Portmarnock, County Dublin

Energy Master Plan

FINAL Report

Portmarnock Sustainable Energy Community

IHER Energy Services Ltd

Report by IHER Energy Services, 9th March 2021

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Version: 8

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1 Introduction

Portmarnock is a coastal village in Fingal with a population 9,351 located 16km north of Dublin city. It is a very tight knit community which is surrounded by green areas. It has an area of 750 hectares of which 230 hectares have been developed for housing and businesses, 236 hectares are occupied by golf courses and other sports clubs (24ha) with the remainder areas consisting of parks, agricultural land(small) and areas of environmental importance.

Portmarnock, Co Dublin comprises 3,750 dwellings, 55 business premises, 4 schools (3 x national and 1 x second level))and several sporting clubs. New housing is currently being developed to the south of the village centre with an estimated 900 units being added to the current stock over the next 4 – 5 years.

This Energy Master Plan is intended to provide a framework setting out the transition to reduced energy usage and a low carbon future.

More generally, Portmarnock Community Association (PCA) is the overall body representing residents of the village. It has a large number of representative functions which include Tidy Towns, FORUM, Fingal PPN, Dublin Airport Environmental Group, Green Coast etc. There are many very substantial bodies in the voluntary sector (sports, cultural, vocational, educational, religious etc.) in the village.

The SEC has been established as an entity within the PCA.

1.1 Deliverables

IHER Energy Services was appointed by the Portmarnock Sustainable Energy Community (PSEC) appointed in April 2020 to prepare an Energy Master Plan and Register of Opportunities for Portmarnock.

The deliverables required included the following:

1. Quantify the current energy consumption of Portmarnock SEC – baseline of electrical, thermal and transport energy demand.
2. Carry out Energy Audits of 8 x domestic, 3 x public and 2 x commercial buildings
3. Create a Register of Opportunities (RoO)
    - Identifying projects that can avail of the Communities Energy Grant *and*
    - Identifying projects that can avail of the Better Energy Homes grant
    - Propose actions, based on baseline figures, to achieve a 10% reduction in energy usage over 3, 4 & 5 year periods

The EMP report should include:

- Executive Summary of the findings of the overall EMP and recommendations
- All assessments and audits included in clearly identified and structured annexes

- The populated Register of Opportunities (RoO) spreadsheet

The EMP is to be developed as a working tool rather than simply a 'finished' report. The format should facilitate the following:

- Maintaining records
- Setting targets against the baseline
- Periodic updating of energy consumption/generation
- Measuring progress against targets

2 Residential BER Database Analysis

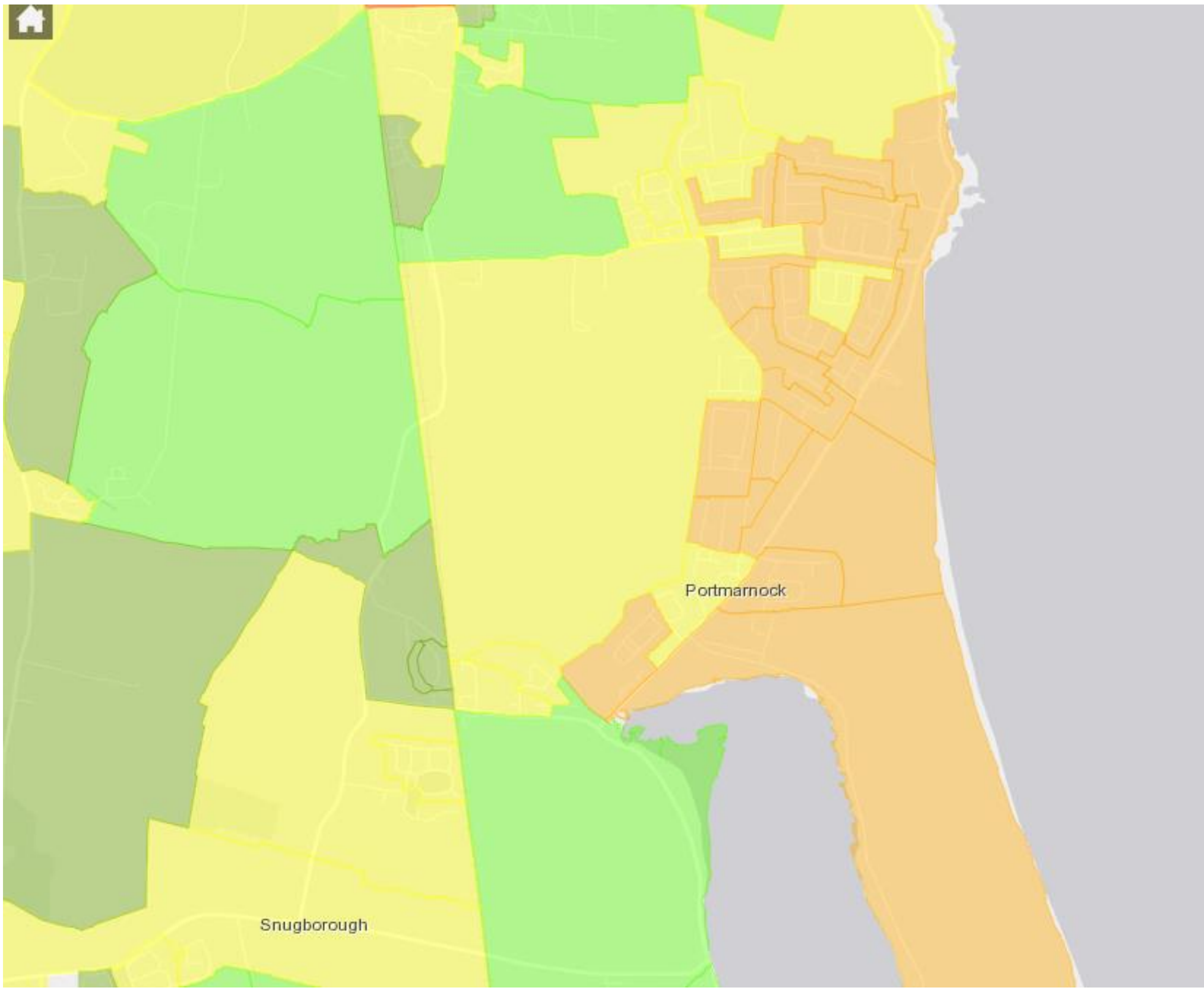
2.1 National BER Mapping Application

All BERs in Ireland are published under a single National Administration System, managed by SEAI.

Within the last 12 months, SEAI launched a national mapping tool that is publicly available. https://www.seai.ie/technologies/seai-maps/ber-map/

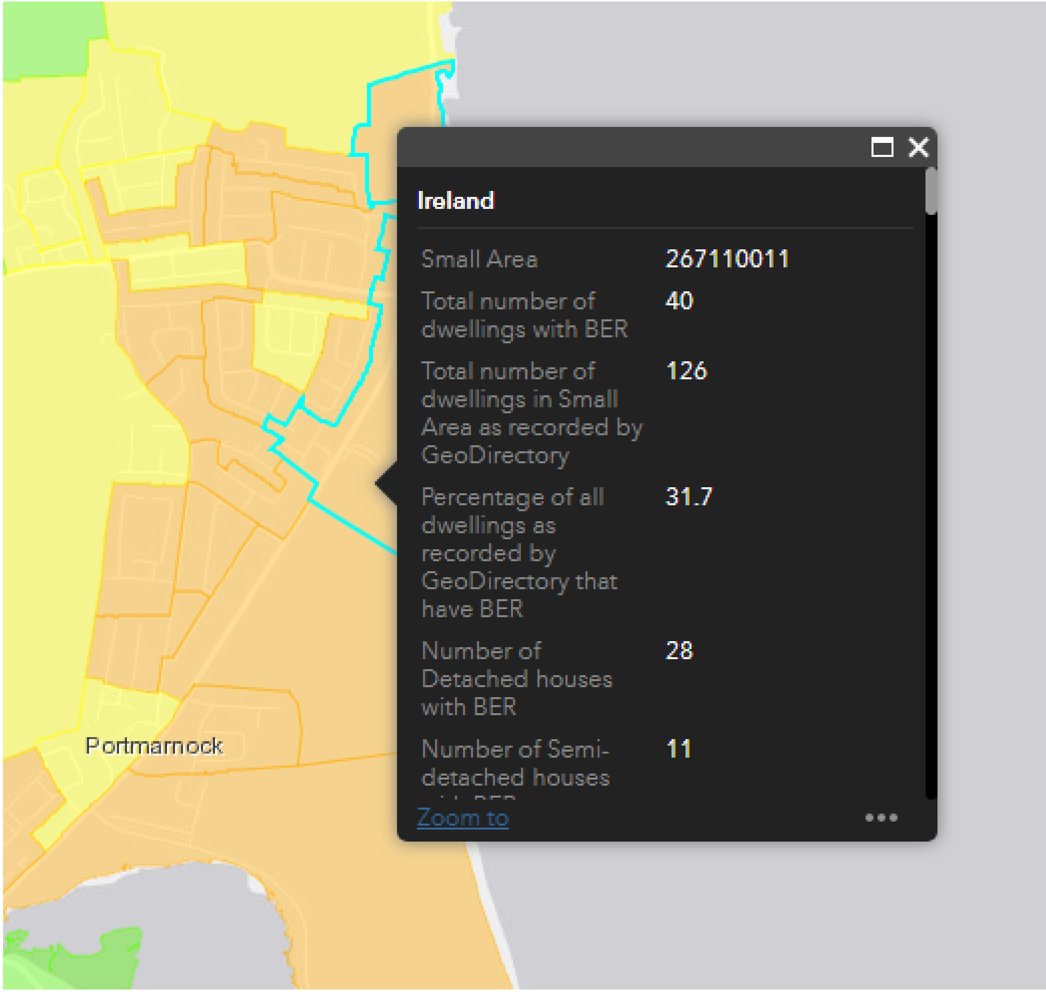
The current map for the Portmarnock area is shown in Figure 1 below. The map is colour coded to the BER colour scale and the boundary conditions refer to small Area. Small Areas are the smallest geographical boundaries used for Census purposes and typically comprise 100-200 dwellings.

Figure 1: Extract from National Residential BER map



When you click into any particular Small Area, a host of detailed data is available as shown in Figure 2. The slider scale on the right opens up a huge level of detail.

Figure 2: Small Area Details -National Residential BER map

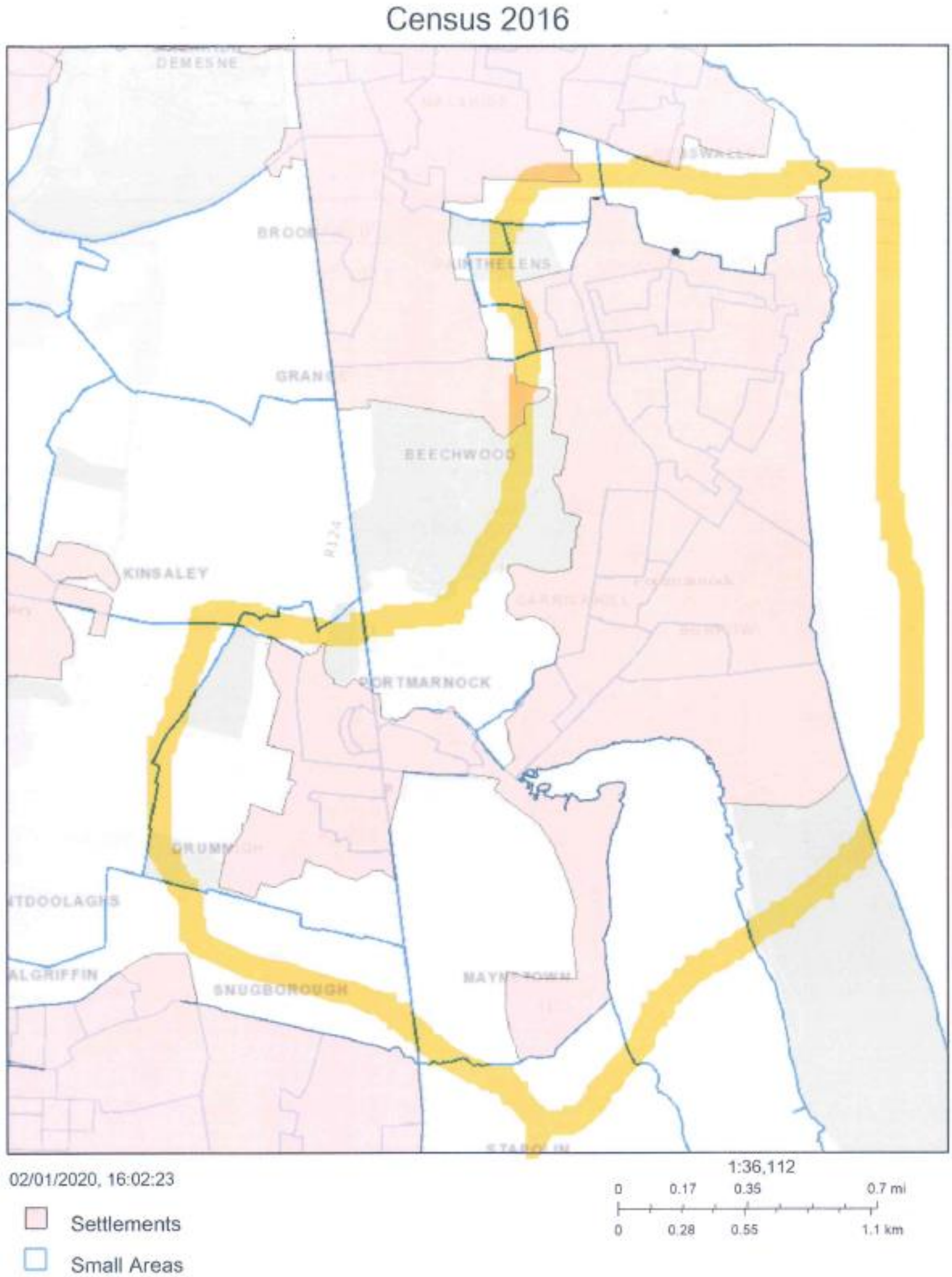


However, while this tool is useful and provides an excellent visual insight, it does not provide data in a summary format that would assist in further developing an energy master plan.

