The Downs Sustainable Energy Community Register of Opportunities Report

Produced by Energy Co-operatives Ireland Ltd

Supported by

Sustainable Energy Authority of Ireland

And Westmeath County Council

January 2025

1 Registry of Opportunities (RoO)

This is an assessment of the means by which The Downs SEC can achieve efficiencies to reduce energy demand as well as take up renewable energy generation opportunities. The energy use patterns, costs and associated carbon emissions are described in the Baseline Energy Use study which accompanies this RoO. The opportunities are summarised in Section 1.1 below.

The Register of opportunities is intended to be a strategic plan by which the community can achieve energy efficiencies, local income retention and small-scale energy generation which will help secure a more sustainable future for the SEC area.

The Registry of Opportunities has been drawn up on the basis of realistic achievability. It focusses on cost effective measures using technologies and approaches that have been fully tested elsewhere. Its recommendations are achievable within the timeframe outlined and within a realistic economic framework.

The strategy is being conducted in consultation with the Sec committee and this draft is open to revision. Additional opportunities and recommendations can be included at the request of the committee on review of this draft.

1.1 Summary of recommendations.

The recommendations outlined here and explored in greater detail in Sections 1.4 to 1.8. If implemented they would achieve a 43% reduction in the SECs CO2 emissions and would save in today's values €4,033,963[1] per year.

1.1.1 Opportunities in the Home

These are a set of achievable actions for residents in the SEC area. They involve realistic payback periods and long-term benefits both economically and for sustainability. The actions promoted are in the main grant assisted and open to favourable credit terms.

1.1.1.1 Home Retrofits

Retrofit 15% of G-C3 homes each year to B3 achieving a 100% of all homes retrofitted by 2031. This will achieve a total reduction of 1,829 tonnes of CO2 annually for the SEC area. It will ultimately save the community an estimated €956,600 annually on home energy bills (see Section 1.4)

1.1.1.2 Electric Vehicles

Running a campaign for a switch from fossil fuel cars, whereby 5% of vehicle owners purchase EVs (slightly less than the typical turnover of 6.7% of vehicles generally). A switch to EVs would save an estimated 890 tCO2 or €678,008 per year. See Section 1.5.

1.1.1.3 Photovoltaics 3kW systems

Install 3kW of Photovoltaic panels on up to 70% of all homes. This will generate up to 9,874MW of carbon free electricity annually, will save 2.311 tCO2 and between energy costs avoided and energy supplier rebates of approximately €2,567,397. This opportunity will achieve payback in 5-6 years but will be made more beneficial the more quickly this is achieved given the gradual reductions of SEAI PV installation grants year on year. See Section 1.4.4.9.

1.1.2 Opportunities in the Non-Domestic Sector:

1.1.2.1 Energy Efficiencies

In tandem with the home retrofits, 15% SME and Community Buildings to be upgraded each year achieving 30% energy reduction overall, saving 1,052 tCO2 in carbon emissions and €878,248 in costs. See Section 1.6.1.

[1] This includes an income and avoided cost for homes, farms and businesses from electricity generated from micro-scale PV installations.

1.1.2.2 GV and PSV to EV

Information campaign to encourage GV and PSV owners to switch to EV Vans, and a campaign to help inform farmers and contractors of the benefits and feasibility if switching the current tractors and building machinery fleet in the SEC to HVO. These actions could save 1,469 tCO2 emissions and €891,734 in costs to PSV drivers, and businesses per year. See Section 1.7

1.1.2.3 HVO as a temporary replacement for Tractors and GVs greater than 5 tonnes

Hydrogenated Vegetable Oil (HVO) is a like for like replacement for diesel. It is available on sale from fuel suppliers in the SEC. We recommend a switch for HVO by vehicle owners in sectors where Battery powered vehicles are not a mature technology. This would save an estimated 1,276 tCO2 emissions. See Section 1.7.2 and 1.7.4.

1.1.2.4 Businesses and community organisations micro-PV installations

This will see widespread use of existing suitable roof-space in the built environment leveraged for distributed energy generation using PV. This will in effect result in the creation of a dispersed solar park not requiring overcoming either planning or electricity grid re-enforcement obstacles while at the same time generating income locally and offsetting carbon emissions from grid electricity. As many of the recommendations for non-domestic users of energy involve technologies that switch from fossil fuels to electricity: this opportunity will have a synergistic effect of promoting decarbonisation across a range of energy use areas. This micro-PV opportunity will result in an estimated €159,418 in locally retained value (between avoided costs and electricity supplier repayments) and 174 tCO2 avoided.

1.2 Sustainability impacts from the recommendations

The SEC would reduce carbon emissions associated with energy use by 7,229 tCO2/yr (43% of the current emissions.

Table 1: Staged implementation of recommendations

	Emissions Reductions Each Year in tCo2/yr									
	Action	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**TOTAL**	**Tree eq**
1.1	Retrofit 15% of G-C3 homes each year to B3	274	274	274	274	274	274	183	1829	130,613
1.2	15% ND Buildings upgraded each year achieving 30% energy reduction overall	158	158	158	158	158	158	105	1052	75,111
1.3	Information campaign to encourage GV switch to EV Vans	207	207	207	207	207	207	138	1378	98,427
1.4	Information campaign to encourage PSV switch to EV Vans	23	23	23	23				91	6,479
1.5	5% replacement of FF ICE domestic cars with EVs annually	133	133	133	133	133	133	89	890	63,546
1.6	Campaign for Tractors, Machinery and HGVs in SEC to switch to HVO		319	319	319	319			1276	91,165
2.1	50 homes with 3kWp installations with 116 additional homes recruited each year until a target of 746	53	120	120	120	120	120	120	773	55,195
2.2	Businesses and community organisations install PV	43	43	43	43				246	17,584
	Total Emissions Reduction tCO2	**871**	**1242**	**1242**	**1242**	**1176**	**857**	**599**	**7534**	**538,121**

The CO2 saved by implementing the achievable and economically favourable actions outlined in the RoO would be equivalent to that offset by the planting of over 500,000 trees. This would be a huge step towards the community of the SEC achieving a sustainable future.

Contents

1.2.1 Table of Figures

1.2.2 List of Tables Used

1.2.3 List of terms used in this document

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. We provide a glossary of key terms used through-out this report and an explanation of their meaning.

Active Travel	Transport where most of the power supplied is from exercise: e.g., walking and cycling
ASHP Air Source Heat Pumps	A highly efficient electrically driven heating system. It is explained further in the Appendices
BER	An energy rating system where A1 is the most energy efficient to G the least efficient. The levels of the energy use for each rating are discussed in the Appendix
BEU	Baseline Energy Use: a study of the energy use in the SEC as its starting point on its sustainability journey: in this case 2022
CEG (Clean Export Premium)	Homeowners are eligible to receive a Clean Export Guarantee (CEG) tariff, for any exported electricity, at a competitive market rate from their electricity supplier
CEP (Clean Export Premium)	A payment received by a micro-generator for electricity exported to the grid
Electoral Division (ED)	A legally defined administrative area comprising a number of townlands and small urban areas. It is a demographic unit in the Central Statistics Office data collection.
Energy Master Plan EMP	A study funded by the SEAI of the total energy requirement of a community as well as a set of recommendations as to how this can be reduced and powered by sustainable energy
EPA	Environmental Protection Agency
EV Electric Vehicle	A vehicle driven by an electric motor powered by a plug-in rechargeable battery - sometimes referred to as BEV (Battery Electric Vehicle)
FCEVs - fuel cell vehicles	These are vehicles driven by an electric motor (similar to EVs) but that use compressed hydrogen as their energy storage
TDSEC	The Downs Sustainable Energy Community
gCO2	grammes of CO2 emitted
Hybrid	We refer to vehicles that are primarily powered by fossil fuel burning internal combustion engines, but also having supplementary recharging battery that reduces the need for fossil fuels
HVO	Hydrotreated Vegetable Oil (HVO) is a type of renewable diesel fuel that is produced by hydrotreating vegetable oil. It is a high-quality, low-emission fuel that can be used as a direct replacement for fossil diesel in diesel engines

ICE	Internal Combustion Engine: an engine that burns fossil fuels (diesel, petrol, or gas) for its power - usually, and throughout this report, used in connection to road vehicles
kW	kilowatt - a measure of electrical power
kWh	kilowatt hour: a unit of electricity - the application of one kilowatt for one hour. This is determined by electricity suppliers as the basic unit of electricity
kWp	kilowatt peak power: a system that delivers one kilowatt. Over one hour at maximum output it will produce 1 kWh
MW	Megawatt = a thousand kilowatts
MWh	Megawatt hour: a thousand-kilowatt hours
Net zero	An energy system where any generation of Carbon Dioxide from energy production is balanced by carbon offset measures such as sequestration by trees, bogs, etc
Payback	The time taken for the nett income from a project amount to the initial investment
Pobal	A state-sponsored organisation in the Republic of Ireland with responsibility for administering and managing government and EU funding aimed at supporting social inclusion and addressing social disadvantage in the country
PV	Photovoltaic: panels that convert light (photons) into electricity (volts).
RoO	Register of Opportunities: a live document provided separately to the SEC which will enable it to track its progress against the BEU through efficiency, avoidance and generation projects
ROI	Return on Investment. This is a profitability ratio that compares the net profits received for the lifetime of the investment to the original cost of an investment, expressed as a percentage
SEAI	The Sustainable Energy Authority of Ireland
SPA (Special Protection Area)	A special protection area (SPA) is a designation under the European Union Directive on the Conservation of Wild Birds. Under the Directive, Member States of the European Union (EU) have a duty to safeguard the habitats of migratory birds and certain particularly threatened birds.
Turbine	A machine which converts turning power into electricity
TWh	Terawatt hours: a million-megawatt hours

1.3 Context

The Downs SEC commissioning document outlined the key targets which the SEC committee and the SEAI Mentors wished the EMP to explore:

> "Our objective from this sustainable energy project is to produce a strategic plan that will transition The Downs SEC from energy inefficiency and over reliance in fossil fuels to a community that is energy efficient and has reliable sources of energy. We would like to develop examples of both business and private case studies with a view to getting a number of homes in particular to sign up and switch to green energy. We feel there is huge potential for energy conservation within the community. LED lighting is the easiest way to introduce efficiency reform. Given the culture of cutting turf and burning fossil fuels locally we believe that the timing is perfect to educate the community on renewable sources of energy."

Energy Co-operatives Ireland Ltd were commissioned following a competitive tendering process, to produce a Baseline Energy Use survey (published separately) and this Registry of Opportunities (RoO). This RoO was produced following an extensive survey of community need, and local planning, and policy contexts as well as community stakeholder engagement.

Our study which is called a 'Registry of Opportunities' (RoO) will look at these areas of energy and sustainability actions in detail, namely:

- Recruiting homes and businesses to switch to green energy
- Energy Conservation measures within the community
- LED lighting efficiencies
- Tracking strategy to enable homeowners to move away from turf as a heating fuel

In addition to these opportunities, through our study if the SEC and our discussions with committee members, we identified a number of other realistic and currently achievable opportunities to reduce fossil fuel use. We outline them in detail here also.

Our study is driven by the need to achieve sustainability targets. We therefore look at solutions which the SEC can carry out in the short and medium terms (i.e. over the next 3 years) as well as longer term possibilities. Our RoO describes the steps, the capacity requirements, and the financial supports needed and available, to achieve the RoO.

1.3.1 The 'living document' principle.

It is right that sustainability plans are well thought out and prepared in sufficient detail. However, they must also be responsive to changing contexts: whether that be social, economic or policy changes. Thus, our RoO is prepared in a way which can be updated to suit changing conditions. It is also first and foremost a document which will include guides for action and local capacity building. In this way, the EMP will be impactful in the real world and not simply a work of research.

1.4 Domestic Level Retrofits

The residential sector accounts for almost one quarter of the energy used in Ireland[2]. It is also responsible for 15.5% of the energy-related CO2 emissions. Owing to the lack of a large local industrial sector, domestic heating and power accounted a greater percentage of the SEC area's energy use at 40% of the total. The domestic sector must a key target for efficiency and fossil fuel reduction strategies. The good news that it is within the power of local homeowners to make these changes and subsequently reap the benefits.

In this section, we will outline a range of opportunities for local homeowners and community residents to demonstrate how they can increase their levels of sustainability. This is by improving the degree of energy efficiency of their homes, making transport choices that will be less carbon intensive, as well as making simple behavioural changes that can reduce their imported fossil fuel dependency. We will also discuss how they can engage in micro-generation at the home level.

1.4.1 Behaviour-change efficiencies

While we are all aware of the scale of the environmental challenge that faces our communities, it is critical that we as citizens are also aware of our own role in addressing that challenge. Research shows that what we do at home can help guide us to taking bigger, more noticeable community actions:

> Individual behaviour creates the foundation for action in social, economic, and environmental sustainability, and potentially guides our ability to work with one another to make life-affirming decisions. In short, it is a matter of aligning our day-to-day behaviours with our well-stated values that will result in greater sustainable community action.

[2] https://www.seai.ie/data-and-insights/seai-statistics/residential/

Pappas & Pappas (2014)[3]

We present a list in Appendix, Section 2.1, of some quite simple actions that the homeowner can take to reduce the level of energy use in their own home with just behaviour changes. We summarise the highlights here:

Cost reduction measures:

- Change your energy provider – this can save you 20% per year
- Consume less solid fuel and bottled gas, and more oil to heat your home and water[4].
- Consider switching to smart or night meter tariffs: but be aware this should be accompanied by only using immersion, dishwashers, and washing machines between 11pm and 7 am.
- Don't use an electric clothes dryer except when it is unavoidable

Quick Home Improvement Measures:

- Track down and eliminate draughts: check windows, external doors, vents, floor spaces, fireplaces, and stoves.
- Install a stove instead of an open fireplace. Stoves are three times more efficient.
- Check insulation levels in attic, basement, walls (including the meter box), and floor spaces: It should be at least 400m thick (200mm between the joists, and 200mm above the joists). Don't stack boxes on top of insulation, use loft legs.
- Check your boiler and stove is serviced.

Energy Reduction Measures:

- Switch to more efficient appliances and lower temperature settings
- Don't use standby on devices and turn off lights when possible.
- Use LED lights

Solid fuel heating both drastically reduces a home's airtightness while at the same time delivering very poor typical efficiency - 20-30% for open fires[5]. This means that to achieve the same level of delivered energy as a 1kW electric room heater (costing €0.29 per hour to run) a fireplace will burn 4kWh per hour (costing €0.37/hr) of fuel. So, switching to electricity can save on average 20%, using oil will save 250%.

[3] https://files.eric.ed.gov/fulltext/EJ1060565.pdf

[4] An open fire has an efficiency of 25%, an oil boiler >80%. So 1kWh of delivered heating energy from coal costs €0.37 while 1kWh delivered heating from oil is €0.144 which is 250% cheaper.

[5] https://www.seai.ie/publications/Energy-Efficiency-in-Ireland-2016-Report.pdf

If the householder is attached to the open fire in certain rooms for aesthetic reasons, they could consider following the action discussed in Section 1.4.4.7. This recommended replacing cut turf and imported anthracite with locally sourced dried timber and short crop willow fuel products from sustainably managed Irish plantations.

Domestically cut turf is theoretically free to the homeowner with turbary rights: if the homeowner cuts the turf themselves. However, turf harvesting even on the domestic scale by hand comes with sustainability challenges. We understand that there is a strong cultural and aesthetic significance to turf in the SEC. We recommend that homeowners use existing harvested turf supplies **very sparingly** and instead replace sod turf space heating with other more sustainable also locally produced biomass.

While not zero carbon owing to the fossil fuels used in processing and transporting, locally produced biomass produces much lower carbon emissions than imported coals or even hand-harvested sod peat. When sustainably managed mixed forestry and coppice plantations also have significant biodiversity and ecology rehabilitation benefits.

1.4.2 BERs

Achieving energy efficiencies through both behaviour-change and building upgrades reduces both the cost of energy and the carbon emissions to the homeowner.

We identified opportunities for efficiencies in the homes of the SEC by conducting BER surveys of homes to establish levels of efficiency and across the domestic built environment and then providing each sampled home with a roadmap of measures to move them from their base level efficiency to B2 minimum.

1.4.3 Sample Homes

We advertised for SEC residents to volunteer for a free BER and Home Energy Upgrade report through local flyer and email announcements. We recruited 7 homes whose homes were surveyed by SEAI registered BER assessors. The assessors provided home owners with a set of recommended upgrades which could be carried out to improve the energy efficiency and comfort of their homes. A sample of such a report (which is found in the accompanying Register of Opportunities Document which is a live excel report to which other homes can be added) is shown below.

Figure 1: For illustration purposes only - a home with characteristics very similar to the one studied in The Downs and discussed below[6]

In the sample home, the BER Assessor identifies just 6 measures which, when completed in order, will bring the home's BER from an E2-rating with estimated energy use of 30,177kWh/yr adjusted[7] (49,470kWh/yr unadjusted) to just 1,234 kWh/yr.

Adjusted energy costs for the home are € 3,621 per year for its current E2-rating. However, with upgrading to an B1 rating with potential energy costs would be €358 per. This represents a potential saving of €3,263. This is a potential 90% reduction of energy costs. The report also indicates the reduction of carbon emissions achievable. In this case, post works the CO2 emissions of the home would be reduced by 14 tonnes CO2 which is the equivalent of carbon sequestered by 997 mature trees annually.

The estimated cost of making the upgrades here can be seen in this document prepared by the SEAI based on the upgrades it funds across the country: *One Stop Shop Service median costs and grants*. Based on the figures reported, the home studied would require a spend of approximately €38,000 (net grant). This would mean that he works would have a payback period of 11 years.

We produced 7 such reports each representing a home type in the SEC area. These are included in the RoO.

[6] The home itself is not shown for confidentiality reasons.

[7] BER is a hypothesized energy consumption for the dwelling and does not reflect the actual energy bill – simply what the bill would be, were the owner to heat the building to normal healthy levels (20C). It is quite likely such occupants due to economic pressures may underheat their homes. We therefore apply an adjustment based on a study by Coyne & Denny, 2021, 'Mind the Energy Performance Gap: testing the accuracy of building Energy Performance Certificates in Ireland', *Energy Efficiency*, Vol 14, https://link.springer.com/article/10.1007/s12053-021-09960-1

The Energy Upgrade report below did not include a recommendation to install PV[8]. However, we recommend that this be undertaken whenever possible. In the current environment, domestic scale PV should be installed whenever possible (*in parallel* to energy efficiency measures). This has far-reaching sustainability benefits as well as presenting an excellent value for money opportunity which is technically very straightforward. For further discussion, see Section 1.4.4.9 below.

[8] Photovoltaic panels: these roof mounted panels convert sunlight into electricity which is used in the home for appliances and water heating with the excess exported to the grid. Discussed in greater detail in Section 1.1.1.3

Home Energy Upgrade Advisory Report

BER No. [redacted]

Your Home's Energy Performance Potential

Potential with upgrades

Loss of heat from your home

NOW	POTENTIAL
Poor	Good

An upgrade package to **stop losing money** on your energy bill

Your BER assessor has recommended a package of upgrades that will raise your home's energy performance.

