Shankill Energy Master Plan

Final Report

Report by IHER Energy Services, 8th March 2023

Author: Michael Hanratty

Version:10

Contents

1 Executive Summary

The Government's Climate Action Plan (2023) CAP 2023 re-establishes the target to achieve a e 51% reduction in Greenhouse Gas (GHG) emissions by 2030 from the 2018 baseline.

It provides updated sectoral targets for 2030 including:

- 40% reduction in emissions from residential buildings
- 45% reduction in emissions from commercial/ public buildings
- 50% reduction in transport emissions
- 75% reduction in emissions from the power generation sector by adopting large scale renewables

This Shankill Action Green Earth (SAGE) Energy Master Plan (EMP) addresses how the Shankill community can respond to national effort to meet the Climate Action Plan targets.

The Energy Master Plan presented in this report is an overall vision and will provide the local community with a clear pathway towards a low carbon future. This is possible if the recommendations in this report are implemented and built upon. The EMP sets out how we can reduce our energy demand through conscious actions in our households and through adopting a fabric first approach to upgrading the thermal efficiency of our homes. We can improve efficiency with low-energy lighting and heat pumps, and we can generate our own electricity with solar. We can plan to retrofit our homes to make them super energy efficient over time, while encouraging fully passive-housing construction. We can advocate for the decarbonisation of our transport and electricity grids. Our non-domestic building owners should adopt a similar strategy and there is a pathway to change how we travel to reduce energy use and carbon emissions.

Baseline Methodology (MH-bulk of text all moved to Introduction section)

The SAGE baseline was established using a mix of desk research using publicly available data from the Central Statistics Office, SEAI and elsewhere. In addition, energy audits were conducted on five houses and three non-domestic buildings.

Estimates of energy use in the local community buildings, schools, creches and commercial units have been estimated according to energy use benchmarks provided by SEAI. Three Ashrae Level 1 audits were conducted on non-domestic buildings to report on energy use and potential energy upgrade measures.

Estimates for energy use for transport have been estimated using commute length and mode data available in the census supplemented with data provided by Codema.

All of the data inputs were collated into an excel model that produced the summary baseline data in the Table below.

	CO2 (tonnes)	Total (kWh)	Energy Cost
Residential	25,242	**93,976,094**	€12,032,535
Non-residential	11,459	**45,777,516**	€1,668,100
Transport	15,711	**66,963,434**	€9,281,988
Total	**52,412**	**206,717,043**	**€22,982,623**

The baseline model indicates that within the SAGE study boundary, the residential sector accounts for 48% of CO_2 emissions, with non-residential and transport accounting for 22% and 30% respectively.

Residential Energy related carbon emissions have been estimated at 25,242 tonnes per annum, equivalent to 5.5 tonnes per resident.

Natural Gas is the most common space heating source with over 69% of dwellings in the survey area using it. Oil comes in next with 22% and electricity represents just 5% of the total.

Ireland currently has 6.3% of its heat sector demand met by renewable energy like biomass and biogas and heat pumps which is the lowest percentage of any country in Europe and well below the European Union average of 22%.

Residential Energy Saving Targets

Using 2022 as the base year, the SAGE EMP model proposes that a 3.5% annual reduction in primary energy (kWh) in the total population of BERs in Shankill will achieve 30% reduction in energy use by 2032.

Year	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**
Primary Energy (kWh/m2/year)	204	196	190	183	177	170	164	159	153	148	143
		-3%	-7%	-10%	-13%	-16%	-19%	-22%	-25%	-27%	-30%

As the carbon content of electricity will reduce continually into the future as more renewables are added to the mix, there would be a predicted corresponding 42% reduction in CO2 emissions by 2032.

There are 4,031 residential units in Shankill (CSO). The EMP model assumes that approximately 25% of these dwellings would need to be retrofitted by 2027 ranging from shallow measures to deep retrofit (See Section 9.3) in order to be on track for the 3.5% reduction target. These measures are also laid out in the Register of Opportunities (ROO).

Heat pumps have become an increasingly effective way to heat buildings and for buildings to decarbonize due to operating, equipment, and installation costs becoming more competitive in certain markets. Today's models are 4 to 5 times more energy efficient than gas/oil boilers. It is clear that using heat pumps instead of traditional boilers and furnaces have significant potential to cut CO_2 emissions and SEAI is actively encouraging the change with a range of grants available to homeowners to install them.

SEAI's grant schemes do not insist on specific air tightness levels being achieved. However, the pilot SEAI deep retrofit scheme in 2017/2018 insisted on an air permeability of 5m3/hour/m2 being achieved via air tightness testing for a dwelling as part of a deep retrofit. Good air tightness in a dwelling is critical to ensure optimum results and performance for a heat pump installation. This air permeability target of 5m3/hour/m2 is also the air permeability target required for new buildings. This would represent a good target to aim for if a heat pump is being installed in a retrofit project.

Commercial / Public Building Usage & Targets

The data available on energy use in non-domestic buildings is extremely limited. Apart from 12 monthly billing data provided as part of the audit process for the three nominated buildings (St Anne's' National School, St Joseph's Nursing Home and Shankill Business Centre - Station House), the analysis relied on a count of businesses and assigning fairly crude energy use estimate provided by SEAI. Thus, the commercial sector baseline estimate should be treated with caution. This gap does signal a need to get the non-domestic building owners on board as stakeholders in SAGE. As a minimum, all building owners/ managers should maintain records of annual energy use and costs so these metrics can be tracked year on year.

In terms of targets, again using 2022 as the base year, the SAGE EMP model predicts that a 4% annual reduction in primary energy (kWh) in the non-domestic buildings in Shankill will achieve a 34% reduction in energy use by 2032.

Year	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Primary Energy (GWh/m2/year)	45.78	43.95	42.19	40.50	38.88	37.33	35.83	34.40	33.02	31.70	30.43
		-4%	-8%	-12%	-15%	-18%	-22%	-25%	-28%	-31%	-34%

As the carbon content of electricity will reduce continually into the future as more renewables are added to the mix, there would be a predicted corresponding 46% reduction in CO2 emissions by 2032.

As of now there is no clear suites of measures available to recommend to non-domestic building owners in Shankill. A significant engagement process would be recommended to conduct additional audits in order to give a clear roadmap identifying specific energy efficiency measures and to enable emissions reduction targets to be established or this sector.

Transport Target

The Climate Action Plan 2023 promotes the Avoid-Shift-Improve approach. In 2020, 3.8% of the vehicles in Shankill with Battery Electric Vehicles (BEVs). The Climate Action Plan has set a target that 30% of vehicles will be BEVs by 2030. This would essentially mean that of the current 5,800 vehicles in Shankill, 1,700 of these would be EVs by 2030. This equates to 3.5% annual reduction in energy use per annum from switching to electric vehicles, achieving a 26% reduction by 2030 and 32% by 2032.