So, the BER dataset behind the tool was also reviewed and the relevant summary data for the Portmarnock area was collated.

In order to access the relevant data for Portmarnock, it was necessary to create a list of Small Area codes for Portmarnock. As there is no national listing system that assigns specific Small Ares codes to towns or villages, some investigation was required. The PSEC committee provided the map in Figure 3 enclosing all Portmarnock Small area. Secondly, a list was provided from the national address registry listing Portmarnock in dwelling addresses and there were linked to small Areas. Finally, all Small Areas were then cross-checked in the SEAI BER map.

Figure 3: Marked-up 2016 Census Map



Finally, the definitive list of Small Areas for Portmarnock, with total dwelling counts and residential BER counts was created as shown in Table 1.

Table 1: Small Area list with published BER Totals

Portmarnock EMP SAs	Total Dwellings	Published BERs	% with BERs	Location
267005003	111	39	35%	west of Drumnigh
267005006	90	37	41%	part of Drumnigh wood
267099026	102	30	29%	Old Road
267099029	86	45	52%	Seabrook Manor
267099030	86	47	55%	Seabrook Manor
267105021	78	27	35%	west of Torcail
267105022	77	23	30%	Torcail
267110001	81	31	38%	Limetree
267110002	101	40	40%	Onward close
267110003	125	47	38%	Redfern
267110004	124	37	30%	Carrickhill
267110005	83	43	52%	Quarry
267110006	94	41	44%	Dal Riada
267110007	124	32	26%	Kelvin
267110008	100	36	36%	Portmarnock Cresc
267110009	95	43	45%	Carrickhill Walk
267110010	152	58	38%	Portmarnock Park
267110011	126	40	32%	Coast road
267110012	83	16	19%	Beach Park
267110013	109	29	27%	Bracken
267110014	88	26	30%	Limetree
267111001	100	53	53%	Strandmill
267111002	231	180	78%	Moyne Rd/ Coast Rd
267111003	100	30	30%	Dunes
267111004	145	54	37%	Ardilaun
267111005	185	56	30%	Woodlands
267111006	78	40	51%	The Links
267111007	112	30	27%	St Patricks ave
267111008	97	26	27%	Carrick Court
267111009	144	66	46%	Church ave
267111010	208	95	46%	Station rd/ Kiln
267111011	116	42	36%	Strand rd
267111012	111	38	34%	Carrickhill drive
Total	**3742**	**1438**	38%	

2.2 National BER Database – Portmarnock

While this national BER map dataset is helpful, it summarises all data to Small Area level. More granular data is contained in the SEAI national BER research tool.

The SEAI national BER database contains details of all 813,000 published and current residential BER certificates. The BER database is publicly available but it does not list actual addresses. However, we obtained a version that includes the relevant Small Area code.

The same Small Areas as in table 1 were identified and records for 1,500 dwellings in Portmarnock were extracted. These records were analysed in detail as explained in the next section.

2.3 BER Database Analysis

A range of charts and tables are provided in the following sections which provide insights on the current energy performance of the stock and provide key indicators to assist with identifying future strategy and objectives.

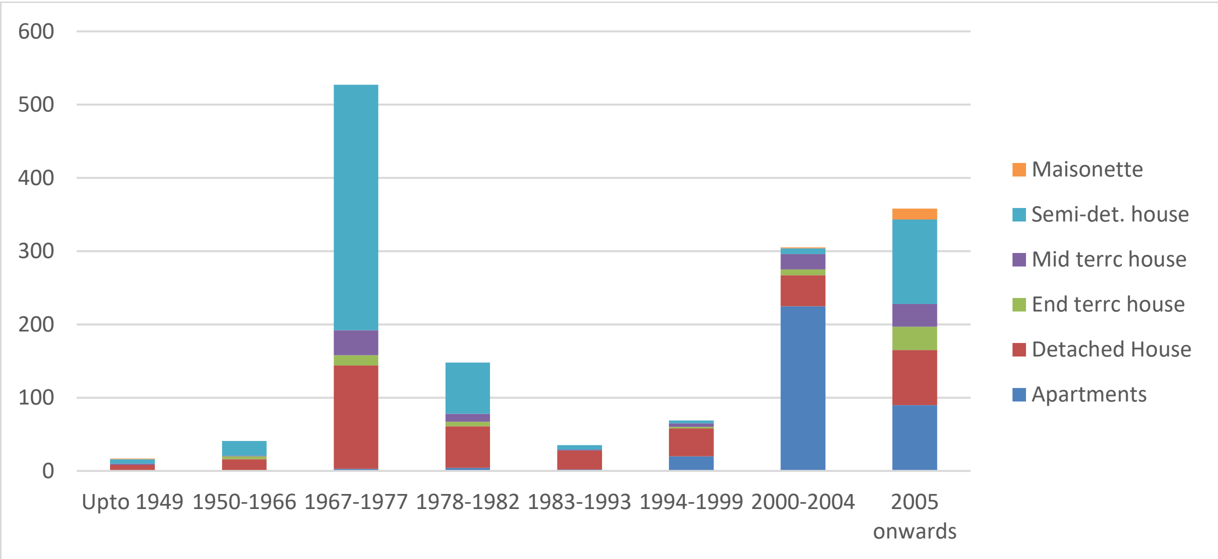
2.3.1 Building Stock by Type and Age

Figure 4 shows stock by year of construction and dwelling type.

It shows how the initial growth in stock occurred from 1967 – 1967. Building Regulations did not require insulation prior to 1978 so this stock would have been built without insulation.

New construction was modest until 2000, when essentially the second significant wave of construction began to take place.

Figure 4: Stock by Type and Age



2.3.2 BER Rating By Age Band

Table 2 shows stock by year of construction and BER rating band.

For the 1967 – 1977 stock, many are seen to be in the D bands and lower.

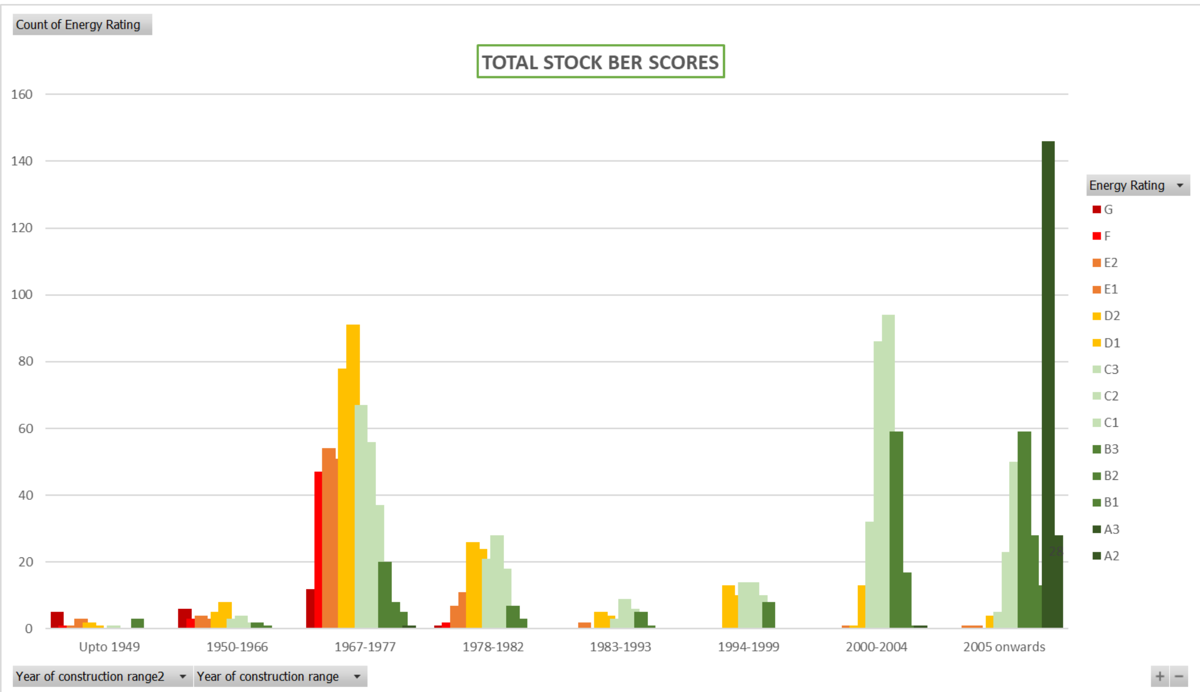
By comparison the vast majority of the 2000 onwards stock has ratings in the C band and better. For age bands 2000 onwards, 30 dwellings are in the A2 band and 156 are in the A3 band. One dwelling from the 1967-1977 band is in the A3 band.

Table 2: BER Ratings by Age Band

Row Labels	G	F	E2	E1	D2	D1	C3	C2	C1	B3	B2	B1	A3	A2	Grand Total
Upto 1949	5	1	1	3	2	1		1			3				17
1950-1966	6	3	4	3	5	8	3	4	2	2	1				41
1967-1977	12	47	54	51	78	91	67	56	37	20	8	5	1		527
1978-1982	1	2	7	11	26	24	21	28	18	7	3				148
1983-1993			2		5	4	3	9	6	5	1				35
1994-1999					13	10	14	14	10	8					69
2000-2004				1	1	13	32	86	94	59	17	1	1		305
2005 onwards			1	1		4	5	23	50	59	28	13	146	28	358
Grand Total	24	53	69	70	130	155	145	221	217	160	61	19	148	28	1500

The same data is shown graphically in Figure 5.

Figure 5: BER Ratings by Age Band



A separate cross-check was done on the analysis of the dataset associated with Table 1, to identify the Small Areas where more than 80% of those with BERs were dated pre 1983. 18 Small Areas meet this criterion, with a total dwelling count of 1,977 dwellings.

2.4 Wall Types

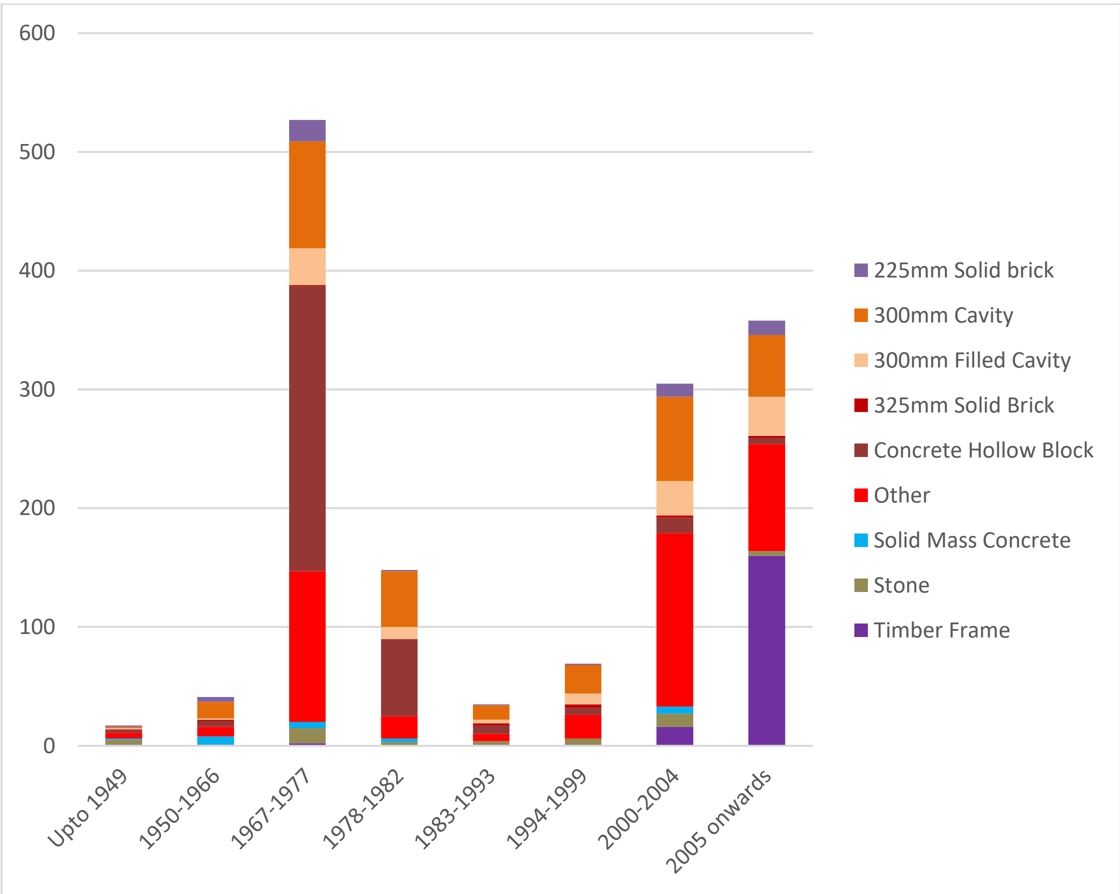
The BER dataset records the main wall type.

Figure 6 shows predominant wall type from 1967-1977 is hollow block with cavity wall construction is also significant. It is important to note that wall type is determined by the BER assessor by visual inspection rather than an invasive check. That said, most new houses in Dublin in that 1967-1977 era were built using hollow block wall construction.

Post 2005, it can be seen that timber frame construction was the most dominant type.

The category "other" refers to unknown wall types as decided by the relevant BER assessor.

Figure 6: Stock by Wall Types



2.5 Wall Insulation Levels

The BER xml file provides information on the levels of wall insulation by indicating the U value (in W/m^2K).

Draft Building Regulations were first introduced in Ireland in 1976 and there were revisions in 1981 (draft also), leading to full Building Regulations in 1991 with subsequent revisions in 1997, 2002, 2005, 2008 and 2011. Allowing for the transition interval between the commencement date for new regulations and the completion of the construction process, dwellings built two years after the introduction of the new regulations are considered to meet the new regulations.

Thus, it is assumed that all dwellings built before 1977 were not insulated. The default U values defined in Appendix S of the SEAI DEAP manual v3.2.1 are shown in table 3.

