in the Carrigaline SEC (17 and over). This means there are 756 cars per 1000 adults in Carrigaline. This doesn't account for those individuals who do not have a driving license, so the number of people who are able to drive them is likely to be lower.

If we assume that all drivers in Carrigaline operate diesel powered vehicles, then the annual average CO_2 emissions per driver in Carrigaline is 2.67 tonnes. (Based off the County Cork average annual km driven in 2019 [22]). Given the unpredictable and skewed transport data as a result of COVD-19 from 2020-2022, it is more beneficial for the SEC to use the conservative estimate of the 2019 data.

There were 5390 homes in Carrigaline as per the 2016 census, meaning there are 1.62 cars available for every home in Carrigaline, with 59% of homes owning more than one car. The SEC could appeal to those homeowners with more multiple cars to replace one with a bicycle or e-bike.

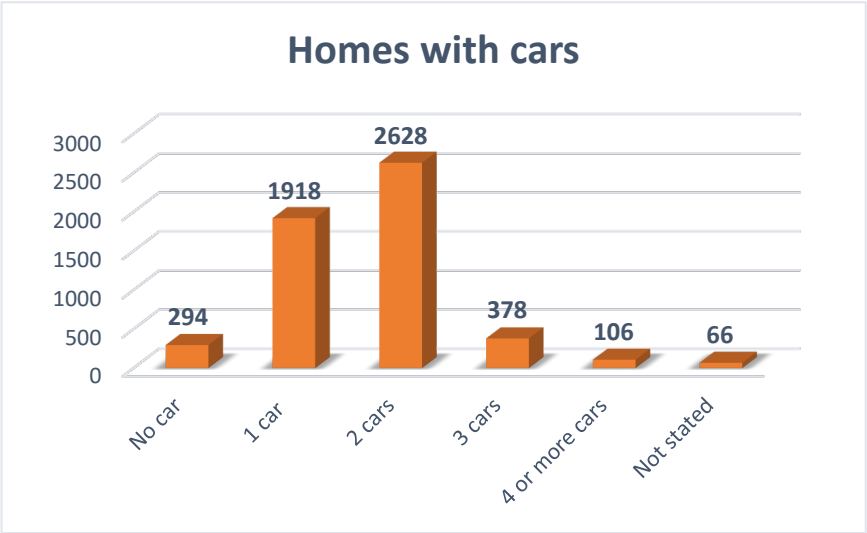


Figure 17 – Bar chart evidencing number of cars each home owns in SEC (CSO, 2016)

Increasing the rate of cycling

It is noted that the amount of cycling within Carrigaline makes up a tiny percentage of the journeys taken for work purposes, in contrast to the number of individuals who travel by other modes. However, plans are underway to address the lack of cycling within the community which have been outlined in the Carrigaline TPREP.

[22] https://www.cso.ie/en/releasesandpublications/ep/p-tranom/transportomnibus2019/roadtrafficvolumes/

In addition to the upgrades to the Carrigaline townscape, one key element of the TPREP was the extension of the Carrigaline to Crosshaven Greenway. The majority of this facility already exists but ends approximately 1km outside of Carrigaline. The extension of the greenway will be along the existing Crosshaven Road in as far as Main Street with a further extension proposed westwards along the Owenbue River.

The delivery of this Greenway combined with the public realm works on Main Street will provide the platform for changing the way residents travel within their town. The enhanced pedestrian and cycle network will also include a short section of the planned Carrigaline to Passage West Cycleway over the Owenabue River to provide improved access to the local schools on Bóthar Guidel and the growing population to the north of the town.

As referenced above, the TPREP also announced the delivery of the Carrigaline to Passage West Cycleway, which further enhances the active travel access to the centre of town, whilst providing a safe and direct cycle route to Ringaskiddy which will enable active transport commuting to the employment hub.

This report has discussed the first phase of plans in the TPREP that focus on cycling and pedestrian schemes, such as the upgrade to Main Street, with the extension of the Crosshaven Greenway and the delivery of the section of the Carrigaline to Passage West Cycleway.

However, the future pedestrian and cycle network proposed in the TPREP also aims to maximise access to the town centre and key educational, employment and leisure facilities from the outer residential areas. It is hoped that the plans within the report will remove barriers for cyclists and pedestrians and provide more safety and priority at the appropriate locations.

Specifically, one of the challenges that Carrigaline faces is limited connection between residential estates. This has created indirect routes across the town which can significantly increase journey distance and travel time, which discourages active travel. For example, the TPREP references a hypothetical journey from one of the residential housing developments in the North West of Carrigaline to the Soccer Club which could be more than halved in terms of distance if the appropriate measures were implemented.

If the vision for the TPREP's active transport infrastructure is implemented, this scenario would be replicated across Carrigaline, where previously indirect and time-consuming routes from the suburbs to destinations within the town are shorter and make active travel much more appealing. In the long-term the TPREP proposes completing the pedestrian and cycle network focusing on Cork Road and areas to the north east and finally the completion of works to the south of Carrigaline. However, this will require further assessment and consultation with the wider community before implementing any official plans. The linked video is a useful visual aid for understanding the TPREP - https://www.youtube.com/watch?v=0hxmHkn5XP8

The improvement in active travel infrastructure can only be a positive thing when it comes to addressing active travels low rates in Carrigaline and it would be expected that this will lead to a corresponding increase in the uptake of cycling. However, the infrastructure alone will not be enough, so to see a noticeable uptake in cycling in the SEC behavioural programmes, awareness days/weeks and change agents should be employed.

For example, it is understood that the town is home to a cycling club known as the Carrigdhoun Cycling Club. Perhaps the cycling club could use their influence to provide demonstrations within the local schools and education centres, so to educate younger members of the community about safe cycling and developing good habits at an early age that will continue into adulthood.

By encouraging more people, particularly younger people to use bicycles, investing in bicycle infrastructure and getting people in the habit of seeing more bikes in their town, this will encourage intergenerational cycling that would have a lasting impact on the towns transport profile.

Furthermore, the results from the SEC survey seem to suggest that a sizeable number of individuals within the town have access to a bicycle. This reinforces the value of initiatives that aim to get members of the community cycling, as the equipment is largely already there, therefore little investment is required. Given the increasingly higher diesel and petrol costs for fuelling motor vehicles, economically a bicycle has become a more attractive choice, given that after the initial purchase there are essentially no costs bar maintenance.

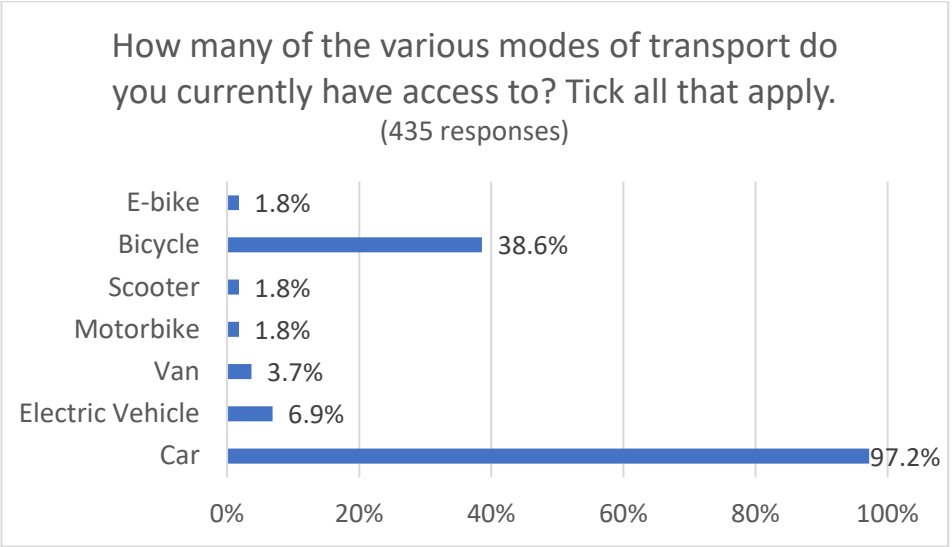


Figure 18 – SEC Energy Survey question on the modes of transport individuals have access to (Carrigaline SEC Home Energy Survey, 2022)

Furthermore, the initial cost of purchasing a bicycle could be offset for individuals with the Bike to Work Scheme. Under the scheme an employer can pay for a new bicycle (including bicycle accessories) and the employee then repays the cost in regular instalments from their gross salary.

An employee can save on the costs of cycling to work because your repayments come out of your salary before tax, USC and PRSI are deducted. This means that someone on the highest rate of tax will save almost half of the cost of a new bike and equipment. The scheme applies to bikes and equipment up to the value of €1,250 and for e-bikes and related safety equipment up to the value of €1,500.

The Carrigaline SEC could encourage employers within the community who aren't currently offering this scheme to do so and promote the Bike to Work scheme to employees on a regular basis.

E-bikes

Whilst estimates for how many grams of CO_2 e-bikes emit per kilometre driven vary widely due to differing methodologies, if a conservative estimate of 10g/CO_2/km was used, this would result in a reduction of 2.52 tonnes of CO_2 emissions annually per driver (based on earlier assumption of 2.67 tonnes of CO_2 per driver).

If approximately a quarter of the 2 car households and all 3 & 4 car households made this swap (1141 homes) and we assume that all cars are diesel powered and every car owner was driving the Co Cork average, the SEC would save roughly 3046 tonnes of CO_2.

For context this equates to 17.7% of Carrigaline SECs emissions from cars. This may be seen as difficult transition to make, but if we look at the average commute times for work, school and college in Carrigaline, the commute times lends itself to a reduction in cars given over a quarter of the SECs population have a commute time of under 15 minutes (28.8%).

Of course, it would be presumptuous to read too much into the commute times, particularly for those under 15 minutes as this is likely to be skewed by students attending school.

However, the survey issued around the SEC broadly gives the same results, with an additional 26.5% of respondents indicating that they either work/study from home or are currently not at school, work or college, which may indicate that most of their travelling would be localised.

Table 16 – Commute time for residents in the Carrigaline SEC to education or work (CSO, 2016)

	No. of people	% of total
Under 15 mins	3285	28.8%
1/4 hour - under 1/2 hour	4002	35.1%
1/2 hour - under 3/4 hour	2576	22.6%
3/4 hour - under 1 hour	628	5.5%
1 hour - under 1 1/2 hours	388	3.4%
1 1/2 hours and over	140	1.2%
Not stated	373	3.3%
Total	**11,392**	**100.0%**

Table 17 – Commute time for residents in the Carrigaline SEC to education or work from SEC Energy Survey (436 responses) (Carrigaline SEC Home Energy Survey, 2022)

Commuting time	No. of people	% of total
Under 15 mins	103	23.6%
1/4 hour - under 1/2 hour	102	23.4%
1/2 hour - under 3/4 hour	76	17.4%
3/4 hour - under 1 hour	22	5.9%
1 hour - under 1 1/2 hours	14	3.1%
1 1/2 hours and over	0	0%
Not at school, work or college	67	15.4%
I work/study from home	49	11.2%
Total	**436**	**100.0%**

A more detailed transport study which evidences where individuals are going on their commute, along with a breakdown of what mode of transport they use would provide a more reflective outlook of the transport profile in the SEC.

Commuting and car usage

It is extremely difficult to accurately calculate the mean car mileage for the Carrigaline SEC. We can see what the average commuting time is for those attending education or going to work, but this doesn't indicate which mode of transport they used on their journey.

There are 8,732 cars in circulation within the Carrigaline SEC. From that total 5,766 cars are used for commuting to work, school or college. This means that there are approximately 2,966 cars that are not regularly used for commuting purposes, which are more likely to drive a below average amount of distance annually.

The SEC could target those individuals who are not commuting for work or education in an effort to encourage them to use alternative means of transport that are less CO_2 intensive.

The findings in the Census data are reaffirmed by the SEC Energy Survey, which indicates that there is a significant number of drivers in the community who are travelling under the County Average for private cars per year, with 43.5% of 437 respondents stating that they drive under 10,000 km per year.

This reaffirms the previous point that a there are sections of the community who drive such little distances annually, that they could replace their car with a different mode of transport.

Table 18 - If you do you have a motor vehicle, how many kilometres do you estimate that you drive annually? (437 responses) (Carrigaline SEC Home Energy Survey, 2022)

Distance travelled by private car	% of total	No. of people
5,000	9.2%	40
10,000	34.3%	150
15,000	25.6%	112
20,000	13.5%	59
25,000	5.0%	22
30,000	4.3%	19
35,000	2.5%	11
40,000	0.9%	4
45,000	0.9%	4
Don't have a motor vehicle	3.7%	16

E-Scooters

Similar to an e-bike, an e-scooter (Electric scooter) is a small platform with two or more wheels that is propelled by an electric motor. Whilst there are a plethora of start-ups seeking to launch e-scooter services in Ireland, e-scooter operators will have to wait until late 2023 to get the green light as the Government formally introduces legislation governing their commercial usage. However, users over 16 are still free to purchase their own e-scooters from retailers without the need for a licence. E-scooters have grown in popularity in recent years, particularly during the COVID-19 pandemic were users sought to find alternative means of transport in urban areas.

E-scooters have proven to be particularly popular with younger users, which is a positive for Carrigaline, were almost a third of the local population lies between the ages of 16-39 as per the last census results. Carrigaline SEC should monitor progress on legislation regarding e-scooters, but in the meantime could begin building relationships with private vendors who have announced their intention to enter the market when legislation comes into force, particularly Irish start-ups to allow for a 'boots on the ground' presence for any proposed launch of a scheme.

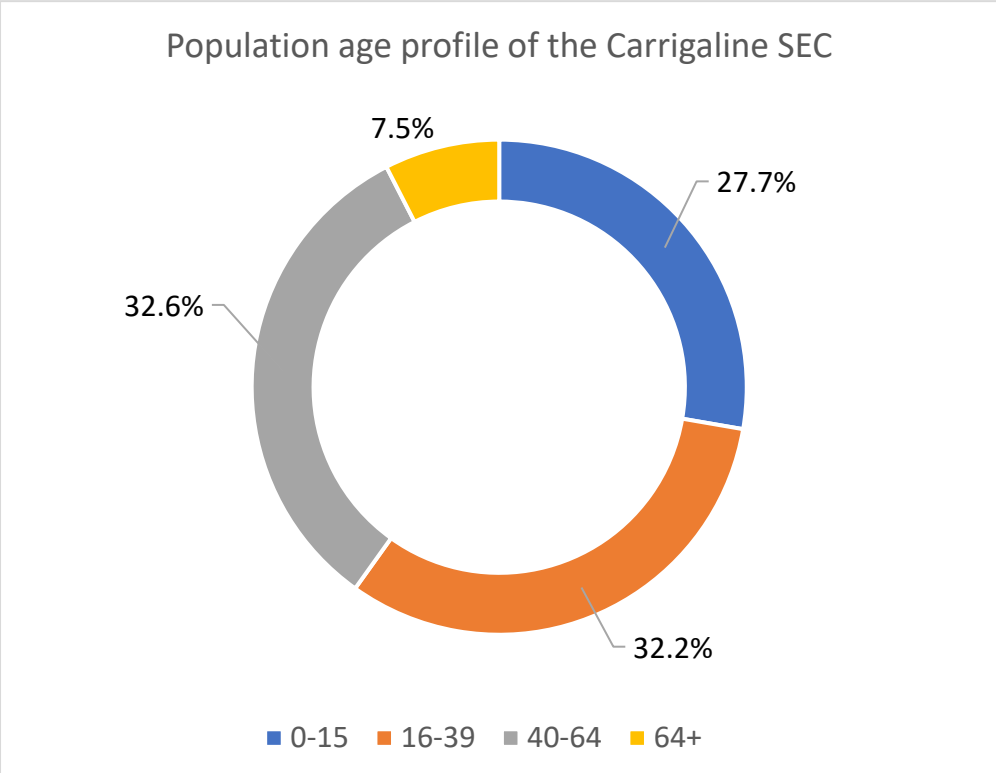


Figure 19 – Pie chart representing the population age breakdown in Carrigaline (CSO, 2016)

What may work against the adoption of e-scooters in Carrigaline is the typical distance covered by commuters to either education or their workplace each day. According to the SEC energy survey, only 14% of respondents live within 4km of their normal place of work or education. This suggests that it will be difficult to significantly influence transport emissions via a transition to either bicycles or e-bikes.