Year	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Primary Energy (GWh/m2/year)	66.85	64.35	61.93	59.60	57.37	55.21	53.14	51.15	49.23	47.38	45.60
		-3.75%	-7.37%	-10.84%	-14.19%	-17.41%	-20.51%	-23.50%	-26.37%	-29.13%	-31.79%

However, the carbon projection for transport is the most valid. Assuming, EVs are projected to account for 30% of vehicles by 2030, the balance of 70% will be diesel or petrol cars whose carbon contribution will not alter unless the annual km usage per vehicle reduces in the interim. Data is emerging that shows that diesel and petrol cars fuel efficiencies will increase by 10 to 15% in the next 10 to 20 years. The model predicts a 34% reduction in carbon emissions from the transport sector by 2032 (19% by 2030).

Year	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
kilo tonnes CO2 - Transport	15.12	15.00	14.84	14.64	14.37	14.02	13.57	12.99	12.23	11.24	9.95
		-0.8%	-1.8%	-3.2%	-5.0%	-7.3%	-10.2%	-14.1%	-19.1%	-25.7%	**-34.2%**

As the carbon content of electricity will reduce continually into the future as more renewables are added to the mix, the CO2 model summary for all sectors predicts a 42% reduction in carbon emissions by 2032.

Total KiloTonnes Carbon Dioxide	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Residential	27.04	25.57	24.16	22.83	21.55	20.34	19.19	18.09	17.05	16.05	15.11
Commercial & Public	11.46	9.51	9.07	8.64	8.24	7.86	7.49	7.14	6.81	6.49	6.19
Transport	15.12	15.00	14.84	14.64	14.37	14.02	13.57	12.99	12.23	11.24	9.95
Total	**53.62**	**50.08**	**48.07**	**46.11**	**44.17**	**42.22**	**40.25**	**38.22**	**36.08**	**33.78**	**31.24**
		-7%	-10%	-14%	-18%	-21%	-25%	-29%	-33%	-37%	-42%

Deployment of Renewables

As Community RESS projects must be in range 500kW (0.5MW) to 5000kW (5MW), the SAGE committee are aware that there is no area large enough available in Shankill to accommodate a community solar PV project of minimum 500kW size nor are there sites available that could accommodate a wind energy project. What about the roofs on commercial buildings/industrial estates?

As an alternative, SAGE will indicate its willingness to participate as shareholders in another community energy project, for example in Wicklow.

For public and commercial buildings, SAGE identified several potential locations for solar PV installations including the roofs of the three primary schools and one secondary school. It is also noted that LIDL are planning a PV installation on the roof of their store.

With regards to grants, PV on schools can access the non-domestic Microgen Grant (NDMG) where grants of €2,400 are available for systems up to a maximum 6kWp (Approx. 16 Panels or 25m^2) with potential savings of between €2,000 - €3000 annual electrical costs (depending on installation size and current utility rates).

Following the 2022 budget, there as an announcement by Government that a new programme would be introduced for the installation of PV arrays on all schools – details of the proposed scheme are not yet published at the time of writing this report.

SAGE proposes to promote renewable energy installations both for individual dwellings and businesses. The Solar Meitheal idea is to bring numbers of households together to install Solar PV on a group basis. Benefits of this would include shared knowledge and resources among the group, bulk discounts and peace of mind regarding value and quality. Commercial business should not be overlooked as they can play a vital role in this as a lot of the energy generated during the day in domestic dwellings is not utilised fully because houses are vacant because homeowners are working and this energy can be immediately diverted and used by commercial businesses.

Mobilisation

The EMP sets out the baseline and then scopes out a viable roadmap to 2030/ 2032 indicating the level of investment and change that will be needed to achieve the carbon reduction targets. The next challenge for SAGE will be to put a framework into place to implement the actions suggested.

The Register of Opportunities, presented towards the end of the report, highlights a number of tangible projects that might be taken on by the SAGE in the short term. Many Government supports including funding mechanisms are available to help SAGE in this work and potentially via County Council.

The SAGE committee plan to meet Dun Laoghaire Rathdown County Council face-to-face as a next step to discuss how to initiate the action listed in the Register of Opportunities and to clarify synergies with the Council's own plans. They also plan to engage directly with local Councillors to enlist their support.

SAGE also commented that SEAI should create an additional service to assist SEC with mobilisation after their EMP has been completed.

2 Introduction

This Shankill Action Green Earth (SAGE) Energy Master Plan (EMP) study has been commissioned in order to accelerate the transition to a more sustainable future for the local area and its population.

If we are going to make meaningful progress toward the new revised global climate targets set out in the new Climate Action Plan 2023 each and every one of us needs to switch from reactive mode to a proactive mode. The Sustainable Energy Community (SEC) initiative set up by SEAI is an initiative set up by SEAI to allow local communities to be proactive in this area and to become actively involved in drawing up plans to improve how energy is used and develop a sustainable energy system for the benefit of their community. SEC will also help contribute to increasing public acceptance of renewable energy projects and make it easier to attract private investments in the clean energy transition. By coming together as a community and taking ownership of this issue, the local residents have the potential to provide direct benefits to their local community by increasing energy efficiency, lowering their electricity bills and creating local job opportunities.

SAGE covers the area of Shankill, Rathmichael and parts of Loughlinstown in South County Dublin.

The population of the designated area is 11,360. Within the SAGE area the building stock contains approximately 4301 houses and apartments, one hospital, three churches, three schools, one golf club, a Lidl supermarket and approximately 50 businesses including leisure activities.

A further breakdown of the population shows that 85% of the population live in houses/bungalows and 12% live in flats/ apartments. The census lists 280 houses in the survey area as either unoccupied, vacant, derelict or a holiday home.

The estimated energy spend within the SEC area is estimated at €23 million.

Other stakeholders within the SAGE Sustainable Energy Community are two residents' associations, three schools, Tidy Towns and Eco Congregation involving local churches.

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

2.1 Deliverables

IHER Energy Services was appointed by SAGE in April 2022 to prepare an Energy Master Plan and Register of Opportunities.

The deliverables required included the following:

1. Establish the current, baseline energy consumption, CO_2 emissions, energy use (kWh) and energy cost across all the residential buildings, commercial / public buildings and transport in the area.
2. Carry out Energy Audits of 5 x domestic, 3 x public/ commercial buildings as part of the process to identify and quantify opportunities for energy demand reduction in these buildings. Identify how renewable energy could meet a meaningful proportion of this energy demand
3. Prepare an Energy Master Plan Report
4. Create a Register of Opportunities (RoO)

    - Propose actions, based on baseline figures, to achieve, where possible, a 51% reduction in GHG emissions in line with the Climate Action Plan by 2030
    - Identify projects that can avail of the Communities Energy Grant *and*
    - Identify projects that can avail of the Better Energy Homes grant

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

2.2 Methodology

Our analysis is based on a mix of desk research using publicly available data from the Central Statistics Office, SEAI and elsewhere, as well as field research, measuring properties and carrying out building-level modelling.