Table 3: Exposed Wall U-values (Appendix S, DEAP v3.2.1)

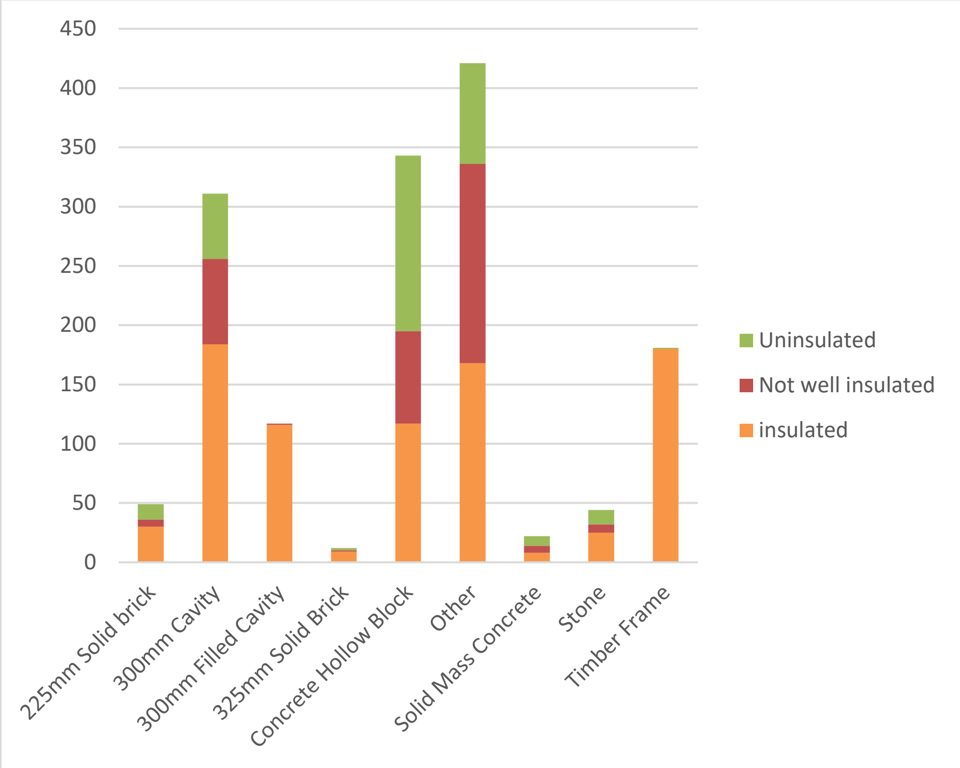
Age Band	A	B	C	D	E	F	G	H	I	J
Wall type	Before 1900	1900-1929	1930-1949	1950-1966	1967-1977	1978-1982	1983-1993	1994-1999	2000-2004	2005 onwards
stone	2.1	2.1	2.1	2.1	2.1	1.1	0.6	0.55	0.55	0.37
225mm solid brick	2.1	2.1	2.1	2.1	2.1	1.1	0.6	0.55	0.55	0.37
325mm solid brick	1.64	1.64	1.64	1.64	1.64	1.1	0.6	0.55	0.55	0.37
300mm cavity	2.1	1.78	1.78	1.78	1.78	1.1	0.6	0.55	0.55	0.37
300mm filled cavity	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.55	0.55	0.37
solid mass concrete	2.2	2.2	2.2	2.2	2.2	1.1	0.6	0.55	0.55	0.37
concrete hollow block	2.4	2.4	2.4	2.4	2.4	1.1	0.6	0.55	0.55	0.37
timber frame	2.5	1.9	1.9	1.1	1.1	1.1	0.6	0.55	0.55	0.37

In order to determine if walls are insulated to a reasonable standard, analysis was done on all dwellings to divide them into 3 categories:

- Insulated: wall U values of 0.6 W/ m^2 or less
- Not well insulated: wall U values >0.6W/m2K and < 1.64 W/ m^2K
- Uninsulated: wall U values > 1.64 W/ m^2K

The results of the analysis are shown in figure 7 and listed in table 4.

Figure 7. Wall U Value Analysis



Apart from the timber frame-built dwellings, all other categories have significant quantities of uninsulated or not well insulated walls. The "unknown types" have a similar distribution and are likely to include some of all other types.

The small areas that predominantly have uninsulated hollow block wall and cavity wall insulation can be determined by applying filters to the BER dataset.

Table 4: Wall insulation levels by Wall Type

Count of Wall Ins. Level	Column Labels			
Row Labels	**insulated**	**Not well insulated**	**Uninsulated**	**Grand Total**
225mm Solid brick	30	6	13	49
300mm Cavity	184	72	55	311
300mm Filled Cavity	116	1		117
325mm Solid Brick	9	1	2	12
Concrete Hollow Block	117	78	148	343
Other	168	168	85	421
Solid Mass Concrete	8	6	8	22
Stone	25	7	12	44
Timber Frame	180		1	181
Grand Total	**837**	**339**	**324**	**1500**

2.6 Windows

In analysing window performance, windows were subdivided into those with U values =< 2.8 W/m2K (equivalent to 12mm gap air-filled double glazing) and those with U values > 2.8 W/ m^2K, which represents much older double glazing and single glazing.

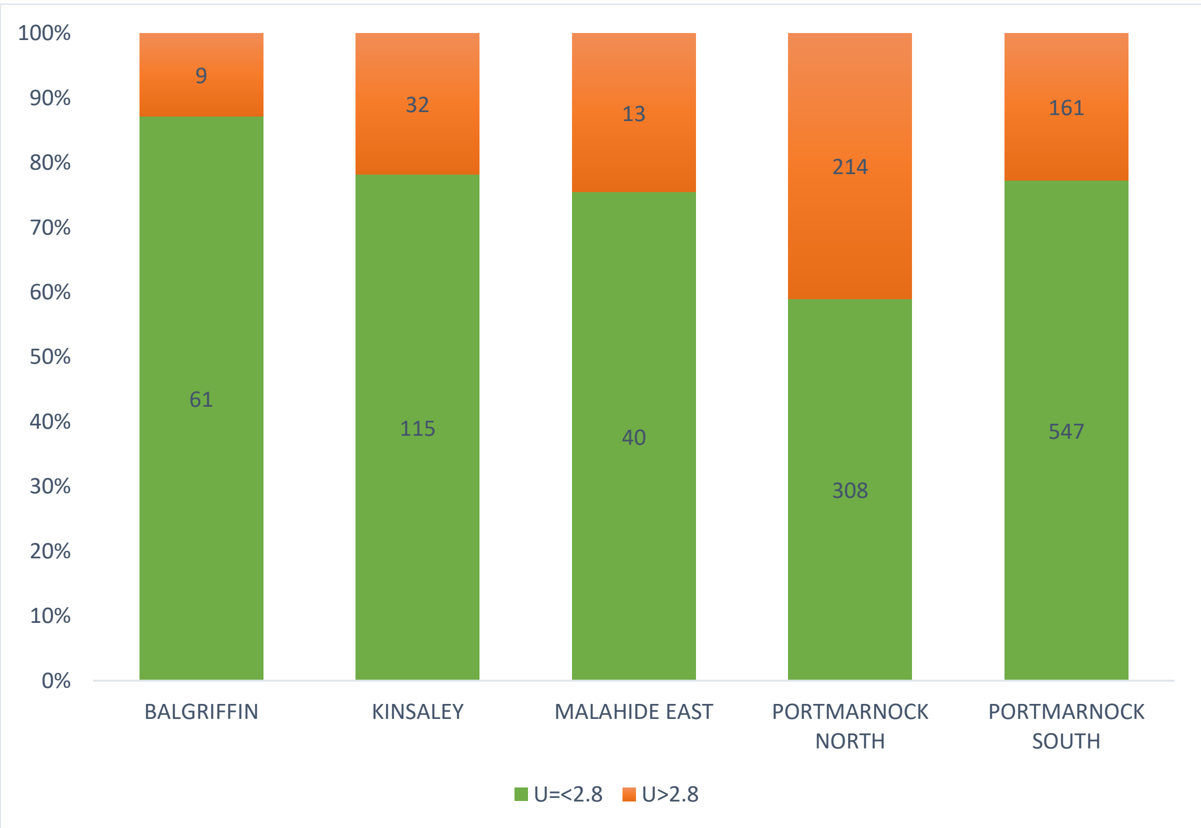
The window type counts by electoral district (next level above Small Areas) are shown in table 5. The analysis shows that roughly one third of windows have U values greater than 2.8.

Table 5: Windows U Value Analysis

Row Labels	U=<2.8	U>2.8	Grand Total
BALGRIFFIN	61	9	**70**
KINSALEY	115	32	**147**
MALAHIDE EAST	40	13	**53**
PORTMARNOCK NORTH	308	214	**522**
PORTMARNOCK SOUTH	547	161	**708**
Grand Total	**1071**	**429**	**1500**

The same data is illustrated in figure 8, showing Portmarnock North has the highest proportion of older window types.

Figure 8. Window U all U Value Analysis

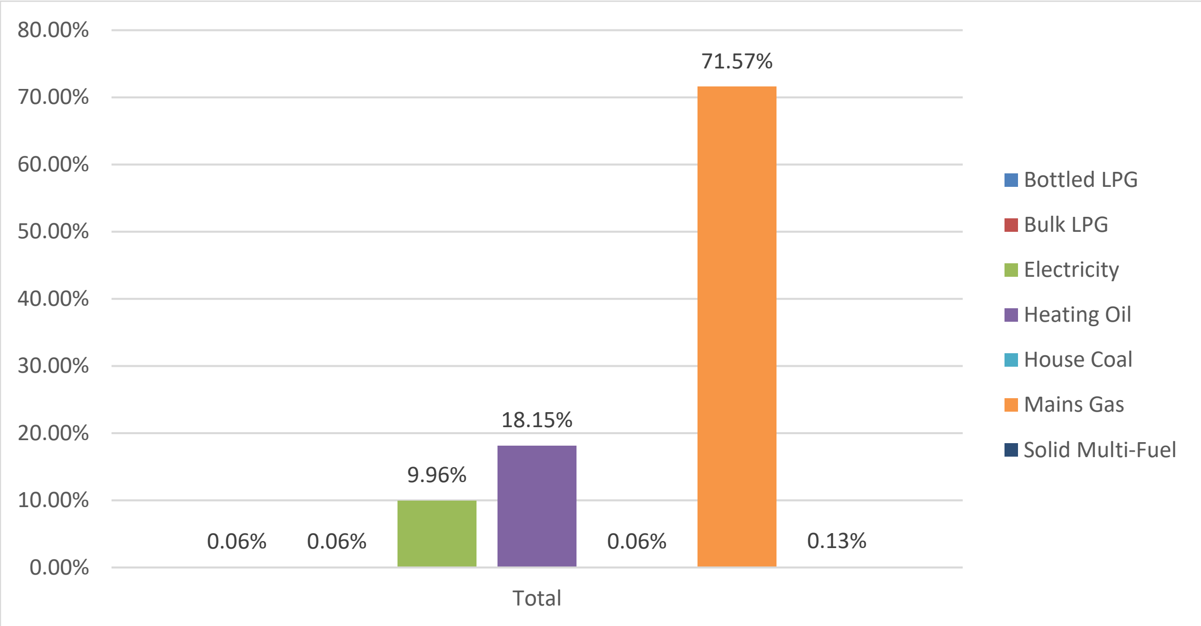


2.7 Fuel Types

The main fuel types are shown in Figure 9, comprising mains gas (72%), oil (18%) and electricity (10%).

Most dwellings using electricity were built post 2005 and have heat pumps installed. Some apartments are heated by storage heating.

Figure 9. Main Heating Fuel Types



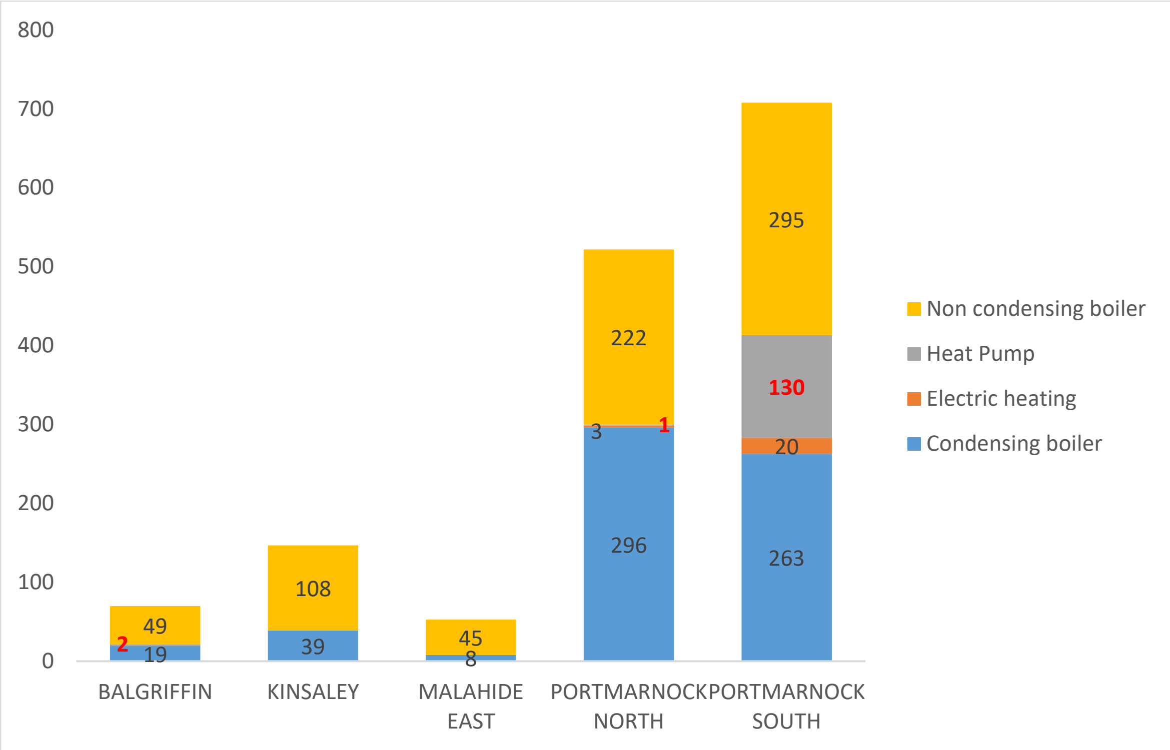
2.8 Heating System Types

Table 6 and figure 10 show heating system types used in houses and apartments, spread across the 5 electoral districts.