Energy Performance of your home	NOW	POTENTIAL
Roofs	Good	Good
Walls	Poor	Good
Windows	Poor	Good
Floor	Poor	No Upgrade
Space heating	Very Poor	Very Good
Water heating	Very Poor	Very Good
Renewables	Very Poor	Fair

GRANTS AVAILABLE?

subject to availability, terms and conditions

For further information visit www.seai.ie/grants or call 01 8082100

Compare your home's performance | Before and after upgrades

Your home's current **energy performance**	NOW E2	Your home's potential **energy performance**	POTENTIAL B1

Benefits of upgrading your home

INCREASE your home's value

INCREASE your home's comfort

REDUCE your energy bills

SAVE

CO_2 TONNES 14

= the same as planting **997 tree(s) each year**

To find out more visit **www.seai.ie**

seai SUSTAINABLE ENERGY AUTHORITY OF IRELAND

Home Energy Upgrade Advisory Report

Your journey from BER E2 **to** BER B1

Your BER assessor has recommended a package of energy upgrades that maximise the energy performance of your home. The recommendations are for guidance only and can be completed at your own discretion.
The recommendations are just one potential pathway to an improved BER and it is open to you to discuss alternative packages with your professional advisors.

Package of energy upgrades to save money, make your home more comfortable and protect the environment

Recommended Package of Energy Upgrades	Cost (Approx.)[4]	Grant Available [5]	Comfort
External doors 1.4 W/m^{2}K average U-Value [1, 2]	€ € € €	✔	★ ★ ★ ☆ ☆
Roof insulation; pitched (at ceiling) 0.16 W/m^{2}K, pitched (on slope) 0.20 W/m^{2}K, room in roof (on side) 0.20 W/m^{2}K, flat 0.22 W/m^{2}K average U-Value [1, 2]	€ € € €	✔	★ ★ ★ ★ ☆
Wall insulation 0.35 W/m^{2}K average U-Value [1, 2]	€ € € €	✔	★ ★ ★ ★ ☆
Windows double glazing 1.4 W/m^{2}K average U-Value [1, 2]	€ € € €	✔	★ ★ ★ ★ ☆
Air-to-Water or Ground-to-Water or Water-to-Water heat pump with fully integrated heating controls [3]	€ € € €	✔	★ ★ ★ ★ ☆

1. *Major Renovation is defined in the Building Regulations Part L Technical Guidance Document and means the renovation of a dwelling where more than 25 % of the surface of the dwelling envelope undergoes renovation. Where a dwelling undergoes a major renovation, the energy performance of the whole dwelling should be improved to the cost optimal level by achieving a B2 or by implementing the energy performance improvements as set out in the Building Regulations Part L Technical Guidance Document.*
2. *This energy upgrade will reduce your home's heat loss and is an important first step to improving the energy efficiency of your home.*
3. *A dwelling should have low heat loss to ensure the heat pump runs efficiently. An ideal heat loss indicator (HLI) is less than 2.0 W/(K·m^2). An upper HLI limit applies to SEAI grants. Where the HLI is between 2 and 2.3 W/(K·m^2), additional heat pump grant eligibility criteria apply.*
4. *Investment Cost Legend:*
   - *€ < 5,000*
   - *€€ 5,000 - < 15,000*
   - *€€€ 15,000 - < 30,000*
   - *€€€€ 30,000 - 50,000*
5. *A grant for this type of upgrade is available at the time of publication of this report. Grant availability is subject to eligibility criteria and should be checked to see if the works to your own home meet the eligibility criteria. Eligibility criteria are subject to change.*

GRANTS AVAILABLE?

✔

subject to availability, terms and conditions

For further information visit www.seai.ie/grants or call 01 8082100

Home Energy Upgrade Advisory Report

Start your journey to upgrade your home

If you're not ready for the maximum SEAI grant, consider picking one or two energy upgrades, selecting areas with the poorest performance.

GRANT APPLICATION

To start your application today visit
www.seai.ie/grants

Simple energy upgrades - quick, cheap, easy

Draughtproofing
Draughtproofing, fitted to windows, doors and loft or attic hatches, improves airtightness and thermal comfort, reduces heat loss, improves noise insulation and reduces dust ingress.

Lighting
Correct lighting levels are essential for visual comfort, safety and for aesthetic effects. Fit efficient electric lighting and maximise the use of daylight.

Potential impact of the **recommended energy upgrades**

Energy upgrade	Now		Potential	
	Value	Energy Efficiency	Value	Energy Efficiency
Home Heat Loss Indicator (HLI)[1]	3.369 W/(K·m^2)	Poor	2.190 W/(K·m^2)	Good
External doors (average U-Value[2])	2.621 W/m^{2}K	Fair	1.491 W/m^{2}K	Very Good
Roof insulation (average U-Value[2])	0.256 W/m^{2}K	Good	0.198 W/m^{2}K	Good
Wall insulation (average U-Value[2])	1.343 W/m^{2}K	Poor	0.347 W/m^{2}K	Good
Windows double glazing (average U-Value[2])	2.649 W/m^{2}K	Poor	1.400 W/m^{2}K	Good
Air-to-Water or Ground-to-Water or Water-to-Water heat pump with fully integrated heating controls (Primary Energy Efficiency[3])	59%	Very Poor	200%	Very Good
Lighting	52.24 Lm/W	Good	66.90 Lm/W	Very Good
Renewable Energy Ratio (RER)	0%	Very Poor	6%	Fair

1. *The Home Heat Loss Indicator (HLI) is a summary of the overall performance of the home. It includes all the fabric and ventilation upgrades listed in the table*
2. *A U-value is a measure of the heat loss through the building fabric. The higher the U-value, the greater the heat loss*
3. *Primary energy efficiency is the efficiency divided by the primary energy conversion factor*
4. *Indicators are based on the average elemental U-values in the BER and where partial upgrades occur, average U-values may remain above the optimum U-value.*

Home Energy Upgrade Advisory Report

Your Home's Details

Home Address

[redacted] THE DOWNS MULLINGAR CO. WESTMEATH,

House Details

Year of construction: 1970
Dwelling type: Detached house
Total floor area: 145.1 m^2

About the Home Energy Upgrade Advisory Report

This document is a first step to assist you in engaging with a professional to determine suitable energy upgrades for your home.

It was prepared by a BER assessor using general assumptions and information from your BER assessment. The improvement in the BER has been estimated based on the assumption of certain values for energy upgrades and is provided as an indicator only.

This document is for information only and does not constitute professional or legal advice. The homeowner waives and releases any and all claims against SEAI and/or the BER assessor arising from the contents of this advisory report.

Use this document to:

Better understand how your home performs and how to make it more comfortable and affordable to run.

Provide information on home energy upgrades to discuss further with a professional or contractor.

Identify small simple steps you can take to improve the comfort of your home, if grant supported works aren't suitable for you right now.

Start the grant application process with SEAI, who may have substantial support available.

Recommended Energy Upgrades

The recommendations contained within your advisory report have been generated based on the data inputs contained within your BER assessment. SEAI recommends you seek professional advice and use suitably qualified installers to assess the suitability of the recommendations for your own particular home.

SEAI and the BER assessor accept no responsibility for and give no guarantees, undertakings or warranties concerning the accuracy, completeness or fitness-for-purpose of the information contained herein and do not accept any liability whatsoever arising from the contents hereof.

Further information on upgrading your home is available in **S.R. 54:2014 Code of Practice for the Energy Efficient Retrofit of Dwellings**, available from www.nsai.ie.

Building Regulations

The aim of the building regulations is to provide for the safety and welfare of people in and about buildings. Where applicable, works should be completed in accordance with the relevant Building Regulations. The primary responsibility for compliance with the requirements of the Building Regulations rests with the designers, builders and owners of buildings. Technical Guidance Documents for the Building Regulations and other supporting documents are available from the Department of Housing, Local Government and Heritage website at www.housing.gov.ie.

Costs

The investment cost indicators are guidelines only. Actual costs will vary depending on house size, specification and market conditions. Cost indicators may be calculated based on a partial upgrade if some sections of the building element are already adequately insulated.

Please consider the environment before printing this document.

BER Privacy Notice: www.seai.ie/publications/BER-Privacy-Notice.pdf

Ventilation

Care should always be taken to ensure sufficient levels of ventilation in each room. Signs of inadequate ventilation are persistent condensation and mould growth and should be addressed in the first instance. It is important not to permanently close or cover over air vents as they are required to provide ventilation. Further guidance on ventilation provision when carrying out retrofit works is available in Section 10 Ventilation of S.R. 54:2014 Code of Practice for the Energy Efficient Retrofit of Dwellings.

Radon

Radon gas at high concentration causes lung cancer and is estimated to be responsible for 300 cases per annum in Ireland. Retrofitting provides an opportunity to test for, and remediate for, radon, where indicated. A radon test is low cost and non-disruptive. The only way to know if a home has a radon issue is to test. Further information on radon, including testing, is available on the EPA website www.epa.ie.

Heat producing Appliances

It is important to ensure that there is an adequate air supply to all heat producing appliances e.g. any fixed appliance (including a cooker or an open fire) which is designed to burn solid fuel, oil, bio-fuel or gas and to provide permanent ventilation for all non-room sealed combustion appliances. Useful health and safety information can be found on the Carbon Monoxide safety website: www.carbonmonoxide.ie. Further guidance on air supply for heat producing appliances is available in Section 7 and Section 10 Ventilation of S.R. 54:2014 Code of Practice for the Energy Efficient Retrofit of Dwellings.

Evidence for BER

Documentary evidence of energy upgrades is required for your BER and should be retained and provided to your BER assessor to ensure the energy performance uplift is captured in your BER. Your BER Assessor can advise you on documentary evidence requirements. Further information is available on https://www.seai.ie/home-energy/building-energy-rating-ber/.

1.4.4 Typical Retrofit Measures in SEC homes

The recommended works are based on a fabric first approach. That is, improve the energy efficiency of the building by sealing off drafts and increasing insulation. It is typical in an energy upgrade to exchange stoves for fireplaces or to block up the chimney altogether. These measures have the immediate benefit of sealing off a major source of drafts. Improving seals to doors and windows is also an excellent first step.

As a rule of thumb, insulation should be installed from the top of the house downwards.

1.4.4.1 Roofs and attics

Felt or fiberglass insulation should be laid in **two layers with opposite direction**. If using fibrous insulation, do not store items on the insulation that would compress it. If you use the attic for storage, you should probably use in-rafter insulation.

Flat roofs can be insulated with purpose manufactured insulation boards. These are typically thicker than 150mm, the key is to achieve a thermal value (U-values) of 0.16 W/m2K for ceiling level insulation or 0.20 W/m2K for rafter insulation. Insulation should be installed by a professional who will guarantee that there will be no gaps between insulation material joins. **ROOF INSULATION GUIDE LINK**.

1.4.4.2 Walls

Many homes built pre 2007 would probably benefit from external insulation where this is feasible. This can be costly but will refresh and future-proof the home for the generations to come adding to its value as well as saving energy, money and reducing carbon emissions.

External wall insulation is the best way to insulate your walls. External insulation involves fixing insulation materials such as mineral wool or expanded polystyrene slabs to the outer surface of the wall. Although it is expensive, it also resolves issues such as rain penetration and poor airtightness.

Cavity walls are of two rows of brick or blocks space between them. This was a very common building technique for houses throughout Ireland as it reduced the possibility of damp on the inside wall of the house, and the gap prevented 'thermal bridging'. Adding insulation improves the thermal efficiency of the wall, but until the mid-2000's there usually was not enough insulation put into the gap at construction. Post construction, the best method of insulating these is by injecting insulation outside into the cavity.

Internal Wall Insulation involves fixing insulation to the inner surfaces of your external walls (i.e. not the walls between rooms). The contractor attaches insulation board to

the walls then plaster finishes inside. The work required can be quite disruptive and means re-modelling the walls inside.

WALL INSULATION GUIDE LINK

1.4.4.3 Windows and Doors

Upgrades to these were recommended in most of our audits. These are costly but are often necessary to reduce drafts and loss of heat from thin glazing. It would be essential that you discuss whether you need to upgrade windows to achieve the necessary fabric level: but in many cases you will.

HEAT LOSS INDICATOR

A reduction in what is known as the 'Heat Loss Indicator' (HLI) is required for energy efficiency. This is a measurement of airtightness. In all but exceptional circumstances, an HLI of less than 2 is needed before a heat pump can be installed, although close to 2 can be acceptable where achieving an HLI of less than 2 is not cost effective.

1.4.4.4 Heating System Controls

Heating controls for your home heating system can lower your energy consumption by up to 20%. Without these controls, home heating systems will waste energy due to the lack of precise regulation over how much heat is being used to warm your home and heat your water. As a result, they will be more expensive to operate.

GUIDE TO HEATING CONTROLS

1.4.4.5 Heat Pumps or Biomass?

Most of the upgrade reports recommended the installation of air-source to-water heat pumps (ASHP) (explained more fully in Appendix Section 2.6.1). This would increase the efficiency of the heating system and incorporate advanced heating controls. Heat pumps are in many situations the recommended sustainable heating system.

However, given the geographical context of the SEC, we also recommend examine biomass powered heating opportunities. Typically, large rural Irish homes require 15-20kW biomass boilers consuming 3-4 tonnes of biomass per year. This requires a bulk blown delivery of wood pellets to a 6-7m^3 silo.

1.4.4.6 Pellet Boilers

Policy in Ireland has moved away from supporting domestic pellet installations to commercial scale (we discuss this in Section 1.6.3). However, as the industry has matured, pellet boilers have become cheaper. The case study home (post insulation works) would need a 12-15kW boiler. The radiators etc would not need to be changed in the home. Equipment and installation costs should be in the region of €6,500.

In our example, the energy costs post pellet boiler installation will be approximately €300 less per year over the existing oil system. This gives a payback of 15-20 years.

However, the carbon reductions benefits are considerable. Wood pellets produced in Ireland using wood fired drying embody are low: 30g per kWh heat (home heating oil is 264g CO2/kWh).

1.4.4.7 Replace Turf with Willow and Dried Wood for Heating

The Downs is situated in a peat producing region of Ireland. There is a long history of households cutting, drying and using turf to heat homes. Recent changes to environmental legislation has resulted in heat production for sale being prohibited[9]. This legislation was introduced as a protection measure for bogs as well as a recognition that turf for heating has a considerable carbon emissions impact. 1kW of heat produced by turf burning produces 374.4g CO2.

We recognise, and were told during our stakeholder consultations, that there is an aesthetic appeal to using turf as a heating fuel in the area. Therefore, we recommend that residents with existing turf stocks conserve these for aesthetic use only and instead use other sustainable solid fuels for heating purposes.

There are products and processes available already which are more environmentally sustainable than turf:

Willow

Dried Timber

These are products that could well be produced locally and distributed directly to homeowners of via fuel product manufacturer and distributers.

[9] Householders faq solid fuel regulations: https://www.longfordcoco.ie/services/environment/air-quality/solid-fuel-regulations/householders-faq-solid-fuel-regulations.pdf

1.4.4.8 Heat Pumps

We recommend a switch to air-source to-water heat pumps (ASHP) (explained more fully in Appendix Section 2.6.1) in our retrofitting projects. This would reduce the amount of energy required to heat the home.

Heat pumps have an efficiency of 3:1 which means that for every kWh of electricity is put into the system, 3kWh of heat are produced. Heat pump technology is now very advanced and reliable. There are well over 55,000 heat pumps installed in Irish homes, and the Climate Action Plan outlines plans for 400,000 heat pumps in existing Irish homes by 2030. As a solution to the country's heating needs, heat pumps, in particular ASHPs are a route recommended by the SEAI. They are particularly recommended in areas where there is no gas grid. The economics of the ASHP are very favourable in comparison to an oil alternative.

The cost of installing a heat pump varies from home to home quite considerably. We have done assessments of typical costs however and on the homes in our survey, the typical cost was €12,500. However, an Apartment can qualify for a €4,500 grant from the SEAI and a Semi-Detached/End of Terrace/Detached/Mid Terrace house a grant of €6,500 towards the cost of an ASHP, effectively reducing the cost for a typical heat pump installation to €6,000.

Typically, a homeowner reduces the amount of energy used in the home by installing a Heat Pump by 33%: this provides a payback period, net of grant of 10 years on current prices. However, this payback period is reduced to under 7 years when combined with a PV installation of 3kW. We discuss the value of small-scale PV below.

1.4.4.9 Domestic PV

In many of the Upgrade reports, we were able to recommend domestic PV installations (after fabric and heating system upgrades are completed). This will have the benefit of reducing the amount of electricity the home will consume after the heat pump insulation. It will also decarbonise the electricity consumed by the home. The current carbon intensity of electricity in Ireland has dropped to is 234g CO2/kWh[10] in 2023. This means that it produces less carbon than home heating oil (257g CO2/kWh).

A domestic solar PV system consists of a number of solar panels mounted to your roof (or in your garden or adjacent field) and connected into the electrical loads within your building. PV systems are rated in kilowatts (kW[11]). A 3kW solar PV system would require

[10] https://www.climatecouncil.ie/councilpublications/annualreviewandreport/AR2024-Electricity-final.pdf

[11] Kilowatt power: a system that delivers one kilowatt. Over one hour at a *theoretical maximum* output it will produce 1 kWh.

8X400W solar panels on a roof, approximately 15m^2 in area. The useable roof area in the example home was 120m^2

Summary	
PV technology:	Crystalline silicon
PV installed [kWp]:	3
Simulation outputs:	
Slope angle [°]:	35
Yearly PV energy production [kWh]:	**2,690.5**
System loss [%]:	14

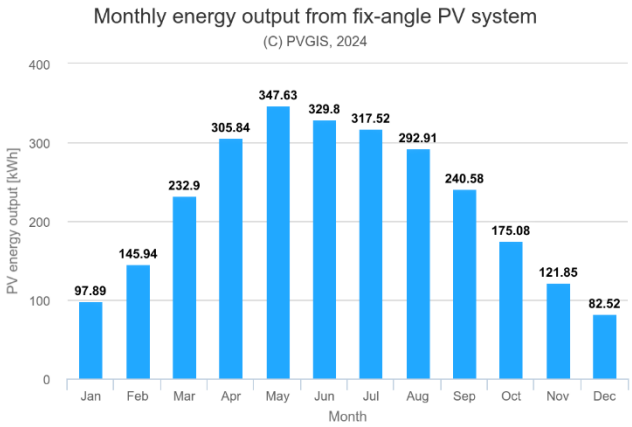


Figure 2: PV output from 3 kW Installation in The Downs[12]

A roof mounted 3 kW PV system on a south facing roof in The Downs will produce 2,690 kWh per year. The average house in The Downs consumes 5,294 kWh of electrical power in a year for lighting, appliances, and cooking[13].

Since a consumer today pays on average[14] €0.32 per kWh to their electricity provider, a 3 kW PV panel system (if the home is occupied during the day and 50% of the electricity is consumed in the home) will save the homeowner approximately €430 per year. There would also be an additional payment from the Clean Export Guarantee (CEG) (of approximately €309[15] per year in this case). On an installation costing €6,250, this would achieve a simple payback of 6 years if the installation qualified for a grant (€1,850).

There is a significant grant incentive available from the SEAI for PV installation for homeowners. The full details are available[16] at this link.