Our main focus is on the residential sector which provides the biggest opportunities for energy savings in the local area. Two primary data sources have been used in the housing analysis. Data extracted from the Building Energy Rating database for the buildings in the area and also the predicted energy performance of archetypal homes that are representative of the local area. BER audits were conducted on five representative homes and three stages of energy efficiency upgrades are presented in each case.

Data from Census 2016, for the electoral divisions that makes up the local area, provides statistical data on the local population and housing stock from 2016. We have been unable to access the latest Census data but when the information is made available, the analysis and report could be updated.

Estimates of energy use in the local community buildings, schools, creches and commercial units have been estimated according to energy use benchmarks provided by SEAI. Three Ashrae Level 1 audits were conducted on non-domestic buildings to report on energy use and potential energy upgrade measures.

Estimates for energy use for transport have been estimated using commute length and mode data available in the census supplemented with data provided by Codema.

3 Shankill Small Areas / CSO Map

3.1 Shankill Small Areas

The CSO provides detailed census data at different geographical boundaries. All population and building data maps are available at the following locations.

https://cso.maps.arcgis.com

Small Areas are the smallest geographical boundaries used for Census purposes and typically comprise 100-200 dwellings. Electoral districts are a further level up.

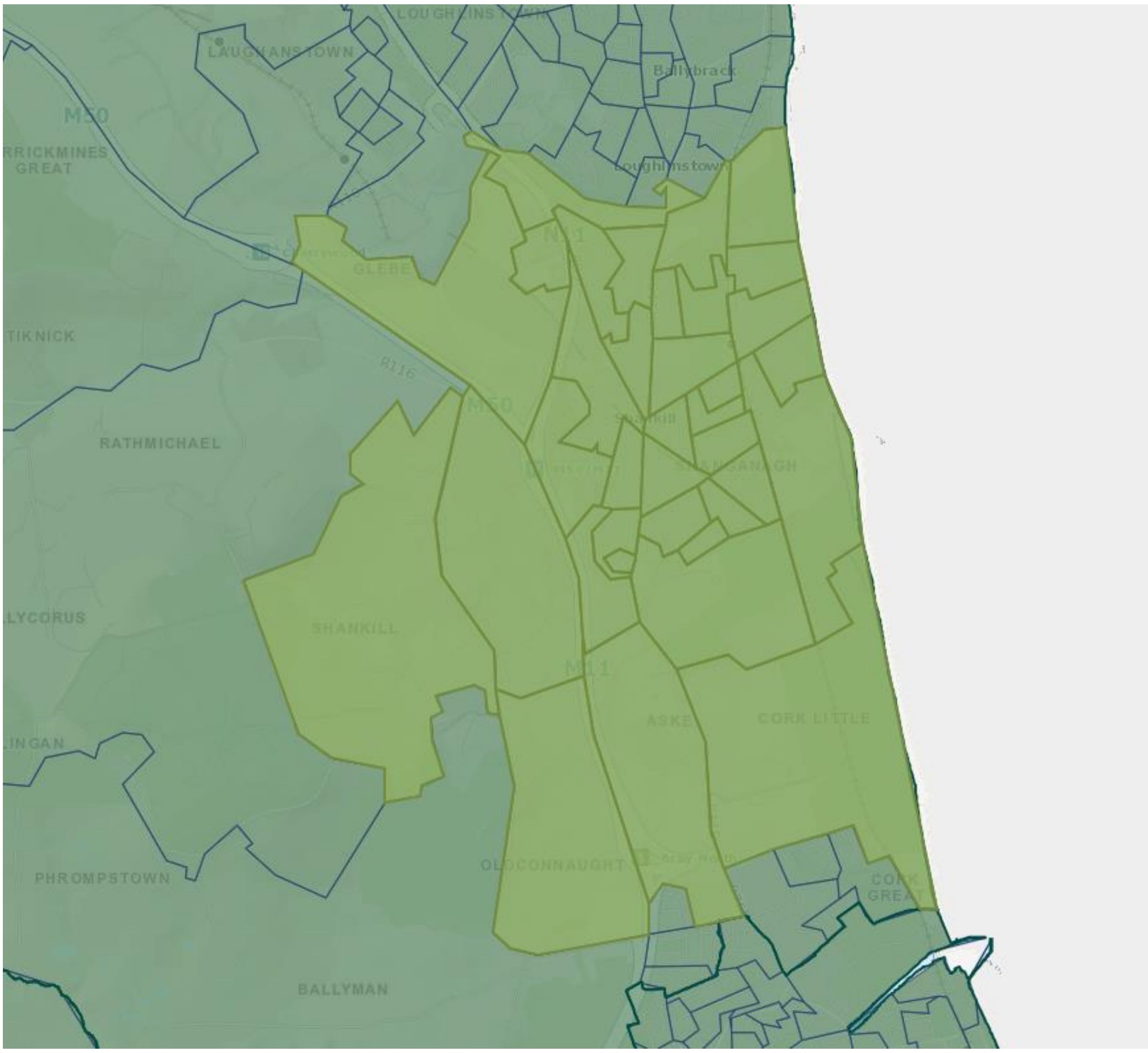
The SAGE committee provided a list of all Small Areas contained within the EMP catchment area.

Table 1: Shankill Small Areas List

Shankill Small Areas		
267097001	267120017	267122004
267120002	267121001	267122005
267120003	267121002	267122006
267120008	267121003	267122007
267120009	267121004	267122008
267120010	267121005	267122009
267120011	267121006	267122010
267120012	267121007	267122011
267120013	267121008	267122012
267120014	267121009	267122013
267120015	267121010	267122014
267120016	267122003	267122015

By clicking on the CSO mapping tool, the Shankill Small Areas can be displayed in map format as shown in figure 1.