Table 6: Main Space Heating Types

Row Labels	Condensing boiler	Electric heating	Heat Pump (electric)	Non condensing boiler	Grand Total
BALGRIFFIN	19		2	49	70
KINSALEY	39			108	147
MALAHIDE EAST	8			45	53
PORTMARNOCK NORTH	296	3	1	222	522
PORTMARNOCK SOUTH	263	20	130	295	708
Grand Total	**625**	**23**	**133**	**719**	**1500**

Figure 10: Space Heating Types for Houses, Apartments



It is notable that 133 dwellings have heat pumps (powered by electricity) and 23 have direct electric or storage heaters.

For regular oil and gas boilers, more than 50% of existing boilers are inefficient non-condensing types which will be candidates for replacement in the future.

3 Baseline of Electrical, Thermal and Transport Demand

The baseline energy demand comprises energy use in the 3,742 residential buildings, 55 commercial/ public buildings, sports clubs and transport.

3.1 Residential Buildings

From the BER database analysis of 1,500 published BER certs, we can derive the following:

- The average primary energy value of a Portmarnock dwelling is 203 kWh/ m^2/year.
- The average floor area of a Portmarnock dwelling is 127m^2.
- Thus, the average primary energy per dwelling is 25,780 kWh per year 2016 Census as shown in table 7. Note that the BER calculates energy used for space heating, water heating, pumps and fans and lighting. It does not include energy used for cooking or other appliances.

Table 7: Average Primary Energy Per Dwelling

Average Primary Energy (from 1500 BERs)	**Average Floor Area (from 1500 BERs)**	**Average Primary Energy per dwelling (kWh/ annum)**
203	127	25,781

Note that the average primary energy for a new dwelling would be roughly 7,500 kWh per annum, not including renewable generation which is mandatory at a minimum of 20%.

Expanding this to the total stock of 3,742 dwellings, the total estimated primary energy consumption of all dwellings is 96,472,501 kWh per annum or also expressed as 96.5 GWh (gigawatt hours) – see table 8.

Table 8: Total Estimated Annual Primary Energy of all Dwellings

Total Number of Dwellings	Total Primary Energy (kWh - all Dwellings)
3742	96,472,502

Another useful metric is the annual energy spend. The SEAI publication Energy in the Residential Sector advised the average Irish household spend for heating and electricity is €1990.

For the 3,742 dwellings in Portmarnock, this indicates an annual energy spend of €7.5m (table 9).

Table 9: Total Estimated Annual Energy Spend - all Dwellings

Total Dwellings	Annual Energy Bill (heating & electricity)	Annual Residential Energy Costs
3742	€1,990	€7,446,580

3.2 Commercial and Public Buildings

There are 58 businesses (mostly small) in the village, the majority of which are concentrated in the service sector. There are two substantial hotels and a leisure centre.

There are three national Schools and one community (2nd Level) school. There is one church and a Primary Care Health Centre in the village centre. There are two facilities catering for disabilities in the South Fingal area based in Portmarnock.

The SEAI publication SEC Partnership – Guidance Notes for EMP funding Application process (October 2018), advises an average energy spend for small businesses of €15,300 per annum (split €5,100 for electricity and €10,200 for gas) and an average spend of €57,000 for large business (split €21,000 for electricity and €36,000 for gas). The two hotels and the leisure centre would be deemed large businesses.

As annual fuel costs are available from the energy audit report on the Sport and Leisure Centre and St Helen's National Schools, this data can be used in estimating the annual non-domestic energy costs per annum for all building in Table 10 below. All four schools can be deemed to have the same energy usage for this purpose. It would be ideal if energy usage data was available for all 60 businesses but this is outside the scope of this study.

Table 10: Total Estimated Annual Energy Spend – Commercial & Public Buildings

	Number	**Annual Energy Bill (heating & electricity)**	**Annual Business Energy Costs**
Small businesses	58	€15,300	€887,400
Large businesses	2	€57,000	€114,000
Sport & Leisure Centre			€112,496
Schools	4	€13,286	€53,144
Total			€1,167,040

The annual energy usage in kWh and CO_2 emissions can be estimated by using SEAI published commercial fuel price comparison price data for electricity and gas to convert costs back to kWh. https://www.seai.ie/data-and-insights/seai-statistics/key-statistics/energy-data/

Similarly by using kWh/CO_2 conversion factors, the total annual energy and carbon dioxide emissions for non-domestic buildings were estimated.

Table 11: Total Estimated Annual Energy Use and CO_2 emissions – Commercial/ non-domestic

	Electricity	**Fossil Fuel**	**Total**
Total Primary Energy (kWh)	2,414,758	13,780,508	16,195,267
Total CO_2 (tonnes)	1,253,260	2,838,785	4,092

3.3 Transport

There are 5,214 cars in the community per CSO 2016. At an average spend of €1602 (average spend for petrol cars is €1,525 with the diesel spend at €1,680) the total spend on car transport is €8.35m.

The Department of Transport's annual bulletin provides vehicles registration stats. This includes the total numbers of vehicles taxed in each county under each tax band, national figures for the fuel type and age of the fleet, as well as fuel type of new registrations. https://www.gov.ie/en/publication/0f943b-irish-bulletin-of-vehicle-and-driver-statistics-2019/

Table 12 indicates the national split of vehicles by fuel type applied to the Portmarnock stock.

Table 12: Vehicles by Type

Total Cars: 5214	petrol	diesel	BEV
	56.9%	42.7%	0.4%
5214 Cars split	2,967	2,226	21

National statistics on average distances travelled, kWh/km and GCO_2/km are shown in Table 13.

Table 13: National Vehicle Performance Values

		National average annual km	*kWh/km (TPER)*	*gCO_2/km*
Car	*Petrol*	*12,113*	*0.73*	*167*
	Diesel	*19,681*	*0.7*	*167*
	BEV	*12,958*	*0.38*	*65*
Motorcycle		*2,741*	*0.41*	*94*
Van		*19,787*	*1.01*	*243*
Truck		*44,671*	*3.47*	

The Table 13 data was created by Codema using data from a variety of sources:

Private (ICE) car, public transport emissions	https://www.cie.ie/Enviromental-Corporate-Responsibility/Climate-action
BEV efficiency	https://www.iea.org/reports/global-ev-outlook-2020
Motorbike emissions	https://www.co2nnect.org/help_sheets/?op_id=602&opt_id=98
LCV emissions	https://www.transportenvironment.org/sites/te/files/publications/CE_Delft_4L06_Van_use_in_Europe_def.pdf
HGV emissions	https://aems.ie/download/hgv-fuel-consumption-white-paper-icct/
E-bikes	https://www.bosch-ebike.com/en/service/range-assistant/
SUV emissions uplift	https://www.transportenvironment.org/sites/te/files/publications/2018_04_CO2_emissions_cars_The_facts_report_final_0_0.pdf

Combining the data in Table 12 and Table 13 enables the annual energy use and CO_2 emissions for Portmarnock transport fleet to be estimated in Table 14.

Table 14: Transport: Annual kWh and CO_2 emissions estimate

Total Cars (5,214)	**Petrol**	**Diesel**	**Battery EV**	**Totals**
National annual average km	12,113	19,681	12,958	
kWh per car/annum	8,842.49	13,776.70	4,924.04	
kg CO_2 per car/annum	2,023	3,287	842	
5,214 Cars split	2967	2226	21	
kWh -all cars/a	26,233,599	30,672,142	102,696	57,008,436
CO_2 - all cars/a	6,001,385	7,317,497	17,566	13,336,448

In addition to cars, there is a DART station at the southern end of the village serving Dublin city and onwards to Greystones in Co. Wicklow. There are three bus routes which pass through the village one terminating at Dublin airport with the others travelling into Dublin City centre.

The impact of the Covid pandemic of future transport patterns and energy use will be seen in the years' ahead. It is expected that there will be a longer term transition to more remote working that may reduce commuting behaviours and resulting fuel usage. There is also expected to be a gradual transition to electric cars and a switch to more cycling.

It is difficult to estimate the future changes in energy usage for transport, but one can be certain that there will be many changes from the status quo in 2019.

3.4 Summary Baseline CO_2 emissions, Energy Usage and Spend

The baseline energy and CO_2 emissions for Portmarnock across all sectors is summarised in Table 15.

Table 15: Baseline EMP Summary – Portmarnock

	CO_2 (tonnes)	**Total (kWh)**	**Energy Cost**
Residential	25,913	96,472,502	€7,446,580
Non-residential	4,092	16,195,267	€1,167,040
Transport	13,336	57,008,436	€8,350,000
Total	**43,341**	**169,676,205**	**€16,963,620**

4 Energy Audits of Residential Buildings

4.1 Methodology

IHER Energy Services met with the Portmarnock SEC team at the outset to fully explore the desired outputs from the project work.

Portmarnock SEC provided a list of 8 houses, 3 public buildings and 2 commercial buildings for energy audit.

The full list of residential buildings is shown below representing the most common house types and estates in Portmarnock as detailed in Table 16 below.

Table 16: Survey addresses

	Estate	**Typical House Type**	**Year Built**
1	Carrick Court	semi-detached	1974
2	Limetree Avenue	semi-detached	1972
3	Carrickhill heights	detached	1975
4	Portmarnock Drive	detached	1972
5	Wheatfield Road	detached	1972
6	The Dunes	detached	1973
7	Strandmill Road	terraced	1976
8	St. Anne's Square	terraced	1962

An initial BER survey was conducted on each house. Some of the survey details were altered as required so that the house surveyed would represent a typical house in that location that might have had only minor energy upgrades to date.

Energy retrofit analysis was done on each of the 8 house types and the impact of 3 levels of upgrade measure packages were assessed in each case. The three retrofit packages were as follows:

- **Starter Package**

The starter package typically includes lower cost measures and those measures that can be incorporated in additional measures if adopted at a later stage.

These include:

- Increase attic insulation to 300mm
- Cavity wall insulation (where applicable)
- A heating controls upgrade: This measure includes the provision of a room thermostat, thermostatic radiator valves, a cylinder thermostat, two motorised valves and a 7-day programmer that allows independent time and temperature control for space and water heating
- Installation of low energy lights

Standard Package

The standard package adds the following measures to the starter package:

- Internal or external wall insulation (whichever is applicable)
- A condensing boiler (90%+ efficient)
- New double-glazed windows (U value =1.4) & new doors
- A wood burning stove, typically 75% efficient to replace an open fire (30% efficient)

- **Advanced Package**

The advanced package adds further to the standard package but moves away from the gas boiler solution to a heat pump providing space heating and hot water. The advanced package would include:

- Increase attic insulation to 300mm
- Insulate other roof types (sloped and/or flat roofs)
- Cavity wall insulation and/or Internal or external wall insulation (whichever is applicable)
- Insulate suspended timber floors where present
- Upgrade windows to triple glazing and install high specification doors
- Replace open fire with a wood stove
- Address any air-tightness issues and install a demand control ventilation system for improved air quality
- Install an air-source heat pump to deliver space heating and hot water. Make necessary alterations to radiators and pipework as required to ensure optimum heat pump performance

- **Optional Measures**

Additional measures that would not be directly reflected in the BER calculation should always be considered on a case-by-case basis.

These include:

A: Carry out sensible air-tightness steps to minimise draughts.

- Draught-proof front & rear door / porch if required
- Draught-proof hot-press pipe holes, attic hatch door, install chimney balloons

B: Upgrade existing double glazing with new low e glass.

Replace old double-glazing with more efficient up-to-date double glazing by replacing the glass panels. Must be evaluated on a case by case basis to assess existing frames and quality of window installation.

C: Partial internal / external wall insulation for selected colder rooms. This will reduce heat loss and improve heat loss in individual rooms.

Please note: None of the measures listed above in A, B or C are eligible for grant support.

4.2 Retrofit Calculator & Brochure for each House Type

A retrofit calculator was used to calculate all of the key metrics for the three retrofit options for all eight dwellings. A pdf version is shown in Appendix A.

The calculator was designed as a workshop version showing the following:

- calculation values taken from the BER software
- SEAI grants per measure
- typical industry average costs for upgrade measures
- estimated running costs
- estimated payback period.

In addition, the key results from the retrofit analysis was placed into a separate more descriptive brochure for each of the eight house types. The brochure for the Carrickhill house type is shown in Appendix B. This brochure can be adapted for use as required.

4.3 Assumptions

In developing the typology analysis, IHER made a number of important assumptions:

Typical Current Conditions:

Each house that was surveyed was treated as a house type and so any recent energy upgrades were largely ignored as they would not reflect the wider housing stock. The typical house was assumed to have had modest energy upgrades only since it was originally built. So, for example, a house built in the 1970s may not have had a central heating system, roof insulation or double glazing when originally built. Modest upgrades since then are likely to include the installation of a central heating system in the 1980s, double glazing perhaps in the 1990s and say 50mm to 100mm of roof insulation at some stage.

Source Data including Industry Average Cost of Works and Energy Costs

IHER used a combination of the cost of works from a variety of sources to arrive at typical industry costs. The typical industry average costs are listed in Appendix C.

Final contractor quotations will naturally vary from these industry average costs. Solar PV costs are tending to become more competitive whereas insulation prices are expected to be more costly in the immediate future.

Calibration Factors and Payback Analysis

Care needs to be taken when using BER-based energy usage results to calculate annual energy costs. The BER methodology assumes the house is heated from October to May for 8 hours per day with the living room heated to 21°C and the rest of the habitable rooms heated to 18°C. This same assumption applies equally to a G-rated house or an A-Rated house. While there is no major study in Ireland exploring this topic, several EU studies have shown that a G-rated house might only use 50% of the energy predicted by the BER calculation as it would be too expensive to heat it to the assumed heating pattern. This calibration factor should then be applied to the BER-calculated energy values to more accurately reflect running costs and savings arising from upgrade measures.

For the PORTMARNOCK SEC, IHER has introduced a calibration factor into the BER-based energy costs calculation. These calibration factors are included in the retrofit calculator.

Energy Costs

Energy costs are based on the SEAI domestic fuel price values (01 July, 2020) listed in Table 17.