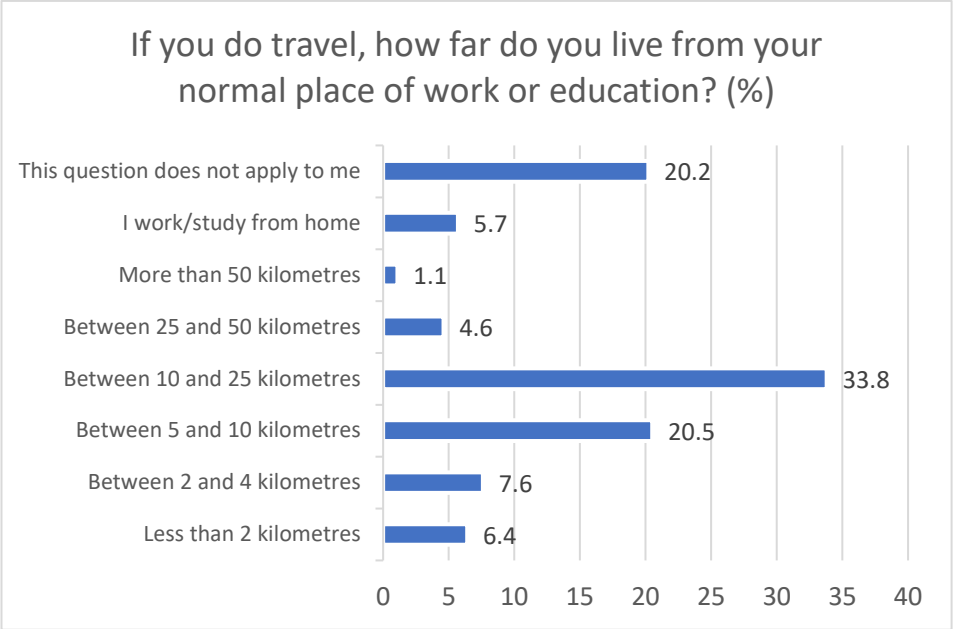


Figure 20 – SEC Energy Survey question asking respondents how far in kilometres do they live from their normal place of work or education (439 responses) (Carrigaline SEC Home Energy Survey, 2022)

Promotion of public transport services

Ultimately, whilst the census results were recorded in 2016 and the percentage of bus users could have risen, the SEC should try to investigate why the number of bus users is so low. The results from the census are further underlined by the SEC survey, in which only 3% of respondents out of 439 indicated that they use the bus regularly to commute to education or work.

Table 19 – SEC Energy Survey question asking which mode of transport do respondents typically use to commute to education or work (439 responses) (Carrigaline SEC Home Energy Survey, 2022)

Commuting to work or education	% of total	No. of people
Car driver	63.8	280
Not at school, work or college	15.7	69
Work or study mainly from home	8.2	36
On foot	4.1	18
Electric Vehicle	2.3	10
Bus, minibus or coach	3	13
Bicycle	0.7	3
Van	1.4	6

To address this, the SEC and other community groups should continue to lobby Cork County Council and/or contact local bus service providers and prove that sufficient demand is there to add more direct and frequent routes. Whilst it will be difficult for Carrigaline SEC to have any meaningful impact on the fuel choice used by the likes of Bus Eireann, they can campaign their Local Link services to begin the decarbonisation of the bus fleet.

For example, Laois County Council along with TFI Local Link Laois Offaly has launched its first electric bus that will operate across both counties [23]. Carrigaline SEC could lobby Cork County Council to replicate this initiative over the coming years and should be able to justify this given the population of Carrigaline and surrounding towns.

[23] https://locallinklaoisoffaly.ie/2021/03/31/tfi-local-link-laois-offaly-launches-its-first-electric-bus/#:~:text=TFI%20LOCAL%20LINK%20LAOIS%20OFFALY%20LAUNCHES%20ITS%20FIRST%20ELECTRIC%20BUS,-by%20TFI%20Laois&text=In%20conjunction%20with%20Laois%20County,its%20services%20in%20both%20counties.

Non-residential sector

Background

In order to achieve a 51% reduction in Carbon emissions by 2030 and a subsequent 'Climate neutral economy' by 2050, the business community will have to go through a period of transition in the same way as other sectors of the economy. Over the next decade businesses are encouraged to invest in a greener future, through sustainable products, services and business models.

Many of the avenues that the non-residential sector can take to reduce their carbon footprint and move towards a more sustainable model show crossover with the opportunities in the residential sector. However, there are a significant number of commercial processes such as refrigeration within convenience stores, air compressors at warehouse facilities and lighting arrangements in the hospitality industry which use significant amounts of energy and require tailored strategies to reduce this.

Given the turnover that some SMEs are recording in Ireland it can be difficult to have oversight of all monetary outgoings from a business. Therefore, many business owners simply don't notice the amount of unnecessary energy they are using in the day-to-day running of their business.

For this reason, an important theme throughout all these reports is the importance of engaging employee's regarding good energy management and educating all building users on the ways in which everyone within the building can contribute towards saving energy. Simple measures, such as installing lights with motion sensors, or switching off any equipment not in use rather than leaving them on standby, have proven to be successful in saving energy.

The recent Government announcement aimed at accelerating the decarbonisation of Irish businesses will see a new €55 million programme to help businesses plan for a more sustainable future and accelerate their decarbonisation journeys. The programme, which will run over the next five years will primarily comprise of the following:

- The Climate Planning Fund for Business, will give businesses a €1,800 grant to devise a personalised plan to identify how best to eliminate their reliance on fossil fuels and up to €50,000 matched funding to go towards specific capacity building
- The Enterprise Emissions Reduction Investment Fund will offer up to €1 million for manufacturing businesses to upgrade their processes. With funding to invest in energy monitoring and tracking, carbon neutral heating processes, smart metering and research and development

Large Industry in Carrigaline

Whilst Carrigaline is surrounded by large pharmaceutical companies, none of them are in the SEC area. The main companies within the area are:

Pepsico

Pepsico have been in operation since 2003. They are one of the largest sites in the SEC area. Located on a large twenty-seven-acre site at Kilnagleary, they manufacture concentrate for the international market. They employ approximately one hundred and fifty people in operations. As part of their sustainability programme, they have energy objectives and complete energy audits. More info on Pepsi Co's climate strategy is contained within a supplementary document to this report (Annex E).

Kerry Group

The Kerry group manufactures ingredients for the food sector. Located on their own site at Kilnagleary they employ approximately 90 personnel. They are presently undertaking an energy audit.

Business and Retail Sectors

The SEC committee has estimated that there are about 350 small and medium enterprises (SME) currently operating in the town and surrounding areas, operating retail, professional and other services. There are also several light industrial estates.

Retail is mainly located in the main street and immediate surroundings and is a mix of supermarkets, a co-operative store, small shops, pharmacies, bars, cafés, and fast-food restaurants.

The building stock is a traditional build of block and painted plaster with tiles or felted roof. Building fabric in the main street is a mix of old and new in traditional Irish main street architectural design. There are several vacant/derelict properties.

While some of these premises may use alternative energy sources, smart metering technologies, or have future - proofing capability for renewable energy or water saving built in, there is a significant opportunity to upgrade the entire cohort and is something the community should target over the next decade.

SuperValu is the biggest supermarket/shopping complex in the town. Founded in 1856 it occupies an area of approximately 30,000 square feet. Over the years it has increased in size, and now includes a café, pharmacy, two hairdressers, post office, and three shops in addition to the supermarket.

Separate to the main street, there are clusters of service industries dotted around the town most notably in or on:

- The old Carrigaline Pottery facility – late 20th century building cluster, light industry
- The old CB&PR Railway station – late 20th century buildings clustered with 1903 station, light industry
- Crosshaven Road and Kilnagleary Business Parks – late 20th century buildings, light industry, and some manufacturing
- Church Road and The Estuary boatyard – late 20th century buildings, light industry, and some retail

The building stock is a wide variety of light industrial architectural styles including concrete block and metal cladding sandwich panels, steel and concrete portal and pitched roofs using cladding panels, single ply membrane and northlights. It is safe to assume these premises use alternative energy sources, smart metering technologies, or have future-proofing capability for renewable energy or water saving built in.

Method

An analysis of non-residential energy consumption within the SEC catchment was carried out using various data sources including Chartered Institution of Building Services Engineers (CIBSE) TM46 Energy Benchmarks, Valuations Office and Energy Consumption and SEAI's 'Extensive Survey of Commercial Building Stock in Ireland'.

In order to estimate the potential energy usage of all non-residential premises within the catchment area, a method based on estimated floor area and business category was implemented. Energy benchmarks for various business categories were sourced from "CIBSE TM46 Energy Benchmarks and Energy Consumption Guide" and were applied to the floor area data available.

Table 20 – An example of the CIBSE energy values applied to a typical office. These are multiplied by the area (m^2) of each Office Building in the SEC, the data for which is obtained from the Valuations Office

	Annual data for an office
Typical Electricity consumption (kWh/m^2)	95
Typical fossil fuel consumption (kWh/m^2)	330
Typical Electricity emissions ($kgCO_2/m^2$)	31.4
Typical fossil fuel emissions ($kgCO_2/m^2$)	62.7

As part of the energy master plan for Carrigaline, two premises were audited an Ashrae level 1 standard to identify any opportunities within these premises for energy efficiency measures. The recommendations within the reports are based on utility data, a site audit, and related engineering calculations.

The site audit consisted of a walk-through of the facility and review of the electrical and mechanical systems and equipment. It is recommended that the organisations implement the measures identified in their reports to contribute towards the energy consumption reduction goals as set out in the Climate Action Plan.

The premises which were audited are detailed in the following list and a detailed report was provided to each of the property owners the results of which are located within the supplementary document to this report (See Annex C):

1. An Energy Audit of a sample farm (dairy farm).
2. An Energy Audit of Carrigaline Community Complex.

Results and Analysis

Below is an overview of the estimated total energy usage, emissions and spend from the non-residential sector within the Carrigaline SEC. This helps the SEC get an idea of just how much their non-residential sector needs to reduce its energy usage by in order to keep in line with the Irish Government's targets in the Climate Action Plan.

Table 21 - SEC Non-Residential Energy, CO_2 and Spend (CIBSE, 2012)

Electricity consumption (MW·h)	Thermal Energy consumption (MW·h)	Electricity emissions (tCO_2)	Thermal Energy emissions (tCO_2)	Total emissions (tCO_2)	Total Energy Spend (€)
18,697	**36,449**	**10,287**	**6,925**	**17,213**	**€9,723,980**

Support for SMEs

Aside from the recommendations contained within the EMP and supplementary non-residential audits, businesses can utilise the ClimateToolKit [24] website launched by the government to help businesses get started in taking climate action.

This online tool allows SMEs to input some simple information and get an estimate of their carbon footprint and a personalised action plan to reduce it. Each tailored action plan includes straight-forward, practical instructions and highlights the relevant help that is available from Government, through agencies such as Enterprise Ireland, the Local Enterprise Offices and SEAI.

SEAI have also launched a free, online, learning platform called the 'SEAI Energy Academy' which is designed to help businesses increase their energy efficiency and reduce their energy related costs. It delivers short, interactive, animated modules on a wide array of topic areas including business and office energy efficiency.

Furthermore, SEAI are currently running an energy audit scheme that offers SMEs a €2,000 voucher towards the cost of a high-quality energy audit [25]. These energy audits are suitable for businesses with an annual energy spend of over €10,000. These energy audits delve deeper than those contained within the report, analysing the sites suitability for various renewable technologies, the most significant users of energy in their business and their overall carbon footprint.

A highly detailed audit like this gives business owners the confidence to take appropriate steps to improve both their energy efficiency and reduce their annual energy bills. The non-residential audits identified several opportunities within the premises and Carrigaline SEC which can be developed into energy efficiency projects. The standout projects are:

- **Abbey Dairy Farm**
  - Solar PV - Consider installing solar PV panels on the south facing roof. A 6kWp system would be appropriate here. A simple 6kWp system, consisting of 18 panels, a DC to AC inverter and battery would be appropriate.

- **Carrigaline Community Complex**
  - Energy Monitoring Equipment - Install energy trackers throughout the building to monitor energy use throughout the building and across the day to see when and where the significant energy users are.

[24] climatetoolkit4business.gov.ie

[25] https://www.seai.ie/business-and-public-sector/small-and-medium-business/supports/energy-audits/

Reducing energy use

It is common knowledge that large companies have a significant impact on the environment due to their size and scale of operations. As a result, it is widely acknowledged they have a responsibility to reduce their energy use and decarbonise in order to mitigate the negative impact of their operations on the environment.

By taking the lead in this manner and reducing energy use, these larger companies can provide a positive example and set a template for smaller businesses and public buildings to follow. This can create a ripple effect that can lead to a significant reduction in greenhouse gas emissions across industries and communities.

It's understood that efforts to lower the energy use, install renewables and lower carbon output have started to take place in Carrigaline amongst businesses. Some of the larger businesses in particular, such as PepsiCo, SuperValu and Lidl have led this transition, with a bespoke register of opportunities created to reduce energy use at PepsiCo over the coming decade highlighting the changes taking place at some of the biggest employers in the SEC. Furthermore, a 52 panel Solar PV array is proposed for Aldi which is currently under construction.

Collins' SuperValu in particular has been a leader in developing an energy efficient operation at their site. Firstly, the supermarket has had 100% LED lighting since 2011, with an update in 2015, evidencing that the business was very much ahead of the curve when it came to energy efficiency.

There is set to be a further update of the LED technology in store later this year, with a full installation of new LED lighting to replace all old lighting throughout main shop in September 2023, which is hoped to further reduce energy use.

This has been supplemented by a full refit of all refrigeration throughout – new chill cabinets to include energy saving doors and lighting. Furthermore, there has been a full refit of the refrigeration area, featuring the removal of all compressors and ancillary works transitioning the to a more sustainable gas refrigerant system using only CO_2 extracted and compressed from the surrounding air.

They also have a significant amount of Solar energy generation at the store, with estimates as of April 2023 indicating that since December 2022, their 300-panel installation has accounted for over 63% of their electricity demand.

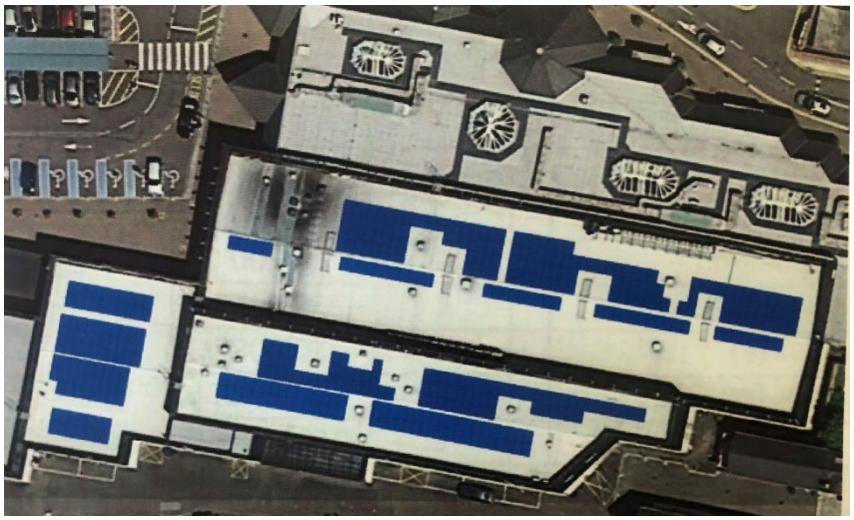
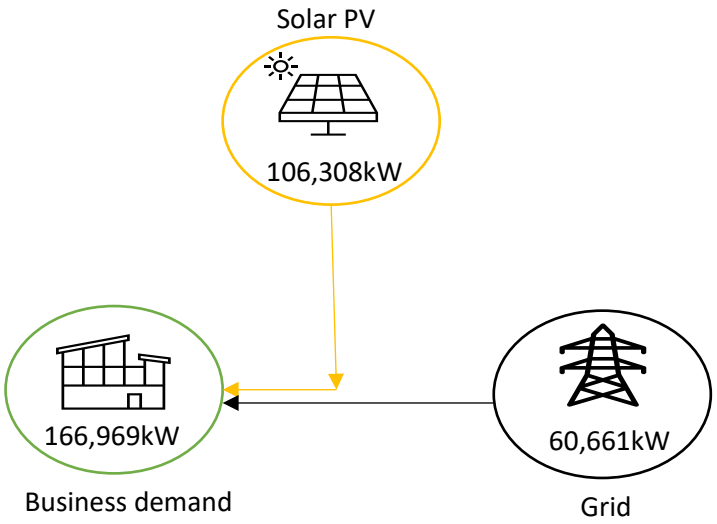


Figure 21 – Overhead view of the Solar panels on the roof of Supervalu

The graphics below illustrate the impact that the addition of the Solar PV installation has had on operations at Supervalu:



The electricity generated from renewable sources has led to:

3.69 (tonnes) of coal saved

4.38 (tonnes) of CO_2 avoided

6 equivalent trees planted

The second phase of Solar panels were planned to be installed in the middle of April 2023 over the current walkways with approx. 258 PV panels expected to be fully operational by End of May 2023.