Fig. 1: Shankill Small Areas Map

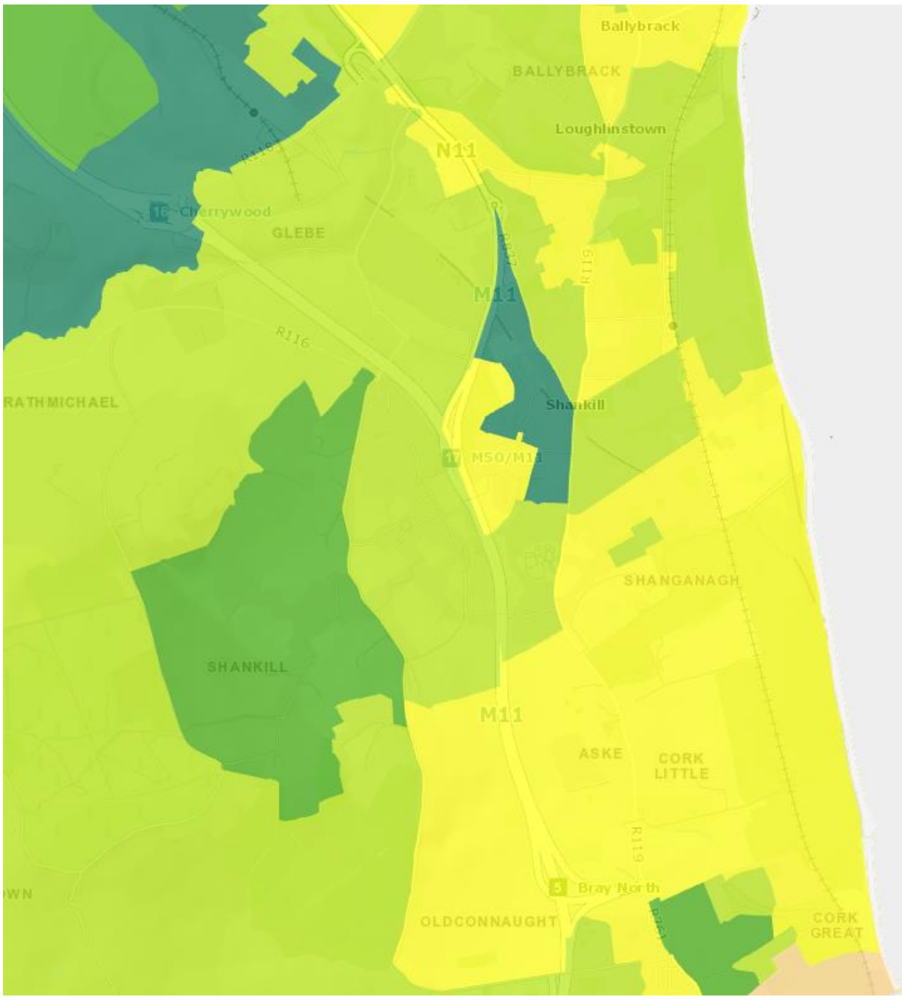


3.2 National BER Mapping Application

All BERs in Ireland are published under a single National Administration System, managed by SEAI. The SEAI also provides a national mapping tool that is publicly available. https://www.seai.ie/technologies/seai-maps/ber-map/

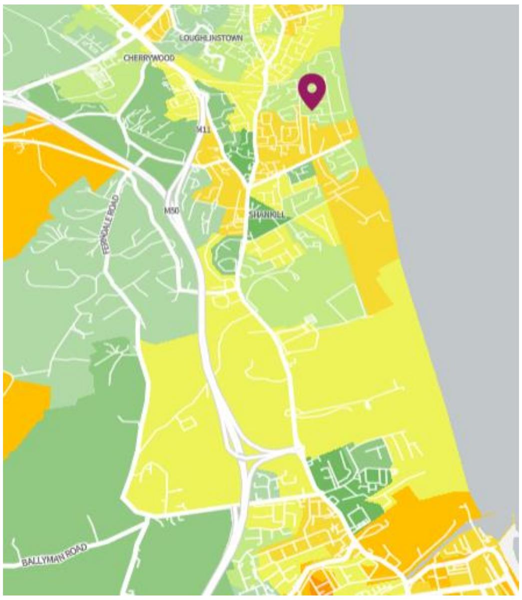
The current map for the Shankill area is shown in Figure 2 below. The map is colour coded to the BER colour scale and the boundary conditions refer to small Area. Small Areas are the smallest geographical boundaries used for Census purposes and typically comprise 100-200 dwellings.

Figure 2: Extract from National Residential BER map



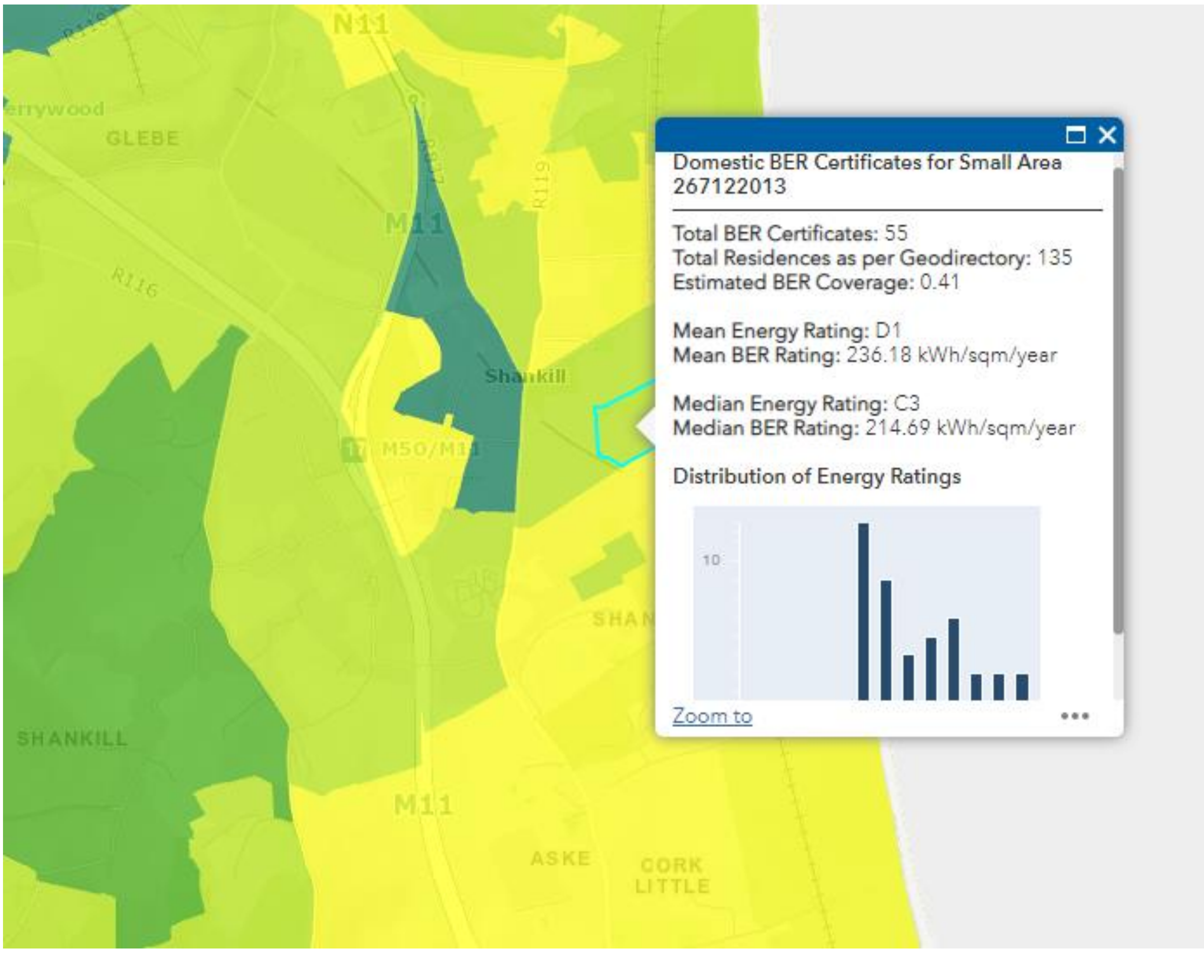
A similar map is available via the BERWOW application.