Note that for heat pumps, as heat pumps operate 24 hours per day, the electricity price (ElHP.Water and El.HP.SH) is based on a combination of day and night rate electricity. For water heating, it is assumed that the day-night ratio is 20:80. For space heating the day-night ratio is 60:40.

Table 17: Energy Prices (per kWh delivered) - 2020

Gas	€0.07
Oil	€0.07
Electricity	€0.20
Smokeless	€0.06
El.HP.Water	€0.11
El.HP.SH	€0.16

SEAI Better Energy Homes Grants

SEAI provides grants to homeowners via its Better Energy Homes (BEH) scheme. (These same grant levels apply to Sustainable Energy Community applications.)

The current BEH grants are listed in Table 18. It should be noted that oil & gas condensing boilers no longer receive any grant funding.

Table 18: BEH Grants – 2020

	SEAI BEH Grant Amounts (€) - 2020
Roof	€400
Wall-CWI	€400
Wall-IWI -detached	€2,400
Wall-IWI -semi-detached	€2,200
Wall-IWI -mid terrace	€1,600
Wall-EWI -detached	€6,000
Wall-EWI -semi-detached	€4,500
Wall-EWI -mid terrace	€2,750
Controls only	€700
Solar Heating	€1,200
Heat Pump (air-to-water)	€3,500
Heat Pump (air-to-air)	€600
Solar Photovoltaic	€900 per kWp up to 2kWp. €300 for each additional kWp over 2KP and €600 for battery storage.

4.4 Key Survey Findings & Presentation of Results

Wall & Floor Insulation:

All of the houses surveyed were constructed prior to the first Draft Building Regulations in 1976. Thus, these houses were built originally without wall insulation or floor insulation. Almost all have 9 inch single-leaf hollow block wall construction with a mix of internal finishes including wet plaster, plasterboard on dabs and plasterboard on battens.

The upgrade solution for these single leaf walls is either external or internal wall insulation. External is preferred where physically possible as it ensures intermediate floors and dividing walls are fully insulated. Where boundary issues or sensitive brick finishes present a challenge, internal insulation is a good alternative.

Some also have cavity walls at the front than could be further insulated by filling the remaining cavity. Otherwise, adding additional or replacement internal insulation or adding external insulation would not be merited on economic grounds unless specific problems were identified.

Two house types (Strandmill Road) and Saint Anne's Square had cavity wall construction and so filling the cavity wall would be a primary wall insulation option. Additional internal or external insulation could be considered to top-up the cavity wall insulation.

Many house types have suspended timber floors which should be insulated whenever the opportunity arises.

Heating Controls:

Almost without exception, heating controls were less than required in all house types and this would be a very common finding. Thus, a heating controls upgrade meeting the SEAI Better Energy Homes specification, detailed in 7.4 below, is recommended.

5 Energy Audits of Domestic and Non-Domestic Buildings

5.1 **Methodology**

Energy audits were conducted on four large buildings:

- Portmarnock Sports and Leisure Centre
- Portmarnock AFC
- St. Helen’s National School
- Portmarnock Golf Club

Detailed energy audit reports were conducted and a separate report has been produced for each building.

5.2 Results

The content of the energy audit reports will not be repeated here but a range of improvements were recommended for each building, some with short to medium terms paybacks and others with very long-term paybacks.

Overall, Portmarnock has a wide range of non-domestic buildings and each has its own unique profile and building type. Thus, by way of contribution to a medium terms Energy Master Plan, one proposal to consider would be that each non-domestic business should conduct its own energy audit to set out its individual energy saving target looking out to 2030.

As a minimum, each non-domestic building should record and track their own energy use and CO_2 footprint annually.

6 Register of Opportunities

6.1 Assumptions

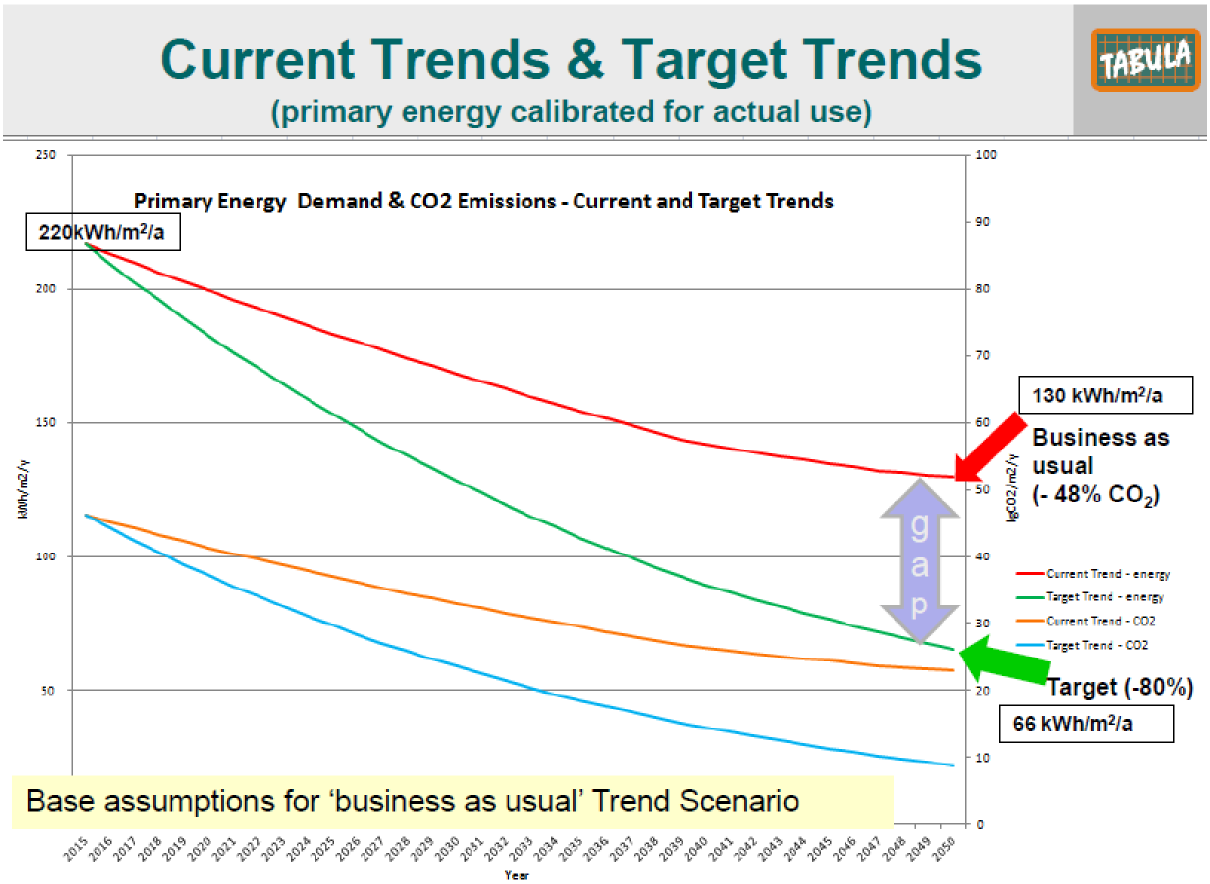
The original ambition of the RFQ was to propose actions, based on baseline figures, to achieve a 10% reduction in energy usage over 3, 4 & 5 year periods.

It is worthwhile to put this ambition into context.

In 2015, the authors of this report produced a report under the EU EPICOPE project based on a study of the required energy reduction for the housing stock of the north side of Dublin city by 2050. https://episcope.eu/fileadmin/episcope/public/docs/pilot_actions/IE_EPISCOPE_LocalCaseStudy_EnergyAction.pdf

The report concluded that to achieve an 80% reduction in greenhouse gas emissions by 2050, a deep retrofit to 75% of the housing stock to A2/A3 rating and a 75% decarbonisation of the grid would be required as shown in Figure 11.

Figure 11: EPISCOPE Projection for Northside of Dublin City to 2050



On 12th December 2020, at the UN Climate Summit, the EU committed to a 55% cut in greenhouse gas emissions by 2030. Separately Ireland has committed to a 7% reduction each year between 2020 and 2030.

The Irish Climate Action plan has set a target to reduce greenhouse gas emissions by 50% by 2030.

6.2 2025/ 2030 Residential Target

Several targets were evaluated and a decision was agreed within PSEC to set a target for a 4% reduction in residential energy per annum out to 2030. :

The average dwelling in Portmarnock has a primary energy of 202 kWh/ m^2 /year.

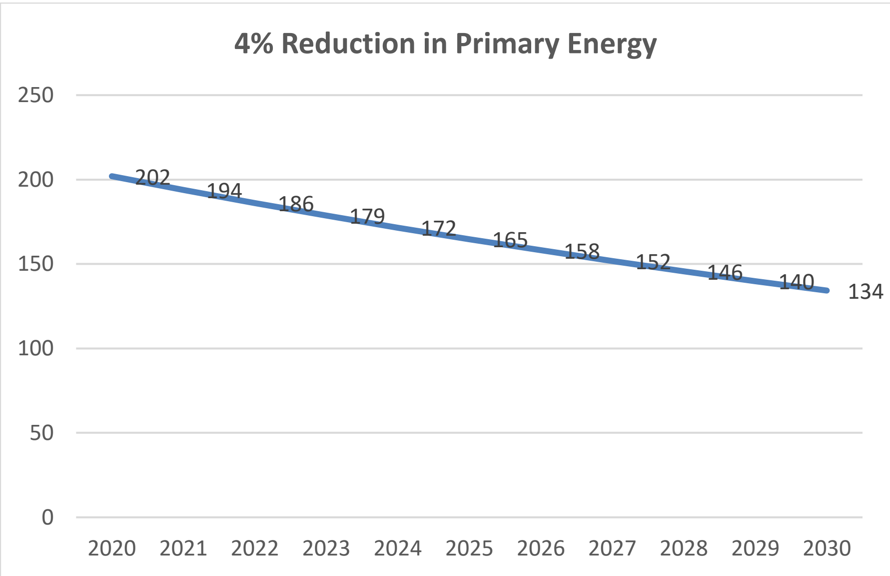
A 4% reduction per annum would result in an 18% cumulative reduction by 2025 and 34% reduction by 2030 with respective primary energy values shown in Table 19.

Table 19: 4% reduction in Residential BER average

Year	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Primary Energy (kWh/m2/year)	202	194	186	179	172	165	158	152	146	140	134
		-4%	-8%	-12%	-15%	-18%	-22%	-25%	-28%	-31%	-34%

The trend is illustrated in Figure 12.

Figure 12: 4% Reduction Trend Per Annum



6.3 Residential Strategy for 5 Year Plan (2021-2025) & Retrofit Targets

The key focus of the Energy Master Plan will be the 2,000 dwellings (1,977 to be exact as mentioned in Section 2.3) that were built up to 1983. The vast bulk of these were built prior to Building Regulations requiring any form of insulation.

While Table 2 shows the counts and range of BERs for this age band and approximately 200 dwellings in the pre-1983 band have a rating of C3 or better. It is probable that the majority of those better BERs were produced as part of energy upgrade grant works. Thus, it can be concluded that 1,800 of the pre 1983 dwellings will have ratings of D1 or worse, and would be similar to the eight typology case studies.

The eight typologies can be broken into two categories:

- Strandmill / St Anne's Square: cavity wall construction with solid floors – all uninsulated
- Carrickhill, The Dunes, Limetree etc: hollow block wall construction with suspended timber floors – all uninsulated

The focus for retrofit should be on the older pre 1982 stock in the 2021-2025 period. There will be also be opportunities to upgrade some of the newer stock. For example, much of the stock post 2000 would be suited to converting to heat pumps when replacing boilers between now and 2030.

To create a strategy model for 2025 and 2030, the following needs to be taken into account:

- **Current state**: 1500 dwellings have BER certs with an average primary energy value of 202 kWh/ m^2/annum.

- **Additional BER per annum (2021-2025)**:

  The number of new BERs published per annum over the last 5 years are shown in Table 20. On average, 150 new BERs (approx..) were published per annum over the last 5 years.

  Table 20: BER published each year- last 5 years

	New BERs Per Annum
2015	138
2016	104
2017	201
2018	155
2019	146
Average	**148.8**

  Thus, it is reasonable to assume, 750 additional residential BERs will be published each year over the next 5 years.

  For the purposes of modelling, it will be assumed that these BERs will also have an average primary energy value of 202 kWh/ m^2/annum.

- **New Dwellings (2021-2025)**:

  A potential additional 900 new dwellings are predicted to be constructed in the next 4/5 years.

  All new dwellings are required to meet the 2019 Technical Guidance Document Part L NZEB standard. It will be assumed that these new dwellings will each have a primary energy value of 50 kWh/ m^2/annum.

Retrofit Scenario 1 (excluding New Dwellings) -

Scenario 1 is based on the following assumptions:

- 750 additional residential BERs will be published each year over the next 5 years. Assumed average primary energy is 202 kWh/ m^2/year.
- 25% of existing dwellings with BERs of D1 or worse are upgraded (= total number 125)
- 525 additional dwellings of the pre 1983 stock are upgraded. Thus 650 dwellings in total will be upgraded falling into three separate categories of measures as indicated in Table 21.

Table 21: Retrofit Targets 2021-2025

Category	Measure	Number of homes upgraded	New Rating
1	Roof insulation, new condensing boiler and heating controls	**150**	C3
2	Standard measures package (roof insulation, internal or external wall insulation, boiler and heating controls, wood stove)	**350**	B2
3	Advanced Measures (Standard with heat pump and whole house ventilation)	**150**	A3
	Total Dwellings upgraded	**650**	

The impact of this combination of assumptions would be to achieve an average primary energy per dwelling at 173.5 kWh/m^2 /year by 2025. This is short of the 4% target of 165 kWh/ m^2 /year required by 2025 for the 4% per annum reduction target but the shortfall could be met by other investments such as PV installations or it could be made up by additional retrofit measures from 2026 -2030.