[12] https://re.jrc.ec.europa.eu/pvg_tools/en/tools.html
[13] Though not at the times shown in Figure 2 – PV output is highest in the daytime during summer. Electricity consumption is typically highest at night during the winter.
[14] https://www.seai.ie/publications/Domestic-Fuel-Cost-Comparison.pdf
[15] The Energia domestic export rate is €0.23 per unit at time of writing. There is a €400/yr tax threshold on export earnings
[16] https://www.seai.ie/grants/home-energy-grants/solar-electricity-grant/

Table 2; SEAI PV Grants for Homeowners

Value	Example
€800 per kWp up to 2kWp	€1,600 for 2kW solar panels
€250 for every additional kW up to 4kW	€1,850 for 3kW solar panels
Total Solar PV grant capped at €2,100	**€2,100 for 4kW solar panels**

These grants amounts are reducing each year. The SEC is advised to alert homeowners of this and to move on a PV installation campaign as a priority.

Excess electricity produced can also be stored in a hot water immersion tank or in a battery. The water tank should be well insulated and with a capacity of more than 250 litres – it can be installed at the same time as the PV. Batteries of 5 kWh storage can cost up to €2,500, and this system will only occasionally exceed that level of solar production (in May-August). Excess electricity can also be used to power a BEV that is parked during the day at the home. The CEG exports from the house into the electrical network on the road outside your home for a typical price in 2023 of €0.25 per kWh. The best solution is to manage your electricity consumption (for example diverting power to the hot water tank, using the washing machine and dishwasher) to match the best PV generation times i.e., daytime. The SEAI has a calculator that shows payback period for typical installations, customisable by county, size of system and retail price of electricity. It is available at this LINK.

1.4.5 Community Level Impacts of Efficiency Measures

If we assume that the homes in the SEC upgrade from their current level to a minimum B2, we can make predictions on the effect this would have on the SEC's energy consumption and carbon emissions. We do not expect homes from B3-A1 to require retrofitting.

If all SEC homes were B3 or above, we can expect a considerable energy saving dividend of approximately 7,314 MWh and home energy related emissions reductions of 1,828 tonnes of CO2. The equivalent carbon offsetting of 130,000 trees.

The *current*[17] home energy use in the SEC would be reduced by 30%.

[17] We use the adjusted energy use value here which is 36% greater than the reported kWh/m2/yr in the BER

1.4.6 Community Level impact of Domestic PV

98.3% of the homes across the SEC are houses, with only 1.7% apartments. If we assume that of these houses 70% will be able to accommodate 3 kW PV. This means that of the 1064 houses, 745 will be able to install on average 3 kW. This would produce approximately 2,374 MWh of zero carbon electricity. This would remove approximately 772 tCO2 from the SECs CO2 emissions.

The sustainability effect of such carbon reduction will be the equivalent of the amount of carbon sequestered by 55,143 mature conifers.

If we add the replacement of mains electricity by PV to the benefits of retrofits in the earlier section, we see that taken together they would reduce the SECs domestic carbon emissions by 2,600 tCO2 per year or 26% the current total.

The total cost the community of such a large scale roll out of PV would be €3.2m. However, with a payback period of approximately 6 years, the community would as a whole benefit by €550,000 per annum until 2049: amounting to a net income for the community of €10,472,000 for the lifetime of the installations.

1.4.7 Costs of efficiency measures

Our home surveys in this EMP were not required to cost the retrofits according to current market conditions. However, elsewhere we have costed heating upgrades and PV installations using supplier information at the time of surveys (in Table 9: Guidance Costs for Energy Upgrades).

There has been construction inflation since some of those surveys were carried out, but we include these 2022-23 figures here as useful indicators of the average costs of retrofitting works. We cannot guarantee that these costs will be what a given homeowner will be quoted. The cost of works is site and contractor specific, but the median price per meter from our 2022-23 work was €553/m^2 **excluding SEAI support**.

There is however a wide range of costs per square metre for retrofits. There does not appear to be any strong correlation between age of build, starting BER, or construction type. We do not propose to draw any strong conclusions for the cost of energy upgrades across the SEC. However, the individual homeowner could benefit from comparing their own home with those surveyed below in the appendix.

1.4.8 Available Supports

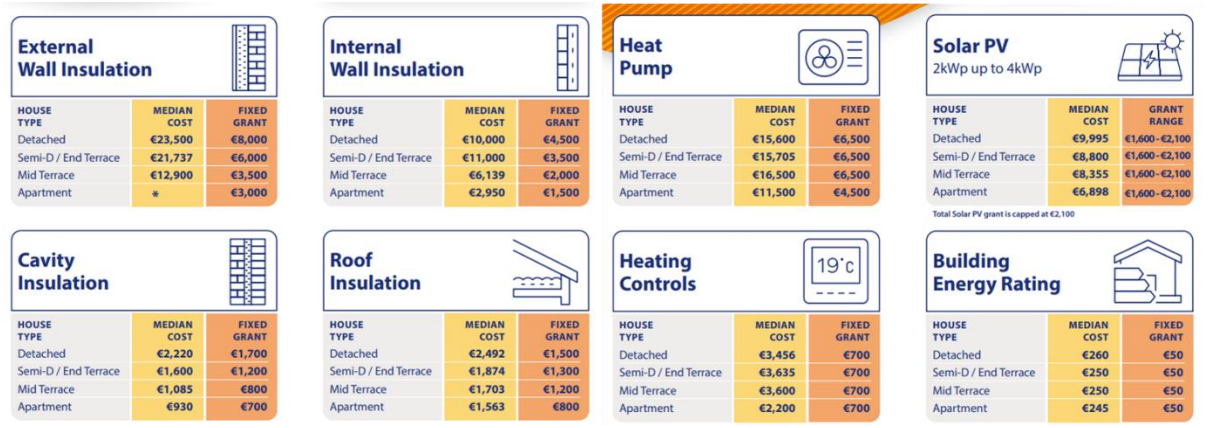
Irish homeowners are relatively fortunate in the level of assistance that is available to them for energy efficiency upgrade works. In keeping with the requirement of the commissioning SEC, we emphasise here the benefits of collectively organised retrofitting works – and indeed recommend this approach, although there is a guide to other supports for the individual homeowner in the Appendices.

1.4.8.1 Individual Level Supports

There are three categories of applicants to the SEAI Home Energy Grant Scheme[18] of which this is a brief summary. These are:

- Individual Energy Upgrade Grants towards the cost of various upgrades for a typical family home with SEAI grants
- One Stop Shop Service based on set grants per measure, this can be grant funded by SEAI 45 - 50% of the cost for a typical family home.
- Fully Funded Energy Upgrade for qualifying homeowners in receipt of certain welfare benefits.
- Unsecured loans available at a reduced interest rate from AIB, PTSB and Bank Ireland. The state subsidises loans by 2% for energy upgrades.

These supports are discussed in greater detail in Appendix Section 2.5. There is also a full explanation of the schemes, grants, and levels of funding on the SEAI site here. The individual level supports may not be enough to allow some homeowners to carry out the necessary upgrades. There are improved levels of supports for some qualifying homeowners (Section 1.4.8.2 below)



External Wall Insulation

HOUSE TYPE	MEDIAN COST	FIXED GRANT
Detached	€23,500	€8,000
Semi-D / End Terrace	€21,737	€6,000
Mid Terrace	€12,900	€3,500
Apartment	*	€3,000

Internal Wall Insulation

HOUSE TYPE	MEDIAN COST	FIXED GRANT
Detached	€10,000	€4,500
Semi-D / End Terrace	€11,000	€3,500
Mid Terrace	€6,139	€2,000
Apartment	€2,950	€1,500

Heat Pump

HOUSE TYPE	MEDIAN COST	FIXED GRANT
Detached	€15,600	€6,500
Semi-D / End Terrace	€15,705	€6,500
Mid Terrace	€16,500	€6,500
Apartment	€11,500	€4,500

Solar PV 2kWp up to 4kWp

HOUSE TYPE	MEDIAN COST	GRANT RANGE
Detached	€9,995	€1,600 - €2,100
Semi-D / End Terrace	€8,800	€1,600 - €2,100
Mid Terrace	€8,355	€1,600 - €2,100
Apartment	€6,898	€1,600 - €2,100

Total Solar PV grant is capped at €2,100

Cavity Insulation

HOUSE TYPE	MEDIAN COST	FIXED GRANT
Detached	€2,220	€1,700
Semi-D / End Terrace	€1,600	€1,200
Mid Terrace	€1,085	€800
Apartment	€930	€700

Roof Insulation

HOUSE TYPE	MEDIAN COST	FIXED GRANT
Detached	€2,492	€1,500
Semi-D / End Terrace	€1,874	€1,300
Mid Terrace	€1,703	€1,200
Apartment	€1,563	€800

Heating Controls

HOUSE TYPE	MEDIAN COST	FIXED GRANT
Detached	€3,456	€700
Semi-D / End Terrace	€3,635	€700
Mid Terrace	€3,600	€700
Apartment	€2,200	€700

Building Energy Rating

HOUSE TYPE	MEDIAN COST	FIXED GRANT
Detached	€260	€50
Semi-D / End Terrace	€250	€50
Mid Terrace	€250	€50
Apartment	€245	€50

Figure 3: Individual energy upgrades costs and grants, average cost per measure

1.1.1.1.1. Community Energy Grants

The Community Energy Grants (CEG) scheme is a Sustainable Authority of Ireland (SEAI) scheme to achieve national retrofitting of community and SME buildings and homes. It provides capital grants for energy efficiency projects for communities throughout the country. The criteria for participating in CEG projects are that they must be community orientated with a focus on cross-sectoral approach. This means that they involve homeowners, SMEs, and Community Buildings, and have inputs from

[18] Available at this link: https://www.seai.ie/grants/home-energy-grants/

private citizens, companies, community groups and if possible municipal and corporate bodies.

There is a mandatory requirement for all projects to support **10 homes** for applications below €1M.

According to the SEAI, successful Community Energy Grant projects 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 types of measures that are targeted through the grant program are:

- 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

The EMP has therefore collected enough information from community buildings and homeowners to potentially bring together an application with a Community Energy Grant application specialist.

Table 17: CEG 2024 Funding Levels.

Non-Residential	
Type	Funding Level
Not for profit/Charities/State Schools with Charity Status*	Up to 50%
Private sector	Up to 30%
Public Sector	Up to 30%

* subject to prior written agreement with the SEAI's communities team

There is no cap or maximum grant amount permitted to homeowners for upgrade grants. The grants have fixed values for each energy upgrade. The total value of the grant depends on the type of house and what energy upgrades are carried out. It is

estimated that to bring a standard detached home from an E to a B2 rating, it will cost approximately €45k but would qualify for a grant of €22.5k covering up to 50% of the costs.

1.4.8.2100% Support Levels.

Some homeowners qualify for 100% grant funding for retrofits. These are homeowners in receipt of certain welfare benefits:

- Fuel Allowance
- Job Seekers Allowance for over six months with a child under seven
- Working Family Payment
- One-Parent Family Payment
- Domiciliary Care Allowance
- Carers Allowance
- Disability Allowance for over six months with a child under seven

We discuss the SEAI homeowner grants for individual homeowner applicants in Appendix Section 1.11.4.1.

A list of Community Energy Grant Project co-coordinators is available here: https://www.seai.ie/grants/community-grants/project-coordinator/

1.5 Domestic Transport

There are a number of opportunities available to the residents in the SEC area to increase the sustainability of their transport use.

1.5.1 Context

The National Climate Action Plan[19] states that there will be a 42-50% reduction in emissions from the transport sector by 2030 if Ireland is to meet its Climate targets.

To achieve these reductions, a transition towards more sustainable forms of transport is required, including safe and accessible walking and cycle routes to appropriate public transport links serving the needs of the residents, and the implementation of appropriate infrastructure to support the electrification of private cars.

The Climate Action Plan aims to encourage active travel (walking and cycling), with public transport being encouraged over the private car. The SEC area has real opportunities in these areas which are discussed below.

[19] https://www.gov.ie/en/publication/6223e-climate-action-plan-2021/

As noted in Section 3.4.1 of the Baseline Energy Use Document, dealing with the transport policy of Westmeath County Council, local authority policy is in in favour of developing a network of 'direct, comfortable, convenient and safe cycle routes and footpaths, particularly in urban areas and in the vicinity of schools.' This is of particular relevance to The Downs itself.

1.5.2 More Efficient Car Use:

As with individual actions to achieve home energy efficiency, there are actions the citizen can take to reduce the impact of their private car use. These are described in Table 3.

Table 3: More Efficient Car Use

Reduce the most inefficient journeys by car where possible
Save CO2 and money by sharing journeys, particularly those to Mullingar and beyond.
Plan ahead by combining trips (shopping, school runs etc.)
For cars that do not automatically turn off when idling, switch off if you will be stopped for more than 9 seconds
An energy-aware driving style is one which accelerates and decelerates slowly and uses higher gears and lower revs, when possible. This can save 13% on fuel and emissions.
Inflate tyres correctly to manufacturers' recommendations
Avoid harsh acceleration or heavy breaking. Slowing down in good time saves fuel, smooth style around bends
Cars are parked 95% of the time, do you need a second car?
The sunroof fully open consumes up to 4% more fuel, half-open - 3%
A roof rack can increase fuel consumption by 40% and a cycle rack with two bicycles by 10% - 15%
Use air-conditioning sparingly – it increases fuel costs
Rear screen heater's increases fuel consumption by 3% - 5%, so switch it off once the window is demisted
Front windows left half open consume more fuel at higher speeds so use the air vents instead
Do not carry unnecessary weights in the boot, clean it out.
The average new car emits 120g of carbon dioxide for every kilometre. SUV's can emit a staggering 330g carbon dioxide per km.
Consider joining a transport sharing group or **start one yourself**. TFI has an introduction as to how to go about this here: https://www.transportforireland.ie/wp-content/uploads/2021/06/Carpool_Guide_2019_compressed.pdf

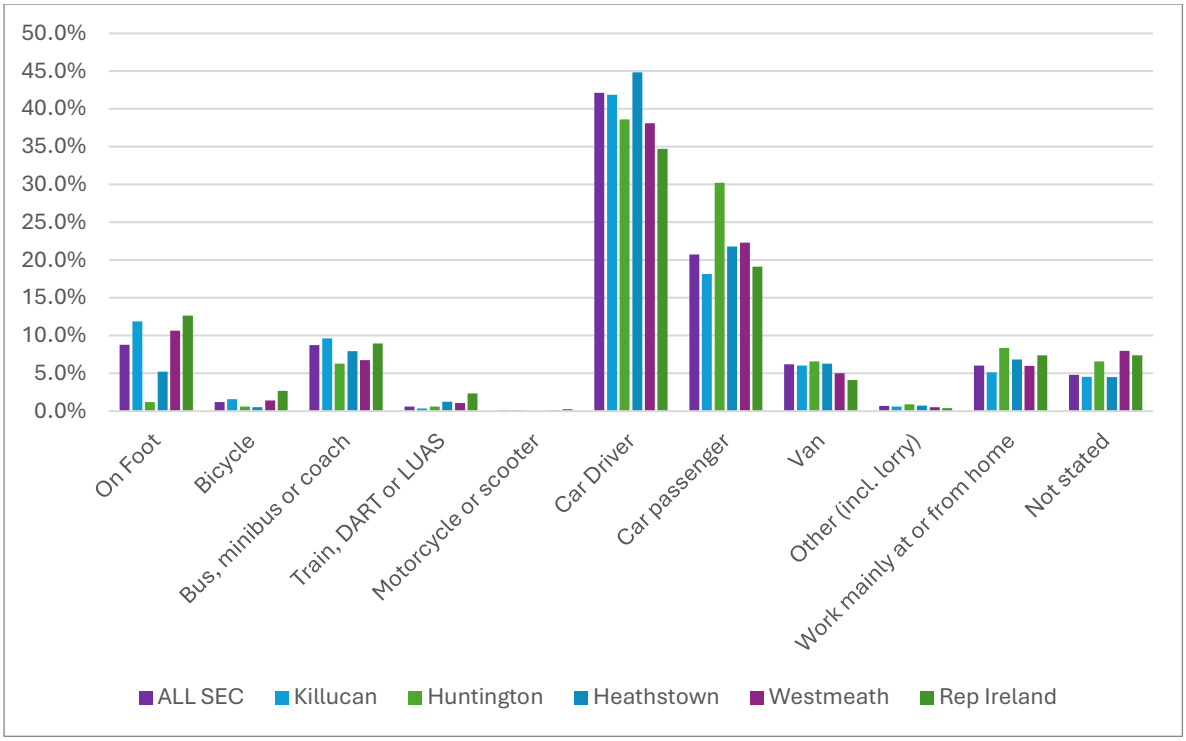


Figure 4: Means of travel to school, college or work.

The great majority of commuting is done by car in the SEC (42% as driver, 20.7% as passenger) but this is only slightly more than the same proportion as Westmeath (38% drivers, 23% passengers).

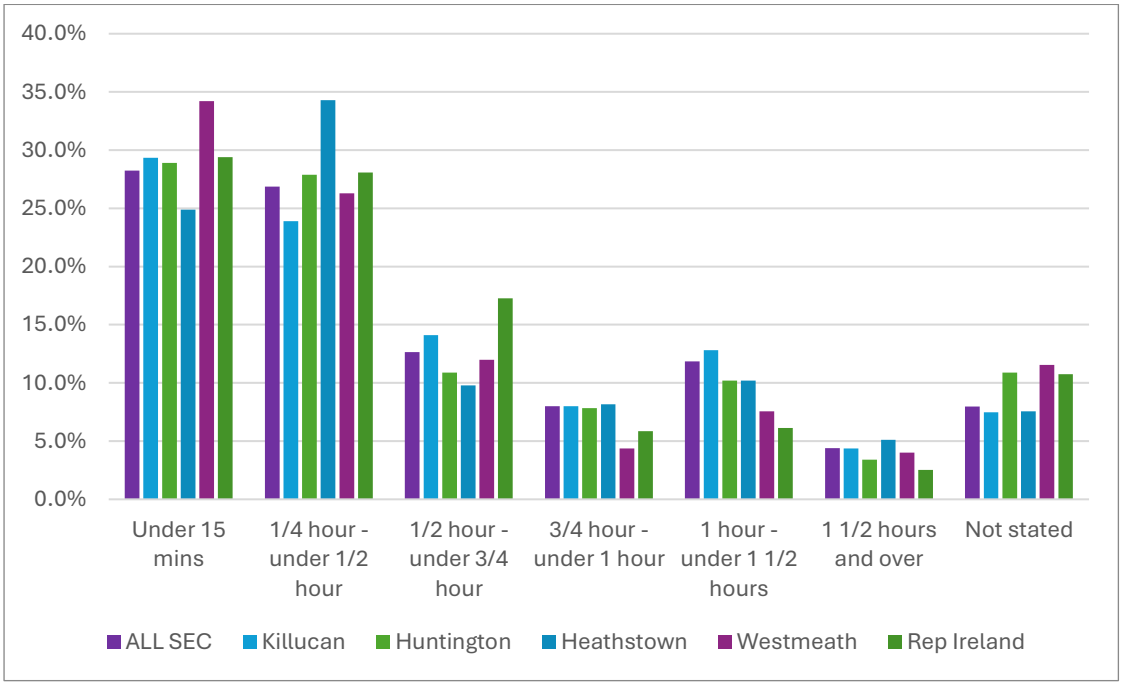


Figure 5: Commuting Time in SEC, Westmeath and Rep of Ireland

Figure 5 shows that 28% of commutes in the SEC are under 15 minutes. This is the length of time that it would typically take to drive from The Downs to Mullingar Train station at 8.30 on a weekday: a distance of 10km. We discuss currently feasible alternative active travel options for this commute in Section 1.5.4 below.