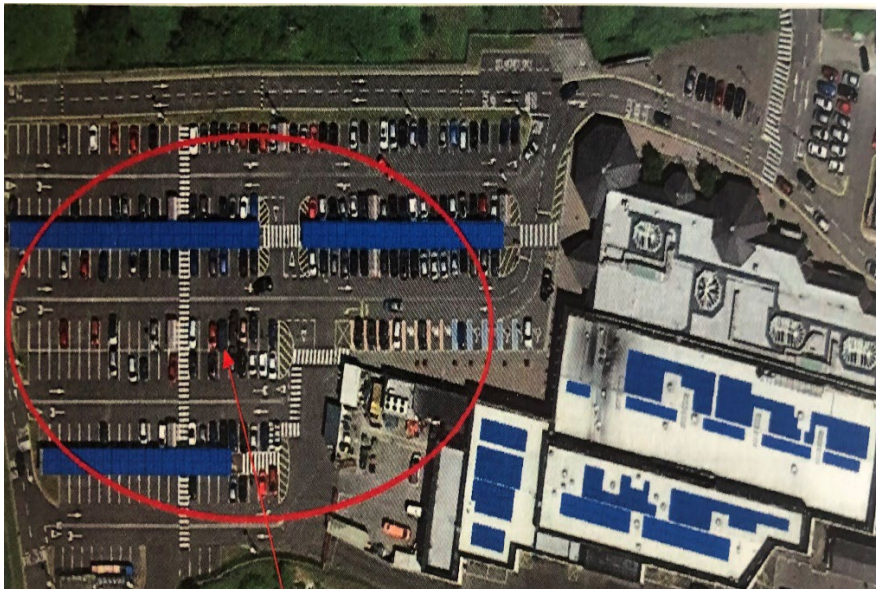


Figure 22 – Overhead view of the Solar panels on the walkways of the Supervalu site

The initiatives and efforts in Collins Supervalu are part of a wider goal from Supervalus' parent company – Musgrave Group – to reach net zero carbon emissions by 2040. All Supervalu and Centra stores adhere to an Energy Policy Plan set by Musgrave Group which is guiding each stores energy strategy over the next decade.

Clubs and community groups

Clubs and community groups, especially sports clubs, play an essential role in bringing people together and fostering a sense of community. However, these organisations also have a role to play in minimsing their energy usage.

By using energy-efficient equipment, implementing energy-saving practices, and promoting awareness among members, sports clubs can significantly reduce their energy consumption and contribute to a more sustainable future. Not only does this benefit the environment, but it can also save the organisation money on energy costs in the long run. Moreover, reducing energy use can set a positive example for members and the wider community, demonstrating the importance of sustainable practices and inspiring others to follow suit.

This is particularly important in a town like Carrigaline, which is home to a number of community groups and sports clubs. In fact, there are more than 60 clubs and sporting organisations in the SEC area. However, over 90% do not have their own premises.

One of the largest exceptions to this is Carrigaline Tennis Club, which has floodlights installed to enable members to play and practice into the evening hours. However, they also represent one of the biggest energy users, with conventional floodlights consuming vast amounts of electricity.

In fact, in an Energy Audit carried out into Carrigaline Tennis Club, the floodlights represented 79% of the total electrical load on site. This high energy consumption not only puts a strain on the environment but also on the club's finances, with over €8,200 spent annually to power the floodlights.

Table 22 – Breakdown of the electricity bills for Carrigaline Tennis Club

Energy User	Cost per yr (€)	Usage per yr (kWh)
Tennis Court Floodlights	€ 8,228	20,452
Car Park Lighting	€ 123	307
Indoor Lighting	€ 151	374
Others	€ 1,868	4,643
Total	€ 10,369.17	25,776

To address these issues, sports clubs are increasingly turning to LED floodlights. LED floodlights use significantly less energy than traditional lights, while still delivering bright, high-quality lighting. This makes them an ideal solution for sports clubs looking to reduce their environmental impact and save money on energy bills. Furthermore, LED floodlights have a longer lifespan than conventional lights, reducing the need for replacements and maintenance costs.

The energy audit carried out on Carrigaline Tennis Club analysed how many hours the floodlights tend to be on over the course of a year and was able to come up with a representative estimate of their usage and subsequent energy consumption.

For other clubs and societies in Carrigaline that use floodlights or similar energy intensive equipment, it is important they carry out a similar audit so that they can make informed decisions about the extent to which they should invest in upgrading their energy efficiency.

For example, if Carrigaline GAA club wished to upgrade their array of floodlights, on their pitches alone they have:

- Pitch 1 - 48 No. 2KW Floodlights – 98kWh of energy for 1 hour of use
- Pitch 2 – 16 No. 1KW Floodlights – 16kWh of energy for 1 hour use
- Pitch 3 – 6 No. 500W Floodlights – 3kWh of energy for 1 hour use

If all of the floodlights on the respective pitches were turned on for 1 hour a day this would cost approximately €49.95 (assuming a 43-cent p/kWh rate). If they were turned on for 1 hour for 200 days this would cost €9,890.

Of course, it would be expected that not all of the floodlights would be turned on at all of the pitches, but this gives a good idea of the potential energy usage and cost over a year for a club.

If we take the example of Carrigaline tennis club, it was estimated that it would cost €46,836 to upgrade the existing 36kW floodlight array. Naturally then it would take a significant amount of capital expenditure to upgrade the 115kW array of floodlights for Carrigaline GAA.

An energy audit would reveal how much lighting is actually used over the course of year and which lighting to prioritise depending on the usage the pitch gets. This will ensure the club is not using money to upgrade its efficiency for equipment it doesn't actually need.

Schools

Energy usage in Irish schools is a topic of growing interest as the country seeks to decarbonise it's public building stock. Schools are significant energy consumers, and their energy usage can have a significant impact on school budgets. Energy usage in Irish schools also makes a sizeable contribution to carbon emissions and climate change. However, by implementing energy-saving measures and promoting awareness among students and staff, schools can significantly reduce their carbon footprint and contribute to a more sustainable future.

For example, by using energy-efficient lighting, upgrading heating and cooling systems, and ensuring that appliances are turned off when not in use, schools can significantly reduce their energy consumption. Additionally, schools can promote awareness among students and staff by encouraging energy-saving practices such as turning off lights and computers when not in use, and by providing information on the benefits of energy efficiency and sustainability.

By promoting sustainable practices, schools can set a positive example for students, empowering them to become 'change agents' within their own homes, influencing their parents and guardians' attitudes and behaviours towards energy usage along the way.

Carrigaline has more than twenty educational facilities, including more than eleven early years/preschools, seven primary schools, three secondary schools and several specialised adult and further education units. The buildings range in age from the early 1960s to 2022. Similar to the audit carried out on the Tennis Club, PlanEnergy were given access to a detailed energy audit that was carried out on Carrigaline Community School by SEAI. This audit analysed the buildings energy profile so that tailored recommendations could be made on how to reduce its energy consumption.

The school's energy consumption, cost and emissions over the course of 2018 are displayed in Table 23. It is important to note that the costs and emission factors if calculated again today would have changed due to the increases in energy and the lower emission factor associated with producing electricity.

Table 23 – Summary of Fuel types used by Carrigaline Community School (SEAI, 2019)

Fuel Type	Quantity (kWh)	Spend (excl. VAT)	CO_2 Emissions (tonnes)
Electricity	175,250	€32,952	51
Natural Gas	502,160	€25,727	90.4
Total	**677,410**	**€58,678**	**141.4**

The audit into the school also revealed that the following amount of energy was used for per pupil on average annually in Carrigaline Community School (1079 pupils)

Table 24 – Average annual energy consumption per pupil in Carrigaline Community School (SEAI, 2019)

Fuel Type	kWh/pupil/year
Electric	162.42
Fossil Fuel	465.39
Total	627.81

Like many other schools, the audit revealed that lighting was the dominant source for electricity usage, accounting for half of the consumption. It's understood that the school were in the process of getting their lighting upgraded from luminaires to LED lights, therefore the main organisational improvements suggested are the formation of a small energy team and the preparation of an Energy Policy / Statement.

Table 25 – Breakdown of the energy demand in Carrigaline Community School (SEAI, 2019)

Electrical Energy Consumption	% of Total
Lighting	50
Outside Lighting	10
Computer Rooms	10
Sports Hall / Playing Area	6
Other power usage	24
Thermal Energy Consumption	**% of Total**
Space Heating / Hot Water Main Building	90
Space / Hot Water Heating Sports Hall	10

The team can then drive a new energy awareness program among the staff, students and other stakeholders. For the vast majority of schools, these three recommendations would form the bulk of the majority of energy audits. However, for schools that have already taken these steps, Solar PV would be recommended, especially due to the fact that a schools energy usage profile over a day generally matches when Solar energy is at its peak in terms of availability.

Carrigaline Community School had been using 175,250 kWh per annum, which is a significant amount of electricity that could not be totally offset by Solar PV alone. Depending on the amount of roof space available a Solar PV array upwards of 30kWp could be installed at the school which would reduce the amount of electricity it purchases from the grid by 15%.

Of course, this is undoubtably a significant investment for any school, irrespective of the payback they would get on their Solar Panels, so it is welcome that there are plans to provide fully funded 6kWp Solar PV arrays to schools across the country beginning this year. It is understood that schools will have to apply for this funding through the 'Summer Works Program 2023' which as of writing is yet to open.

Carrigaline SEC are advised to engage and collaborate with the local primary and post primary schools and inform of them of schemes such as the one described above or point schools towards the resources that SEAI have developed and their range of technical supports regarding energy efficiency and sustainability in schools.

For example, the SEAIs' Energy in Education program offers various workshops and training for teachers, helping them to develop and deliver material to the class about sustainable energy. This training also helps to make teachers and staff more aware of how to monitor and track energy use within their own facility. Additional SEAI school specific resources include:

- SEAI School Workshops
- Climate SOS Publication
- Tutorial on Energy Experiments
- Monitoring & Reporting datasheets for Schools
- Interactive whiteboard lessons

Agriculture

The agriculture sector is broad, but energy demand is largely restricted to the dairy sub-sector. Other sub-sectors such as tillage, beef, poultry and pork have associated environmental impacts, but the energy demand is typically fairly low. According to Teagasc[26] the main drivers of energy consumption on dairy farms in Ireland are milk cooling (31%), the milking machine (20%) and water heating (23%). These areas would therefore offer the greatest amount of scope for energy savings. The cost of electrical energy has increased dramatically since 2020 and awareness of energy consumption in dairy farms is becoming a significant issue in the cost of milk production.

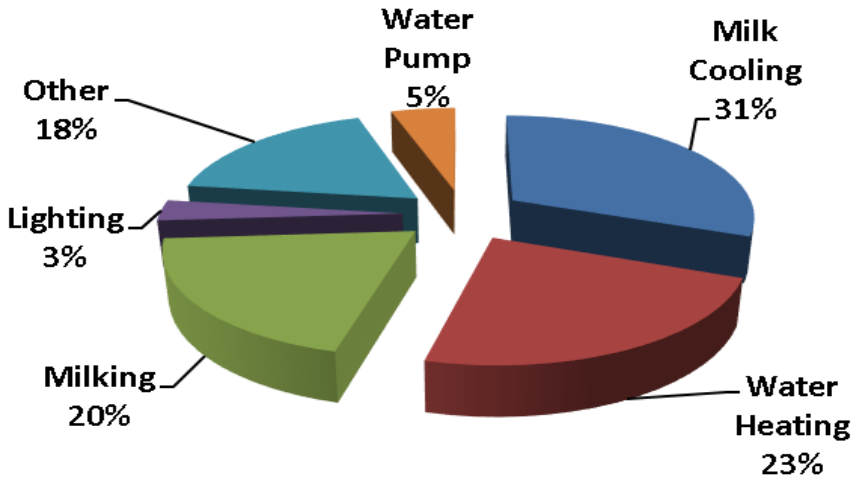


Figure 23 - Average electricity component consumption on 60 commercial dairy farms (Teagasc, 2021)

[26] Teagasc (2021) Reducing energy costs on dairy farms, Available at: https://www.teagasc.ie/news--events/daily/dairy/reducing-energy-costs-on-dairy-farms.php

Table 26 – Results from a Teagasc energy efficiency audit of 22 dairy farms [27]

Function	Watts consumed per litre of milk produced	Percentage of electricity consumed during day rate tariff
Milk cooling	13.02	60
Water heating	9.83	45
Milking	8.44	71
Lighting	1.37	89
Other	7.54	69
Pumping	2.13	38
Total	42.34	62

Background

Carrigaline and its surrounding area is home to a variety of agricultural activities and the landscape is characterised by a mix of pasture and arable land, with dairy farming being the most common type of energy-utilising farming activity. Many of the dairy farms in the area are family-owned and operated, with a focus on producing high-quality raw milk for use in dairy products like cheese and butter.

The agriculture sector in Carrigaline and surrounding areas is supported by a range of organisations and initiatives, including the Teagasc advisory service, which provides support and advice to farmers on a range of issues, including farm management, energy use, animal health, and soil fertility.

[27] Teagasc (2020) Dairy Farm Energy, Available at: https://www.teagasc.ie/rural-economy/rural-development/diversification/dairy-farm-energy/

The annual Ballygarvan Agricultural Show is also an important event for the local agricultural community, showcasing the best in local farming and livestock. Overall, the agriculture sector in Carrigaline and County Cork plays an important role in the local economy, providing employment and contributing to the production of high-quality food products for both domestic and international markets.

As per correspondence with the Carrigaline SEC Steering Group, there are 29 farms in the SEC catchment area. Some of these farms are commercial owner-occupied farms and the remainder are made up of owner-occupied part-time farms and also farms which are rented to commercial farmers from outside the area. Farm size varies and farms are divided into 3 size categories.

Table 27 – Breakdown of the farms and their sizes in the Carrigaline SEC

	Large 41- 80 Hectares	Medium 21- 40 Hectares	Small 0- 20 Hectares
Dairy	4	6	0
Mixed	2	8	9

As previously referenced, dairy farming is the predominant commercial enterprise across the farms. Other enterprises are beef/cattle and various tillage enterprises which are which are collectively described as Mixed. The non-dairy (Mixed) farms would normally have a mix of cattle and tillage and are usually the smaller farms.

There has been a large number of studies carried out into the Irish Dairy industry, which have provided up-to-date, high-quality data that can be applied to the Carrigaline SEC to understand their energy use. However, the same cannot be said for beef farms or tillage. This could be attributed to their relative lack of energy use in comparison to dairy farms or the significant increase in output from dairy farms over the last decade.

For this reason, the EMP focused on the Dairy sector for the Energy Master Plan, as the lack of credible and up-to-date data for non-dairy farms, coupled with the fact that dairy farms comprise a significant amount of the large and medium sized farms in the SEC, means that they are likely to make up the vast majority of energy use in the agriculture sector in the SEC area.

Method

The calculations set out in Table 27 are based on a number of assumptions and a collection of data specific to the Carrigaline SEC. Firstly, from the data that we were given, we can see that in the SEC there are 10 dairy farms, with 4 large farms and 6 medium farms. Large farms are categorised as being between 41-80 hectares, therefore for the purposes of this data collection we have opted to use a midpoint of 60 hectares on average for every large farm. The same logic has been applied for the medium farms, which are categorised as being between 21-40 hectares – therefore 30 hectares for every medium farm has been selected as the average area.

The data that was supplied did not detail the number of cows on each of the farms. Therefore, assumptions were made about the number of dairy cows based on the amount of farm area available. A Teagasc study [28] which analysed the daily and seasonal trends of electricity and water use on pasture-based automatic milking dairy farms studied 7 farms in detail. In the data collection it was evidenced that on average, there were approx. 2.42 dairy cows for every hectare of farm area.

The same Teagasc study also indicates that approximately 336 kWh of electricity is used per cow on an annual basis to produce milk. This logic was applied to the calculation above in the following way:

Average no. of cows per farm * No. of farms = Total no. of cows

Total no. of cows * kWh of electricity per cow = Total kWh of electricity consumed

The total amount of units of electricity from each farm category was then applied by a typical market electricity night deal rate of 52.82 cent during the daytime and 26.11 cent at night.

By analysing the data supplied in the Abbey Farm energy audit we can see that approximately 46.3% of energy is used on the day time rate and 53.7% on the night rate. This is reflective of many farms which utilise the cheaper rate offered from midnight to 7am.

((Total kWh/100) * 46.3) *0.5282 = Day cost of electricity

((Total kWh/100) * 53.7) *0.2611 = Night cost of electricity

Day cost of electricity + Night cost of electricity = Total cost of electricity

The CO_2 from electricity generation was simply calculated by multiplying the units consumed by the conversion factor used for the amount of CO_2 generated per kWh of electricity produced in Ireland in 2021 – in this case 331g of CO_2 per kWh [29].

Finally, to calculate the CO_2 from dairy cows, if we return to the Teagasc study, the average dairy cow produces roughly 5,372 litres of milk annually. The Environmental Protection Agency [30] has estimated that 1.14kg of CO_2 is released per kg of milk of milk produced, therefore:

[28] Shortall, J., O'Brien, B., Sleator, R.D. and Upton, J., 2018. Daily and seasonal trends of electricity and water use on pasture-based automatic milking dairy farms. *Journal of dairy science*, *101*(2), pp.1565-1578.