Table 22: 2025 Scenario 1

Row Labels	G	F	E2	E1	D2	D1	C3	C2	C1	B3	B2	B1	A3	A2	Grand Total
2020 total	24	53	69	70	130	155	145	221	217	160	61	19	148	28	1500
Upgrades on 25% of D1 or worse: 2021-2025	-6	-13	-17	-18	-33	-39									-125
Altered 2020 Total	18	40	52	53	98	116	145	221	217	160	61	19	148	28	1375
2021-2025 - additional BERs								750							750
2021-2025 upgrades only								150			350		150		650
2025 - Estimated BER Count	18	40	52	53	98	116	145	1121	217	160	411	19	298	28	2775
Primary Band (kWh/m2/year)	475	415	360	320	280	245	215	185	165	135	115	85	65	35	
Primary Band (kWh/m2/year) - all BERs	8,550	16,496	18,630	16,800	27,300	28,481	31,175	207,385	35,805	21,600	47,265	1,615	19,370	980	481,453
Average Primary Energy (kWh/m2/year)															173.51

This data is Table 22 is shown in full in Appendix D.

Scenario 2 (including New Dwellings)

Scenario 2 will include the 900 new dwellings that will possibly be built by 2025. So scenario 2 is based on the following assumptions:

- 750 additional residential BERs will be published each year over the next 5 years. Assumed average primary energy is 202 kWh/ m^2/year.

- 25% of existing dwellings with BERs of D1 or worse are upgraded (= total number 125)
- 525 additional dwellings on of the pre 1983 stock are upgraded. Thus 500 dwellings in total will be upgraded falling into three separate categories of measures as indicated in Table 21.
- 900 new dwellings with a primary energy value of 50 kWh/ m^2/annum.

Table 23: 2025 Scenario 2

Row Labels	G	F	E2	E1	D2	D1	C3	C2	C1	B3	B2	B1	A3	A2	Grand Total
2020 total	24	53	69	70	130	155	145	221	217	160	61	19	148	28	1500
Upgrades on 25% of D1 or worse: 2021-2025	-6	-13	-17	-18	-33	-39									-125
Altered 2020 Total	18	40	52	53	98	116	145	221	217	160	61	19	148	28	1375
2021-2025 - additional BERs							375	375							750
2021-2025 upgrades only								200			300		150		650
New Build 2025													450	450	900
2025 - Estimated BER Count	18	39.75	51.75	52.5	97.5	116.25	520	796	217	160	361	19	748	478	3675
Primary Band (kWh/m2/year)	475	415	360	320	280	245	215	185	165	135	115	85	65	35	
Primary Band (kWh/m2/year) - all BERs	8,550	16,496	18,630	16,800	27,300	28,481	111,800	147,260	35,805	21,600	41,515	1,615	48,620	16,730	541,203
Average Primary Energy (kWh/m2/year)															147.28

The impact of this combination of assumptions is markedly different due to the impact of the new dwellings. This scenario would achieve an average primary energy per dwelling at 147 kWh/ m^2 /year. This would equate to a 6% per annum reduction overall by 2025.

Summary:

Looking at both residential scenario 1 and scenario 2 provides a useful understanding of the scale of work required to upgrade the existing stock. When new dwellings are added to the model, they can be seen to enable targets to be achieved – but it would be unwise to use the impact of the new stock to deflect attention away from the task needed to improve the performance of the older inefficient housing stock.

Thus, given that the new housing stock is still at a planning stage and thus not yet confirmed, for the purposes of this EMP, scenario 1 will be adopted so that a firm focus will be placed on improving the poor performance of the older stock.

6.4 Commercial and Public Building Strategy

Due the range of energy usage patterns of typical businesses and public buildings, it is more challenging to both establish current energy usage and CO_2 emissions and then to set out energy retrofit /reduction targets.

The baseline energy usage and CO_2 emissions for commercial and public building are set out in Section 3.2. The current total annual energy usage for commercial and public buildings in estimated at 16,200,000 kWh or 16.2GWh (gigawatt-hours).

It is proposed that a 4% annual energy reduction target also be set for commercial and public buildings.

This would result in the reduction target shown in Table 24.

Table 24: 4% reduction in Commercial/ Public Building Energy Usage

Year	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Primary Energy (GWh/m2/year)	16.20	15.55	14.93	14.33	13.76	13.20	12.68	12.17	11.68	11.22	10.77
		-4%	-8%	-12%	-15%	-18%	-22%	-25%	-28%	-31%	-34%

The commercial / public building programme requires a specific plan that would include:

- Provide a simple energy saving menu for local businesses in conjunction with local business association. PSEC plans to engage a consultant to carry out high level assessment and prepare menu of behavioural energy saving measures for businesses including tracking energy use.
- Promote energy auditing and setting of long-term energy saving targets by local businesses to follow up on initial energy savings measures.

6.5 Transport Strategy

The latest estimates put the total number of electric vehicles (EVs) on Irish roads at slightly over 10,000 – that's less than half of 1 per cent of the 2.7 million internal combustion vehicles in the country at the moment.

While the public may not have taken to EVs in large numbers, the Climate Action Plan has set a target of increasing the number of EVs on the roads to 1 million by 2030 – that's an increase of 990,000 or an average of about 100,000 a year give or take the odd 5,000 here or there.

That's a tall order and the early signs of the target being achieved are not good, and that's putting it mildly. Despite grants of around €10,000 per car and free public charging until fairly recently, sales have been sluggish.

Just 3,443 electric cars were registered in 2019. That was out of a total of 117,000 new cars sold in the country that year. For the first six months of 2020 sales of EVs totalled 1,992. On those figures we are only about 96,000 cars a year short of making the target.

In order to model the energy profile for transport out to 2030, the following assumptions have been made:

- The proportion of EVs in the total stock with increase to 20% by 2030. This is ambitious tough it is short of the Government target of 37% EV share of the total stock by then.
- Motor vehicle stock has a shorter life than building stock and it is upgraded annually with more energy efficient models. So what reduction in energy use and CO_2 emissions can be expected in the coming years? Codema has advised that a very good source for average new car emissions is the European Environment Agency. The dashboard facility on this page is quite useful to compare Ireland against the rest of Europe and allows you to select each individual fuel type. http://co2cars.apps.eea.europa.eu/ .For estimating future emissions, the EU emissions requirements are given for the average across a manufacturer's entire fleet, and assume a certain percentage of EVs to bring the average down. So for internal combustion engine (ICE) emissions, Codema is not projecting much of a decrease out to

2030, particularly due to the increased proportion of SUVs being sold. Working off the assumption that the 2019 new car emissions will represent the average ICE car on the road in 2030, this represents a reduction from 167 gCO_2/km now to 144 gCO_2/km by 2030. For the purposes of this study it is being assumed that the efficiency of the petrol/ diesel stock will improve by 15% by 2030.

- The Covid pandemic has dramatically reduced motorised transport activity due to home working and travel restrictions. It is not clear what the longer term impact will be though it is clear that there will be a higher level of home working and remote meetings post pandemic with a resultant reduction in travel. However, as such impacts are not estimable right now, they will not be included in this current model.

Table 14 estimates current energy use for transport at 57,000,000 kWh or 57 GWh.

Assuming a 20% EV market share by 2030, Table 25 shows the results split in car types.

Table 25: Vehicles by Type (2030)

Total Cars: 5214	petrol	diesel	BEV
	45.6%	34.4%	20%
5,214 Cars split	2,378	1,794	1,043

Combining the data in Table 25 and Table 13 (including a 15% improvement in the efficiency of petrol/ diesel vehicles) enables the annual energy use and CO_2 emissions for Portmarnock transport fleet by 2030 to be estimated in Table 26.

Table 26: Transport: Annual kWh and CO_2 emissions estimate

Total Cars (5,214) - 2030	**Petrol**	**Diesel**	**Battery EV**	**Totals**
National annual average km	12,113	19,681	12,958	
kWh per car/annum	7,516.12	11,710.20	4,185.43	
kg CO_2 per car/annum	1,719	2,794	716	
5,214 Cars split	2378	1794	1043	
kWh -all cars/a	17,870,198	21,003,593	4,364,571	43,238,362
CO_2 - all cars/a	4,088,114	5,010,857	746,571	9,845,542

The net result would be a 25% reduction in transport energy and CO_2 emissions by 2030. This is equivalent to a 3% reduction in transport energy use per annum as shown in Table 27.

Table 27: 3% reduction in Transport Energy Usage

Year	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Primary Energy (GWh/m2/year)	57.01	55.30	53.64	52.03	50.47	48.95	47.49	46.06	44.68	43.34	42.04
		-3%	-6%	-9%	-11%	-14%	-17%	-19%	-22%	-24%	-26%

6.6 EMP Target Summary

The individual targets are summarised in Table 28 and presented in figure 13.

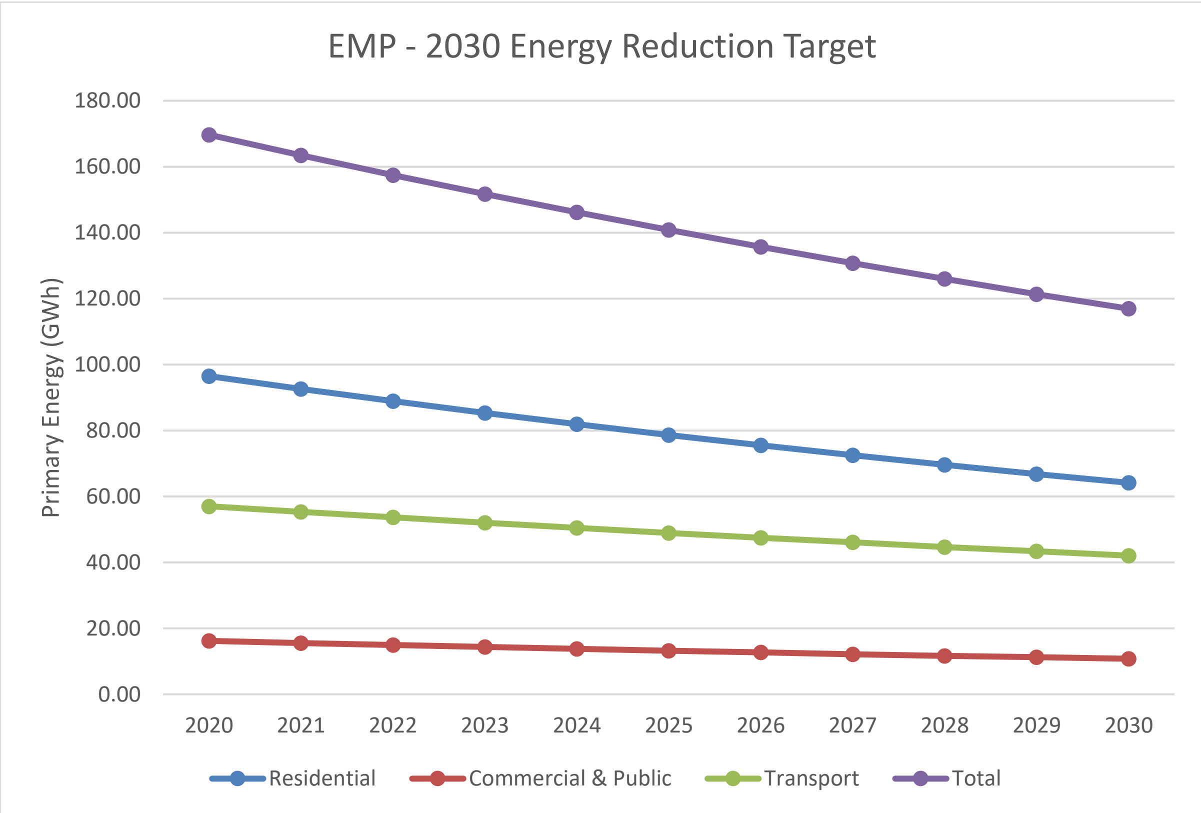
Table 28: Summary of Annual Energy Reduction Model Targets.

Primary Energy (GWh/m2/year)	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**
Residential	96.47	92.61	88.91	85.35	81.94	78.66	75.51	72.49	69.59	66.81	64.14
Commercial & Public	16.20	15.55	14.93	14.33	13.76	13.20	12.68	12.17	11.68	11.22	10.77
Transport	57.01	55.30	53.64	52.03	50.47	48.95	47.49	46.06	44.68	43.34	42.04
Total	**169.68**	**163.46**	**157.47**	**151.71**	**146.16**	**140.82**	**135.68**	**130.72**	**125.96**	**121.36**	**116.94**

The net overall reduction from 169.68 GWh to 119.94 GWh is 31%.

The specific analysis of current conditions and proposed measures in all three sectors can be revisited and revised over time to fine tune target setting.

Figure 13: 2030 Energy Reduction Target



6.7 Register of Opportunities Results

The recommended lists of actions, both practical measures and behavioural measures are summarised in the Register of Opportunities (RoO).

The RoO comes in two parts:

1. The PSEC prepared a table of actions, including behavioural measures, and these are listed in Appendix F.
2. The report authors populated the SEAI RoO template with both the specific energy efficiency measures identified in the residential strategy and the measures recommended in the public building audits. The RoO also contains the key opportunities proposed by the PSEC including the behavioural measures.

The purpose of the RoO is to summarise the key measures, and the associated estimated annual savings and the net capital costs.

7 Supporting Information on Measures & Technologies

While many of the recommended measures are well known, additional information is provided below on the less well-known technologies.

7.1 External Wall insulation

Houses built using 9 inch (225mm) solid wall or hollow block (block with hollow centre) construction methods, and where the walls are not insulated, should consider either external or internal wall insulation. External wall insulation is recommended where there are no issues with boundary walls or potential issues with traditional brick finishes.

External Wall Insulation (EWI) involves fixing insulating materials such as mineral wool or expanded polystyrene slabs to the outer surface of the wall. The insulation is then covered with a special render to provide weather resistance. A steel or fibreglass mesh is embedded in this render to provide strength and impact resistance. External insulation systems can also solve additional problems (other than poor levels of insulation) suffered by some homes such as rain penetration, poor air-tightness or frost damage.

Homeowners availing of wall insulation grants under the SEAI Better Energy Homes are required to install wall insulation which should achieve a U-value of 0.27 W/m^2K or better (i.e. lower). The external insulation product installed must be NSAI Agrément Certified.

7.2 Internal Wall Insulation

Internal insulation (sometimes referred to as 'dry-lining') involves fixing insulation to the inner surfaces of external walls.

This usually involves fixing an insulation board to the walls and covering it with a vapour barrier layer and plasterboard. One of the main disadvantages of internal insulation is the loss of room space; this may be minimized by using high performance insulation products that are thinner. While this is often a more affordable option than installing external wall insulation, the loss or space and potential necessity to take out and re-fit fitted kitchens and appliances can result in people choosing the external insulation option.