Figure 3: BER Map via BERWOW tool



When you click into any particular Small Area, additional data is available as shown in Figure 4.

Figure 4: 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 Shankill was collated.

4 Residential BER Database Analysis

From the supporting table behind the BER map, the percentage of dwellings with BERs is shown for each Small Area. The average is 44%, with the lowest at 21%.

Table 2: Small Area list with published BER Totals

SmallArea	ElectoralDivision	Total Dwellings	Published BER (Existing)	% with BERs	Location
267097001	Killiney South	99	40	40%	Shanganagh Cliffs
267120002	Shankill-Rathmichael	103	32	31%	Quarry Road/ Rathmichael Dales
267120003	Shankill-Rathmichael	152	56	37%	Falls Road/ Mullinastill Road
267120008	Shankill-Rathmichael	114	66	58%	Alley River Road/ Woodbrok Downs
267120009	Shankill-Rathmichael	117	41	35%	Allies River Road
267120010	Shankill-Rathmichael	144	64	44%	Crinken Glen
267120011	Shankill-Rathmichael	144	70	49%	Olcovar
267120012	Shankill-Rathmichael	127	54	43%	Stonebridge Close/ Lower Road
267120013	Shankill-Rathmichael	205	31	15%	Stonebridge/ New Vale Cottages
267120014	Shankill-Rathmichael	109	45	41%	Ballybride/ Ferndale Glen
267120015	Shankill-Rathmichael	163	74	45%	Cherrington Road
267120016	Shankill-Rathmichael	79	31	39%	White Gables/ Parc na Silla Rise
267120017	Shankill-Rathmichael	225	96	43%	Library Road/ New Vale Crescent
267121001	Shankill-Rathsallagh	112	79	71%	Shanganagh Cliffs
267121002	Shankill-Rathsallagh	129	80	62%	Shanganagh Cliffs
267121003	Shankill-Rathsallagh	139	74	53%	Shanganagh Wood/ Clonasleigh
267121004	Shankill-Rathsallagh	116	25	22%	Rathsallagh Park
267121005	Shankill-Rathsallagh	111	32	29%	Rathsallagh Grove
267121006	Shankill-Rathsallagh	131	67	51%	Clifton Park/ Rathsallagh Grove
267121007	Shankill-Rathsallagh	123	35	28%	Seaview Wood/ Seaview Park
267121008	Shankill-Rathsallagh	145	61	42%	Rathmichael Park/ Hazelwood
267121009	Shankill-Rathsallagh	109	31	28%	Seaview Lawn
267121010	Shankill-Rathsallagh	115	50	43%	Corbawn Avenue/ Eaton Brae
267122003	Shankill-Shanganagh	126	35	28%	The Green
267122004	Shankill-Shanganagh	139	62	45%	Corbawn Wood/ Quinns Road
267122005	Shankill-Shanganagh	177	51	29%	Aubrey Park/ Aubrey Grove
267122006	Shankill-Shanganagh	112	32	29%	Shanganagh Grove
267122007	Shankill-Shanganagh	112	57	51%	St Annes Park
267122008	Shankill-Shanganagh	83	39	47%	Shrewsbury Road/ Quinns Road
267122009	Shankill-Shanganagh	108	38	35%	Castle Farm
267122010	Shankill-Shanganagh	99	21	21%	Castle Farm
267122011	Shankill-Shanganagh	146	64	44%	Corbawn Court
267122012	Shankill-Shanganagh	94	43	46%	Dorney Court
267122013	Shankill-Shanganagh	135	55	41%	Foxes Grove
267122014	Shankill-Shanganagh	86	28	33%	Holly Park/ Thomond
267122015	Shankill-Shanganagh	99	28	28%	Eaton Wood Court
	Total	**4527**	**1787**	**40%**	

4.1 National BER Database – Shankill

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 provide actual addresses. However, a version of the BER Database that contains relevant Small Area codes has been extracted for the Shankill area.

The same Small Areas as in table 1 were identified and records for 1,968 dwellings in Shankill were extracted. These records were analysed in detail as explained in the next section.

4.2 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.