Reducing car journeys and increased cycling and walking cuts down on energy emissions. The road infrastructure in an around The Downs, makes a switch to cycling possible for those commuting to Mullingar. We suggest a community level campaign would have a positive effect on increasing bicycle use in this area of the SEC.

Providing cycling infrastructure alone does not guarantee that people to switch to cycling. Instead, infrastructure improvement and communication outreach should be combined. Mass marketing is simple and looks impressive, but it is often not very effective. Peer-to-peer and norm-defining campaigns to specific target groups tend to be much more effective. The SEC could offer a stimulus to increased active travel to that provided by the Council on an infrastructural level. We propose partnership approach which recognises the on the ground strengths and citizen expert strengths of the former and the resources, policy authority, and engineering expertise of the latter.[20]

There are a number of resources for cycling behaviour change campaigning. These are provided in the Resources Section 2.5 below.

1.5.3 Electric Vehicles

The most sustainable car is the one you already own, but one that's also kept parked in the driveway. However, cars are considered a standard necessity for modern life, especially in rural areas where services and community hubs are dispersed. In this section we identify opportunities available for drivers.

Replacement of diesel and petrol cars by Battery Electric Vehicles (EV) is a national policy aim in the medium term. The CAP targets 1,000,000 zero emission vehicles by 2030. There is even still however some slowness of car owners to buy in to this policy, particularly in the Rural Ireland. It is important to note however, that battery range has increased rapidly in the past few years.

Many drivers are not fully aware of their typical driving ranges, and they feel that a typical EV range of 300km as not enough for their social and work needs. Car use data does not agree with this, however.

[20] Although have to be quick to recognise that there is specialist engineering expertise in this very area on the SEC committee.

2019 (i.e., pre-pandemic) car journey data from the CSO[21] shows that 79% of car journeys in Ireland (excluding the Dublin area) was 15 kms and took 22.7 minutes. This is backed up by 2022 Census data: across the SEC, for 73% of commuters, the average journey time is less than 30 minutes probably within a distance of less than 30 kms and thus well within the range of an EV.

The generally occasional need for drivers to travel further than the standard 250kms range of an EV could be addressed in a variety of means – whether through car share or public transport with an EV driver using park and ride facilities at the train station in Mullingar.

It is possible for a person to track their actual travel times and distances over the course of a year using tools such as Google Timeline. We suggest that this could be promoted at transport workshops in the SEC (which is discussed in the RoO Excel) to illustrate quite how occasional a >250km car journey is for most people.

There are still state sponsored incentives for drivers wishing to switch to EVs (see Appendix Section 2.3) through the SEAI. The condition that these be new and of eligible make and model means that they start in price at €21,500, for the Dacia Spring, inclusive of the SEAI grant and VRT relief.

There were 2.3m private cars registered in Ireland in 2021. 104,932 new cars were registered in 2021. This indicates an approximate renewal of 5% of private cars per annum in Ireland. The replacement over time of 5% per annum of the ICE vehicle stock with EVs in the SEC area would have a significantly positive effect on emissions and reduced fossil fuel imports. In effect reducing vehicle emissions by 35% in 2030.

1.5.4 Active Travel (explained)

The Grand Canal Way runs which runs through The Downs, near to Coralstown and to the South of Killucan and Rathwire. This forms the basis of a safe cycleway between the

[21] CSO, 2021, Travel Behaviour Trends 2021, https://www.cso.ie/en/releasesandpublications/ep/p-ntstb/travelbehaviourtrends2021/distanceandduration/#:~:text=The%20average%20journey%20distance%20in,the%20same%20period%20in%202019.

SEC and Mullingar. The NTA's draft Westmeath Cycleway public consultation document[22] presents this opportunity.

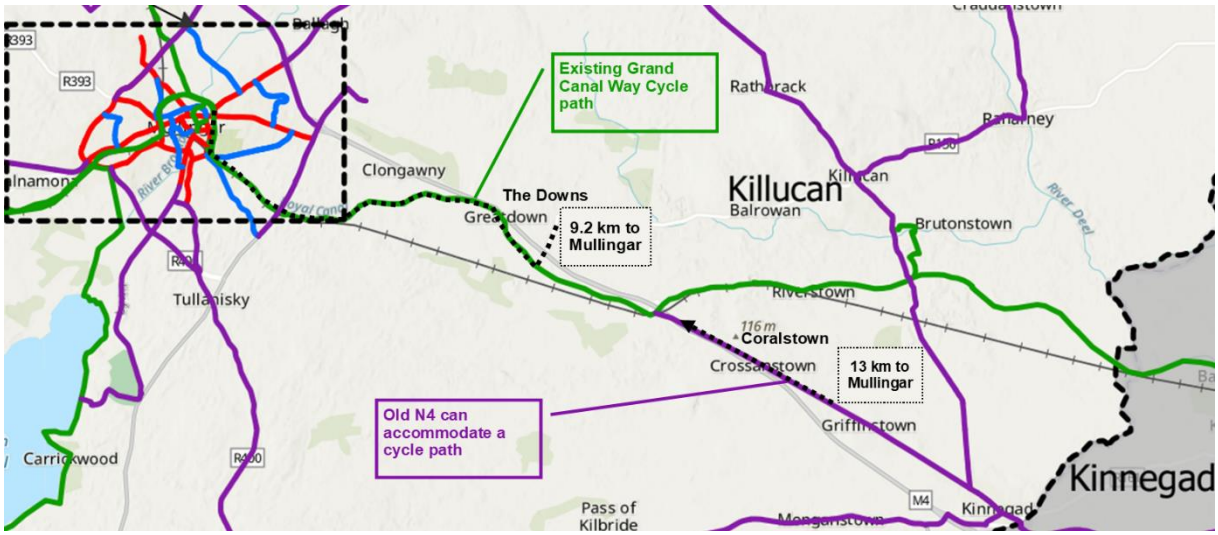


Figure 6: NTA Proposed Cycleway in SEC area

The estimated 9.2 kms distance along the Grand Canal Way that can serve as an active travel route would represent a reasonable travel distance. The cycleway is largely flat (it follows the Canal at The Downs). The average cycling speed without traffic is 20km/h. This makes the proposed cycleway a comfortable 25 mins cycle time.

Cycling to work or college in Mullingar for older students and adult commuters is eminently feasible. This can reduce the need for a second car in many families leading to considerable savings on tax, insurance, fuel and vehicle purchase costs. Health benefits of active travel are self-evident – especially in an area of low pollution such as in this SEC. From a sustainability perspective, switching from car to cycling would save on average 634 kg of CO2 emissions per annum[23]. **This is the same as offset by 54 mature conifer trees, or slightly more CO2 emissions per passenger than three return economy flights from Dublin to Stanstead London.**

Fear of wet weather is usually seen as a significant deterrent against choosing active travel. However, as a study of weather in Dublin Airport shows[24], the in the typical

[22] https://consult.nationaltransport.ie/sites/default/files/CycleConnects%20-%20Westmeath%20Cycle%20Network.pdf

[23] (254 work-days/yr minus 17days) X 20kms Commute X .160gCO2/km (https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2023 - MID UPPER) = 758kg CO2/yr. 1 conifer offsets 14kg CO2/yr. An economy passenger is responsible for 0.182 kg CO2e per km (DEFRA, Short-haul, to/from UK). Dublin-Stanstead distance = ~550km. Thus 1 return trip produces 198kg CO2. 634kgCO2/194kgCO2 = 3.2 trips

[24] https://www.dublincycling.com/cycling/how-rainy-dublin Westmeath and Dublin are climatically very similar.

commuting year, with a 1hr cycling journey, a commuter would encounter 1mm of rain only 17 times a year (6.6% of working days). We account for this in our figures above.

An active travel awareness campaign could be considered by a subcommittee of the SEC group.

1.6 Non-Domestic Sector Opportunities

As we saw in Section 5.3 of the Baseline Energy Survey of the SEC, the non-domestic sector in the SEC amounts to 42% of all energy use. This includes estimated agriculture energy use (diesel and electricity mainly). Of this, 53% of energy used in the non-domestic sector is for appliances, equipment and heating. This represents an opportunity for achieving energy efficiencies and fossil fuel reductions through adoption of renewable energy sources.

The remaining 47% of energy use in the SEC is accounted for by diesel used in transport. This represents a greater challenge for efficiencies, however, there will be opportunities for fossil fuel reductions achievable through adoption of non-fossil fuel using equipment or lower carbon intensive alternatives.

1.6.1 SME Level Efficiencies and Retrofits

There are SEAI supported programs to assist SMEs identify where they can reduce their energy demands and fossil fuel use. These are outlined in Appendix Section 2.4.

We conducted surveys of two community buildings in the SEC area. The details of these surveys have been provided to the building owners themselves, but we summarise the central findings in Table 4. In the appendices, we also include examples of an SME audit we have conducted in a similar rural SEC elsewhere as a guide for what efficiencies are possible in the commercial sector in The Downs.

Table 4: Sampled Non-Domestic Energy Savings Summary

Type	Potential Savings kWh	Cost Savings	Cost[25] of measures €	Payback (yrs)	CO2 reduction kg
Community Building the Downs 1	33,033 73% reduction	€6,403 84% reduction	€49,500	7.7	9,460 74% reduction
Community Building the Downs 2	40,440 76% reduction	€12,248 84% reduction	€155,500	12.7	12,010 83% reduction
SME (not the Downs) – retail outlet	28,437 84% reduction	€6,477 96% reduction	€35,200	5.4	9,700 92% reduction

As we can see that the payback for the energy efficiency works is less than 13 years at a maximum and **as little as 5.4 years for the SME**

There are a great many SMEs in the area that qualify for the SEAIs supports – that is they are independent businesses, or they are public bodies with a floor area less than 500m^2 and spending less than €10,000 per year on energy.

From our buildings survey we have identified that there are approximately 4 SME offices, 9 restaurants and bars, and 16 retail businesses that would qualify under the SEAI Energy audit scheme (Section 2.4. It is recommended that these building owners/managers apply for assistance in a batched process whereby energy efficiencies and sustainability measures can be identified and carried out**.** A typical energy review can achieve energy and financial savings of 20-30%.

In our surveyed buildings, the energy savings and consequent carbon emission reductions were greater than 80%

The actions recommended as opportunities are often not technically challenging, they are proven measures such as installing the right insulation, replacing oil and gas boilers with heat pumps, and installing correctly sized and sited PV panels, as well as simple, very cheap context-specific measures.

Most SMEs receive a grant for energy audits. SEAI's Support Scheme for Energy Audits (SSEA) will offer SMEs a €2,000 voucher towards the cost of a high-quality energy audit. In most cases, this will cover the total cost of the audit. The SSEA is a much more detailed review of your energy use than a domestic level audit. An SSEA runs to 40 plus

[25] This does **not** include any grants assistance that the organisation may also benefit from.

pages, involves site visits and a close look at energy bills. There is a template for the report here.

1.6.2 Typical efficiency measures

Table 5 shows an extract from an anonymised energy report from an SME that participated in another EMP we carried out[26]. It shows a summary of the measures that are typically recommended.

The SME is at its busiest during the day. By sizing the PV appropriately, and due to the size of the onsite electricity consumption, the payback for the PV was calculated as a very favourable 4.3 years, with an ROI of 471% over 25 years (that is 18% per annum). However, although this is the 'big ticket' item, even a cost-free measure such as adopting a more efficient use of onsite plant (recommendation 8) provides some valuable savings.

[26] For confidentiality reasons, we do not name the SME here.

Table 5: RoO for SME Example in the SEC

EEM #	Category	Description	Fuel Type	Delivered Energy Kilowatt-hour savings	Savings [€]	CO_2 Savings (Tonnes)	Estimated Cost [€]	Simple Payback (Years)
2	Thermal/electrical	Energy monitoring and awareness programme for all users.	Smokeless Fuel/Electricity	4,173	€737	1.49	€500	0.7
3	Thermal	Building Fabric, doors, windows	Smokeless Fuel	5,289	€684	1.5	€18,500	27.1
4	Thermal	Pipework insulation	Smokeless Fuel	4,080	€384	1.2	€1,000	2.6
Electrical Energy and Electrical Cost Saving Projects								
5	Electrical	Lighting	Electricity	510	€197	0.2	€300	1.5
6	Electrical	Lighting controls	Electricity	3,187	€1,233	1.1	€300	0.2
7	Electrical	Car Charger	Electricity			0	€1,600	
8	Electrical	More efficient use of Air Compressor	Electricity	3,520	€272	1.2	€0	Instant
Renewable Energy Generation								
9	Electrical	PV Analysis	Electricity	2,678	€1,036	1	€8,000	7.7
10	Electrical	Battery	Electricity	5,000	€1,934	2	€5,000	2.6
TOTALS				**28,437**	**€6,477**	**9.7**	**€35,200**	**5.4**

Most of the measures are low cost – with the exception of the retrofitting of the building's walls and windows. Overall cost for all works is, in the scheme of the businesses overall turnover, quite modest and the costs can be written against taxes due. The 5.4 years payback – with no grant supports – is an excellent return. Interest on loans is an allowable tax deduction. Grant supports for SMEs is discussed in the next section.

The EMP Registry of Opportunities document provided to the SEC in parallel to this report includes details of energy efficiencies, upgrades, and retrofits that can act as a model for many of the non-domestic buildings in the SEC area. It is proposed that the SEC engage with the relevant groups and stakeholders to hold information workshops that will make the potential savings of energy and carbon emissions reductions apparent.

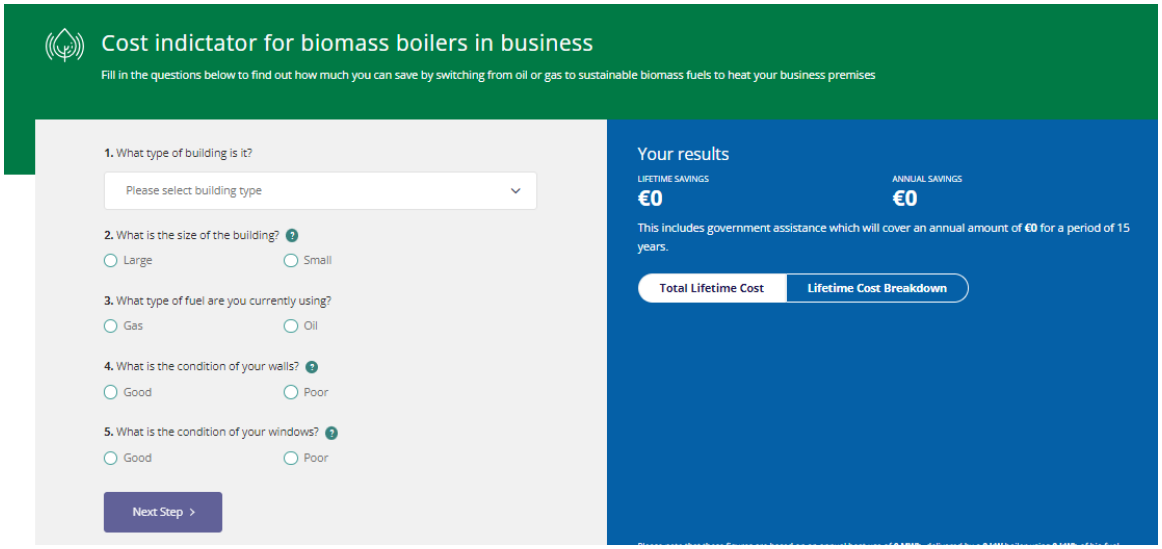
It is therefore recommended as a key opportunity that the SEC promote the SEAI's Support Scheme for Energy Audits. Targeting 15-20% of SMEs and community organisations per year would achieve very considerable economic and sustainability benefits for the SEC.

1.6.3 Biomass

Biomass, typically woodchip or wood pellets in the non-domestic context is a viable and cost-effective replacement for heating oil and LPG in most applications. Space requirements are a consideration, but the SECs distributed settlement pattern means that the approximately 1m^3 per tonne required does not resent the same issues as it might in towns or cities.

Biomass is no longer grant supported for the domestic user. It is however in the non-domestic sphere[27].

[27] https://www.seai.ie/renewable-energy/bioenergy/biomass-heating/



The SEAI has a calculator which provides indicative benefits for a biomass heating system in a non-domestic premises. All businesses in the SEC should be encouraged to run these calculations. We provide a list of contacts needed who can examine the

There are Irish-based suppliers of biomass fuel who source their fuel from sustainable sources. It is essential that biomass is sustainably sourced in order to guarantee that it is as close to carbon neutral as possible.

feasibility of non-domestic installations for SMEs and community buildings in the Appendix

1.6.4 Summary of available supports for non-domestic energy users.

This section is a brief summary of the supports available to non-domestic building owners and there are more resources in the Appendix.

1.6.4.1 Energy Efficiency Loan Scheme

This supports eligible SMEs to invest in the energy efficiency of their enterprises. Loan amounts from €10,000 to a maximum of €150,000 per borrower, over terms of 1 year up to 10 years.

1.6.4.2 Small businesses

The Energy Efficiency Grant, available through the Local Enterprise Offices, will provide funding to small businesses to invest in more energy efficient technology. It supports the investment in technologies and equipment identified in a Green for Micro Report, GreenStart Report or an SEAI Energy Audit with 50% of eligible costs up to a maximum grant of €5,000. The aim of the scheme is to reduce the impact of enterprises on the environment thereby increasing the agility and resilience of these businesses.

1.6.4.3 Non-Domestic Microgeneration Scheme

The Non-Domestic Microgen Scheme from the SEAI funding ranges from €2,700 to €162,600, to support a wide range of businesses to switch to solar electricity. The scheme provides grant supports for PV installation up to 1,000 kWp (1MWp) capacity. This scheme helps towards the installation of solar PV for business, school, community centres, or other non-profit organisations. PV technology reduces commercial electricity costs and increases security of supply, while enhancing a positive sustainability image. It should be remembered that on site PV generation is carbon neutral while grid electricity has a carbon intensity of 234gCO2/kWh. The scale of installation grant funding is for installation sizes greater than 6 kWp up to 1,000 kW.

The grant for 6kW is up to €2,400.

There are also additional grant amounts of:

- €300/kWp for each extra kW installed between 7kW -20kW
- €200/kW for each extra kW installed between 21kW- 200kW
- €150/kW for each extra kW installed between 201kW-1,000kW

1.6.4.4 EXEED Grant Scheme

The EXEED Grant Scheme - SEAI is designed for organisations who are planning an energy investment project. Grant support of up to €1,000,000 per project is available.[28]

[28] https://www.seai.ie/business-and-public-sector/business-grants-and-supports/exeed-certified-grant/?gclid=CjwKCAjw-eKpBhAbEiwAqFL0moImFi7qM5JSOw8K6NaMlMKsyw2LL8qohWZBL6ZaaWVLQk5gOlTLahoC6JQQAvD_BwE

1.6.4.5 Support Scheme for Renewable Heat

The Support Scheme for Renewable Heat - SEAI is open to commercial, industrial, agricultural, district heating, public sector, and other non-domestic heat users. The scheme offers 30% of installation costs of selected renewable technologies.