7.3 Cavity Wall Insulation

A cavity wall consists of two rows of bricks or concrete block with a cavity or space between them. If a house was built before the mid 1980's and has cavity walls, it is possible that the cavity may not contain insulation. Injection of insulating product from the outside is the best method for insulating this type of wall. Cavity wall construction is less common in Dublin and surrounding counties.

7.4 Heating Controls Package

To subdivide the home into independently controlled space heating and water heating zones, motorized controlled valves must be installed, along with at least one room thermostat and or thermostatic radiator valves (TRVs), a hot water cylinder thermostat (if required) and a 7-day programmable timer. The cylinder and room thermostats can then operate to create a boiler interlock to ensure your boiler only operates when required.

7.5 Air-to Water Heat Pump

In the last decade **air-to-water heat pumps** have become a popular renewable choice for heating and hot water systems, suitable for new and retrofit projects. As this is a relatively new technology, a lot of questions arise which give rise to many misconceptions.

What is a Heat Pump and what is an Air-to-water heat pump?

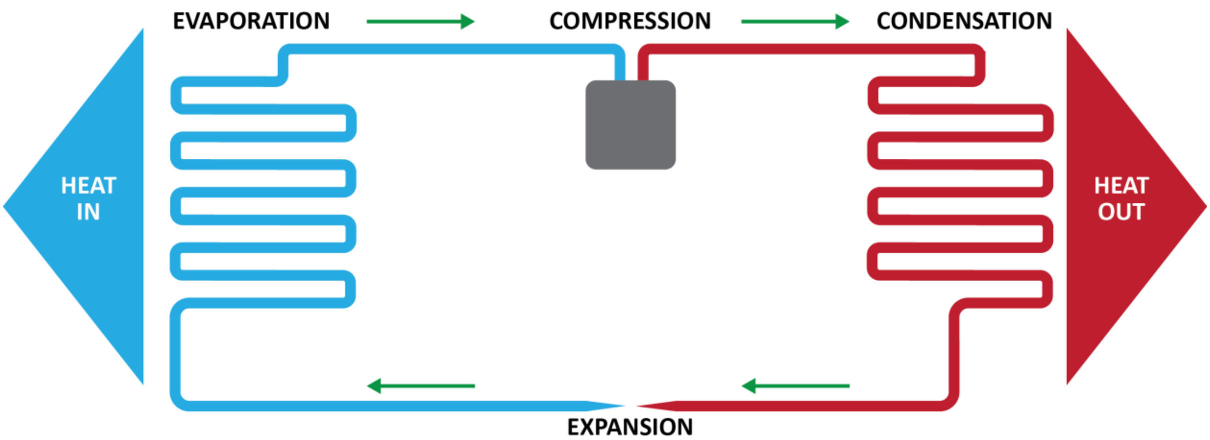
Heat Pump technology is being used in one of the most common appliances in our homes – the fridge. The principle of a heat pump is to move energy by the means of electricity, refrigerant gas and a compressor and in doing so, can provide both space heating, hot water and cooling.

To cool, the heat pump extracts heat from a warmer ambient e.g. the food in the fridge; and dumps it. To heat, the heat pump extracts heat from the air outside our homes and tranfers it inside our homes.

An AIR-TO-WATER heat pump transfers the heat obtained from the outside air to the water in our heating systems.

How does the Air-to-water heat pump work?

Air passes the heat exchanger outside called the EVAPORATOR and the refrigerant gas absorbs heat from outside air and evaporates. The vapour passes into the compressor and by compression increases its temperature and pressure. Hot vapour is condensed in the 2nd heat exchanger, the heat being passed via water to the space heating or domestic hot water system. The liquid refrigerant passes back through the expansion valve, reducing its pressure ready to start the cycle again.



What happens when outside temperature are very low?

Most air-to-water heat pumps are equipped with an electrical back-up heater, which can be programmed to provide heating when external temperatures fall below a specified point. This point is called equilibrium temperature and is usually set at -3 °C but in most cases the electrical back-up is not required for heating at all. Traditionally, manufacturers in the heat pump industry have their air-to-water heat pumps designed to suit the European climate working even at outdoor temperatures of -25 °C.

What is the efficiency of an the Air-to-water heat pump?

A heat pump's efficiency is often referred to as a **Coefficient of Performance (COP).** The COP describes the **ratio of electrical power used to heating power produced** under fixed input and output conditions by the heat pump unit only. A COP is used for examining the performance of a heat pump unit at ideal test conditions, usually in a laboratory.

A COP of 4 means for every 1kW of electrical energy used, 4kW of useful energy is produced – a net 3kW of useful energy will be 'free' generated by the heat pump. The COP decreases with falling ambient air temperatures and rising flow temperatures.

The Seasonal Performance Factor (SPF) or Seasonal Coefficient of Performance (SCOP) describes the ratio of the amount of electrical energy used by all components associated with the heat pump system, to the amount of heat energy delivered to the heating system, over a long period of time (e.g. season or year).

SPF is a better indicator of performance for the purposes of examining the "real-life" performance of a heat pump than COP and takes into account the full heating system installed.

Does the type of heat emitter have an affect on the SPF?

SPF values may vary depending on the type of heat emitters used and aiming for a low flow temperature will result in high SPF figures. Ideally with an Air-to-water heat pump we should use an UFH – underfloor heating system because this only requires flow temperatures up to 35°C, resulting in SPFs over 500%.

We can also use low temperature radiators, aluminium or steel panel or fan coils which require flow temperatures up to 55 °C, resulting in SPF's around 400%.

The hot water production efficiency though for any heat pump it is not that high due to the high flow temperature required to heat water. This figure is in around the 200% mark and takes into account that most air-to-water heat pumps require an electrical immersion to raise the temperature in the tank to 60 °C, as an anti-legionella protection.

Are there any specific requirements when applying for a heat pump grant?

SEAI launched a new heat pump grant in April 2018. Before applying for the heat pump grant, a homeowner must be able to demonstrate their house has good levels of insulation and air tightness. The homeowner needs to engage the services of an SEAI registered Technical Advisor to perform an energy audit and BER calculation to prove that total heat loss is less than or equal to 2 Watts/m^2 as calculated in the BER software. More details are available on https://www.seai.ie/grants/home-grants/better-energy-homes/heat-pump-systems/

7.6 Demand Control Ventilation

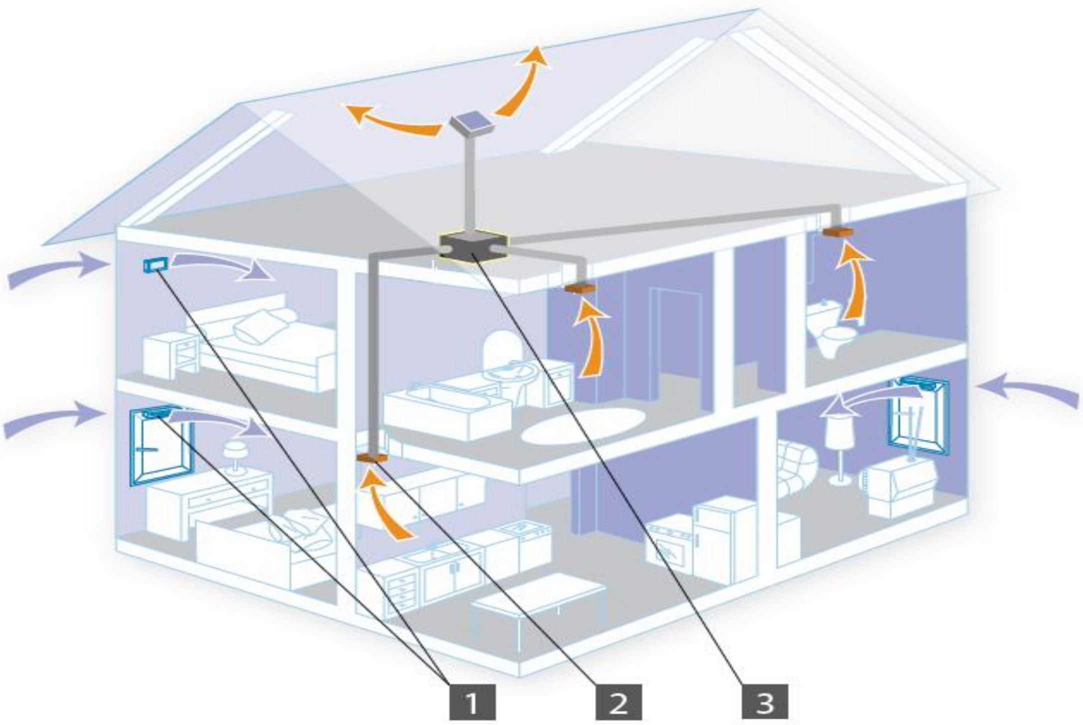
Demand control ventilation (DCV) provides a smart whole-house ventilation system. DCV is particularly appropriate in retrofit projects as it avoids the needs for extensive ductwork associated with mechanical heat recovery ventilation (MHRV) systems.

DCV works using humidistat-based vents in bedrooms and living rooms. These vents have a clever material strip that expands and opens the vents wider when humidity levels are higher and contracts and thus closes the vent again when humidity levels are returned to normal. These inlet vents have no mechanical or electrical parts.

DCV uses extract grilles to take air away from wet rooms like kitchens and bathrooms in ducts connected to a central point. A central fan exhausts unwanted air out of the building.

Both the inlets and the extract grilles react to indoor air quality (IAQ) and thus adjust the rate of airflow; the fan detects these changes in pressure, which means there are no cables or controls needed, and adjusts its running speed accordingly. The fan is typically very quiet (about the same as a PC) and uses minimal electricity (about the same as a low energy light bulb). It does not require filter changes or regular servicing.

1. Air inlets - supply fresh air
2. Extract grilles – take air from wet rooms
3. Fan – exhausts air from the building



7.7 Solar Thermal

Solar thermal can meet 50% of a home's hot water needs. While solar thermal has not featured in the three packages created for the PORTMARNOCK SEC, it is, of course, a worthy renewable option.

Solar thermal is unlikely to be included in a deep retrofit package as it would not be possible in most cases to achieve A3 without the use of a heat pump (which also provides 100% of hot water needs all year round). Solar thermal could, very logically, be added to a standard retrofit upgrade when used in conjunction with a conventional gas or oil boiler.

7.8 Solar Photovoltaic (PV)

Solar PV panels generate electricity that is then fed via an inverter into the home's distribution board. It is important that the number of PV panels and thus the power generated in watts matches the base/ minimum electrical load of the house.

As well as supplying electricity for normal household devices, PV-generated electricity can also be used to supply heat pumps, electric car batteries and also can be diverted to electric immersions in hot water tanks. New battery technologies will also enable some of the electricity generated to be stored.

It is expected that a feed-in tariff for the export of electricity generated in homes to the ESB network will be introduced during 2021. There is no indication yet as to the tariff levels, but it unlikely to be set at a level where a homeowner would profit from exporting electricity.

7.9 BER Evidence

All building owners need to be aware that they should retain appropriate technical evidence if they get energy efficiency works carried out so that this evidence can be used for any future BER certification. That is particularly important if these works are done outside of the SEAI grant process. BER assessors are subject to strict proofs of evidence and a comprehensive auditing regime.

So, for example, if new windows are installed, it is vital to ensure the window suppliers provide test certificates meeting SEAI standards. Or if internal wall insulation or say flat roof insulation is carried out, it is important to make sure that a formal statement is provided by the installer confirming exactly what product type and what thickness of insulation was installed. If this quality evidence is not available to the BER assessor, the latter will need to use more conservative default values which will results in a poorer BER score.

Appendix A – Retrofit Calculator:

Variant	BER	Energy (kWh/m²/y)	Running Costs Calculation (kWh/y per fuel): Main SH	Sec SH	Main WH	Suppl WH	Pumps/fans	Lighting	Calib. Fac	Energy costs	Savings	Investment costs	SEAI Grants	Costs inc. grants	Payback (years)
Current state	F	400.08	44553 Oil	4711 Smokeless	4606 Oil	1051 Electricity	299 Electricity	344 Electricity	0.75	€ 3,063	N.A.	N.A.	N.A.	N.A.	N.A.
Starter package	D2	299.74	32063 Oil	3570 Smokeless	4415 Oil	0 Electricity	260 Electricity	298 Electricity	0.9	€ 2,606	€ 457	€ 3,612	€ 1,100	€ 2,512	5.5
Standard measures	B3	133.06	11779 Oil	1906 Smokeless	4192 Oil	0 Electricity	260 Electricity	298 Electricity	1	€ 1,350	€ 1,713	€ 41,109	€ 7,100	€ 34,009	19.9
Advanced measures	B1	85.54	4235 El.HP.SH	1726 Smokeless	843 El.HP.Water	0 Electricity	130 Electricity	298 Electricity	1	€ 942	€ 2,121	€ 81,079	€ 9,900	€ 71,179	33.6

Proposed measures & costs breakdown

Measure	Starter	Standard	Advanced	Area (m2)	Starter	Standard	Advanced
Attic insulation	☑	☑	☑	95.6	€ 1,912	€ 1,912	€ 1,912
Sloping Roof ins.	☐	☐	☐		€ -	€ -	€ -
Flat Roof ins.	☐	☐	☐		€ -	€ -	€ -
Cavity fill	☐	☐	☐		€ -	€ -	€ -
IWI	☐	☐	☐		€ -	€ -	€ -
EWI	☐	☑	☑	159.2	€ -	€ 33,432	€ 33,432
Susp. Floor insul.	☐	☐	☑	96	€ -	€ -	€ 4,320
2G Windows	☐	☐	☐		€ -	€ -	€ -
3G Windows	☐	☐	☑	42.9	€ -	€ -	€ 21,450
Doors	☐	☑	☑	1.95	€ -	€ 1,365	€ 1,365
Condensing Boiler	☐	☑	☐	N.A	€ -	€ 2,700	€ -
Heating Controls	☑	☑	☐	N.A	€ 1,600	€ 1,600	€ -
Wood Stove	☐	☐	☐	N.A	€ -	€ -	€ -
AS Heat Pump	☐	☐	☑	N.A	€ -	€ -	€ 15,500
MVHR	☐	☐	☐	N.A	€ -	€ -	€ -
DCV & AT measures	☐	☐	☑	N.A	€ -	€ -	€ 3,000
Photovoltaics	☐	☐	☐	N.A	€ -	€ -	€ -
Project Mgt	☐	☐	☐	N.A	€ -	€ -	€ -
Low energy lights	☑	☑	☑	N.A	€ 100	€ 100	€ 100
					Starter	**Standard**	**Advanced***
Totals:					€ 3,612	€ 41,109	€ 81,079
Grants					€ 1,100	€ 7,100	€ 9,900