[29] Environmental Protection Agency (2022) EPA data shows Ireland's 2021 Greenhouse Gas Emissions above pre-Covid levels, Available at: https://www.epa.ie/news-releases/news-releases-2022/epa-data-shows-irelands-2021-greenhouse-gas-emissions-above-pre-covid-levels.php

[30] O' Mara, F., Richards, K.G., Shalloo, L., Donnellan, T., Finn, J.A. and Lanigan, G., 2021. Sustainability of ruminant livestock production in Ireland. *Animal Frontiers*, *11*(4), pp.32-43.

Average litres of milk per cow * Average CO_2 (kg) per kg of milk produced = Average CO_2 (kg) per cow

The Average CO_2 per cow from dairy production is estimated to be 6124kg. When this is multiplied by the number of cows across each farm group:

Average CO_2 kg per cow * Total No. of cows = CO_2 from cattle

The results of these calculations are set out in the tables below:

Table 28 - Carrigaline SEC Dairy farm model consumption, costs and emissions

Carrigaline SEC Dairy Farm model	Large	Medium
Number	4	6
Hectares	60	30
Average no. of cows per farm	145	73
Total no. of cows	581	436
Total kWh	195,149	146,362
Day cost of electricity (52.82 cent)	€47,725	€35,794
Night cost of electricity (26.11 cent)	€27,362	€20,521
Total cost of electricity	€75,087	€56,315
CO_2 from electricity generation (Tonnes)	65	48
CO_2 from cattle (Tonnes)	3,557	2,668

Carrigaline SEC Dairy Farm model	
Total cost of electricity	€131,402
Electricity consumption (MWh)	342
Total amount of CO_2 (tonnes)	6,225

Audit of Abbey Farm

PlanEnergy were commissioned by Carrigaline Sustainable Energy Community to conduct an energy audit on Abbey Farm in Carrigaline, Co. Cork. The following data details the findings of the Energy Auditor which was based upon a site visit and information provided by the building owners.

Only 4 electricity bills were provided for analysis which covers the period from 19/01/2022 to 21/07/2022 (240 days). The table below lists the data as if it was extrapolated for an entire year, rather than just 240 days, so we can give a true comparison of how it compares to the Carrigaline SEC dairy farm model. Naturally, by extrapolating data in this manner, we are making a number of assumptions about the farm's energy usage, which in reality may not have occurred.

Table 29 – Comparison of data from Abbey Farm against the SEC Dairy Farm model

	Abbey Farm	Carrigaline SEC Dairy Farm model
Hectares	55	60
Total no. of cows	115	145
Total kWh	35,663	48,787
Cost of electricity	€5,510	€18,772

Explaining the discrepancies

As we could only analyse bills for 240 days and have used this to extrapolate the final figure for an entire year, it is quite possible that the energy usage may have been higher than the figure of 35,663 kWh that we calculated. Considering the variance between some billing periods, with the March billing period only having a usage of 4983 kWh, whereas May had 7876 kWh of usage. It's quite possible that there could have been more months like May as the year went on that we were not aware of.

Table 30 – Billing data for Abbey Farm

Billing Period	Days	Total Cost	Total Usage
19/01/2022	62	€ 751.35	5322
22/03/2022	64	€609.79	4983
25/05/2022	57	€ 1,349.01	7876
21/07/2022	57	€913.28	5269

However, there are also more straightforward, logical explanations as to why Abbey Farm may have a lower energy use. The size of the herd (115 cows) vs the modelled size for a large farm (145) are significantly different. As previously referenced, the data in our model estimates that there are 2.42 cows per hectare, whereas there are 2.09 cows per hectare at Abbey Farm.

If we multiply the number of cows on Abbey Farm (115) by the Dairy Farm models assumption about kWh used per dairy cow annually, we will get a figure of 38,640 kWh – much more similar to the extrapolated total of 35,663 kWh at Abbey Farm.

Furthermore, the audit revealed that Abbey Farm utilises cold well water to pre-cool the temperature of the milk, an energy free manner of carrying out this activity, as opposed to something which relies on electricity to pre-cool the milk.

Naturally the amount of kWh consumed will impact on the price of electricity in the Abbey Farm audit and the SEC Dairy Farm model. This can be explained by the significant increase in electricity prices in the last 12 months, which have risen from 25.88 cent per kWh in March 2022 (as per Abbey Farm audit), to 52.82 cent per kWh at the time of writing (March 2023). In fact, Abbey Farms electricity rate differed in the 4 billing periods for which they provided data:

	Day rate	Night rate
19th Jan 22 – 14th Apr 22	25.88 c/kWh	12.79 c/kWh
15th Apr 22 – 15th Sep 22	33.26 c/kWh	16.44 c/kWh

Abbey Farms annual electricity cost of €5,510 does not take into account any price increases after the September billing period and is based upon an average of the cost over 240 days, therefore it would likely be even higher if we had data for the entire year.

Furthermore, our model of the SECs Dairy Farms doesn't include electricity supplier discounts, of which there were approximately €2,121 across 240 days. If the rate of discounts continued across the course of an entire year this would equate to €3225. When we take this into account, we can see an explanation as to the difference between Abbey Farms electricity costs and the SEC Dairy Farm model.

Table 31 – Comparison of today's electricity prices against those paid in Jan-Apr 2022 and Apr-July 2022

	Today's rates	Audits rates Jan-Apr	Audit rates Apr-July
Cows	115	115	115
kWh	35,663	35,663	35,663
Day cost of electricity	€8,722 (52.82 cent p/kWh)	€4,273 (25.88 cent p/kWh)	€5,492 (33.26 cent p/kWh)
Night cost of electricity	€5,000 (26.11 cent p/kWh)	€2,449 (12.79 cent p/kWh)	€3,148 (16.44 cent p/kWh)
Total cost of electricity	€13,722	€6,723	€8,640

By comparing the various rates of electricity and applying it against Abbey Farms electricity usage we can clearly see why the cost of electricity is so much different between the SEC Dairy Farm model and Abbey Farm. This highlights the importance of regularly changing electricity supplier, choosing a night rate electricity plan and carrying out energy intensive tasks in those hours when a night rate applies – normally 11pm/midnight to 7am.

Opportunities for reducing energy consumption

The first step is to reduce energy wastage i.e., fix hot water leaks, insulate hot water piping and refrigerant gas piping, using lights only when necessary and make use of night rate electricity. Applying these good management practices will reduce energy costs without any capital expenditure. The benefits of reducing electricity consumption are twofold. Reducing milk production cost is an obvious benefit but also due to the fact that a significant portion of electricity generated in Ireland is from fossil fuels, 331g of CO_2 is produced for every kWh of electricity used. Hence reducing electricity consumption will also reduce the sectoral carbon footprint. Advice is available from Teagasc Advisory Services under the Teagasc Climate Action. [31]

Milk cooling

Milk cooling is the largest consumer of energy on Irish dairy farms. The cooling of milk immediately after milking is vital to maintaining high milk quality levels. On a typical Irish dairy farm, the cooling process is completed in two stages: pre-cooling and refrigeration. It is understood from research that a significant percentage of plate heat exchangers (PHE) on dairy farms aren't operating at their full cooling effectiveness.

This is mainly due to the improper milk to water flow ratios being employed. PHE manufactures recommend milk to water flow ratios of between 1:2.5 and 1:3 depending on the model.

[31] https://www.teagasc.ie/publications/2023/tresearch-spring-2023.php

If a PHE is sized correctly in relation to the power of the milk pump and the correct ratio of water is supplied, then the power consumed during the refrigeration stage can be dramatically reduced. Again, advice on this point for individual farms is available from Teagasc but typical savings from efficient operation of cooling systems could be of the order of 50% [32].

Table 32 – Comparison of electricity and oil to power plate heat exchangers for milk cooling

Heating Method	Power Consumed (kWh)	Time (Hrs)	System Efficiency	Useable Water (amount of water drawn between 60-80 degrees Celsius)	Kg of CO_2 produced
Electricity	48.24	16.5	79%	411 litres	15.9
Oil	45.5	1.75	84%	415 litres	12.7

Water heating

The heating of water is a substantial energy input in the operation of a modern dairy farm. Studies from Teagasc have highlighted the energy consumption associated with water heating on modern dairy farms. One particular study presented the results of a water heating trial in Moorepark, which compared the efficiency and cost of electrical water heating versus oil-fired boilers. The study found that electricity used for water heating could add up to 2 kWh per cow per week and that the use of night rate electricity is crucial for reducing costs.

The oil-fired system was found to be more efficient and cost-effective, with a shorter recovery time and lower CO_2 emissions. However, the initial capital investment for the oil-fired system is higher than for electrical heating. The study emphasises the importance of considering both initial purchase cost and ongoing running costs when choosing a water heating system for dairy farms.

A more sustainable method of reducing the electricity consumption from water heating would be the installation of Solar thermal panels. A solar water heating system absorbs as much heat as possible from the sun's radiation in order to pump hot water through a heat exchanger so that the water is pre-heated. It's estimated that a solar thermal system can meet on average 40% of water heating load. Solar heating systems have a long life with low maintenance – many work reliably for at least 20 to 25 years [33]. On dairy farms with high hot water demand, the system can pay for itself two or three times over during its working life. Furthermore, solar thermal systems can avail of grant aid of up to 60% for young farmers.

However, there are some drawbacks which need to be taken into account. The initial capital outlay is higher than that for other systems, with no grant aid available other than the Young Farmers scheme. Also, the Solar thermal system will not replace the water heating system, as the solar tank should only be used as a buffer tank, with its primary role to 'pre heat' the final temperature water tank.

[32] https://www.seai.ie/community-energy/schools/post-primary-school/ag-science/

[33] https://www.teagasc.ie/publications/2020/hot-water-heating-options-for-the-milking-parlour.php

Milking

Conventional vacuum systems incorporate a vacuum pump operating at a fixed speed, a vacuum regulator and a load. To maintain a set vacuum level, the vacuum pump must remove air from the milking system at the same rate as air is being admitted. Since the air admitted is dynamic and the pump out rate is constant, a vacuum regulator is necessary to regulate the difference between the pump capacity and the air load. The typical vacuum regulator is a mechanical device that adjusts the rate of air admission into the system.

The vacuum regulator provides airflow into the system so that the sum of the air admitted by the milking system plus the air admitted through the regulator exactly matches the fixed airflow at the vacuum pump. Introduction of variable speed drive (VSD) technology for controlling vacuum in a milking system adjusts the rate of air removal by changing the speed of the vacuum pump motor. This can contribute to reduction in energy use of up to 25%, while still producing equivalent vacuum stability.

Guidance for investment

It is important for dairy farmers to carefully consider their options before investing in more energy-efficient equipment for several reasons. Firstly, energy-efficient equipment can be expensive to purchase, install, and maintain. Thus, dairy farmers must weigh the benefits of lower energy consumption and cost savings against the initial investment and ongoing maintenance costs.

Secondly, different equipment types and models have varying energy-saving potentials. Therefore, farmers must evaluate the energy efficiency of each equipment type or model they are considering and choose the one that best suits their needs and budget.

Finally, dairy farmers should consider whether there are any available financial incentives, grants, or tax credits for investing in energy-efficient equipment. By considering all of these factors, dairy farmers can make an informed decision about whether or not to invest in more energy-efficient equipment and select the equipment that best meets their needs. One such tool which considers all of the above is the Dairy Energy Decision Support Tool (DEDST).

Dairy Energy Decision Support Tool

This is an online software tool designed to help dairy farmers and industry professionals make informed decisions about energy use on their farms. It was developed by researchers at the Munster Technological University and is funded by the Irish Department of Agriculture, Food and the Marine.

The DEDST tool allows users to input data related to their farm's energy consumption and costs, including electricity, heating, and water. This data is used to provide users with a comprehensive analysis of their farm's energy use, costs, and carbon footprint. The tool also provides recommendations for reducing energy consumption, costs, and emissions.

To use the DEDST tool, users must input various data related to their farm, including the number of cows, milk yield, and the type and age of equipment used. They must also provide data related to their energy consumption, such as electricity bills and heating oil consumption. In addition, users can provide data related to their farm's water use and manure management practices, which can impact energy consumption and emissions.

Once the necessary data has been input, the DEDST tool analyses the information to provide users with a detailed report of their farm's energy use and carbon footprint. This report includes information on energy consumption and costs by category, such as lighting, milk cooling, and water heating. It also includes an estimate of the farm's greenhouse gas emissions and recommendations for reducing energy consumption and emissions.

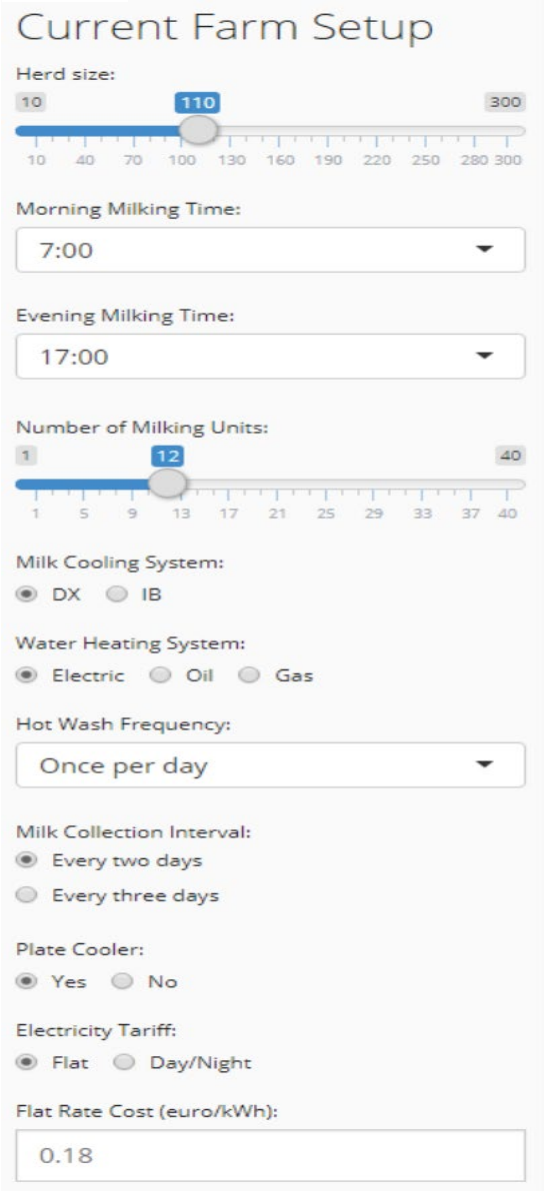
The DEDST tool provides users with customised recommendations for reducing energy consumption, costs, and emissions based on the specific data provided by the user, and may include actions such as upgrading equipment, implementing energy-efficient lighting, or optimising milk cooling systems. The tool also provides information on available grants and funding programs that may be available to help offset the costs of these improvements.

By providing users with a comprehensive analysis of their farm's energy use and emissions, as well as customized recommendations for improvement, the tool can help reduce energy costs, improve profitability, and reduce environmental impact. In addition, the DEDST tool can help dairy farmers meet regulatory requirements related to energy use and emissions.

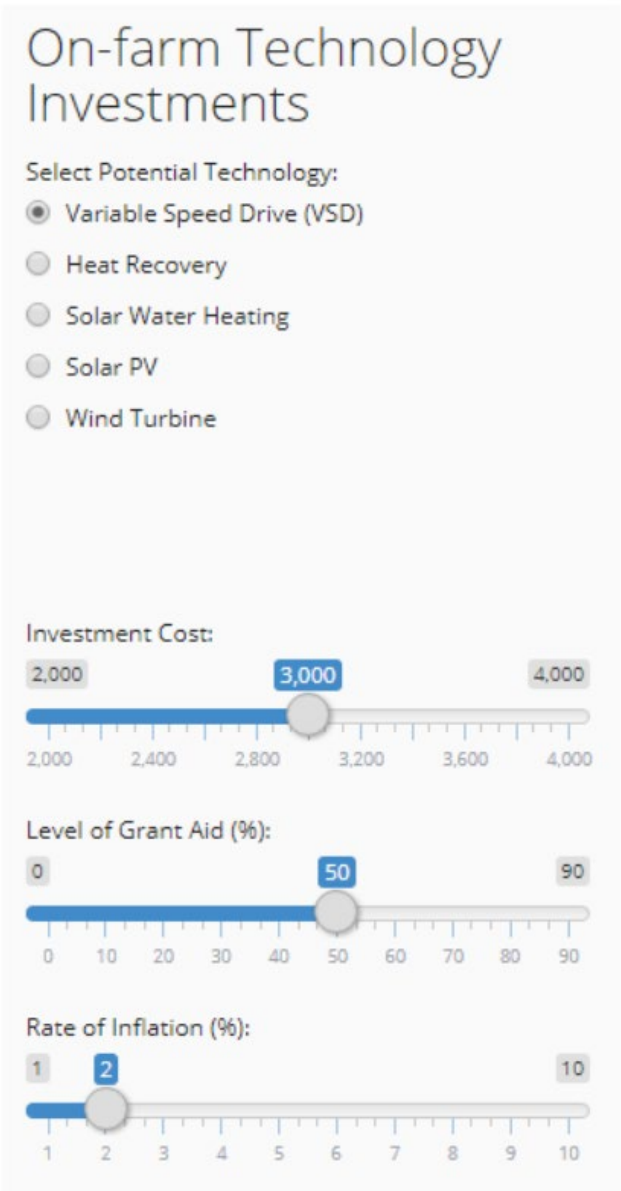
Overall, the Dairy Energy Decision Support Tool developed by the Munster Technological University is an important resource for dairy farmers and industry professionals who are seeking to improve their energy efficiency and environmental sustainability.