1.6.4.6 Community Grant

The Grants for Sustainable Community Projects - SEAI support energy efficiency community projects through capital funding, partnerships, and technical support. The scheme empowers Businesses, Public Sector Organisations, Communities, Housing Associations and Local Authorities to lead deep energy efficient upgrades on the buildings.

1.6.4.7 Accelerated Capital Allowance

The Accelerated Capital Allowance - SEAI is a tax incentive encouraging investment in energy saving technology. Companies and sole traders that operate and pay corporation tax in Ireland can avail of the scheme. Technologies and products supported by ACA need to be on the SEAI's Triple E Products Register.

1.6.4.8 Electric Vehicle Grants (SEAI) – co-funding

The Electric Vehicle Grants - SEAI provides grant supports towards the purchase of new electric vehicles for business and public entities. The co-funded vehicles are typically small goods carrying vans with a technically permissible maximum mass not exceeding 3500kg. A maximum grant of €3,500 is available for qualifying EVs.

1.6.4.9 Energy Contracting Support Scheme

The Energy Contracting Support Scheme - SEAI provides financial assistance to implement energy efficiency and decarbonisation projects. The Scheme aims to support the direct external consultancy and/or specialist advisory costs related to project appraisal and procurement of pay-for-performance energy contracts.

1.6.5 Retrofit Case Study Campaign

The SEC is in a rural area with a strong sense of community. There are excellent peer-to-peer information sharing opportunities available for the SME owners in The Downs. Energy audit findings and the opportunities for upgrades can be shared between

businesses and community organisations. We propose that each of the buildings audited in this EMP to carry out the measures recommended in a staged process. This would provide an opportunity to provide case studies to other businesses and community organisations in the SEC to recruit additional participants in efficiency programmes. Westmeath County Council, the Mullingar Chamber of Commerce, could also assist the SEC committee in this work.

1.6.6 Impacts of Measures

Our survey of premises in the SEC is a detailed examination of a small fraction of businesses and community buildings within the SEC as a whole. We can look to the generality of the SEAI's experience of helping business to reduce energy use. Based on the SEAI's tracking of business owners' experiences, the average SME could reduce its energy bill by as much as 30% by implementing energy efficiency measures. Typically, 10% saving can be achieved with little or no capital cost[29]. However, we have found that most businesses can benefit much more than this. We therefore make estimates for improvements from 'business as usual' moderate efficiency and better efficiency. This is a reasonable approach we feel as we have already resented B3 level efficiencies with PV in the domestic sector.

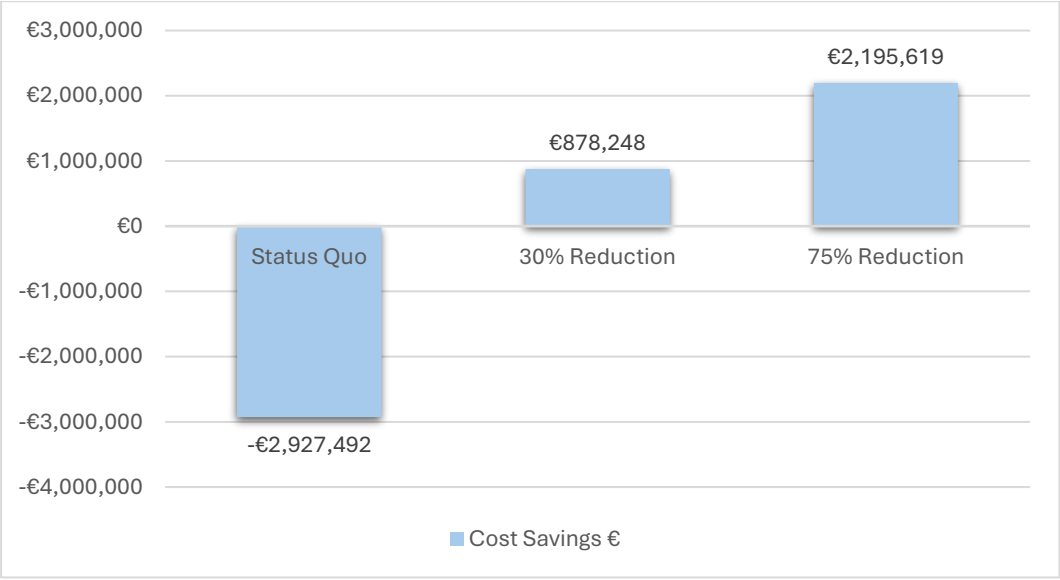


Figure 7: Savings to Non-Domestic Sector by 2 levels of efficiency actions in Euro

Therefore, if qualifying SMEs in the SEC were recruited to participate in the relevant energy reduction program, we can estimate that it would save up to between 4,684 and

[29] https://www.seai.ie/business-and-public-sector/small-and-medium-business/why-invest-in-energy-effi/

11,710 MWh energy (mainly oil and electricity), saving local businesses in the SEC between €878,248 and €2,195,619 per year and avoiding between 1,051 and 2,629 tCO2 emissions.

1.7 Non-Domestic Transport Opportunities

Transport fuel accounts for a large proportion of the non-domestic sector in general at 49%. This can be explained by the fact that Agriculture and transport have significant diesel demand, and both these are vital elements of the commercial life of the SEC. There is no heavy industry in the SEC area itself, and limited manufacturing.

1.7.1 Small PSVs

As discussed above, these represent a very small proportion of the non-domestic carbon emissions (3.3 % of all non-domestic transport related carbon emissions – 107 tCO2). However, they are very amenable to replacement with existing technologies (EVs) and their decarbonisation would play a useful norm-establishing role in the community through their visibility. The cost of an EV is higher than that of a diesel hybrid.[30] The pattern of nighttime driving and daytime charging that is typical of taxi use would mean that while the hybrid driver is achieving a €7.68 cost per 100km and the EV driver is achieving €6.03, the difference of €1.65 would not achieve a realistic payback on its own. There is however a grant scheme that assists small PSV drivers to switch from ICE to EV[31].

1.7.1.1 Electric Small Public Service Vehicle Grant Scheme 2023: eSPSV23

In essence this can provide €20,000 in grant funding for a new EV taxi (second hand EVs are granted less) for qualifying drivers. Drivers should be existing SPSV licence holders; and owners of an SPSV registered for at least the previous three years, and with older vehicles (within three years of the maximum permissible age as originally) or vehicles with a mileage of 300,000 km or greater.

This would mean that, even on peak rate electricity charges, an EV taxi could save its owner an estimated €12,695 over ten years.

[30] A Toyota Corolla Luna Sport hybrid costs (at time of writing) €35,000 while a Toyota BZ4X costs €50,000. It would not be feasible to make up the difference of €14,000 on fuel cost alone, bearing in mind that an EV taxi would recharge during daytime at peak electricity cost.
[31] Full details https://www.nationaltransport.ie/wp-content/uploads/2023/03/eSPSV23-Grant-Scheme-Information-Guide.pdf

Figure 8: Toyota bZ4X

Figure 9: Toyota Corolla Hybrid

The environmental benefit would be considerable, reducing emissions by 4,491 kg CO2/yr (44,910 over a 10-year lifespan). The equivalent of the CO2 uptake of 320 mature trees in a year.

It is important to note that the grant scheme relates to replacement of older and more used vehicles. We can presume that these will be replaced in any event: the contrast is between replacing with ICE or EV.

Over the whole SEC area, the switch amongst PSVs to EVs would save the PSV sector €76,000 over ten years while saving 87 tCO2 yearly: the same as offset by 6,214 mature trees per year.

1.7.2 Tractors and machinery

These were seen to contribute 29% to the non-domestic transport energy use and emissions. Reduction in these emissions would contribute to sustainability. This is an area where it is almost impossible to achieve significant energy efficiencies. There are also technical barriers to switching from ICE to EV (or FCEV) in the short term – there are few market-ready EV tractor or construction machinery examples. However, it may be possible to realise emission reductions opportunities from the adoption of HVO. The caveats previously made around the true sustainability of the feedstocks of HVO remain. And it should be borne in mind that the claims of 95% reduction in CO2 over diesel are based largely on the idea that the feedstock sequesters carbon as it grows. Thus, it is a 'low carbon lifecycle' fuel rather than a low carbon fuel. However, it should be possible to establish a supply-chain certification system even in the short term where HVO fuels of European origin from ethically and sustainably managed sources can be guaranteed. This action should be used effectively as a first step: a way to get commercial and agricultural diesel users to consider looking to alternatives.

Technically a switch from diesel to HVO is achievable today. There is a large HVO supplier in the SEC at Flynn's Fuels. There is an economic cost in that HVO is more expensive by approximately 10% than diesel, but construction companies or farmers may be willing to

absorb this in the interests of increased sustainability and bearing in mind that fuel costs represent a pre-tax business or farm expense.

The difference between the costs of the two fuels is more a matter of policy than reality. Diesel as a fossil fuel product is heavily subsidised where it is produced. It is heavily taxed in Ireland where it is distributed. Both subsidy and tax levels are political judgements. It may be that the level of taxation in Ireland for fossil fuels in the future is raised to account for the cost of the established unsustainability of its use.

The **transition to HVO should be seen as a stop-gap measure however** in advance of a move towards electrification: either directly with battery operated vehicles (though these may be ultimately found to be impracticable) or indirectly through fuel cell electric systems (that use hydrogen as their energy storage). HVO produces carbon at the exhaust: it's relatively lesser emissions over diesel are based on the fact that the feedstock (for example rapeseed oil) takes up carbon as it grows. We discuss HVO is greater detail below in Appendix Section 2.6.4, but state here that or view is that **HVO is not feasibly a long term or widely adoptable replacement for Ireland's diesel use**.

1.7.3 Smaller Goods Vehicles (< 5 tonnes)

These accounted for 69% of all non-domestic road vehicles. These contributed 48.3% of non-domestic transport emissions however, while goods vehicles (GVs) over 5 tonnes (7.2% of non-domestic vehicles in number) contributed 19.2%. This is because the smaller number of > 5t trucks travel longer distances and use more fuel per km than smaller goods vehicles.

GVs less than 5 tonnes are in effect large vans. There are numerous EVs on the market that can meet the requirements of this transport segment up to transit type vans. There is a very good independent guide to EV vans costs available in Ireland here.

The price per km for an electric van will be better than was stated for an electric PSV in Section 1.7.1 above, as the owner will be more easily able to avail of night rate electrical tariffs. This could provide the electric van owner with a cost of €3.36 per 100km[32]. For comparison, a Ford transit requires 7.2L/100km which would cost €11.38/100km[33].

The SEAI have a useful guide (Switching to Electric Vehicles A Guide for Businesses) here. Transitioning the small goods vehicles fleet to electric vehicles has clear economic as well as sustainability logic and this are a medium-term opportunity that the SEC could disseminate to the local businesses.

[32] 16.kWh per 100km @ €0.21/kWh night rate.
[33] Assuming diesel price of €1.58/L

1.7.4 Large Goods vehicles > 5 tonnes

The power demand of these vehicles, were they to be battery powered, would require a significant reconfiguration of our electrical grid. There is therefore much attention being given in this sector to FCEV for large trucks typically travelling long distances (as there is for trains and inter-city buses). This is an area that is being investigated by a large research project in Galway City (Sh2amrock[34]). The renewable gas used in the project (H2) will be produced in Mountlucas Bord na Móna windfarm (20km from the SEC). We suggest that the SEC follow developments in this project and inform the local transport companies of all developments and upcoming opportunities.

HVO has proven its feasibility in this sector. Circle K fuels its delivery trucks with HVO, and other large transport operators have signalled their willingness to switch to this more sustainable fuel. There is a supplier of HVO in the SEC. The caveats in relation to national scale HVO use are discussed above in Section 1.7.2 and Section 2.6.4.

1.7.5 Agriculture

There are 98 farms in the SEC area. Of these the majority raise cattle. There were 5,000 cattle recorded by the CSO in their 2020 Survey of Agriculture.[35] It does not however distinguish between Dairy and other cattle for confidentiality reasons. We assume a 50-50 split between cattle types for the SEC, based on our observations of farming on the area.

1.7.5.1 Dairy Farm Opportunities

The average cost of energy for milk production is €5 per 1,000 Liters of milk. However, this cost can vary significantly between farms, ranging from €2.60 to €8.70 per 1,000 Liters. For a 100-cow farm, this translates to energy costs between €1,500 and €4,500. In the SEC the estimated 2,500 dairy cattle would have average energy costs of €750,000 per year.

The primary factors affecting energy consumption on dairy farms are cooling the milk, operating the milking machine, and heating water. These three activities account for approximately 74% of total energy usage. These are also very commonly powered by electricity.

[34] The authors of this EMP are involved as partners in Sh2amrock
[35] https://www.cso.ie/en/methods/tn/censusofagriculture/

According to Teagasc[36], by implementing management changes and investing in energy-efficient technology, an average dairy farm can potentially save €1,800 per year.

In an analysis of 22 energy audits carried out on Irish Dairy farms, Teagasc recommends efficiency and renewable energy generation actions that can reduce fossil fuel and grid energy consumption. These included:

Table 6: Energy Saving Investments on Irish Dairy Farms Costs and Payback

Action	Cost of action	Annual saving	Simple payback
Move to cheapest supplier	None	€500	Immediate
Milk pre-cooling (installing a plate cooler)	€3,200	€1,000	Three years
Install night rate electricity	None	€1,000	Immediate
Synchronise water heater with night rate	€50	€170	<1 year
Variable speed drive (VSD) on the vacuum pumps	€3,300	€460	7 years
Solar thermal heating	€4,000	€350	>10 years
Heat recovery system (in addition to pre-cooling)	€3,500	€500	7 years

Source: Upton J, and Cashin, B, 'DAIRY FARM ENERGY, Fact Sheet 05', 2020, Teagasc.

The costs and paybacks in the report pre-date the introduction of the Micro-generation Support Scheme, and so we have omitted their estimate here. The payback period for a typical 20 kW PV system on a farm with MSS **should be 4-5 years.**

There is an excellent case study available[37] of the viability of ground mounted PV on a dairy farm in David Foran's farm in Waterford: a 27kW bifacial PV fence on a 250ha dairy farm. This achieved a reported payback of just 4 years (78% of the energy produced was consumed on farm) for a system that should last 25 years (excluding inverter).

It is essential that the sizing and cost of the PV system is investigated thoroughly as the authors have encountered a wide range of costs by installers. Identifying a reliable and reasonably priced PV installation company could be taken on as an action by the SEC itself. This would benefit farms, businesses and homeowners alike.

1.7.5.2 Non-Dairy Farms: PV opportunity

These also have an energy requirement. Over-wintering and lambing sheds have an energy demand for heating and lighting. These farms will also benefit from many of the efficiency measures discussed above. Likewise farm buildings provide rooftop

[36] https://www.teagasc.ie/rural-economy/rural-development/diversification/dairy-farm-energy/

[37] Link to unaffiliated installer contractor case study report: https://sunstreamenergy.ie/portfolio/dairy-farm-foran/ **ECI and SEAI do not endorse third party products or services**

opportunities for PV installations which once the minimum of 20% onsite use threshold is met could provide electricity to the distribution grid which will improve important sources of locally produced revenue and carbon reduction. PV electricity is carbon free while current grid electricity is not.

There are a variety of grants and supports available to famers (e.g. TAMS) which make the payback period for systems very a attractive 4-6 years. On an investment that will last 25 years, the Return on Investment will be above 6% per annum, This represents a significant investment opportunity.

Figure 10: Waterford Dairy Farmer PV installation by Sunstream[38]

[38] https://sunstreamenergy.ie/portfolio/dairy-farm-foran/

1.8 SEC level Opportunities

In this section we discuss the opportunities for carbon emission reduction across the entire SEC in both the domestic and non-domestic sector.

1.8.1 Efficiencies and fossil fuel avoidance

As we have shown there will be considerable savings achievable from domestic retrofits, renewable transport initiatives, active travel, and non-domestic opportunities. These savings will be both financial as well as in CO2 reductions.

1.8.2 Generation

There are, on first view, opportunities for large-scale energy generation in the SEC area. This is due to the distributed settlement patterns in much of the SEC. There is an availability of the kind of land that is required accommodate large grid-scale energy generation.

However, there are considerable environmental, planning, local policy and public acceptance issues that would need to be addressed in pursuing this opportunity.

1.8.2.1 Wind

In terms of wind generation, we would note that the County Development Plan 2021-2027 designates almost all of Westmeath as having low wind generation capacity (the excepted area is deemed as having none). We do not think that wind generation above the on-farm type with a rating of <50kw (~35m mast height[39]) represents an opportunity for the SEC. On-farm wind generation is sized to meet farm needs and is very site specific. It is not a community scale opportunity.

1.8.2.2 Photovoltaic

Over the past 10 years there has been an increase in the efficiency of new PV panels and a reduction in costs per unit owing to greatly increased volumes of production worldwide resulting in an overall reduction in cost per MWh produced.

3-5MW Scale Discussion

There is a proposal for a community owned 5MW PV farm in nearby Marlinstown which borders the SEC. This project would be owned and managed by Mullingar Energy Co-Operative. We understand that there are issues arising for the project in relation to grid access costs which are being worked through. We would suggest that The Downs SEC

[39] An example of such a turbine is shown here: http://www.nationwide-energy.co.uk/downloads/Endurance%2050kw%20turbine%20(25m%20tower).pdf

keep in close contact with the project including encouraging cross membership in the co-operative.

In general, 5 MW PV sites require approximately 10 hectares of contiguous land in a relatively low-lying flat location (incline <5 degrees) with an unobstructed South facing aspect, sheltered from the prevailing elements and sea with a good solar resource. A proximity of less than 2km to 38kV substation with open capacity is advantageous.

Community scale PV would be possible in certain areas of the SEC[40] but would require positive community acceptance and even a partnership status within the development to overcome county policy and public acceptance issues.

The economics of a community scale PV system in the SEC are **good should grid upgrade costs be met**.