Typical Current Conditions (modest upgrades only to date)

Type	Detached	1975	Carrickhill Heights	Version	v2
Walls	Hollow block/Cavity				
Floor	Suspended floor				
Roofs	75mm of fibre insulation at ceiling level				
Windows	PVC, double glazed, 6mm gap				
Doors	Partialy glazed				
Ventilation	Natural. Chimneys and extract fans				
Heating system	Central heating oil boiler, 73% efficient. Closed room heater (solid)				
Space & Htg Controls:	Programmer and TRVs				
Hot water tank	117L, 35mm spray foam, no cylinder stat				

Appendix B - Brochure

Portmarnock SEC House Type 3: Carrickhill Heights

Typical House - Current Conditions (modest upgrades only to date)	
Type	Detached
Year built	1975
Walls	Hollow block/Cavity
Floor	Suspended timber ground floor
Roofs	150mm of fibre insulation at ceiling level.
Windows	PVC, double-glazed, 6mm gap.
Doors	Double-glazed rear door
Ventilation	Natural ventilation with chimney and extract fans
Heating system	Oil boiler, 70% efficient. Solid Fuel room heater (closed front).
Heating Controls	Programmer and TRVs
Hot water tank	96 litre, 35mm lagging jacket, no cylinder thermostat
Original Condition: room heater with back boiler, no heating controls	

Upgrade Measures Package 1: The Starter

	Measures
1	Roof insulation at ceiling level (increase to 300mm)
2	Heating Controls*
3	Low energy lights

Optional step A: Carry out sensible **a**ir-tightness steps to minimise draughts.
- Draught-proof front & rear door / porch if required
- Draught-proof hot-press pipe holes, attic hatch door, install chimney balloons

Optional step B: Upgrade existing double glazing with new low e glass
Replace old double-glazing with more efficient up-to-date double glazing by replacing the glass panels. Must be evaluated on a case by case basis to assess existing frames and quality of window installation.

Optional step C:
Partial internal / external wall insulation for selected colder rooms (improves energy efficiency but no grant available).

***Heating controls would need to be further upgraded if heap pump is installed later**

Upgrade Measures Package 2: Standard Retrofit

	Measures
1	Roof insulation at ceiling level (increase to 300mm)
2	External insulation to walls
3	New Condensing boiler
4	Heating controls
5	New Doors
6	Low energy lights

Upgrade Measures Package 3: deep Retrofit*

	Measures
1	Roof insulation at ceiling level (increase to 300mm)
2	External insulation to walls
3	New triple glazed windows (U=0.9)
4	New Doors
5	Heat Pump
6	Low energy lights

BER and Financial Analysis

Variant	BER	Energy costs	Savings	Investment costs	SEAI Grants	Costs inc. grants	Payback (years)
Current state	F	€ 4,084	N.A.	N.A.	N.A.	N.A.	N.A.
Starter package	D2	€ 2,896	€ 1,188	€ 2,656	€ 1,000	€ 1,656	1.4
Standard measures	B3	€ 1,350	€ 2,734	€ 29,492	€ 7,000	€ 22,492	8.2
Advanced measures	B1	€ 942	€ 3,142	€ 61,697	€ 30,849	€ 30,848	9.8

Important to Note:

1. All measures are presented in a logical order. Ideally it is important to address all insulation, window and air tightness upgrades first of all to minimise heat loss.
2. Heat pumps should only be considered after minimal heat loss has been achieved.

Appendix C

Industry-Average Cost of Measures

Measure Pricing (Industry Average)	
Attic insulation (m^2)	€ 20
Sloping roof insulation (m^2)	€ 90
Flat roof insulation (m^2)	€ 115
Cavity fill insulation (m^2)	€ 15
Internal wall insulation (m^2)	€ 110
External wall insulation (m^2)	€ 210
Suspended floor insulation (m^2)	€ 45
2G Windows (m^2)	€ 450
3G Windows (m^2)	€ 500
Doors (m^2)	€ 700
Condensing boiler	€ 2,700
Heating controls package	€ 1,600
Wood stove	€ 4,000
Air-to-water Heat Pump	€ 15,500
Demand Control Ventilation	€ 3,000
Photovoltaic panels (4 units)	€ 6,000
Solar thermal (2 m^2)	€ 7,500

Appendix D

2025 Projections – Excluding New Build

Row Labels	G	F	E2	E1	D2	D1	C3	C2	C1	B3	B2	B1	A3	A2	Grand Total
2020 total	**24**	**53**	**69**	**70**	**130**	**155**	**145**	**221**	**217**	**160**	**61**	**19**	**148**	**28**	**1500**
Upgrades on 25% of D1 or worse: 2021-2025	**-6**	**-13**	**-17**	**-18**	**-33**	**-39**									**-125**
Altered 2020 Total	**18**	**40**	**52**	**53**	**98**	**116**	**145**	**221**	**217**	**160**	**61**	**19**	**148**	**28**	**1375**
2021-2025 - additional BERs								**750**							**750**
2021-2025 upgrades only								150			350		150		650
2025 - Estimated BER Count	18	40	52	53	98	116	145	1121	217	160	411	19	298	28	**2775**
Primary Band (kWh/m2/year)	**475**	**415**	**360**	**320**	**280**	**245**	**215**	**185**	**165**	**135**	**115**	**85**	**65**	**35**	
Primary Band (kWh/m2/year) - all BERs	8,550	16,496	18,630	16,800	27,300	28,481	31,175	207,385	35,805	21,600	47,265	1,615	19,370	980	481,453
Average Primary Energy (kWh/m2/year)															**173.51**

Appendix E

2025 Projection –Including New Build

Row Labels	G	F	E2	E1	D2	D1	C3	C2	C1	B3	B2	B1	A3	A2	Grand Total
2020 total	**24**	**53**	**69**	**70**	**130**	**155**	**145**	**221**	**217**	**160**	**61**	**19**	**148**	**28**	**1500**
Upgrades on 25% of D1 or worse: 2021-2025	**-6**	**-13**	**-17**	**-18**	**-33**	**-39**									**-125**
Altered 2020 Total	**18**	**40**	**52**	**53**	**98**	**116**	**145**	**221**	**217**	**160**	**61**	**19**	**148**	**28**	**1375**
2021-2025 - additional BERs							**375**	**375**							**750**
2021-2025 upgrades only								200			300		150		650
New Build 2025													450	450	900
2025 - Estimated BER Count	18	39.75	51.75	52.5	97.5	116.25	520	796	217	160	361	19	748	478	**3675**
Primary Band (kWh/m2/year)	**475**	**415**	**360**	**320**	**280**	**245**	**215**	**185**	**165**	**135**	**115**	**85**	**65**	**35**	
Primary Band (kWh/m2/year) - all BERs	8,550	16,496	18,630	16,800	27,300	28,481	111,800	147,260	35,805	21,600	41,515	1,615	48,620	16,730	541,203
Average Primary Energy (kWh/m2/year)															**147.28**

Appendix F

Register of Opportunities and Ranking

Type	Cost	Impact – Energy and cost Reduction	Impact – CO_2 Reduction	Delivery Time Frame
Behavioural 1: Cycling and Walking to School	Cost - Low €2,500 Leaflet, Web Brochure, Facebook Page	Aim - 50% Reduction in Car use delivering children to school	Survey of current car numbers 1 survey per term 2021/22/23	2 years
Behavioural 2: Cycling Commuters to Portmarnock DART Station	Cost - Low €800 Market survey at DART Station Survey Monkey online. €20 – €30,000 for secure bicycle storage Awareness campaign of DART phone apps	Aim – Reduction of 80 all-day cars in car park. Release parking spaces for those who wish to visit the city 4 – 5 hour duration	Reduction of car commutes to the station Reduce car use by short stay visitors to the city	2 – 3 years
Behavioural 3: Cycling Commuters into Dublin	Cost – Low €400 for Survey Monkey online (Fingal Co Co funding in place) Extension of Greenway through Portmarnock as far as the Martello Tower.	Reduction in Car Commuting into Dublin	Reduction in car commutes into the city	2 – 3 years
Behavioural 4: Publicise cycle rental and secure storage at Portmarnock DART station – already in place	No cost as can be publicised using social media and other promotional activities			
Behavioural 5 : Bus Use - Increase awareness of Bus services especially for OAP – bus pass/ family tickets	€200 Web Brochure and Facebook Page Improve awareness of bus Phone Apps	Reduction in car trips into Dublin and for sporting/cultural events		2 – 3 years
Behavioural 6: Electric Car, Scooter and Bicycle Review	Cost: €700 Web brochure reviewing benefits of			

Type	Cost	Impact – Energy and cost Reduction	Impact – CO_2 Reduction	Delivery Time Frame
	electric cars, scooters and bikes Model reviews Car transport updates			
Building Upgrade: Attic Insulation	€400/35% of cost per house €12,000 - €21,000 p.a. based on 30 houses per year	Impact: 10 – 25% reduction in heat loss depending on existing insulation	Impact – CO_2 reduction	5 years
Building Upgrade: LED replacement	€1,000 LEDs to be used for promotions at community events and online promotions	Impact: Small reduction in energy	Small reduction in CO_2	2 - 3 years
Microgeneration Review Project	€10,000 Engage a consultant to review the possibilities for small scale generation e.g. 1.Solar on land 2 – 5 ha. 2. Wind on open ground 3. Battery storage in conjunction with small scale generation			1 year
Energy: Golf Course Operations Maintenance Review	€30,000 Golf courses are major employers in Portmarnock. Review energy use to eliminate fossil fuel use for all equipment except tractors over a 10 – 15 year period Would serve as a national template for golf and all field sports in Ireland	Impact: Reduce energy use and costs	Reduce CO_2 emissions by c. 50 – 60%	2 years
Behavioural 7: Promote reduced home energy savings using energy saving tips and use of Home Energy Saving Kits. Encourage recording	No cost as Home Energy Saving Kits are available for loan from libraries and promotion of energy saving tips can be done with other activities	Cost Saving of €200,000 and 2,550,000 kWh (Target of 10% reduction in energy usage in 1,000 houses)	Reduce CO_2 emissions	1 year

Type	Cost	Impact – Energy and cost Reduction	Impact – CO_2 Reduction	Delivery Time Frame
of actual energy usage in homes				
Energy; Work with energy suppliers and local large business / community centre to install fast charging points for EVs	No cost to the community as charging points to be installed on a commercial basis by energy supplier			2 years
Building Upgrade: Community Grants Programme *Community Centre* – Wall insulation	€20,000	Savings of 90.000 kWh and €3,600 annually	Reduce CO_2 emissions by 18,540 kgCO2	1 year
Energy: Community Grants Programme *Community Centre* - Solar PV	€85,000	Savings of 122.000 kWh and €8,300 annually	Reduce CO_2 emissions by 63,318 kgCO2	1 year
Energy: Community Grants Programme *Primary Schools (2 no.):* Solar PV	€50,000	Savings of 45.000 kWh and €3,000 annually between 2 schools *Note: Used figures from St. Helens for St. Marnocks as they have similar pupil numbers*	Reduce CO_2 emissions by 9,342 kgCO2	1 year
Building Upgrade: Community Grants Programme *Primary School* LED Installation	€25,000	Savings of 26,000 kWh and €1,600 annually (one school only) *Note: Used only St Helens in case St. Marnocks have LED lighting already*	Reduce CO_2 emissions by 5,345 kgCO2	1 year

Type	Cost	Impact – Energy and cost Reduction	Impact – CO_2 Reduction	Delivery Time Frame
Behavioural 8: Provide simple energy saving menu for local businesses in conjunction with local business association	€1,000 Engage consultant to carry out high level assessment and prepare menu of behavioural energy saving measures for businesses including tracking energy use	Cost saving of €50,000 (Target of 5% annual savings in estimated energy cost)		1 year
Behavioural 9: Promote energy auditing and setting of long term energy saving targets by local businesses to follow up on initial energy savings	Cost ?? Assume €900 per audit – c €45,000 for 50 businesses.	Cost saving of €200,000 (Target of 20% further annual savings in estimated energy cost)		3 years
Behavioural 10: Set up and promote a Track my petrol /diesel use spreadsheet to allow people know their weekly /monthly spend and assess potential savings	No cost as the spreadsheet can be easily developed and promoted using SEC resources			1 year
Behavioural 11: Get Transition Year pupils to Use BERWOW to work out the cost of retrofitting their house as an energy saving awareness exercise.	No cost as using existing resources			1 year
Energy: Community Grants Programme Community School Solar PV	€1,000 for energy audit of community school to assess potential and cost			1 year

Appendix G

Definitions:

CODEMA: City of Dublin Energy Management Agency

EMP: Energy Master Plan

kWh: kilowatt-hour. Standard unit of energy equal to a 1kW or 1000 Watt load being powered for 1 hour.

GWh: Gigawatt-hour: equal to 1,000,000 kWh

ICE: internal combustion engine including all hybrids, including plug-ins

Primary Energy: In the energy world, energy can be categorised as delivered energy or primary Energy. Delivered energy is that delivered to the meters or oil storage tanks of a building and is the energy on which fuel bills are based. Primary energy included the delivered energy plus the energy required to transmit that energy from its fossil fuel source. All BER certificates are based on primary energy. The associated conversion factors from delivered to primary for most popular fuels are as follows:

	Primary Energy Conversion Factor	CO_2 emission Factor (kg/kWh)
Gas	1.1	0.203
Oil	1.1	0.272
Electricity	2.08	0.409
Wood logs	1.1	0.025
Smokeless fuel	1.2	0.392

RoO: Register of Opportunities – this is a standard SEAI excel template for listing recommended measures and actions