A list of grant streams for dairy farmers have been included in Annex A at the end of this report that could used to support an investment decision made after using DEDST. The following pages show a hypothetical scenario of how the DEDST tool could be used to guide a decision about whether to invest in Variable Speed Drive equipment for a farmer.

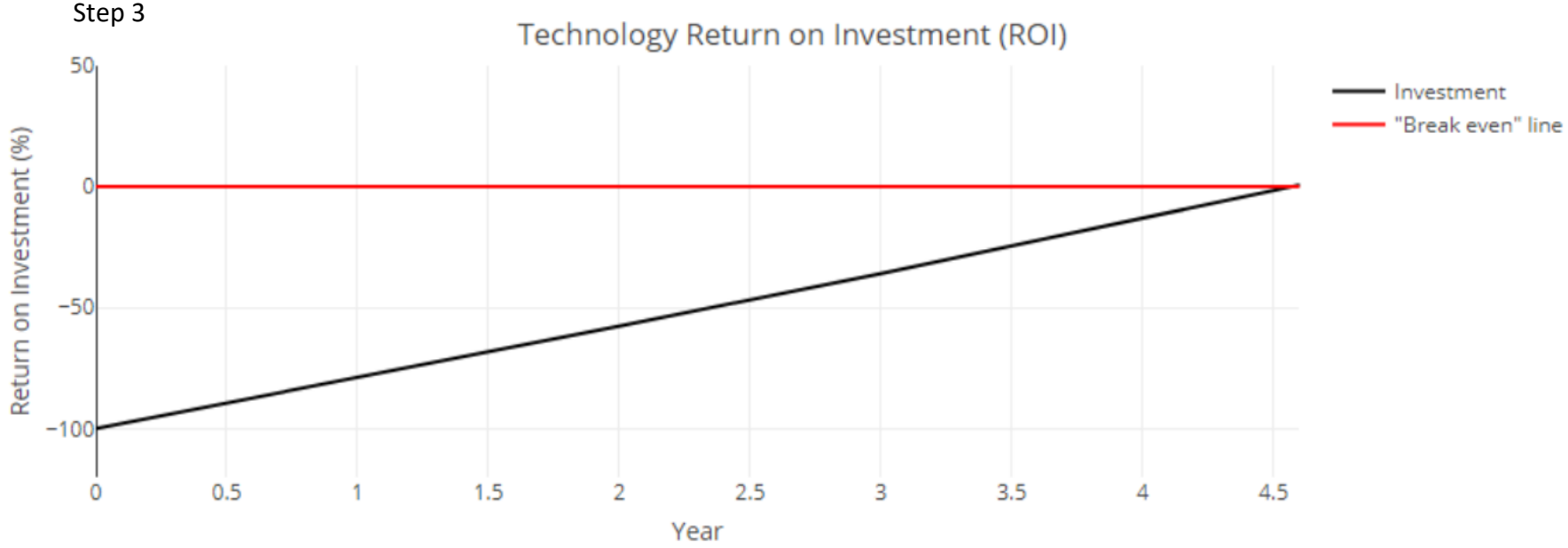
Step 1

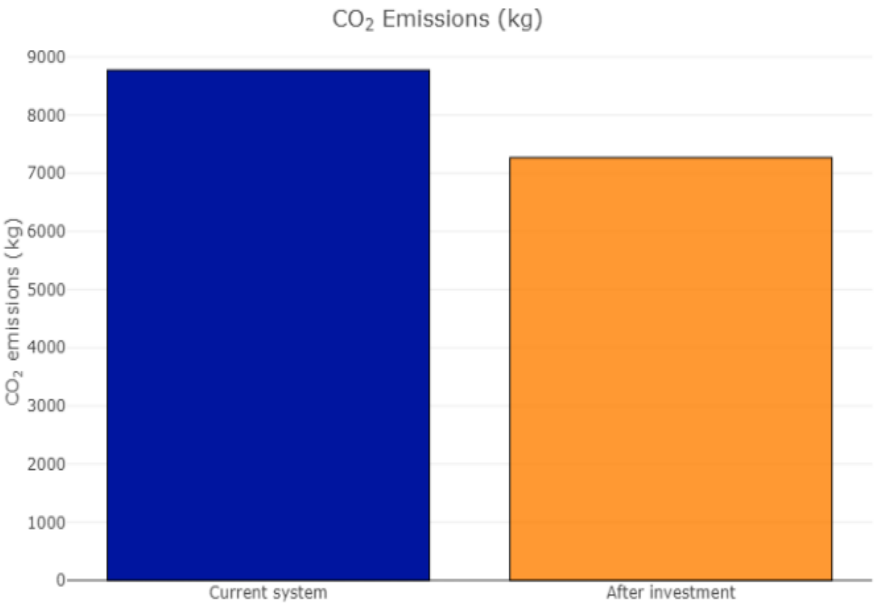

Current Farm Setup
Herd size:
10
110
300
10 40 70 100 130 160 190 220 250 280 300
Morning Milking Time:
7:00
Evening Milking Time:
17:00
Number of Milking Units:
1
12
40
1 5 9 13 17 21 25 29 33 37 40
Milk Cooling System:
DX IB
Water Heating System:
Electric Oil Gas
Hot Wash Frequency:
Once per day
Milk Collection Interval:
Every two days
Every three days
Plate Cooler:
Yes No
Electricity Tariff:
Flat Day/Night
Flat Rate Cost (euro/kWh):
0.18

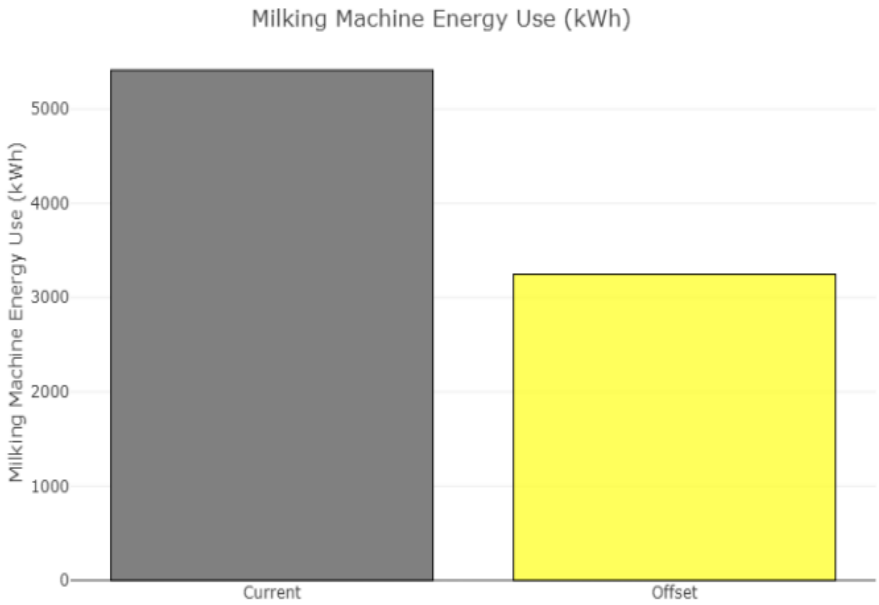
Step 2


On-farm Technology Investments
Select Potential Technology:
Variable Speed Drive (VSD)
Heat Recovery
Solar Water Heating
Solar PV
Wind Turbine
Investment Cost:
2,000
3,000
4,000
2,000 2,400 2,800 3,200 3,600 4,000
Level of Grant Aid (%):
0
50
90
0 10 20 30 40 50 60 70 80 90
Rate of Inflation (%):
1
2
10
1 2 3 4 5 6 7 8 9 10

Step 3


Technology Return on Investment (ROI)
Return on Investment (%)
50
0
−50
−100
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
Year
Investment
"Break even" line


CO_2 Emissions (kg)
CO_2 emissions (kg)
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
Current system
After investment


Milking Machine Energy Use (kWh)
Milking Machine Energy Use (kWh)
5000
4000
3000
2000
1000
0
Current
Offset

Solar PV on farms

Soaring electricity bills and rising uncertainty over energy supplies have left farmers seeking alternative ways to power their farms, including Solar PV. Farms are in many ways, best placed to take advantage of Solar PV due to their access to space and high energy costs.

The lifting of the planning permission required for Solar PV installations on agricultural sites now means that the rooftop limit for Solar PV installations is 300 square metres, a significant increase from the previous limit of 50 square metres. This increase means that farmers could hypothetically cover all of their electricity costs through a Solar PV system. If for whatever reason the roof of the farm is not suitable for Solar PV, farmers can erect 17kW ground mounted systems without the need for planning permission.

TAMS 3

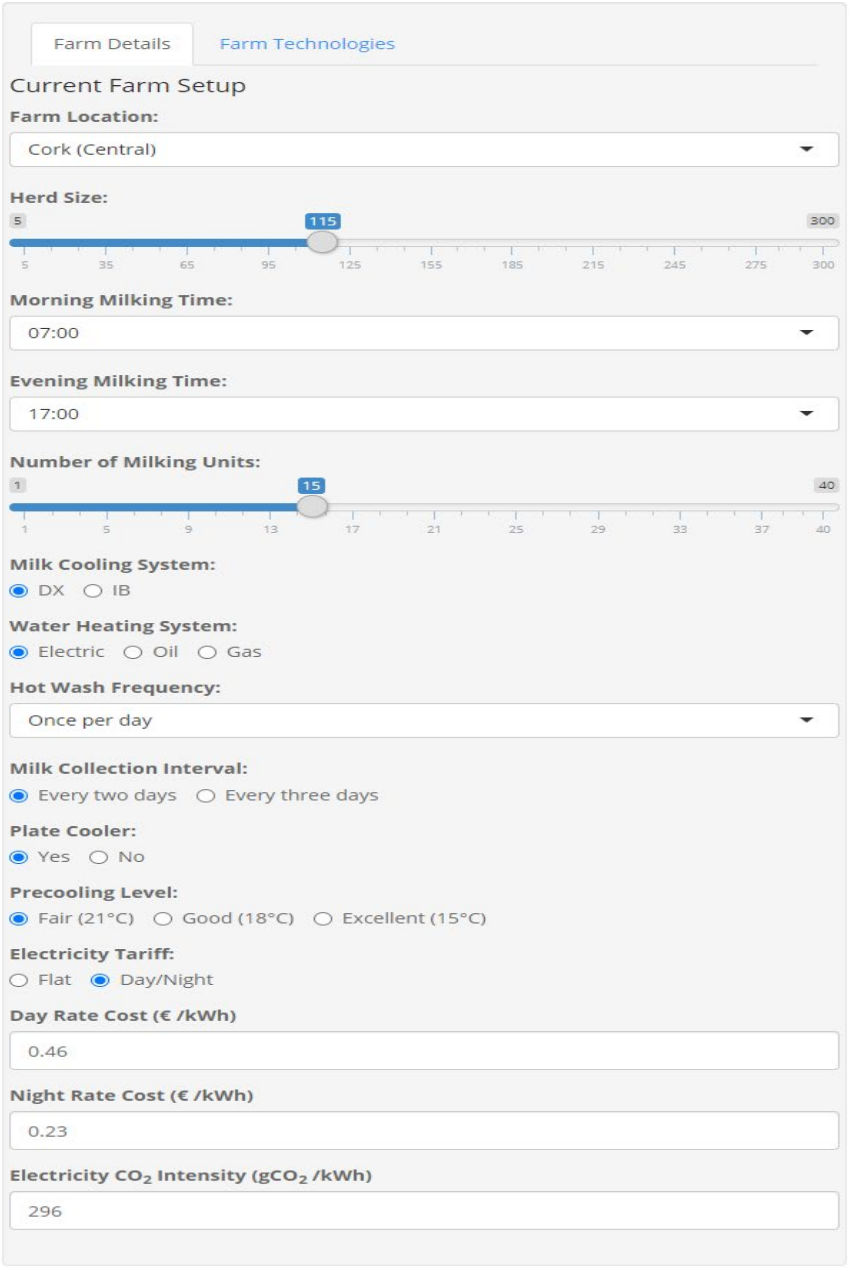
In early 2023, the department for Agriculture, Food and the Marine, announced the opening of applications for solar panels under new Targeted Agricultural Modernisation Scheme (TAMS 3). TAMS provides funding for capital investments on farms and will be in place for five years with a budget of €370 million.

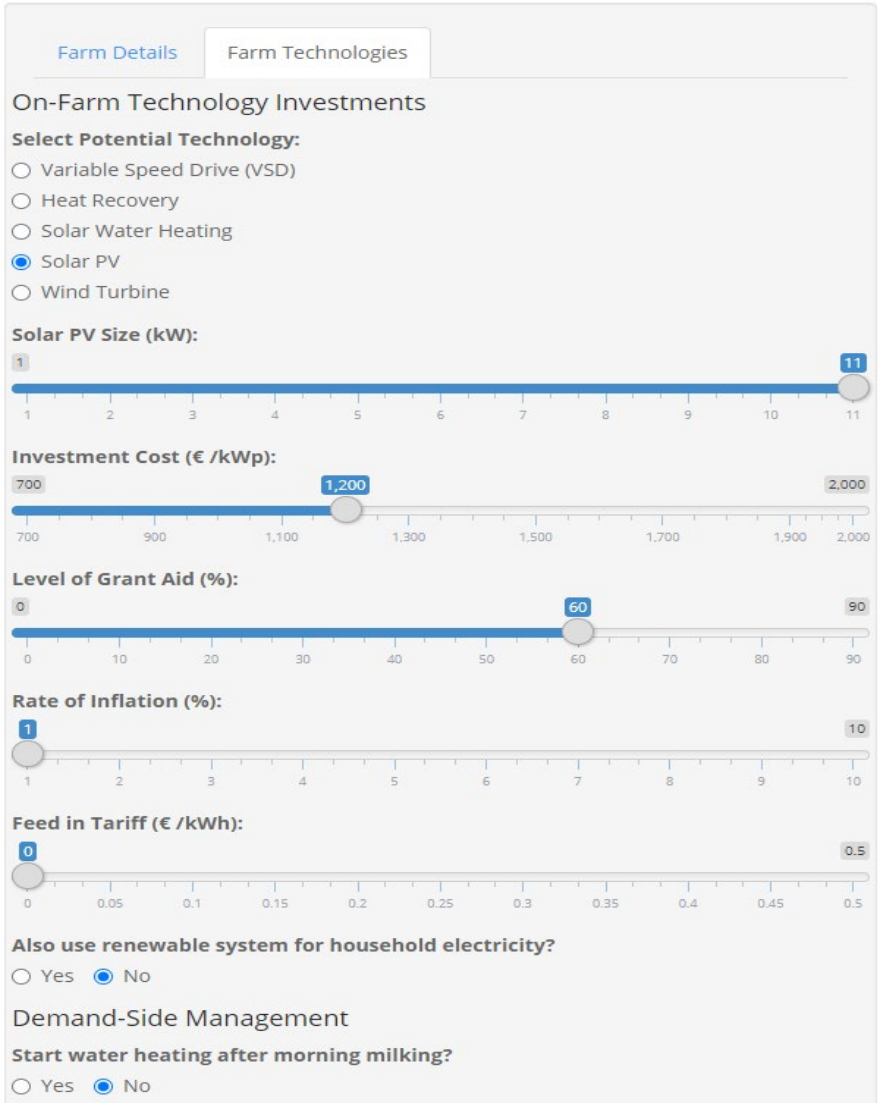
In order to encourage the purchase of solar investments, the solar scheme will be ring fenced with its own investment ceiling of €90,000 and will be grant aided at the enhanced rate of 60%.

Furthermore, under TAMS 3 the investment ceilings have been reset which means every farmer who applied under TAMS II can also apply under TAMS 3. In addition to the higher grant rates, the size of Solar PV systems eligible for grant funding has increased from 11kW to 62kW. Farmers may also include the energy demand of one dwelling house per holding in the sizing of the solar panel array, which will greatly benefit farm families during the current energy crisis.