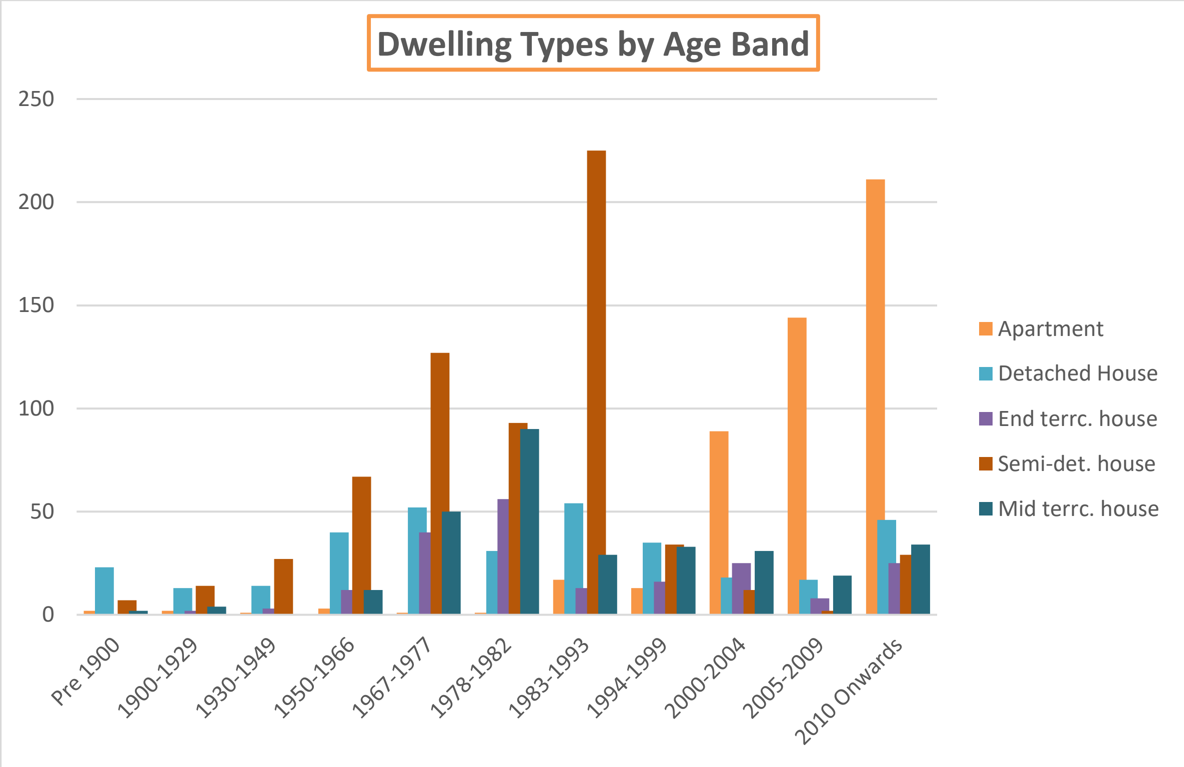
4.2.1 Building Stock by Type and Age

Figure 5 shows stock by year of construction and dwelling type.

It shows how the initial growth in stock occurred from 1967 – 1993. Building Regulations did not require insulation prior to 1978 so the stock 1967-1977 stock would have been built without insulation. Semi-detached houses were the dominant house types with almost no apartments being built during that period.

New construction was modest until 2000, when essentially the second significant wave of construction began to take place. It is notable that apartments have been the dominant dwelling type from 2000 onwards.

Figure 5: Dwelling Type by Age Band



It also useful to show the supporting counts in table 3 below.

Table 3: Dwelling Type by Age Bands

Row Labels	Apartment & Maisonette	Detached House	End terrc. house	Semi-det. house	Mid terrc. house	Grand Total
Pre 1900	2	23		7	2	34
1900-1929	2	13	2	14	4	35
1930-1949	1	14	3	27		45
1950-1966	3	40	12	67	12	134
1967-1977	1	52	40	127	50	270
1978-1982	1	31	56	93	90	271
1983-1993	17	54	13	225	29	338
1994-1999	13	35	16	34	33	131
2000-2004	89	18	25	12	31	175
2005-2009	144	17	8	2	19	190
2010 Onwards	211	46	25	29	34	345
Grand Total	484	343	200	637	304	1968

4.2.2 BER Rating by Age Band

Table 4 shows stock by year of construction and BER rating band. Notable for comment:

- For the 1967 – 1993 stock, many dwellings are in the C and D bands and lower.
- By comparison the vast majority of the 2000-2009 stock has ratings in the C and B bands.

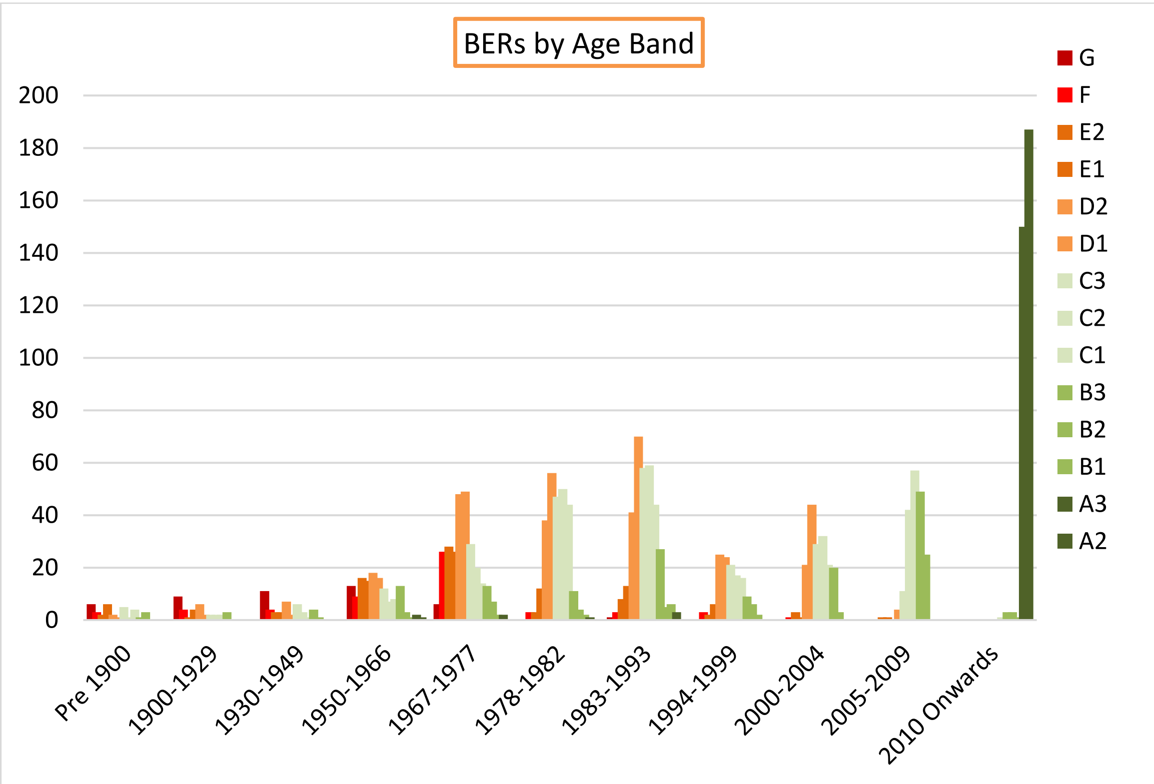
- From 2010 onwards, 98% of ratings are in the A band.
- A small number of older houses that have undergone deeper retrofits have ratings in the A and B bands. Five houses built before 1978 have A ratings.