Solar resource for the area is moderate. Figure 11 shows modelled output from a 5MW PV installation in the SEC area over 12 months.[41]

[40] We do not discuss suitable sites in this report and confine ourselves to technical and economic feasibility only.
[41] Using Photovoltaic Geographical Information System: https://re.jrc.ec.europa.eu/pvg_tools/en/tools.html

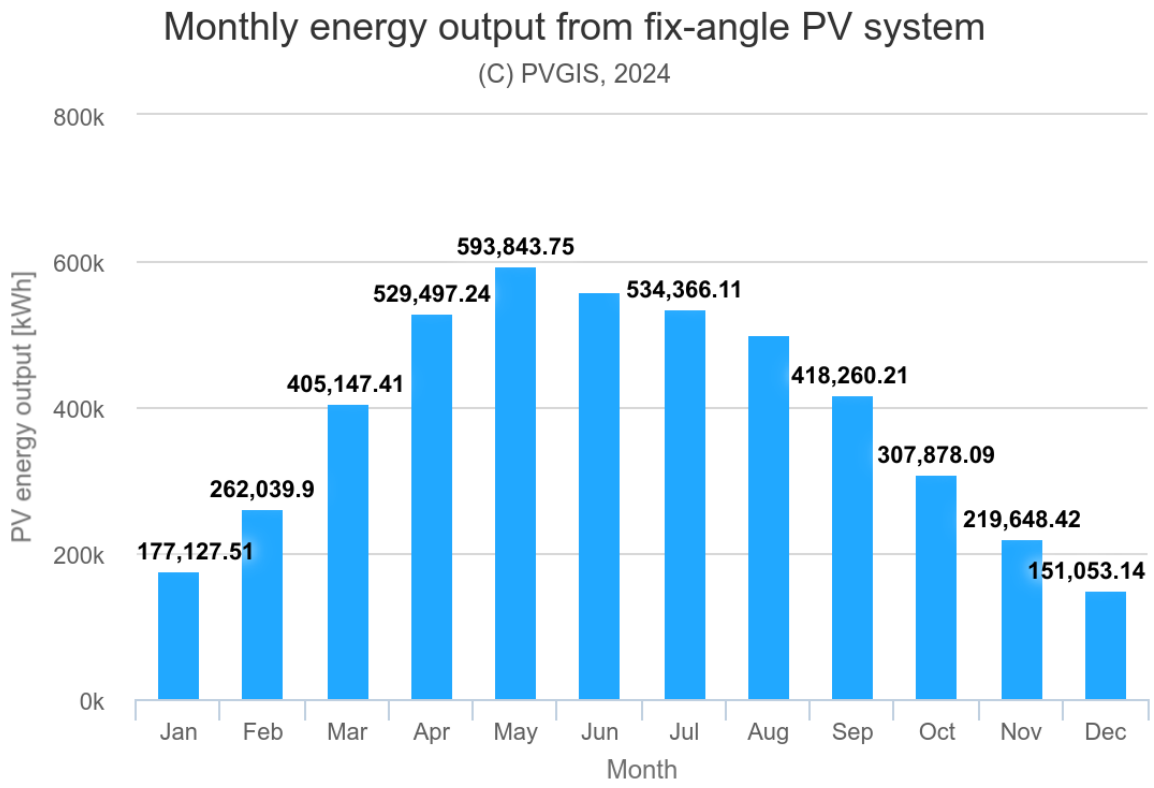


Figure 11: Output from 3MW PV installation in SEC area

The total production would be 4,656 MWh of green electricity. This would have the effect of removing 1,131 tCO2 from the SEC's energy system[42].

At a realistic projected capital cost of €6.5m and including a range of OPEX costs for the 25-year lifespan of the project, the LCOE would be €92 MWh making it an economically viable project. If a community initiative, however, the project would qualify for support from the upcoming Small-Scale Renewable Energy Generation Scheme[43] (SSGS). This would guarantee an export price of €140/MWh.

The SEAI has produced a very helpful guide explaining how to carry through Community Energy PV projects to fruition which is available at this LINK. However, we do not recommend that this opportunity be pursued by the SEC.

Mullingar Energy Co-operative already have a PV project in the pipeline and are being supported by the SEAI expert mentor programme. Capacity on the grid at present is limited to 4.7MW at the 38kV substation at Ballinderry which would serve a project in

[42] Taking into account the replacement of mix fuel source grid electricity with 'green' electricity
[43] Department of the Environment, Climate and Communications, 2022, *Consultation on a Small-Scale Generation Support Scheme (SSG) in Ireland* https://www.gov.ie/en/consultation/353f2-consultation-on-a-small-scale-generation-support-scheme-ssg-in-ireland/

Marlinstown which is adjacent to the SEC. This capacity would likely not be available for a project in The Downs.

Meitheal Approach to PV

Owing to grid capacity issues, we propose a more distributed approach to PV roll-out in The Downs, Coralstown and Killucan which would be better suited to the SECs specific context. We also would recommend the SEC reaching out to Mullingar Energy Co-operative with a view to supporting the Marlinstown project.

Currently, the Irish grid electricity generates 0.255[44] kg of CO2 per kWh, which is similar to that of home heating oil (0.257 kg) but more than natural gas (0.204 kg) used for home heating.

Advancements in solar panel (photovoltaic or PV) technology, government policies, and economic factors have created opportunities for communities like the Downs SEC to generate renewable electricity locally. The existing buildings within the SEC are well-suited for installing small-scale PV systems on homes and businesses due to their generally larger roof spaces compared to the national average, and favourable ownership patterns. However, the feasibility of these PV deployments will depend on the energy consumption of the buildings.

While small-scale PV systems offer a good return on investment (ROI) over time, the initial cost can be a barrier. This could limit participation to wealthier members of the community. The committee that commissioned this report emphasizes the need to explore options that make home and building improvements (retrofits) and small-scale renewable energy generation accessible to everyone whenever possible.

A successful model from County Clare, a community similar to The Downs SEC, is called "Solar Meitheal." This approach involves neighbours grouping together on a PV project where they hire one contractor to install PV across 10-15 homes. This reduces the costs of the work. Details about this model can be found at the provided link: **Solar Meitheal**.

We recommend that the SEC recruit householders in tranches of 10-15 to participate in Solar Meitheal projects to leverage economic advantages of batch installations while also assisting those in fuel poverty in a just transition approach.

[44] https://www.seai.ie/data-and-insights/seai-statistics/conversion-factors The EMP BEU used a benchmark of 332g CO2/kWh.

1.9 Sustainability Effects of Efficiency Opportunities

The opportunities we identified will have considerable benefits to residents and businesses in the SEC area reducing fossil fuel energy consumption and avoiding CO2 emissions. A full implementation of the opportunities discussed above will reduce energy use by 23,014MWh per year or 34%, and carbon emissions by 7,533 tCO2 per year (a 36% reduction). The SEC will also benefit from estimated cost savings of €3,712,039 per year.

Table 7: Estimated Energy Carbon Emissions and Cost Savings from RoO Efficiencies and FF replacements

	Current MWh/yr	Post Action MWh/yr	Current tCO2/yr	Post Action CO2/yr	Current Cost €/yr	Post Action Cost €/yr
Domestic Retrofits	19,243	11,929	7,044	5,216	€2,345,069	€1,736,345
Domestic Switch to EV	9,149	6,404	2,965	2,076	€1,951,777	€1,273,770
Non-Domestic Retrofits	15,613	10,929	3,505	2,454	€2,927,492	€2,049,245
All PSV to EV	464	71	107	17	€84,436	€21,943
<5T GV to EV	6,879	905	1,590	212	€1,109,679	€280,438
Tractors & Machinery to HVO	4,161	4,161	962	192	€671,313	€749,829
>5T GV/HGVs	2,742	2,742	634	127	€438,223	€494,095
772 Domestic PV Installations ~3kW each	8,934	7,772	2,966	2,195	€2,680,346	€2,076,002
Non-Domestic PV	4,690	3,949	1,557	1,311	€1,172,558	€987,188
Total SEC	71,876	48,862	21,331	13,798	€13,380,893	€9,668,854

Figure 12 below clearly shows the areas where the greatest energy savings can be achieved: namely in Domestic and Non-Domestic building retrofits, a switch of 30% of domestic transport to EVs, the switch of PSVs Goods Vehicles from diesel and to EVs, and the switch of Tractors and machinery to HVO, and the installation of a distributed PV system across homes, community buildings, farms and businesses.

These actions are nearly all areas well supported by SEAI and other grants, they make use of mature technologies, and they do not rely on grid upgrades and planning applications.

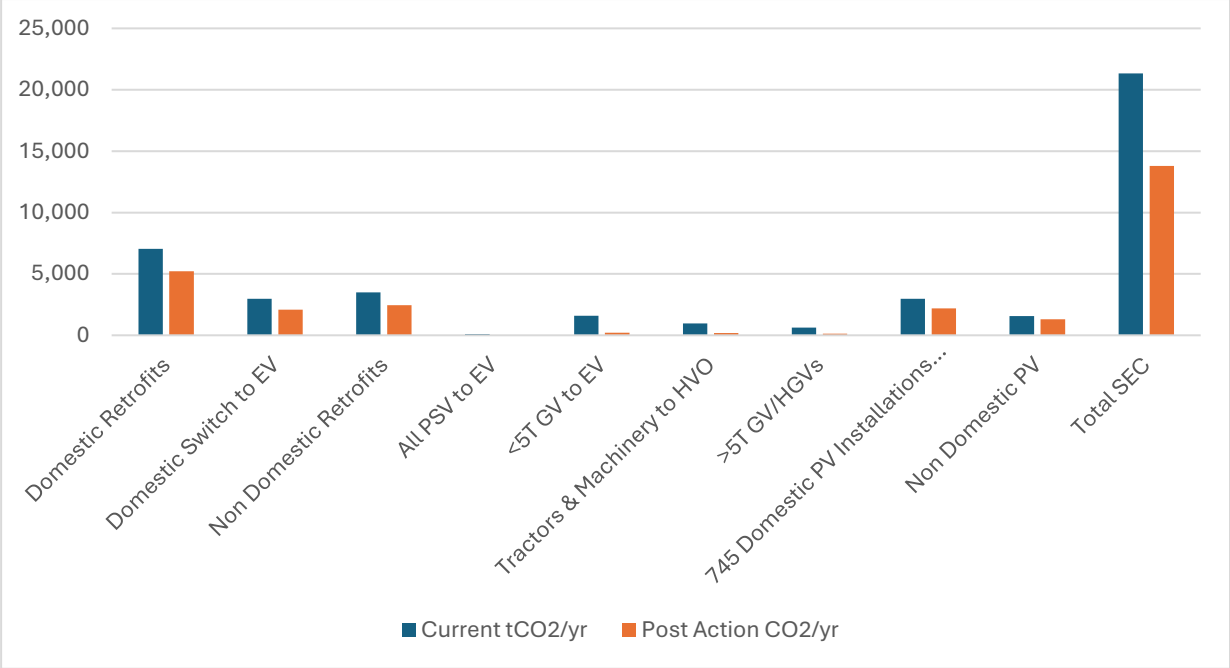


Figure 12: Pre and Post-RoO Carbon Emissions for the SEC from Efficiency and technology switches.

We also recommend a distributed PV generation installation roll-out across the built environment of the SEC. This approach would not incur significant grid upgrades which are costly, disruptive and subject to licences.

Based on our survey of the built environment, between homes, farms, SMEs and community buildings, we have identified an achievable target of 2,975 kW of local energy generation capacity on roofs in the SEC. These installations would not require planning permission or grid upgrade works. They would be supported by an array of grant schemes which would assist with capital costs. The payback period across the projects would average 5-7years.

1.10 Holistic Effects of Co-ordinated Strategy

In this section we bring together the energy conservation and generation measures to show the potential positive impact of carrying through the Energy Master Plan on a holistic level.

1.10.1 Strategy Outline

	Emissions Reductions Each Year in tCo2/yr								
Priority	**Action**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**TOT/yr**
1.1	Retrofit 15% of G-C3 homes each year to B3	274	274	274	274	274	274	183	1829
1.2	15% ND Buildings upgraded each year achieving 30% energy reduction overall	158	158	158	158	158	158	105	1052
1.3	Information campaign to encourage GV owners to switch to EV Vans	207	207	207	207	207	207	138	1378
1.4	Information campaign to encourage PSV owners to switch to EVs	23	23	23	23				91
1.5	5% replacement of FF ICE domestic cars with EVs annually	133	133	133	133	133	133	89	890
1.6	Campaign for Tractors, Machinery and HGVs in SEC to switch to HVO		319	319	319	319			1276
2.1	50 homes with 3kWp installations with 116 additional homes recruited each year until a target of 745	52	120	120	120	120	120	120	773
2.2	Farms, Businesses and Community organisations to install micro-auto consumption PV at power levels (kW) according to onsite demand	62	62	62	62				246
	Total Emissions Reduction tCO2	**908**	**1,296**	**1,296**	**1,296**	**1,211**	**892**	**635**	**7,534**

Table 8: RoO Strategy Outline: Priority and Projected Reduction in CO2

The effect of these measures, taken in consort will achieve the ambitions stated by the SEC in their scoping document for this EMP. Figure 13 shows how the actions would achieve a 39% reduction in SEC energy related emissions with a consequent reduction in energy use.

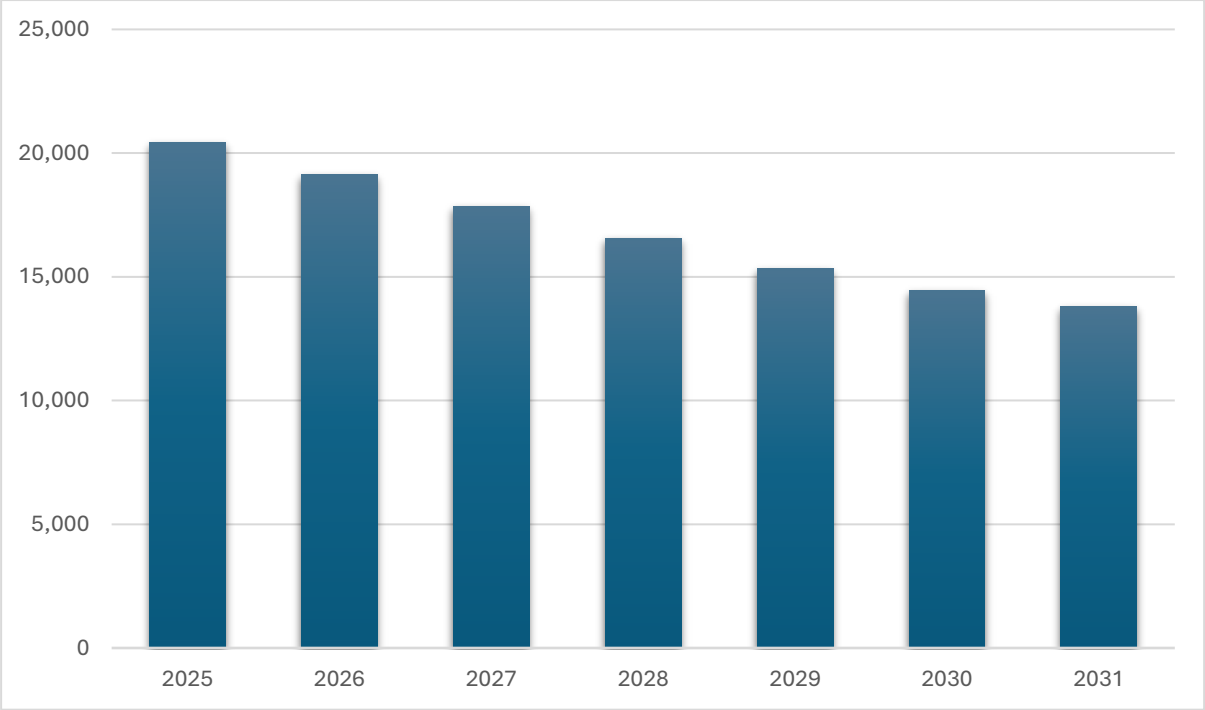


Figure 13: Reductions in Emissions Achieved through EMP Strategy

Financial Savings from Actions are equally significant. Residents and businesses in the SEC will achieve considerable financial benefits to match the sustainability gains that are possible from the actions outlined in this EMP. As we saw in Section 1.4.3 an E2-rated home could save as much as 90% on its energy bills if upgraded to BER B1.

1.11 Next Steps

This report aims at having real world benefits for community sustainability. We provide here an outline of the steps the SEC members can take with the support of the SEAI mentor.

1.11.1 EMP: Spread the Word

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. We suggest that the SEC host workshop events for each of the community subgroups that are targeted by the sustainability actions outlined in this EMP. These would be:

- Homeowners – in particular the fuel poor in relation to home upgrades
- Community Facilities/School Managers in relation to participation in CEG applications as well as facilitating outreach to residents.
- SMEs in relation to energy efficiency projects
- Local business groups, Chambers of Commerce particularly PSV and GV driver groups
- Local Community Groups (Sports, Educational, Cultural, and Religious)
- Local Media – print, radio and social media.

These workshops will enable the SEC to recruit participants in the EMP actions. It is vital that these workshops are pitched appropriately – the needs of each group are very different, even if there are commonalities between all members of the community.

1.11.2 Build Capacities

Building expertise and capacities within the group is critical to achieve the success of the SEC. Already there has been a continuous process of ‘learning, planning and doing’, through the SEC program.

Increasing the membership of the group, delegating responsibilities to achieve different elements of the Master Plan will have the twin benefits of reducing overload on the individuals as well bringing in fresh perspectives.

We recommend a resources analysis exercise which will help build connections with other stakeholders as well as deepening the reservoir of talent and person-power that is available to the SEC to achieve the ambitious program outlined in the EMP.

This report recommends the SEC promote domestic PV installations. We are aware of a successful community led initiative that could offer a strong practice and business model that The Downs SEC could follow. We have facilitated a communication between TDSEC and this group which will help provide the necessary guidance and capacity to assist the TDSEC in achieving this opportunity.

1.11.3 Low Lying Fruit First

The SEC is encouraged to develop low-effort, low-cost efficiency projects first. This will help to increase 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.

We would be confident that, with the support of Westmeath County Council, the SEC would be in a position to commence a Community Energy Grant Scheme for 2025: this will build capacity and demonstrate the value of the collective approach to sustainability. It will also develop the skill sets within the group. There are CEG specialists who have wide experience in managing successful projects. However, the SEC should remain engaged with every step of a CEG to maximize learnings as well as ensuring widest possible community benefit.

1.11.4 Continue the Journey with the SEAI

The SEC program has resources in addition to the county level SEC mentoring. The engagement of specialist mentors is possible, as is the Community Enabling Framework program (more information available here)

The SEC can also benefit from the SEAI's funding streams for energy efficiency projects within your community. These are constantly evolving, and the SEC should continue to engage with SEAI mentors to learn what funding and supports are available.

2. Appendix

2.1. Individual Level Behaviour Changes for homeowners

These are some quick and easy sustainability 'wins' the homeowner can achieve while they are planning long term solutions to their reliance on imported fossil fuels.

Step 1: Do Your Own Audit:

- Check windows, external doors, vents, interstitial floor spaces, fireplaces, and stoves with a stick of incense: and track down and eliminate draughts.
- Check insulation levels in attic, basement, walls (including the meter box), and interstitial floor spaces.
- Check your boiler and stove; what age are they? When were they last serviced?
- Collect energy bills and scrutinise your energy use pattern for a year or 2.
- To save money in the short term see if you need to change your electricity supplier. You probably do.
- Switch to a renewable energy tarrif

Step 2: Actions to save 36% of your energy costs and fossil fuel use:

- Turn everything off – don't leave things on standby (2%)
- Use a clothes line when possible – tumble dryers are very energy heavy (7%)
- Wash clothes @ 30 degrees (1%)
- Turn off lights when not in a room, replace bulbs with CFLs at least, or with LEDs if possible (2%).
- Use oil to heat water – not the electric immersion or electric power shower (24%)

Step 3: Save energy by thinking about the way you control and use heat

Close the curtains at dusk to keep heat in the room that would otherwise be lost through the cold windows, and you could save up to 10% of your heating costs.

- Consider fitting shelves above radiators as they redirect the warm air that rises from them back into the room.
- Ventilate your house 3 to 5 minutes, a couple of times a day, instead of opening windows a little bit all day. Shut off your heating, during ventilation. This can reduce heat loss by 16%.
- Maintain room temperature 19^{0}C (this can save up to €350 every year for each degree lower you heat the house)
- Bleed your radiators regularly. If there is air in your radiator your boiler burns longer. Always start with the lowest and end with the highest radiator.