Batteries are also covered under the grant and can be included in the system, however all Solar PV systems can only be installed and commissioned by Department accepted installers. At the time of writing, it is unknown if farmers who purchase Solar PV systems through TAMs are able to export electricity back to the grid for a set tariff in the same way a residence might be able to. However, there is a significant cost difference between the electricity purchased from the grid, compared to the lower amount individuals receive for selling back to the grid, so it is suggested that farmers store excess Solar PV energy or ensure their system is accurately designed to solely meet the energy needs of the farm.

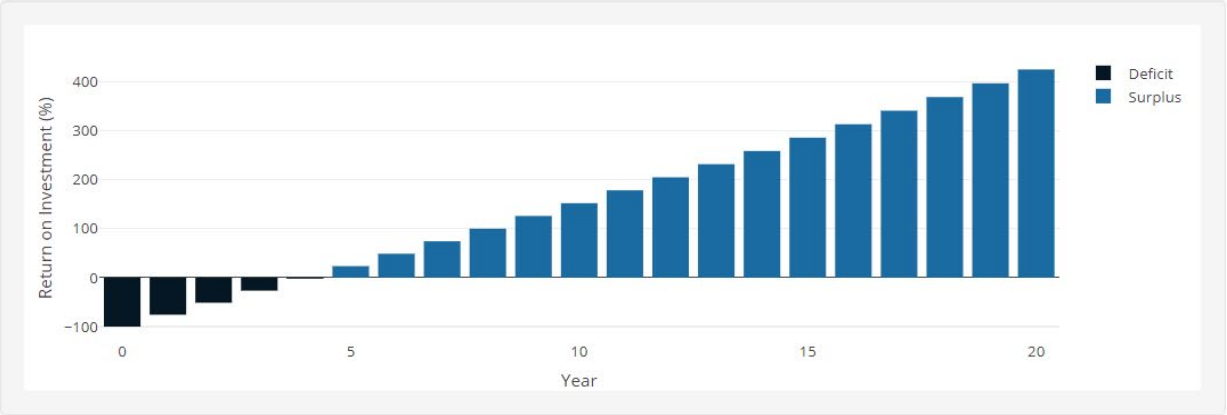
The following pages show a hypothetical scenario of how the DEDST tool could be used to guide a decision about whether to invest in a 11kWp Solar PV array for a farmer, taking into account the 60% grant stream from TAMs.


Farm Details
Farm Technologies
Current Farm Setup
Farm Location:
Cork (Central)
Herd Size:
5
115
300
5 35 65 95 125 155 185 215 245 275 300
Morning Milking Time:
07:00
Evening Milking Time:
17:00
Number of Milking Units:
1
15
40
1 5 9 13 17 21 25 29 33 37 40
Milk Cooling System:
DX IB
Water Heating System:
Electric Oil Gas
Hot Wash Frequency:
Once per day
Milk Collection Interval:
Every two days Every three days
Plate Cooler:
Yes No
Precooling Level:
Fair (21°C) Good (18°C) Excellent (15°C)
Electricity Tariff:
Flat Day/Night
Day Rate Cost (€ /kWh)
0.46
Night Rate Cost (€ /kWh)
0.23
Electricity CO_2 Intensity (gCO_2 /kWh)
296


Farm Details
Farm Technologies
On-Farm Technology Investments
Select Potential Technology:
Variable Speed Drive (VSD)
Heat Recovery
Solar Water Heating
Solar PV
Wind Turbine
Solar PV Size (kW):
1
11
1 2 3 4 5 6 7 8 9 10 11
Investment Cost (€ /kWp):
700
1,200
2,000
700 900 1,100 1,300 1,500 1,700 1,900 2,000
Level of Grant Aid (%):
0
60
90
0 10 20 30 40 50 60 70 80 90
Rate of Inflation (%):
1
10
1 2 3 4 5 6 7 8 9 10
Feed in Tariff (€ /kWh):
0
0.5
0 0.05 0.1 0.15 0.2 0.25 0.3 0.35 0.4 0.45 0.5
Also use renewable system for household electricity?
Yes No
Demand-Side Management
Start water heating after morning milking?
Yes No

Carrigaline SEC Energy Master Plan

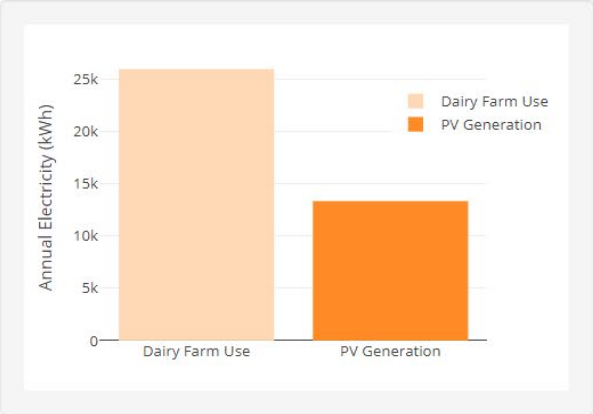
Monetary

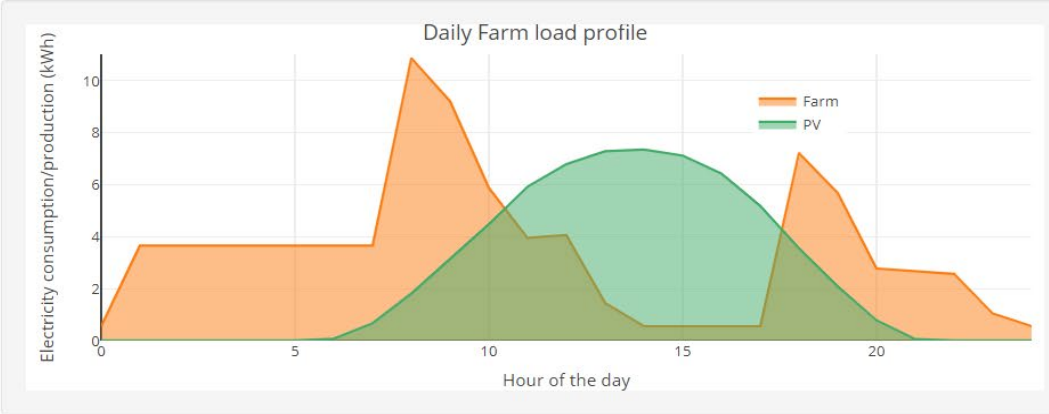


4.1
years payback

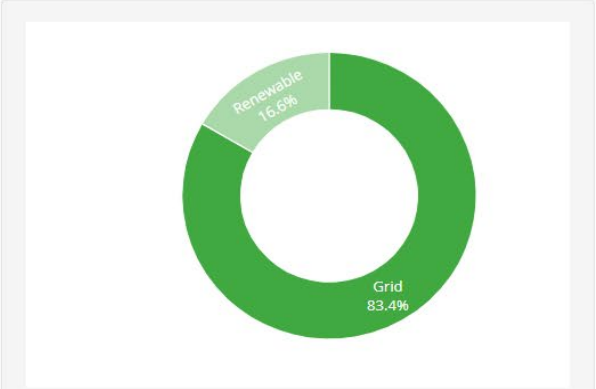
€5,280
net investment cost

Electricity





Environmental



78,821
kg's of carbon saved over 20 years

€67
per tonne of CO_2 reduction

Renewable Electricity

Wind Development in the SEC

Cork County Council has determined that wind farm development is not permissible or will have low wind speeds in vast swathes of the County and unfortunately this has meant that wind development around Carrigaline will not be permitted as Urban Areas are not suitable for wind development in the County Development Plan. However, as Ireland scales up its renewable generation capacity in the coming years it would not be a major surprise urban areas such as Carrigaline were granted permission to set up wind turbines, so the SEC should continue to monitor the situation closely.

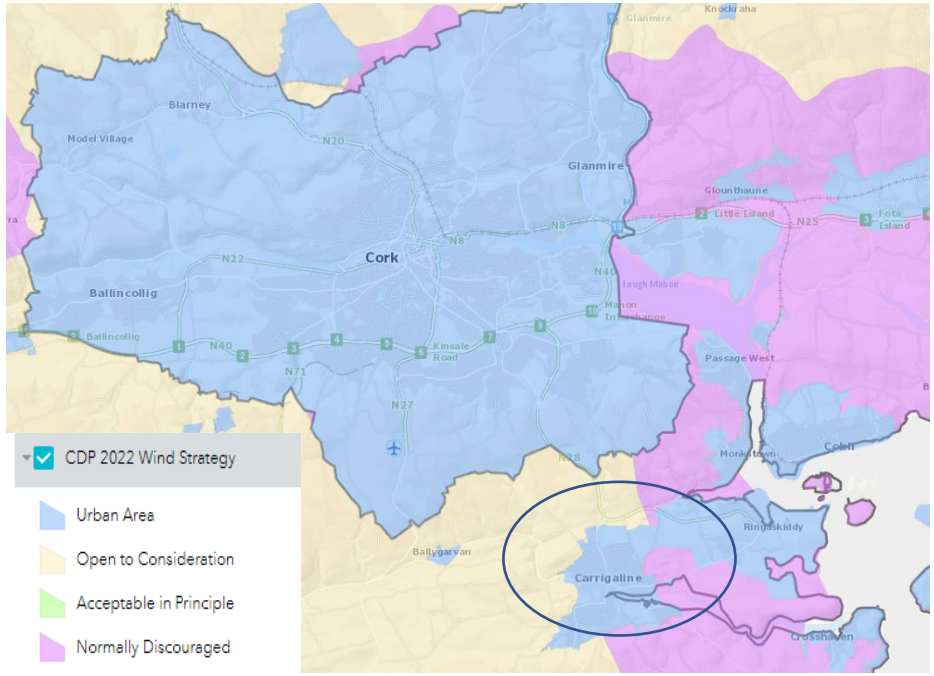


Figure 24 – Map evidencing those areas in Co. Cork favored for wind development (Cork County Council Planning, 2022)

Proximity to substations

The use of energy is supported and influenced by the presence of specific energy infrastructure in the local area. In terms of electricity supply, Figure 23 evidences the sub stations that are within 8km of Carrigaline SEC, which is generally seen as the limit for any non-utility (major development) scale developments. Fortunately, Carrigaline is in the position of having five substations within close proximity of the SEC, with one lying in the SEC itself. It's important to be aware that all substations have a certain amount of capacity for electrical generation.

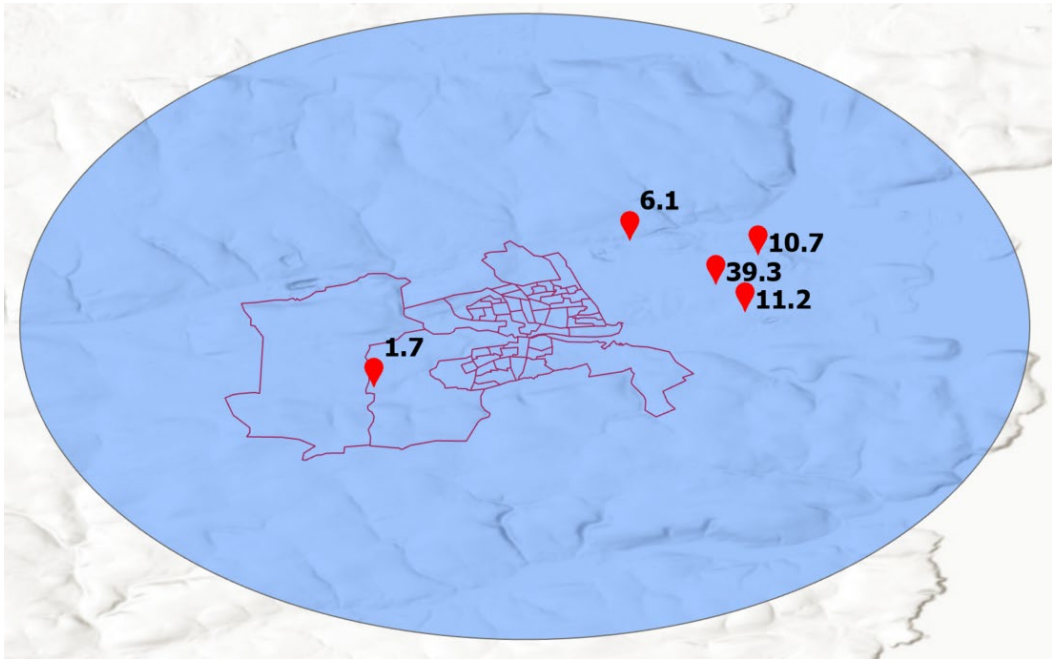


Figure 25 – Carrigaline SECs proximity to existing sub stations (8km buffer). Red points denote substations.

In simple terms, this means we cannot build and connect an unlimited amount of Renewable Energy generating projects to the electricity grid without first upgrading it so that there is sufficient capacity available. The substation nearest the SEC has approximately 1.7 MW of spare capacity available at the time of writing which would be a suitable amount for a community-owned project. This would be a very attractive prospect for a wind project that would fall under the RESS scheme. This data is based on the ESB Network Capacity map which is intermittently updated to reflect the capacity of substations across the country.

Residential Solar PV energy reductions

Towards the end of 2022 the Irish Government announced that houses, regardless of location, may now install unlimited solar panels on their rooftops without any requirement for planning permission (subject to certain conditions). This means it is now more attractive for homeowners to install larger Solar PV systems, given that the previous planning law constrained homeowners to using a maximum of 50% of their roof space for Solar PV.

In order to evaluate the practical potential for Solar PV in the Carrigaline SEC, we have assumed that at least 33% of homes in the SEC (1796) will be suitable for Solar PV. We have also assumed optimal roof orientation, with a 30-degree tilt on a South facing roof, with only mild overshading. We have been unable to include community and commercial buildings within our analysis due to absence of data on the roof area of the buildings.

Table 33 – Overview of the Solar PV potential in the SEC if 33% of homes installed Solar PV

Solar PV system	Potential output (MWh per year)	Percentage of existing electricity demand this would cover
2 kWp	2,468,997	3.4 %
3 kWp	3,703,496	5.1 %
4 kWp	4,937,994	6.8 %
5 kWp	6,172,493	8.5 %

Of course, this total would be much higher if we applied these calculations to 100% of homes in Carrigaline SEC, increased the potential Solar PV system or we were able to include the Commercial/Public buildings, but this gives the SEC a realistic overview of what they could potentially achieve in the next decade.

Renewable Electricity Support Scheme

The Government of Ireland has put in place a scheme called the Renewable Electricity Support Scheme (RESS)[34] which aims to deliver increased community involvement in renewable energy projects. This scheme provides financial support for renewable electricity projects of over 0.5 MW in size in the Republic of Ireland.

RESS is an auction-based scheme, which invites renewable electricity projects to bid for capacity and receive a guaranteed price for the electricity they generate.

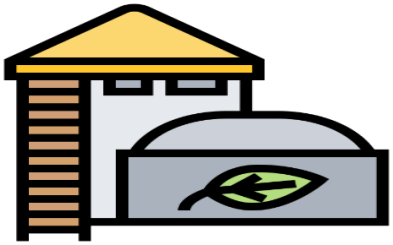
Support schemes like RESS, in place all over the world, are a way of ensuring that renewable energy technologies replace the use of fossil fuels in our economy. Communities are incentivised to invest in renewable technologies by Governments who contract to buy electricity at a guaranteed price for the long term, typically a period of about fifteen years.

In total, about 3,000 'gigawatt-hours' will be put up for auction by the state. The most cost-efficient bidder will be the first picked, the second most cost-efficient will be the second picked and so on until all the gigawatt-hours are accounted for. In essence this means only the most efficient project offering a price at the lowest level will get picked

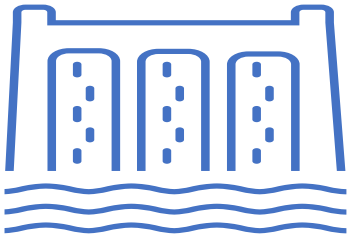
Eligible technologies under the RESS scheme include:

Onshore wind turbines/solar thermal/solar PV technology

Onshore wind turbines/solar thermal/solar PV technology with battery storage



High-efficiency Combined Heat and Power (CHP) boilers fueled exclusively by waste, biomass or biogas



Hydroelectric

All projects looking for support under the RESS scheme will need to meet certain criteria before becoming successful. There are three aspects of community participation in RESS:

- Community Led Projects
- Community Benefit Funds
- Community Enabling Framework

[34] https://www.dccae.gov.ie/en-ie/energy/topics/Renewable-Energy/electricity/renewable-electricity-supports/ress/Pages/default.aspx

Community Led Project Criteria

The application must be made in conjunction with a Sustainable Energy Community (SEC). The SEC must be identified in the Declaration of a Community-Led Project, together with a description of the relationship between the Applicant and the Sustainable Energy Community. In addition:

- Project size must be between 0.5 and 5 Megawatts
- Fully (100%) owned by a Renewable Energy Community (REC)- primary purpose is community benefit (environmental, economic, or social) rather than financial profit
- Community group must be based on open and voluntary participation
- Participation based on local domicile (within close proximity to the RESS project)

Community Benefit Funds

A key feature of RESS is that all projects must establish a 'Community Benefit Fund' to be used for the wider economic, environmental, social and cultural well-being of the local community. The amount payable by RESS Projects into the Community Benefit Fund by the Government is mandated at €2 per Megawatt hour of electricity generated from a RESS Project. This means there are quantifiable funds made available annually for the benefit of the local community.