Table 4: BER Ratings by Age Band

Row Labels	G	F	E2	E1	D2	D1	C3	C2	C1	B3	B2	B1	A3	A2	Grand Total
Pre 1900	6	3	2	6	2	1	5	1	4	1	3				34
1900-1929	9	4	1	4	6	2	2	2	2	3					35
1930-1949	11	4	3	3	7	2	6	3	1	4	1				45
1950-1966	13	9	16	15	18	16	12	7	8	13	3	1	2	1	134
1967-1977	6	26	28	26	48	49	29	20	14	13	7	2	2		270
1978-1982		3	3	12	38	56	47	50	44	11	4	2	1		271
1983-1993	1	3	8	13	41	70	58	59	44	27	5	6	3		338
1994-1999		3	2	6	25	24	21	17	16	9	6	2			131
2000-2004		1	3	1	21	44	29	32	21	20	3				175
2005-2009			1	1		4	11	42	57	49	25				190
2010 Onwards									1	3	3	1	150	187	345
Grand Total	**46**	**56**	**67**	**87**	**206**	**268**	**220**	**233**	**212**	**153**	**60**	**14**	**158**	**188**	**1968**

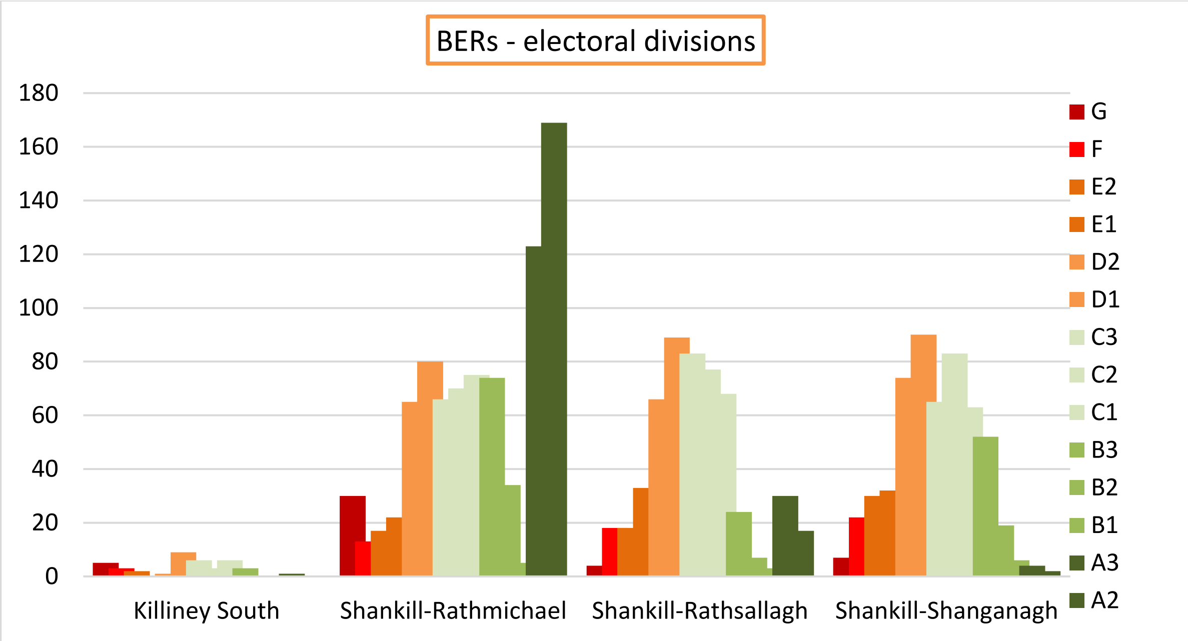
The same data is shown graphically in Figure 6.

Figure 6: BER Ratings by Age Band



The BER spread at Electoral Division level shows that A ratings are found in the Rathmichael ED, where Rathsallagh and Shankill have a BER spread typical of older stock.

Figure 7: BER scores- electrical division level

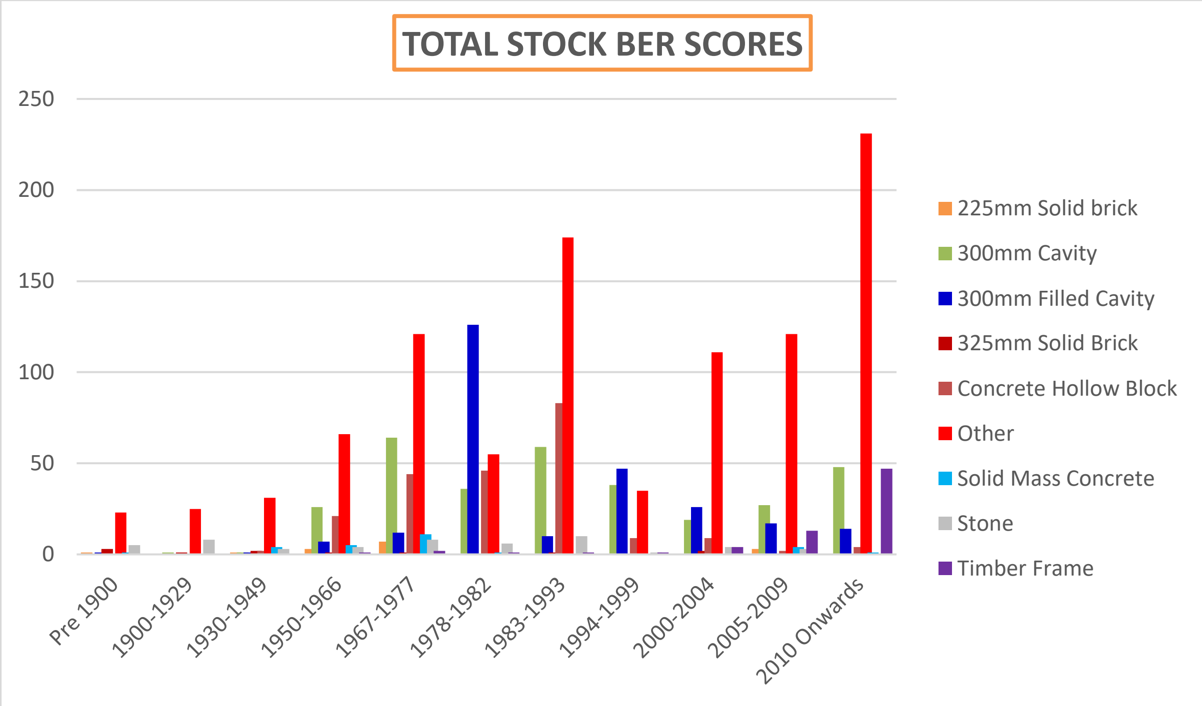


4.3 Wall Types

The BER dataset also records the main wall type. For 993 of the BER records, the category "other" or "unknown" has been selected by the relevant BER assessor. So, for almost 50% of the BERs, the quality of information on wall construction types for this dataset is quite poor, which is a surprise. This particular finding was not found when doing similar analysis for other SECs.

So unfortunately, the dataset is not particularly useful with respect to wall types. Further analysis at small Area level might provide particular insights.

Figure 8: Stock by Wall Types



4.4 Wall Insulation Levels

BER data files also provide information on the levels of wall insulation by indicating the U value (in W/m2K).