2.2. Supports for homeowners.

1.11.4.1 SEAI Supports for Individual Homeowner Applicants

There are three categories of applicants to the SEAI Home Energy Grant Scheme[45] of which this is a brief summary. These are:

Individual Energy Upgrade Grants	**One Stop Shop Service**	**Fully Funded Energy Upgrade**
Up to 80% of the cost of the upgrade for a typical family home with SEAI grants *Homeowners manage their upgrades including:* • contractor selection • grant application • contractor works • pay for full cost of works and claim grants afterwards • follow up BER *For homes built and occupied before:* • 2011 for insulation and heating controls • 2021 for heat pumps and renewable system	Based on set grants per measure, this can be grant funded by SEAI 45 - 50% of the cost for a typical family home *A One Stop Shop contractor manages upgrade including:* • home energy assessment • grant application • project management • upgrade to a minimum B2 BER • contractor works • homeowner pays for the works net of grant • follow up BER *For homes built and occupied before:* • 2011 for insulation and heating controls • 2011 for renewable systems	For qualifying* homeowners in receipt of certain welfare benefits (see below) All home upgrade costs covered by SEAI *Service is managed by SEAI and includes:* • home survey • contractor selection • contractor works • follow up BER *For homes built and occupied before:* 2006 for insulation and heating systems *Receiving one of the following: • Fuel Allowance • Job Seekers Allowance • Working Family Payment • One-Parent Family Payment • Domiciliary Care Allowance • Carers Allowance • Disability Allowance for over six months with a child under seven

There is a full explanation of the schemes, grants, and levels of funding on the SEAI site here

[45] Available at this link: https://www.seai.ie/grants/home-energy-grants/

Grant name	Grant Value
Heat Pump Systems	€6,500
Central Heating System for Heat Pump	€2,000
Heat Pump Air to Air	€3,500
Heating Controls	€700
Solar Hot Water	€1,200
Attic insulation	€800-€1,500
Cavity wall insulation	€700-€1,700
Internal Insulation (Dry Lining)	€1,500-€4,500
External Wall Insulation (The Wrap)	€3,000-€8,000
Windows (Complete Upgrade)	€4,000
External Doors (max. 2)	€800 per door
Floor Insulation	€3,500
Solar PV	0 to 2 kWp €700/kWp 2 to 4 kWp €200/kWp
Home Energy Assessment	€200
BER	€50

Table 9: Guidance Costs for Energy Upgrades

Current BER	House Description – Year – Construction Type	Costs	Floor area m2	Cost/m2
C2	Detached Dormer Bungalow – 2003 - Unknown wall construction	€58,864.25	235	€250.49
C2	Detached Home – 2002 –Cavity Block	€59,747.00	238	€251.04
D1	Detached House - 1970 - Cavity wall construction	€74,058.00	239	€309.87
C3	Detached House - 1999 - Timber frame construction	€74,449.00	214	€347.89
C2	Semi-Detached 2-Storey Dwelling– 1985 – Cavity Block	€29,875.47	82	€364.34
D1	Detached House - 1990 - Cavity wall construction	€51,584.00	138	€373.80
C3	Detached Dwelling– 1978 – Cavity Block	€76,905.45	200	€384.53
C3	Detached 2-Storey Dwelling– 1991 – Cavity Block	€124,024.63	318.8	€389.04
C1	Semi Detached Home – 1991 – Cavity Block	€63,610.00	140	€454.36
F	Detached Home – 2002 –Cavity Block	€64,785.80	117	€553.72
D2	Detached Home – 1973 –Cavity Block	€98,378.00	171	€575.31
E2	Detached Dwelling– 1850 – Stone	€116,711.20	201.41	€579.47
E2	Semi Detached Home – 1940 – Mass Concrete	€58,728.69	100	€587.29
D2	Semi Detached Home – 1990	€78,915.45	133	€593.35
E1	Mid Terraced Dwelling – 1932 –Cavity Block	€63,877.80	103	€620.17
D1	Mid Terrace Dwelling – 1973 – Cavity Block	€57,273.65	90	€636.37
E2	Detached Dwelling – 1976 – Unknown	€105,018.76	153	€686.40
C3	End of Terrace – 1984 - Unknown wall construction	€62,566.61	80	€782.08
E2	End of Terrace Dwelling – 1950 – Mass Concrete	€61,337.51	77.68	€789.62
	Median			€553.72

NOTE: The costs for upgrades **do not include** the SEAI grant deduction. The grants are not paid out as a proportion of the total, rather than as a payment for measures carried out.

2.3. Domestic EV Grants

Table 10: List of Domestic EV grants from SEAI

List Price of Approved EV	Grant
€14,000 to €15,000	€1,500
€15,001 to €16,000	€2,000
€16,001 to €17,000	€2,500
€17,001 to €18,000	€3,000
€18,001 to €60,000	€3,500

Grant Eligibility: to qualify for SEAI grant assistance, the purchased vehicle must be new and one of the approved car models. The full list of car models is available at this link.

2.4. SME Supports

2.4.1. SEAI Energy Academy

The SEAI Energy Academy is a free, online, e-learning platform designed to help businesses increase their energy efficiency and reduce their energy related costs.

The SEAI Energy Academy allows anyone to learn with short, interactive, animated modules. It's mobile friendly and offers flexible, self-paced learning with access available 24/7.

Business owners, CEOs, managers, and facilities teams can join the SEAI Energy Academy and start learning. The SEAI Energy Academy courses are also a great way of engaging, up-skilling, and retaining staff. Courses can be implemented into any business's sustainability strategy helping them embed energy efficiency across their organisation.

LINK HERE

2.4.2. Climate Toolkit 4 Business

The Toolkit helps your business get started on your zero-carbon journey. It recommends the most impactful steps to understand and address your environmental impacts.

This Toolkit provides practical and cost-effective actions that every business can take to support this transformation and build resilience.

The Energy bills / usage information calculator asks how much electricity and gas your business uses every year on average.

The Business travel information calculator asks for vehicle fuels (petrol or diesel) volumes or cost as well as flights taken for business purposes in a year.

Waste and Water Usage is also tracked.

LINK HERE

2.4.3. SME Energy Audits

An energy audit is an important step for businesses that want to save money, save energy, and enhance their brand. An energy audit may be carried out on buildings, processes, or systems and it is a three-step process which involves preparation, a site visit and reporting. The audit report that compiles the findings will help you to understand:

- how much energy your business uses.
- the equipment and processes that use the most energy.
- what actions you should take to save energy, and their estimated cost and impact

SEAI's Support Scheme for Energy Audits (SSEA) will offer SMEs a €2,000 voucher towards the cost of a high-quality energy audit. In most cases, this will cover the total cost of the audit. Application to the scheme is easy, with automatic approval for eligible businesses.

Businesses applying to the scheme must be:

- non-obligated entities
- tax compliant
- registered in the Republic of Ireland
- spend at least €10,000 on energy per year at the site being audited.

Non-obligated parties (that is those who are eligible for the scheme) are: small and medium enterprises (SMEs), or public sector bodies with a useful floor area less than 500m^2 and spending less than €35,000 per year on energy.

2.4.4. SEAI SME Guide to Energy Efficiency

This document is an excellent short guide for SMEs. This practical guide is based on the real-world experiences of a team of professionals who've been helping companies improve their energy efficiency for decades, so the recommendations are tried and tested.

'Based on experience, the average SME could reduce its energy bill by up to 30% by implementing energy efficiency measures. Typically, 10% saving can be achieved with little or no capital cost. Some investment may be required to get the remaining 20% but the payback is generally around 1.5 years. You won't make a better investment!'

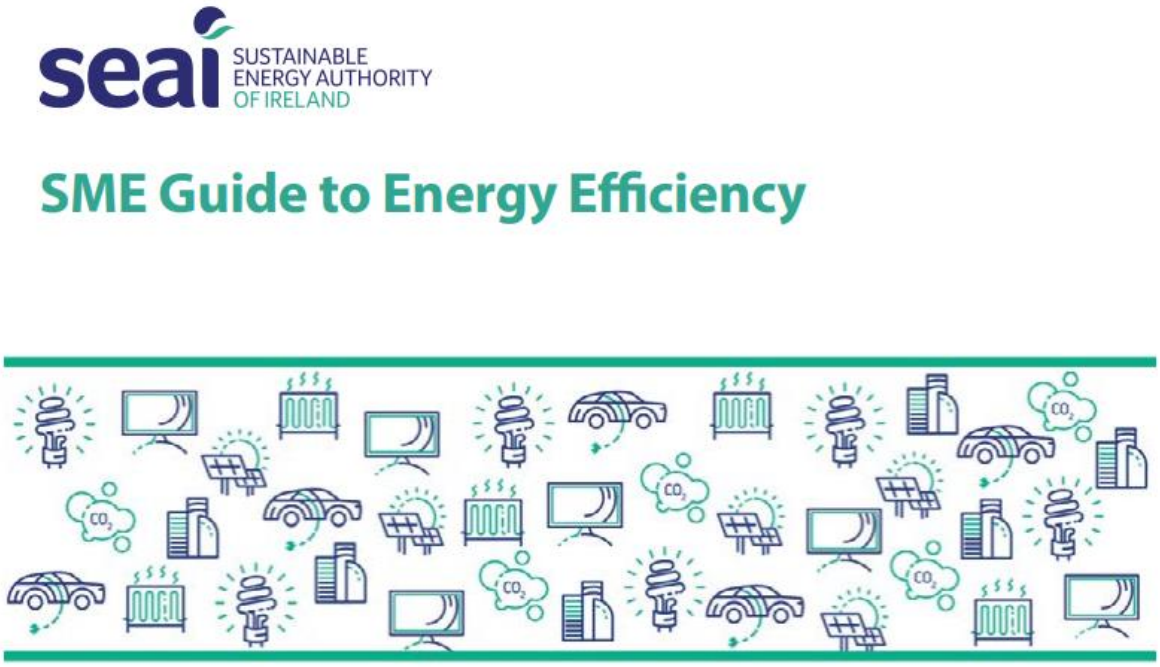


Figure 14: SEAI SME Guide to Energy Efficiency: LINK HERE

2.4.5. PSV: EV Taxi Grants

: https://www.nationaltransport.ie/wp-content/uploads/2023/03/eSPSV23-Grant-Scheme-Information-Guide.pdf

2.4.6. Commercial EVs

The SEAI gives grant supports towards the purchase of new N1 (light commercial vehicle) category electric vehicles for businesses 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 N1S category BEVs when purchased commercially. Approved BEVs with a list price of over €60,000 or 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.

The SEAI also supports the purchase of EV 'Panel Vans' with a grant of €7600 for vans costing up to €90,000.

More details here.

2.4.7. Non-Domestic PV

Through the SEAI it is possible to receive government grant aid towards the installation of solar PV for your business, farm, or community building.

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 improves your sustainability by reducing CO2 emissions. Grant funding is available for systems up to a maximum 1,000kWp (i.e. 1 MW) although the installations we envisage in The Downs' SEC will be much smaller than this (10kWp).

Grant amounts available are shown in Table 11.

Table 11: PV Grants for Businesses, Farms and Community Buildings

Solar PV system	Grant value
1kWp	€900
2kWp	€1,800
3kWp	€2,100
4kWp	€2,400
5kWp	€2,400
6kWp	€2,400
7kWp - 20kWp	€300/kWp
21kWp - 200kWp	€200/kWp
201kWp - 1000kWp (1MWp)	€150/kWp

SEAI: Grants for PV in businesses and farms

SEAI: Solar PV for Business Best Practice Guide

1.11.4.2 Planning for PV Commercial and Community Premises

Solar PV systems installed in a business, industrial, or community resource setting under 50 sq. m (and representing less than 50% of the total roof area) are exempt from planning. A 50m2 installation would be about 8-10kWp. Larger solar PV systems will typically require planning permission.

1.11.4.3 Planning for PV: Farms

Solar panels on houses or agricultural structures, or within their curtilage, is exempted development subject to certain conditions.

Ground-mounted solar — exempted if the array does not exceed 25m2; and the height of the free-standing solar array does not exceed 2m. (25m2 would be a4-5kWp installation)

Roof-mounted — exempted if the array does not exceed 50m2 or 50% of the total roof area, whichever is the lesser; and, the solar panels must be a minimum of 50cm from the edge of the wall or roof on which they are mounted.

Buildings subject to conservation status and all larger ground-mounted installations require planning permission. If there is any doubt it is advisable to contact the local planning officer before any expense is incurred.

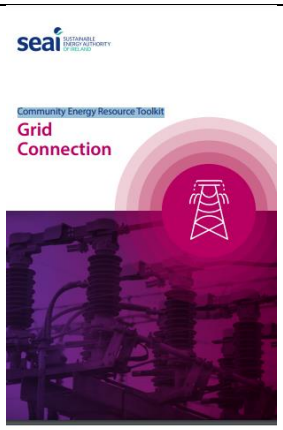
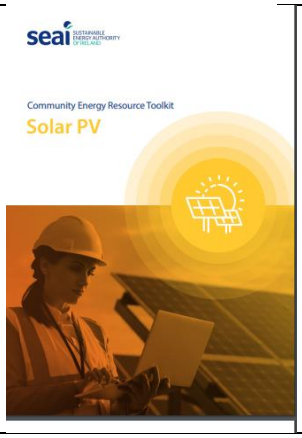
2.5. General Resources

2.5.1. Cycling Campaigning

Table 12: Cycling Campaigning Resources

Resource Name/ Description	Link
Carma: Marketing urban cycling Handbook and Case Studies	LINK
Cyclist.ie – The Irish Cycling Advocacy Network	LINK
EMBRACER: integrating public transport (PT) with informal modes (cycling, ride-hailing, car/bike/scooter sharing, on-demand transport, autonomous shuttles)	LINK
Cyclewalk: Best practices and experience on data collecting and processing, to involve users to improve planning of cycling and walking facilities	LINK
Handshake: Sharing Best Practice of Cycling experience from 12 cities (the assessment tool is useful for city planners)	LINK
European Cyclists' Federation: The European umbrella federation of civil society organisations advocating and working for more and better cycling.	LINK

2.5.2. Community Generation at Scale Resources

Community Energy Resource Toolkit: LINK	
Community level PV Guide: LINK	

2.6. Technologies Discussed in this report.

2.6.1. Heat Pumps

Air to Water Heat Pumps (AWHPs) are a type of heat pump that use outdoor air as a source of heat to warm up water for heating systems and domestic hot water. Here's how they work:

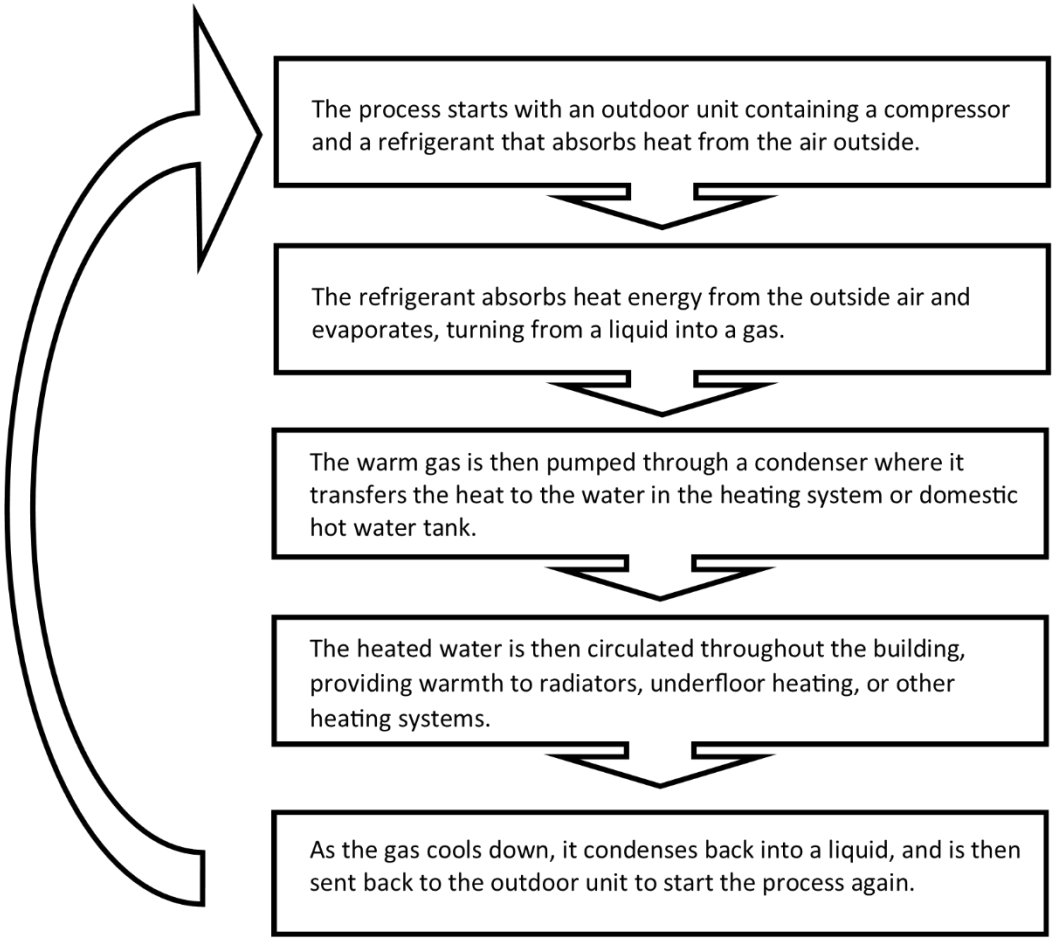


Figure 15: Heat Pump Flow Diagram

AWHPs are highly efficient because they use the freely available heat in the air, and only need a small amount of electricity to operate the compressor and pump. They are also a renewable energy source, as they do not rely on fossil fuels, and can provide significant energy savings compared to traditional heating systems.

AWHPs can have an efficiency of 3:1 which means that for every kWh of electricity is put in, 3kWh of heat are produced.

For further reading, see this SEAI guide: https://www.seai.ie/publications/Heat-Pump-Technology-Guide.pdf

Figure 16: Small Domestic Heat Pump

2.6.2. PV

PV stands for Photovoltaics, which is a method of generating electricity from sunlight. Photovoltaic systems use solar panels made up of photovoltaic cells to convert the energy from the sun into direct current (DC) electricity. This electricity can be used directly, stored in batteries for later use, or converted into alternating current (AC) electricity for use in homes and businesses. PV technology is considered a renewable energy source because it relies on the sun's energy, which is abundant and free, to generate electricity, and it produces no emissions or pollution during operation. PV systems can be installed on rooftops, in fields, or on other open spaces, and they are commonly used for both residential and commercial applications.

PV electricity can be used in the home as well as exported to the grid. The typical modern panel will last 25 years (although it loses some of its efficiency over time). A 2kW power system will require five 400W panels taking up approximately 2m X 5.5m of south facing roof space.

Figure 17: Micro PV installation

https://www.seai.ie/technologies/solar-energy/electricity-from-solar/

2.6.3. EVs

For a list of BEVs on the Irish market see this list compiled by the Irish Credit Union Association: https://www.creditunion.ie/blog/the-best-value-electric-cars-in-ireland/

For an explanation of SEAI supports for BEVs see here: https://www.seai.ie/technologies/electric-vehicles/

BEVs are Cheaper than Petrol Hybrids

A Nissan Leaf (costing €36k) has a range of 385 km from its 62kWh battery. From a Standard rate of electricity this gives a cost per km of 6.2km per kWh = €0.44 which is €0.071/km.