This will allow communities to further invest in local renewable energy, energy efficiency measures and climate action initiatives. For RESS-1 alone it is envisaged that almost €4m in annual payments, over a period of approximately 15 years, will be paid into the Community Benefit Funds in communities that host RESS-1 projects.

With several more RESS auctions planned in the coming decade the total funds involved are several hundred million euro in value over the lifetime of RESS.

Recently it was announced that Community-led projects seeking to apply to future RESS auctions, must be 100% owned by the community, as opposed to being majority owned as was the case for RESS-1. Therefore, Community-Led Projects must now meet the following requirements:

(a) at all relevant times, be 100% owned by a Renewable Energy Community (the "Relevant REC") either by way of (i) a direct ownership of the RESS 2 Project's assets, or (ii) a direct ownership of the shares in the Generator; and
(b) at all relevant times, 100% of all profits, dividends and surpluses derived from the RESS 2 Project are returned to the Relevant REC.

Community Enabling Framework

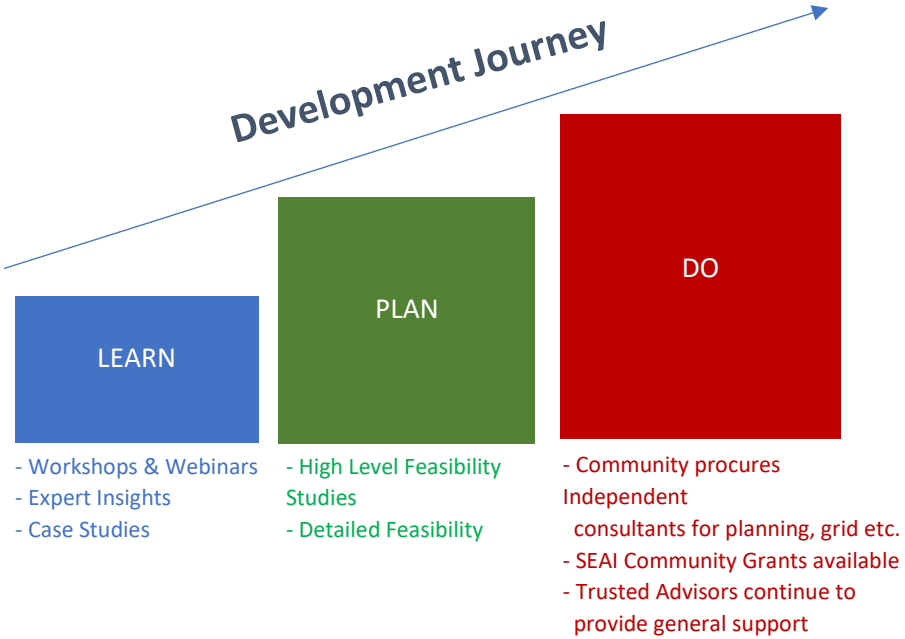
Project planning, grid infrastructure and community buy-in remain the major obstacles to a community led development. Community consensus is the key to the successful development of a community owned project. If there is consensus within the community, an application can then be made to SEAI (or another funding body) to carry out a feasibility study for a renewable energy development in the areas within the community identified. This feasibility study should look at grid capacity and constraints, planning constraints, environmental designations, and residential buffer zones around the proposed sites.

One of the key community provisions as part of RESS is the Community Enabling Framework which provides end-to-end support to create a community energy sector in Ireland that can flourish sustainably over time and one that will deliver meaningful impact to communities nationwide. SEAI have been appointed by the Department of Environment, Climate & Communications (DECC) as the implementation body for this Framework which will provide a range of supports including:

1. **Trusted Intermediary:** this is effectively the RESS community team within SEAI. This is the first place that communities go to seek help with their RESS projects. The contact email is: CommunityRESS@seai.ie

2. **Information warehouse**: SEAI have developed a number of toolkits to help communities understand the RESS journey[35]. Toolkits include: onshore wind, solar PV, the planning process and grid connection. There are several more in development. The Toolkits provides a set of guidance modules across a number of different areas (including technology options, business planning, project development stages, setting up an organisation / governance strategy) to support development and delivery of a Renewable Energy project.

3. The **Trusted Advisor** (TA) service from SEAI is now available for communities who want to develop their own electricity generation projects. The TAs will help the SECs through the development stages of a generation project. This will include two free feasibility studies to determine if the community generation project is viable.



4. **Financial supports**: this is the community RESS enabling grant. The total grant available is 80% of eligible costs up to a maximum of €180,000. Entry to the grant programme is based on the successful completion of the feasibility stage conducted by an SEAI appointed TA from above. The grants can be drawn down in €25,000 tranches on completion of key milestones. A requirement before drawing down the second tranche is the undertaking of a public engagement event to ensure that the generation project is socialised within the community.

[35] https://www.seai.ie/community-energy/ress/enabling-framework/

Sustainable Energy Roadmap

The Sustainability Energy Roadmap is one of the key outputs of the Energy Master Plan as it outlines to the community the scale of the challenge faced in moving the community from their baseline to achieving 2030 reduction targets. The following analysis provides a general path for the SEC to reach each of its targets: 50% energy reduction, 30% CO_2 reduction and 30% energy generation from renewable sources by 2030. These targets have been broken down in each of the sectors detailed in the table below.

Table 34:- 7% Annual reduction in the Carbon Footprint for Carrigaline SEC

tCO_2	**67,611**
% Annual CO2 Reduction	**7%**
Year	**tCO_2**
2023	62,879
2024	58,477
2025	54,384
2026	50,577
2027	47,037
2028	43,744
2029	40,682
2030	37,834

Table 35 – Carrigaline SEC Roadmap up to 2030

Project	Scale	Target application	Rationale	Energy Savings (kWh)	Energy Generation (kWh)	CO_2 Savings (tonnes)
Community owned Solar PV project	3 x 5MW Solar projects	Brownfield site, former landfill site, unused field	Would significantly offset the carbon footprint of the town and many other similar sized SECs around the country (Mullingar Solar Farm) are engaging in similar projects through the RESS auction or the soon to be announced Small Scale Generation Scheme. Wind turbines are likely to become the norm across the country as Ireland aims to hit its Climate targets. Areas on the outskirts of Carrigaline, would be suitable for a large-scale installation.		13,140,000	3,886
Community owned Wind project	11 MW wind turbine				26,280,000	7,774
2kWp Residential Solar PV installations	400 homes	Specific housing developments or sporadic installations across SEC	Residencies have an electrical demand that matches this size of a Solar PV output and is probably the most feasible way of reducing homeowners' electricity usage in an era when heat/transport will become increasingly electric		540,000	160
Electricity efficiency measures in domestic settings	20% decrease in energy consumption	Entire SEC	This gets the community thinking about their energy usage and consumption before taking on the bigger renewable projects. Energy monitoring kits, LED bulbs, identifying inefficient appliances and upgrading them are all steps that many individuals have the capacity to do right away.	10,814,490		3,580
Electricity efficiency measures in non-domestic settings	40% decrease in energy consumption		The same principles apply to non-domestic settings (community/commercial buildings). Given their high energy usage profile, significant savings can be made here. It has the twin benefit of reducing operating costs in the long term for these kind of buildings.	31,451,191		10,410

Project	Scale	Target application	Rationale	Energy Savings (kWh)	Energy Generation (kWh)	CO_2 Savings (tonnes)
Transition from fossil fuels to heat pumps in non-domestic settings	20% decrease in heat use	Commercial & Community buildings		7,289,000		1,917
Increase in EV journeys & reduction in fossil fuelled car journeys	30% increase and 50% decrease respectively	Entire SEC	The impact of remote working and studying post COVID-19 has meant a sizeable number of individuals can spend at least 1 or 2 work/study days from home. Coupled with the enhancements to the bus network around Carrigaline and sales of EVs overtaking diesel/petrol in 2023 we would expect a significant uptake in their use by 2030.	42,505,926		9,138
Electric Vehicle Car rental scheme	Based on 5% of diesel car journeys being replaced		This will give individuals who do not have access to a private car a low carbon method of transport or allow those who are thinking of purchasing an EV an opportunity to try it out.	2,374,376		222
Residential Housing Upgrades from G/F to B2	500	To be done one development at a time, so to maximise efficiencies and scale for contractors	Homes with a lower BER have access to the most amount of grant support and many straightforward, relatively cheaper measures can be installed to quickly improve the buildings BER.	12,210,000		2,812
Residential Housing Upgrades from E1/D2/D1 to B2	1000			12,540,000		3,047

Project	Scale	Target application	Rationale	Energy Savings (kWh)	Energy Generation (kWh)	CO2 Savings (tonnes)
Residential Housing Upgrades from C3/C2/C1 to A2	750	To be done one development at a time, so to maximise efficiencies and scale for contractors	Many of the homes in Carrigaline were built around the 90s-00s and have a BER of C1-C3. It is appropriate that the most common house types are targeted for improvement.	10,912,500		2,837
Using larger commercial or industrial buildings rooftops for Solar PV generation	20 buildings	Engineering companies, warehouses, industrial businesses, hardware stores, supermarkets, car dealerships	These buildings are in the unique position of having a significant amount of roof space in comparison to other buildings around them, coupled with a typically high electricity demand and a usage profile that ties in with the hours in which Solar PV is available. Considering Carrigalines' relatively smaller industrial profile, 20 buildings is an ambitious target over the next few years.	791,424		242

Total Energy Savings (kWh)	Energy Generation (kWh)	CO_2 Savings (tonnes)
130,888,907	39,960,000	46,024
Percentage of 2030 target met		
100.1%	101.9%	212.9%

Register of Opportunities (RoO)

The Register of Opportunities (RoO) developed for Carrigaline SEC provides a list of projects in three categories which have been identified within the community.

Behavior and Energy Efficiency and Renewable Energy Projects have been identified, which have both short- and medium-term timescales. The RoO provides for a detailed project specific planning tool including project cost, energy impact and carbon savings.

The Register of Opportunities (RoO) is a live document used to identify, evaluate, and plan your energy projects and is **a separate document to this EMP**. The complete RoO is provided in a supplementary document to this report (See Annex D).The Sustainable Energy Community owns this document and is responsible for using, editing and improving the content in order to match its ambitions.

The RoO is presented in an excel workbook because some parts contain formulas to calculate financial and energy savings.

As part of the scope of works for the Energy Master Plan for Carrigaline SEC, a number of domestic energy audits and non-residential audits were carried out on buildings selected within the community. Sections of the register of opportunities was generated from these audits based on the information available.

The key criteria when selecting projects where are suitable to progress are:

1) Return on investment or payback period
2) Complexity of the project
3) Are the project costs known?
4) Is supporting funding available?
5) What impact is the project going to have on the community?

Key standout projects are listed below with a full breakdown included in the Register of Opportunities document:

- 6kWp Solar PV system at Carrigaline Community Complex
- Community EV Car share scheme
- Feasibility study for a Renewable Energy Support Scheme (RESS) community power project
- 100 homes within SEC to install Solar PV systems part of group purchase scheme
- Community electric bike scheme

Note: *The costings provided are indicative only and quotations should be sought from suitably qualified contractors following an appropriate design and specification process.*

Action Plan for Carrigaline SEC

Capacity Building

One of the key elements in the development of a successful Sustainable Energy Community is the ability to build capacity within the group which is required for the implementation of successful projects. By increasing the capacity of the SEC there is a higher probability that the group will be able to take on more complex projects as their confidence grows. Capacity building can be achieved by utilising the mentors appointed to the group by SEAI to arrange educational and training initiatives as well as vocational and third level education bodies. The SEC can also work with other established SECs to arrange shared learnings

Energy Master Plan Dissemination to Community

The dissemination of the Energy Master Plan throughout the community is one of the key actions for the SEC now that the plan has been completed. The Energy Master Plan will provide the community with an understanding of what their current energy profile is and where they as a community should put their efforts in reducing their energy and carbon footprint.

Communication and Engagement Events

Engagement with other community organisations to identify shared needs especially in the development of existing community assets for remote working may be beneficial to the greater community. The upgrading and reimagining of community buildings through BEC grants to provide remote working hubs, childcare facilities, or social hubs feeds into the DO stage of the SEC's plan.

Please refer to the sections below for more information on grants. In addition to other community groups, private sector groups such as energy project developers which have community benefit funds may be interested in providing support to the SEC, but only if they are aware of its existence.

Low Lying Fruit First

The SEC is encouraged to develop low-effort, low-cost efficiency projects first to increase their internal capacity and skills. These low-effort, low-cost efficiency measures can be quick wins for the community and encourage the group to tackle more complex, higher effort projects in the future. These projects also provide a focus point for the greater community to prompt discussions and knowledge sharing experiences.

In a residential setting this could include the sharing of a Home Energy Kit around the community, so that individuals can identify significant energy users in their home, allowing them to make more informed decisions about how to reduce their daily energy use.

Enhancing community centres in a way that allows individuals to work remotely will have a sizeable impact on reducing emissions associated with commuting to work.

For businesses or public buildings that operate for 40+ hours a week, they should begin a process of selecting the lowest wattage bulb needed to light the room/area and consider the size of the space and how much natural light the space gets.

Bibliography

[1] CSO, "2016 Census- Small Area Data," Central Statistics Office 2017.

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[4] SEAI, "Conversion Factors,", Available: https://www.seai.ie/data-and-insights/seai-statistics/conversion-factors/

[5] SEAI, "Public Sector Energy Monitoring & Reporting System," 2017, Available: https://www.seai.ie/energy-in-business/monitoring-and-reporting/FAQs.

[6] CSO, “2011 Census - Agriculture.” Central Statistics Office 2012

[7] NSAI, SR54 Code of Practise for the Energy Efficiency Retrofit of Buildings

Annex A – Grant Streams

Community Grant Program

The Community Grant Program is the national retrofit initiative which provides capital grants for energy efficiency projects in Irish communities. The maximum grant available per application in the Communities Energy Grant is €5,000,000, with no singular project exceeding €2,000,000. It is recommended applicants consider grant applications of at least €100,000 due to the level of administration involved in this program.

Successful Community projects must demonstrate some or all of the following characteristics:

- Community benefits
- Multiple elements, not a single focus
- Mix of sustainable solutions
- Innovation and project ambition
- Justified energy savings
- An ability to deliver the project

The following list outlines the types of measures that SEAI want to support through the Communities grant program

- Building Fabric Upgrades
- Technology and System upgrades
- Integration of renewable energy sources
- Domestic Combined Fabric Upgrade
- Single Building Demonstration projects will be considered under the Communities Grant

Community Grant Program 2023 Funding Levels

Domestic support rates are in line with the grant offering available under One Stop Shop (OSS) relevant grants are available to review on SEAI's website using the link:

https://www.seai.ie/grants/home-energy-grants/one-stop-shop/

Fuel Poor homes will be supported at the rates applying to Approved Housing Bodies indicated in the OSS offering. The 2 measures listed below will receive additional support for Fuel Poor homes as follows:

	Detached	Semi Detached	Terrace	APT
External Wall Insulation	€14,000	€11,000	€6,500	€4,500
Internal Wall Insulation	€9,500	€7,000	€4,500	€3,000

Non-Residential	
Type	**Funding Level**
Not for profit/community	30% Up to 50% (may be available subject to state aid rules and SEAI approval in advance)
Private sector	Up to 30%
Public Sector	> 30% ≤ 50%

SEAI's Home Energy Grants

https://www.seai.ie/grants/home-energy-grants/

SEAI primarily has three grants and supports schemes for individual homeowners who wish to make energy upgrades to their home:

- Free Energy Upgrade
- Individual Energy Upgrade Grants
- One Stop Shop Service

Free Energy Upgrade

This SEAI grant provides free energy-efficient home upgrades for homeowners that receive certain welfare payments. Homeowners will receive a free assessment from an SEAI surveyor who will recommend the most suitable upgrades for the property.

Eligible Free Energy Upgrade home improvements		
Attic insulation	Cavity wall insulation	External wall insulation
Internal wall insulation	Replacement windows	Heating Systems upgrade
Heating controls	Ventilation	Compact fluorescent lamps (CFLs)
Draught proofing	Lagging jacket	

To qualify for any of these SEAI grants under the Free Energy Upgrade Scheme, homeowners need to meet all of the following criteria:

- The home must be your main residence and you must be the homeowner

- The home was constructed before 2006. It must have also been lived in prior to this date

- The home has an energy rating of C, D, E, F, or G.