A Nissan Quashquai will cost €35,400 and achieve 5.22 L/100km or 19.16km/l which at a price of 1.60/l petrol is €0.083/km **14% more expensive than the BEV**, excluding tax, VRT, and lower service costs.

2.6.4. Biofuel

We focus on Hydrotreated Vegetable Oil (HVO) here as it is seen as a like-for-like replacement on diesel in most applications, including tractors and construction machinery.

Hydrotreated Vegetable Oil (HVO) is a type of renewable diesel fuel that is produced by hydrotreating vegetable oil. It is a high-quality, low-emission fuel that can be used as a direct replacement for fossil diesel in diesel engines.

The hydrotreating process involves heating the vegetable oil to high temperatures and pressure in the presence of hydrogen gas and a catalyst. This process removes impurities such as sulphur and nitrogen, reducing the carbon chain length of the fatty acids in the feedstock. The end result is a clear, colourless liquid that has excellent cold flow properties and a high cetane number, which is a measure of its combustion quality.

HVO may be considered a transitional sustainable fuel option as it is made from renewable feedstocks and produces lower emissions compared to fossil diesel: although not zero as the lower emissions values relate to the carbon uptake of the feedstock crops: the tailpipe emissions from HVO are slightly below those of diesel. It has also been found to be compatible with existing diesel engines and infrastructure, making it a viable alternative to fossil diesel for transportation and industrial applications in the short and medium terms.

HVO Fuel is available from fuel suppliers in the SEC.

This is a summary guide to biofuels in general. HVO is discussed p12-15

HVO emits carbon at the vehicle's tailpipe. It is deemed low-carbon (as is wood) because the feedstock takes up carbon from the atmosphere as it grows. However, the source of the feedstock should be a concern for sustainability. If the feedstock originates from palm oil plantation sin poorly regulated environments, the fuel cannot in any circumstance be recommended. However, even if, as is suggested by Irish HVO suppliers, the feedstock is sourced from regulated and sustainably managed suppliers, other concerns in the interest of a holistic scientific approach need to be addressed.

The first of these is the issue concerning how much land used for food crops would be diverted to HVO feedstock crops to meet the demand. Is the replacement of diesel for vehicle use with HVO feasible from the land use perspective in Ireland?

Based on our (as yet unpublished paper on HVO and fuel demand in Ireland) we have found (see Table 13)that meeting the diesel transport requirements of Ireland with HVO would require an estimated 1,620,370 hectares of farming land (31% of the total). There is currently 280,000 hectares of arable land for all crops: the rapeseed demand for HVO to meet the current vehicle diesel demand would be 578.7% of all arable land in Ireland. This cannot be seen as a sustainable answer to our vehicle emissions. Therefore, we

recommend HVO in the EMP as a temporary measure, using feedstocks from waste vegetable oil and EU sourced feedstock from existing crops. The post-2030 solution requires other technologies such as green hydrogen fuel cell vehicles or improved (lighter and linger lasting) batteries.

Table 13: Calculation on land use requirement to meet HVO demand Ireland.

Ireland	Rapeseed	Reference
Yield tonnes /ha	5	Teagasc LINK
L/t	450	Teagasc LINK
l/ha	2,250	
HVO per litre	0.96	BOSCH LINK
l HVO/ha	2,160	
gross auto diesel/yr	3,500,000,000	CSO LINK
ha/Rapeseed HVO demand	1,620,370	
ha farming- land Ireland	4,900,000	CSO LINK
ha arable land Ireland	280,000	
% farming land to meet HVO demand	33.1%	
% arable land to meet HVO demand	578.7%	

2.7. Methodologies

In this section we outline the methods we used to arrive at our measures of energy use based on the available data.

2.7.1. Domestic Energy Use

In the home, we look at energy used in heating, in appliance use, and in transport. We do this using a variety of methodologies.

Firstly, we process the national data on Building Energy Rating Certificates (BERs) as published by the CSO: these are provided on a national and a county basis here[46]. We then compare these to the SEAI's average breakdown BERs for each CSO Electoral Division which are published by the SEAI. This presents us with a picture of the state of the energy efficiency of the housing stock in the SEC.

The BERs for each ED are classified according to energy use per square meter for space heating (SH), for Water heating (WH), and for lighting and pumps and fans (L). Appliance use is not included in the BER but we do account for it through *estimated* values (see below SEAI and DECC estimates). For SH and WH, we determine fuel consumed (oil, natural gas, electricity, etc) from the BERs. For Lighting and Pumps, we assume electricity as the energy source.

Energy use of the home is measured as kWh per square meter per year (kWh/m2/yr). A low kWh/m2/yr is considered more efficient than a high kWh/m2/yr. The level of consumption for homes from most efficient A1 to least efficient G under the BER system is rated as shown in Figure 18.

Scientific research, as well as homeowner reported feedback on BER energy use estimates, has found that the notional kWh/m2 usage of the BER does not reflect actual use. This is understood in the rating system which calculates the amount of energy required by the building to achieve comfortable occupancy temperatures for the whole home or building (20 degrees C). The actual use of the building (not all rooms may be heated or used) and the temperatures achieved (the home may be heated to less than 20 degrees C) are not within the survey programme parameters: the survey represents the energy the home or building would require regardless of the user's heating or building use practices. Thus, it has been found (Coyne & Denny, 2021)[47] that there is probably an over estimation of energy use per m2 in lower BER homes (E-G) and an under-estimation of energy use per m2 in higher rated homes (B-A). This research was based on 9,923

[46] https://www.cso.ie/en/statistics/climateandenergy/domesticbuildingenergyratings/ accessed 02/02/2022

[47] Coyne, B., Denny, E. Mind the Energy Performance Gap: testing the accuracy of building Energy Performance Certificates in Ireland. Energy Efficiency 14, 57 (2021). https://doi.org/10.1007/s12053-021-09960-1

observations of one year of actual energy use and a further 9,328 observations from the same sample of houses with a second year of actual energy use.

We use the adjustments indicated by this research in our calculation of actual energy use according to each BER type (G-A). These are shown in Table 14.

Table 14: Adjustments of energy use for homes assumed[48]

BER RATING SUBGROUP	Adjustment +/-
B	+36%
C	+0.50%
D	-24%
E	-39%
F	-56%
G	-56%

[48] Ibid, Table 7, https://link.springer.com/article/10.1007/s12053-021-09960-1/tables/7

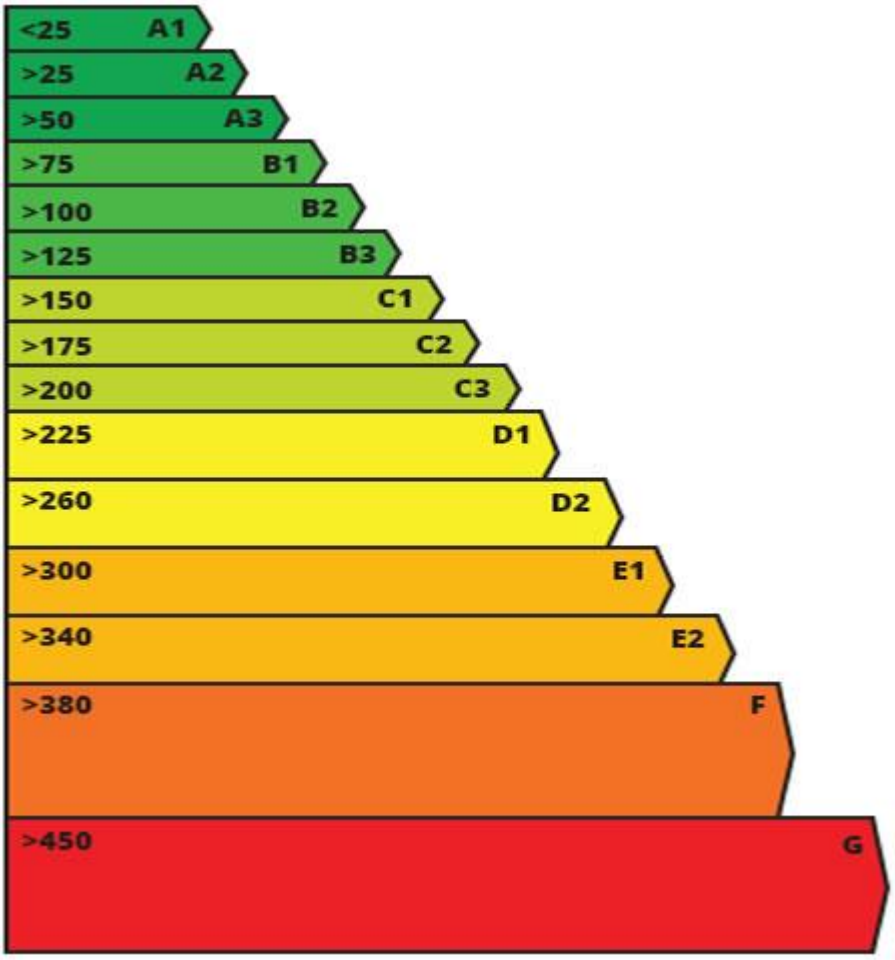


Figure 18: Energy Rating Scale in kWh/m2/yr A1-G

With our method, we calculated the percentage of homes with a BER for each rating A1-G in each ED. We found the results shown in Table 15.

Table 15: Percentage of BER Classes for Each Electoral Division (%)

BER Class	ALL SEC	Killucan	Heathstown	Huntington	Westmeath
A1	0.3%	0.0%	2.6%	0.0%	0.7%
A2	2.9%	3.0%	5.3%	0.0%	3.6%
A3	7.0%	7.2%	10.5%	2.4%	2.9%
B1	1.8%	2.0%	2.6%	0.0%	1.7%
B2	3.4%	2.6%	7.9%	4.9%	3.3%
B3	15.4%	17.0%	5.3%	12.2%	8.1%
C1	17.2%	17.7%	13.2%	17.1%	10.2%
C2	11.2%	12.5%	0.0%	12.2%	12.2%
C3	12.2%	11.5%	15.8%	14.6%	13.5%
D1	7.6%	7.2%	10.5%	7.3%	12.2%
D2	8.3%	8.5%	5.3%	9.8%	9.2%
E1	2.9%	2.3%	2.6%	7.3%	5.2%
E2	3.1%	3.0%	5.3%	2.4%	4.4%
F	2.6%	2.6%	5.3%	0.0%	4.9%
G	4.2%	3.0%	7.9%	9.8%	8.0%

The next step was to find an average energy use for each BER class in each ED. This was achieved by finding the average Space Heating and Water Heating for each class A1-G for both primary and secondary heating in kWh/yr. The SEAI publishes detailed anonymised data from BERs for all homes with a BER, broken down by CSO Small Area[49], which we leveraged to achieve our average energy use (and fuel type) for SH and WH per BER class by ED as well as average m^2 per home for each BER class (384 homes in total).

We did the same for Lighting and Pumps electricity use. This gave an average energy use value for each BER class. This is an important step in our methodology as we found that although the energy consumed per m^2 in some homes is low, the total energy consumed by the home is relatively high: i.e., the home is energy efficient, but it is larger than average. Thus, the total energy consumption and emissions for the home are larger than others in the BER class.

We then estimated the appliance and cooking energy use for each home. This was not assumed to be a simple percentage of the overall energy use added. Appliance use does not relate directly to energy efficiency of the building. An A1 passive house using an electric fridge and kettle will use approximately the same electricity as a C1 house also

[49] https://www.seai.ie/technologies/seai-maps/ber-map/

using an electric fridge and kettle. We arrive instead at an estimated energy use for appliances based on the findings from the SEAI that appliances use on average 10% of the homes energy and cooking 2%. We aggregated the energy use for all homes in the SEC area arriving at an estimate of 2,303 kWh/yr for appliances and 444 kWh/yr for cooking. This is closely related to a figure of 2368 kWh/yr for appliances and 448 kWh/yr for cooking from a 2014 DECC Survey of 250 UK homes[50]. The floor area of the home was also disregarded as we did not consider this to be relevant to appliance use: homes largely use the same electrical appliances regardless of size.

When we added appliance and cooking energy (which here we assume as electrical energy), we arrive at the overall average energy use per BER Class for each ED (Table 16).

[50] Jason Palmer, Nicola Terry, 2014, Powering the Nation 2: Electricity use in homes, and how to reduce it, DECC, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/325741/Powering_the_Nation_2_260614.pdf

Table 16: AVERAGE TOTAL kwh/yr BER Heat for SEC (adjusted – see Table 14)

BER CLASS	Space Heating	Water Heating	All Heat	Heat kWh/m²	Av m² per BER class	Number of Houses per BEC class	SEC Heat kWh/yr
A1	12,183.2	4,339.6	16,522.8	54	303.2	3	46,556.4
A2	5,486.1	4,334.2	9,820.3	62	157.2	31	304,376.7
A3	9,898.4	5,053.5	14,952.0	93	161.6	76	1,137,518.1
B1	14,720.7	4,994.4	19,715.0	137	143.9	20	388,858.8
B2	16,916.3	5,492.4	22,408.7	160	140.1	37	820,836.7
B3	16,353.9	6,702.5	23,056.4	173	132.9	166	3,833,011.9
C1	15,235.4	5,164.7	20,400.2	148	137.5	186	3,793,797.2
C2	16,613.9	5,432.6	22,046.4	170	129.5	121	2,671,177.4
C3	20,028.5	6,297.5	26,326.1	195	135.1	132	3,486,419.9
D1	12,243.9	3,597.6	15,841.5	134	118.4	82	1,294,466.8
D2	16,503.3	5,042.3	21,545.6	199	108.5	90	1,942,694.8
E1	15,278.4	4,309.9	19,588.3	183	107.3	31	607,134.2
E2	16,969.8	3,879.6	20,849.3	203	102.7	34	704,967.4
F	14,229.5	3,468.4	17,697.9	168	105.5	28	498,674.7
G	17,296.0	3,104.4	20,400.4	272	75.1	45	919,717.6

Note: Numbers are rounded to first decimal place

Table 17: Energy Use in the Home by BER Class and for SEC adjusted

	SEC Heat kWh/yr	Lighting and Pumps SEC kWh/yr	Total Appliances & Cooking kWh/yr	Total kWh/yr
A1	46,556.4	7,393.2	7,740.2	61,689.9
A2	304,376.7	39,481.4	85,142.7	429,000.8
A3	1,137,518.1	188,059.1	208,986.6	1,534,563.8
B1	388,858.8	38,730.8	54,181.7	481,771.3
B2	820,836.7	85,601.6	100,623.2	1,007,061.4
B3	3,833,011.9	440,193.5	456,674.4	4,729,879.8
C1	3,793,797.2	526,685.9	510,856.2	4,831,339.3
C2	2,671,177.4	330,321.1	332,830.5	3,334,329.1
C3	3,486,419.9	378,021.5	363,791.5	4,228,232.9
D1	1,294,466.8	207,559.8	224,467.1	1,726,493.7
D2	1,942,694.8	203,730.1	247,687.8	2,394,112.7
E1	607,134.2	72,105.1	85,142.7	764,382.0
E2	704,967.4	88,920.1	92,882.9	886,770.4
F	498,674.7	67,042.2	77,402.4	643,119.3
G	919,717.6	81,664.4	123,843.9	1,125,225.9
Totals	**22,450,208.5**	**2,755,509.8**	**2,972,254.0**	**28,177,972.2**

2.7.2. Levelized cost of electricity

$$\text{LCOE} = \frac{\text{Sum of Costs over Lifetime}}{\text{Sum of Electrical Energy Over Lifetime}} = LCOE = \frac{\sum_{t=1}^{n} \frac{I_t + M_t + F_t}{(1+r)^t}}{\sum_{t=1}^{n} \frac{E_t}{(1+r)^t}}$$

I_t = Investment expenditures in year t (including financing)

M_t = Operations and maintenance expenditures in year t

F_t = Fuel expenditures in year t

E_t = Electricity generation in year t

r = Discount Rate

n = Life of the system

2.8. Data Tables Used

Table 18: Persons per home by ED 2022*

ED	Occupied Homes	Population	Persons Per Home
Killucan	678	2,039	3
Huntington	150	449	3
Heathstown	254	749	2.9
SEC	**1,082**	**3,237**	**3**

Table 19: EDs and Westmeath Pobal Deprivation Index Metrics*

	Huntington	Heathstown	Killucan	Westmeath
Pobal HP Index 2022	2.44	5.32	-0.88	-1.43
Pobal HP Description 2022	Marginally Above Average	Marginally Above Average	Marginally Below Average	Marginally Below Average
Population 2022	449	749	2,039	88,770
Age Dependency Ratio 2022 %	37.42	33.11	35.8	96,221
Lone Parent Ratio 2022 %	9.43	9.46	19.34	8.39
Prop. Primary Education Only 2022 %	7.37	8.51	10.98	35.49
Proportion at Third Level Education 2022 %	41.05	46.14	34.63	17.42
Unemployment Rate - Male	4.27	5.97	6.35	11.03
Unemployment Rate - Female	6.06	3.39	10.73	38.44

Table 20: Car Fuel Assumptions

	km/yr	€/L	g CO2/L	L/100km	kWh/L	Efficiency
Diesel	17,193	€1.88	2640	4.81	10	30%
Petrol	10,704	€1.88	2310	5.52	8.6	25%

Table 21: Energy MWh per person per year. 2019, County, National and SEC area[51]

	MWh	Persons	MWh/person
Ireland	140,000,000	5,149,139	27.18
SEC	**67.2**	**3,237**	**20.7**

The SEC's rural setting makes it on average a lower energy-using community than the Ireland as a whole, lacking as it does energy intensive sectors such as manufacturing and large commercial public sectors.

[51] https://www.seai.ie/data-and-insights/seai-statistics/key-publications/energy-in-ireland/?gad_source=1&gclid=Cj0KCQjwo8S3BhDeARIsAFRmkOOfxl24VTg5jXIKn83RldDdJuLKrLJ8hgTZADiWyV_72s2TosiqedEaAoOcEALw_wcB and CSO 2022 population data.

1.12 References

References to Published Documents are shown here. References to online publications, statistics, etc are given in the relevant footnotes.

Buckley, C and Donnellan, T, 2022, 'Teagasc National Farm Survey 2021 Sustainability Report', Teagasc.

Coyne & Denny, 2021, 'Mind the Energy Performance Gap: testing the accuracy of building Energy Performance Certificates in Ireland', *Energy Efficiency*, Vol 14.

European Commission, 2021, 'Communication from The Commission To The European Parliament, The Council, The European Economic And Social Committee And The Committee Of The Regions Forging a climate-resilient Europe - the new EU Strategy on Adaptation to Climate Change'.

European Commission, 2023, 'Energy efficiency directive'

Government of Ireland, 2023, 'CLIMATE ACTION PLAN 2023 Changing Ireland for the Better'

Jason Palmer, Nicola Terry, 2014, 'Powering the Nation 2: Electricity use in homes, and how to reduce it', DECC,

Pappas and Pappas, 2015, 'The Sustainable Personality: Values and Behaviors in Individual Sustainability', *International* Journal of Higher Education Vol. 4, No. 1, pp12-21

Westmeath County Council, 2021, 'Westmeath County Development Plan 2021-2027'