- You receive one of the following government payments:
  - Fuel Allowance scheme
  - Working Family Payment
  - One-Parent Family Payment
  - Domiciliary Care Allowance
  - Carers Allowance. You must be living with the person you are caring for
  - Disability Allowance for more than six months. You must also have a child less than seven years old
  - Job Seekers Allowance for more than six months. You must also have a child less than seven years old

The Free Energy Upgrade grant will cover all expenses for a Home Survey, Contractor Selection, Contractor Works and a BER certificate. It is important to note that it will be the Surveyor who decides the improvements to make, the homeowner cannot choose which specific upgrades they would like.

Individual Energy Upgrade Grants

This grant allows the homeowner to choose which home improvements to bring, choose the registered contractor, and

complete the work yourself. Despite being more in charge of this grant, you still need to wait for the approval of the grant before starting the project.

To qualify for any of the SEAI individual energy upgrade grants, you need to meet all four of the following criteria:

	Individual Energy Upgrade Grants			
Measure	**Detached**	**Semi D/End of Terrace**	**Mid Terrace**	**Apartment**
Ceiling insulation	€1,500	€1,300	€1,200	€800
Cavity Wall Insulation	€1,700	€1,200	€800	€400
External Wall Insulation	€8,000	€6,000	€3,500	€3,000
Internal Insulation	€4,500	€3,500	€2,000	€1,500
Air to Air Heat pump system	€3,500			
Air to water Heat pump system	€6,000			€4,500
Ground source to water Heat pump system	€6,000			€4,500
Heat Pump Technical Assessment	€200			
Heating Controls (Homes built pre-2011)	€700			
Solar Water heating	€1,200			
Solar PV (Homes built pre-2021)	€1,800 for 2kWp system, additional €300 per kWp up to €2,400			

- The home must be your main residence and you must be the homeowner
- For any of the insulation and heating controls grants, your home must have been constructed and lived in before 2011
- For any of the heat pumps and renewable energy systems grants, your home must have been constructed and lived in before 2021
- Your home must not have received the same home improvement government grant in the past

One Stop Shop Service

Under this programme, homeowners will be able to receive a complete home energy upgrade. These will be managed by registered

contractors who will manage the entire process for you. From the initial assessment, placing the SEAI grant application for you, conducting the work, and providing the final BER.

	One Stop Shop Service grants			
Measure	**Detached**	**Semi D/End of Terrace**	**Mid Terrace**	**Apartment**
Home Energy Assessment	€ 350			
Air Tightness	€ 1,000			
Mechanical Ventilation	€ 1,500			
Solar Hot Water	€ 1,200			
Bonus for reaching B2 with a Heat Pump	€ 2,000			
Heating Controls	€ 700			
Air to Air Heat Pump system	€ 3,500			
Floor insulation	€ 3,500			
External doors (max of 2)	€800 per door			
Heat Pump Systems	€6,500			€4,500
Central Heating System for Heat Pump	€2,000			€1,000

Your home or property needs to meet all of the following criteria to qualify for the One Stop Shop Service grant:

	One Stop Shop Service grants			
Measure	**Detached**	**Semi D/End of Terrace**	**Mid Terrace**	**Apartment**
Ceiling insulation	€3,000	€3,000	€2,000	€1,500
Cavity Wall Insulation	€4,000	€3,000	€1,800	€1,500
External Wall Insulation	€2,000	€1,600	€1,200	€800
Internal Insulation	€4,500	€3,500	€2,000	€1,500
Rafter Insulation	€3,000	€3,000	€2,000	€1,500
Windows (Complete Upgrade)	€4,000	€3,000	€1,800	€1,500
Project Management	€2,000	€1,600	€1,200	€800
Solar PV - 0 to 2kWp	€900/kWp			
Solar PV - 2 to 4kWp	€300/kWp			

- The home must be your main residence and you must be the homeowner
- Your home must have been constructed and lived in before 2011 for insulation and heating controls grants
- Your home must have been constructed and lived in before 2021 for heat pumps and renewable energy systems grants
- Your property must have a B3 or lower energy efficiency rating and a minimum of a B2 upon completion of the upgrades
- Your property must not have received government grants in the past for the same home improvement

For more information and to get in contact with a One Stop Shop, please visit - https://www.seai.ie/grants/home-energy-grants/one-stop-shop/registered-providers/

Electric Vehicles

Privately bought EVs

A maximum grant of €5,000 is available for qualifying new electric vehicles when purchased privately. Approved EVs with a List Price of less than €14,000 will not receive a grant. As of the 1st of July 2021, there is a cap of €60,000 on the full price of all vehicles. The full price of the vehicle to the customer includes all optional extras, paint, and delivery for excludes any incentives such as grants or rebates.

List Price of Approved EV	Grant available
€14,000 to €15,000	€2,000
€15,000 to €16,000	€2,500
€16,000 to €17,000	€3,000
€17,000 to €18,000	€3,500
€18,000 to €19,000	€4,000
€19,000 to €20,000	€4,500
Greater than €20,000	€5,000

Commercially bought EVs

SEAI provides grant supports towards the purchase of new N1 category electric vehicles for business and public entities. N1 category vehicles are typically small goods carrying vans with a technically permissible maximum mass not exceeding 3500kg.
A maximum grant of €3,800 is available for qualifying N1 category EVs when purchased commercially. Approved EVs with a list price of less than €14,000 will not receive a grant. It should be noted that these grants apply to new vehicles only and cannot be claimed on secondhand vehicles.

The grant level depends on the list price of the vehicle. This is the full non-discounted price in the absence of VRT relief or grant support.

Vehicle Registration Tax

Electrical vehicles receive VRT relief separately to SEAI grant support as well as reduced motor tax.

Home Unit Charger

SEAI provide a grant up to the value of €600 towards the purchase and installation of a home charger unit.

Benefit in Kind

For commercial electric cars, Revenue provides an exemption for Benefit in Kind.[36]

[36] https://www.seai.ie/technologies/electric-vehicles/

Schools Grants

SEAI Communities Grant

Schools and Community Organisations can avail of up to **50% grant funding** through the Community grant scheme. This scheme requires the grant application to be made by a diverse group of bodies within a community – including residential, private sector, public sector and not-for-profit/community organisations.

As a result, partnership is essential for a successful application. Schools should seek partnership with your energy supplier, local energy agency, or an experienced community coordinator. The grant scheme opens in November each year and applications must be made by end January the following year. It is unlikely that a school would be the lead applicant so schools should seek experienced coordinators and become part of their application.

Non-Domestic Microgen Grant

The Non-Domestic Microgen Grant (NDMG) provides financial assistance to help schools and other sectors to install solar PV panels to generate electricity on site. Grants are available for systems up to a maximum 6kWp * (Approx. 16 Panels or 25m²) with potential savings of between €2,000 - €3000 annual electrical costs (depending on installation size and current utility rates). The grant amount received is based on the standard output of your solar PV system. A solar PV system with an output of a maximum 6kWp can be grant funded through the scheme. If a larger size system is installed, then the installation will not be considered eligible to claim the NDMG grant.

Solar PV System	Grant Value
1kWp	€900
2kWp	€1,800
3kWp	€2,100
4kWp	€2,400
5kWp	€2,400
6kWp (max)	€2,400

Business grants

Green Transition Fund

As part of Ireland's National Recovery and Resilience Plan and funded by the European Union, the Green Transition Fund will accelerate the decarbonisation of Irish enterprise.

It comprises two separate streams of funding, to support the different aspects of the decarbonisation journey for Irish enterprises. These are:

- **Climate Planning Fund for Business** – building company capability to develop plans for lower-carbon products, processes, and business models.
- **Enterprise Emissions Reduction Investment Fund**– supporting capital investment and Research, Development & Innovation in decarbonisation

Climate Planning Fund for Business

The Climate Planning Fund for Business (CPFB) is targeted at companies of different sizes and at different stages of engagement in their decarbonisation journey. It comprises a range of offers to reflect the different levels of engagement and preparedness of companies. The offers being provided under the CPFB will support companies to accelerate their awareness of decarbonisation opportunities, build capability and put in place sustainability plans.

Grant Offer	Support Available
Climate Action Voucher: Consultancy support to develop an initial sustainability/ decarbonisation/circular economy strategy and action plan.	€1,800 grant
GreenStart: Consultancy grant to support companies to introduce environmental best practice systems and structures, achieve cost and resource reduction targets and lay a foundation for future environmental improvement projects.	Grant rate of up to 80% of eligible costs up to a maximum grant of €5,000
GreenPlus: Support for training projects to develop a high level of environmental management capability, drive environmental efficiencies and achieve improved sustainability.	Grant rate of up to 50% of eligible costs up to a maximum grant of €50,000
Strategic Consultancy: Consultancy grant to assist large energy users develop a carbon reduction roadmap.	Grant rates of up to 50% of eligible costs. Typical maximum support of €35k

Enterprise Emissions Reduction Investment Fund

Companies are at different stages of awareness, engagement and planning for the investments required to transform the sustainability performance of their business through decarbonisation. The Enterprise Emissions Reduction Investment Fund is targeted at companies of different sizes and stages of engagement in their decarbonisation journey: to put in place energy monitoring systems, thereby establishing the carbon footprint of their enterprise; to make investments in decarbonising their manufacturing processes; and to support Research, Development and Innovation (RD&I) in low carbon products and processes.

Grant Offer	Support Available
Capital investment for Energy Monitoring & Tracking (EM & T) Systems: Supporting companies to put in place monitoring and targeting systems to begin accounting for the carbon footprint of their activities	Grant rate of up to 50% of eligible costs, up to a maximum support of €50,000
Capital investment for decarbonisation processes: Supporting investment in carbon reducing technologies in manufacturing combustion processes	Max. grant rate of 30-50%, dependent on company size, up to a maximum support of €1m
Innovation Vouchers: Providing assistance to SMEs to explore a business opportunity or problem with a registered knowledge provider in the areas of sustainability and decarbonisation	€5,000 per company
Exploring Innovation: Grant to support planning of research, development or innovation projects in the areas of sustainability and decarbonisation	Grant rate of up to 50% of eligible costs. Typical maximum support of €35k
Research & Development: Supporting the development of new or substantially improved products, services or processes, in the areas of sustainability and decarbonisation	Grant rates depend on project type and company size
Agile Innovation: Supporting the development of new or substantially improved products, services or processes, in the areas of sustainability and decarbonisation	Grant rate of up to 50% of eligible costs.

Support Scheme for Energy Audits

SEAI are currently running an energy audit scheme that offers SMEs a €2,000 voucher towards the cost of a high-quality energy audit [37]. These energy audits are suitable for businesses with an annual energy spend of over €10,000. These energy audits delve deeper than those contained within the report, analysing the sites suitability for various renewable technologies, the most significant users of energy in their business and their overall carbon footprint.

[37] https://www.seai.ie/business-and-public-sector/small-and-medium-business/supports/energy-audits/

Non-Domestic Microgen Grant

The Non-Domestic Microgen Grant (NDMG) provides financial assistance to help businesses and other sectors to install solar PV panels to generate electricity on site. This technology reduces commercial electricity costs and increases security of supply, while enhancing a positive sustainability image. Grants are available for systems up to a maximum 6kWp * (Approx. 16 Panels or 25m²) with potential savings of between €2,000 - €3000 annual electrical costs (depending on installation size and current utility rates).

* The maximum installation of 6kWp (kilowatt peak) is calculated by adding the rated output of all the panels on your building. If you have a 400W rated panel, you can have a maximum of 15 panels (400 x 15 = 6000W (6kWp))

Solar PV System	Grant Value
1kWp	€900
2kWp	€1,800
3kWp	€2,100
4kWp	€2,400
5kWp	€2,400
6kWp	€2,400
A typical 6kWp Solar PV system installed typically consists of 16-18 panels with an overall area of 25m²	

EXEED

SEAI provide grant support for projects which are following the EXEED Certified standard for Excellence in Energy Efficient Design. The EXEED grant scheme is designed for organisations who are planning an energy investment project. Grant support of up to €3,000,000 per project is available.

The EXEED standard encourages innovation in design projects to help future-proof the investment, by

- optimising energy performance,
- reducing operational energy costs and carbon emissions,
- improving competitiveness and
- demonstrating commitment to sustainability, which could also bring a reputational boost.

This scheme is open to all organisations planning an investment in an energy project. This includes:

- new design projects
- major renovation and major energy upgrades of existing buildings and assets

Expenditure type	Large company	Medium sized company	Small company
Pre-investment professional services to implement EXCEED processes • Design-stage processes set out in EXCEED Certified standard • Strategic input from an independent Energy Efficient Design Expert • To identify the Investment opportunities which will deliver optimum energy performance	Up to 50% grant	Up to 60% grant	Up to 70% grant
Eligible expenditure to implement EXCEED processes • Incremental capital costs compared to counterfactual investment • Professional services associated with implementation	Up to 30% grant	Up to 40% grant	Up to 50% grant

SSRH (Support Scheme for Renewable Heating)

There are two different financial supports available if a business wants to switch to renewable heat. The financial supports include:

- Operational support for a biomass and biogas heating systems
- An installation grant for a commercial heat pump.

SSRH is open to commercial, industrial, agricultural, district heating, public sector and other non-domestic heat users. Applicants must be able to show:

- Conversion from fossil fuels
- Eligible heat use (space heating or process)
- Compliance with eco-design standards
- Heating system design according to building regulations and other relevant regulations
- Qualified designers who are competent to carry out works
- That recipients of payments meet tax clearance requirements

Heat pump installation grant

An installation grant of up to 30% for investment in renewable heating systems using:

- Air source heat pumps
- Ground source heat pumps
- Water source heat pumps

Before you apply It is recommended that you consult an expert who can guide you through your switch to renewable heating.

Accelerated Capital Allowance (ACA)

The Accelerated Capital Allowance (ACA) is a tax incentive scheme that promotes investment in energy efficient products & equipment. The ACA is based on the long-standing 'Wear and Tear Allowance' for investment in capital plant and machinery, whereby capital depreciation can be compensated through a reduction in an organisation's tax liability.

The ACA scheme allows a sole trader, farmer or company that pays corporation tax or income tax on trading or professional income in Ireland to deduct the full cost of the equipment from their profits in the year of purchase. As a result, the business's taxable profits are reduced by the value of qualifying capital expenditure. By contrast, the Wear and Tear Allowance provides for the same tax reduction, but this is spread evenly over an eight-year period.

Eligibility for ACA

Companies, sole traders and farmers that operate and pay corporation tax or income tax on trading or professional income in Ireland can avail of the ACA scheme.

Equipment use

The equipment purchased must be new and bought for use in a trade. It cannot be leased, let or hired to any person, body or organisation.

Time period

ACA can be claimed for the accounting period in which the equipment was first provided, as long as the equipment is included on the published list at some stage during that accounting period.

Eligible costs and minimum expenditure

ACA is available for costs directly related to providing the equipment. Expenditure on the technology must be equal to or exceed the minimum amounts for the relevant class of technology. Find the minimum amounts on the categories and criteria for Triple E page.

How to claim the ACA

1. Decide on the equipment you require.
2. Ensure the equipment model is eligible for ACA by checking the Triple E product register before making purchase.
3. Claim the ACA through your company's return of income form (CT1). There is now a field for ACA on the form alongside the standard capital allowances entry field.

Financial supports for companies purchasing EVs

There are 2 grants available for N1 category vehicles depending on their size. Small to medium vans are classified as N1S for the purpose of the grant. N1S are typically small goods carrying vans with a technically permissible maximum mass not exceeding 3500kg. Large panel vans, classified as N1L for the purpose of the grant must have technically permissible maximum laden mass of exactly 3500kg.

A maximum grant of €3,800 is available for qualifying EV N1S and €7,600 for an N1L category when purchased commercially. Approved EVs with a list price of less than €14,000 will not receive a grant. It should be noted that these grants apply to new vehicles only and cannot be claimed on second hand vehicles.

Dairy Farm grants

As of May 2023 some of the key grants for dairy farmers are:

Grant	% Offered	Notes
Dairy Equipment Scheme (DES)	40% with a €90,000 investment ceiling	This scheme provides grant aid to farmers who are upgrading or investing in new dairy equipment.
Young Farmer Capital Investment Scheme	60% of the eligible cost, with a maximum grant of €60,000	This scheme provides grant aid to young farmers who are starting out in farming or expanding their farm enterprise.
Solar Capital Investment Scheme (SCIS)	60% grant rate, with a €90,000 investment ceiling that is separate from other schemes	This scheme provides grant aid to farmers to get Solar PV installed up to 62kW to offset their electricity costs and consumption.
Women Farmer Capital Investment Scheme (WFCIS)	60% grant rate, with a €90,000 investment ceiling	This scheme provides grant aid to female farmers who are expanding their farm enterprise.

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