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 when constructed. The default U values defined in Appendix S of the SEAI DEAP manual v3.2.1 are shown in table 5.

Table 5: 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

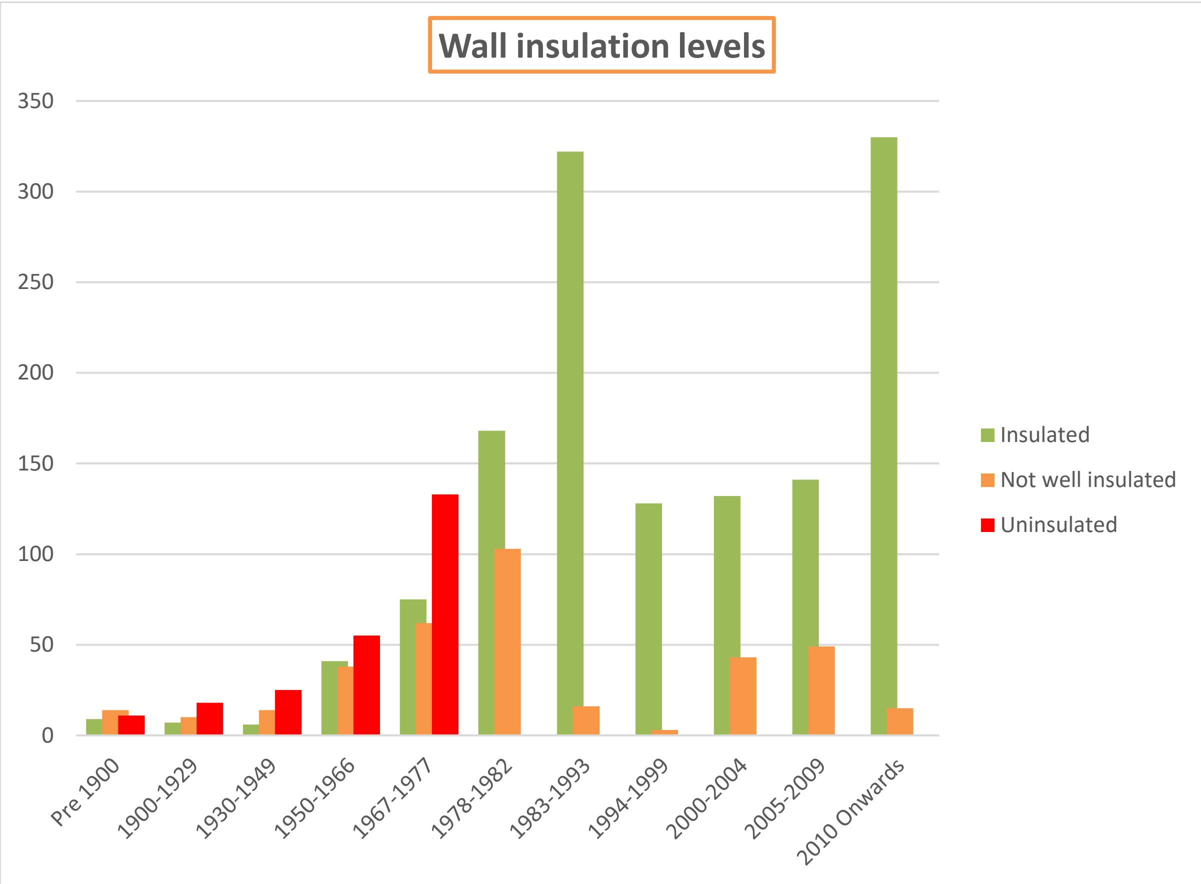
timber frame	2.5	1.9	1.9	1.1	1.1	1.1	0.6	0.55	0.55	0.37

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/ m2 or less
- Not well insulated: wall U values >0.6W/m2K and < 1.64 W/ m2K
- Uninsulated: wall U values > 1.64 W/ m2K

The results of the analysis are shown in figure 9 and listed in table 6.

Figure 9. Wall U Value Analysis



It is not surprising that uninsulated walls (U < 0.6) are reported in houses built up to 1977.

Some walls post 2000 are deemed not well insulated. This is likely to be due to the fact that walls between apartments and unheated corridors are typically uninsulated and therefore are categorized as heat loss walls in the BER methodology. This anomaly can be seen via the U values listed in table 6 below. In fact, all of these apartments are fitted with heat pumps and have HLI values less than 2 (read more on HLIs in Section 3.9 below).

Table 6: Wall U value Anomaly in 2020 Apartments

SmallArea	Year_of_construction	Wall_weighted_Uvalue	Wall Insulation	Boiler Type	HLI Categories
267120012	2020	0.62	Not well insulated	Heat Pump	HLI<2
267120012	2020	0.62	Not well insulated	Heat Pump	HLI<2
267120012	2020	0.62	Not well insulated	Heat Pump	HLI<2
267120012	2020	0.62	Not well insulated	Heat Pump	HLI<2
267120012	2020	0.62	Not well insulated	Heat Pump	HLI<2
267120012	2021	0.77	Not well insulated	Heat Pump	HLI<2
267120012	2021	0.77	Not well insulated	Heat Pump	HLI<2
267120012	2021	0.77	Not well insulated	Heat Pump	HLI<2
267120012	2021	0.77	Not well insulated	Heat Pump	HLI<2
267120012	2021	0.77	Not well insulated	Heat Pump	HLI<2
267120012	2021	0.86	Not well insulated	Heat Pump	HLI<2
267120012	2021	0.86	Not well insulated	Heat Pump	HLI<2
267120012	2021	0.86	Not well insulated	Heat Pump	HLI<2
267120012	2021	0.86	Not well insulated	Heat Pump	HLI<2
267120012	2021	0.63	Not well insulated	Heat Pump	HLI<2

The data behind figure 9 is shown in table 7.

Table 7: Wall insulation levels by Wall Type

Row Labels	Insulated	Not well insulated	Uninsulated	Grand Total
Pre 1900	9	14	11	34
1900-1929	7	10	18	35
1930-1949	6	14	25	45
1950-1966	41	38	55	134
1967-1977	75	62	133	270
1978-1982	168	103		271
1983-1993	322	16		338
1994-1999	128	3		131
2000-2004	132	43		175
2005-2009	141	49		190
2010 Onwards	330	15		345
Grand Total	**1359**	**367**	**242**	**1968**
	69%	**19%**	**12%**	

4.5 Windows

In analysing window performance, windows were subdivided into those with U values =< 2.2W/m2K (equivalent to 12mm gap air-filled double glazing with low-e glass) and those with U values > 2.2 W/m2K, 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 8. The analysis shows that roughly half of the dwellings with BERs have window U values greater than 2.2.

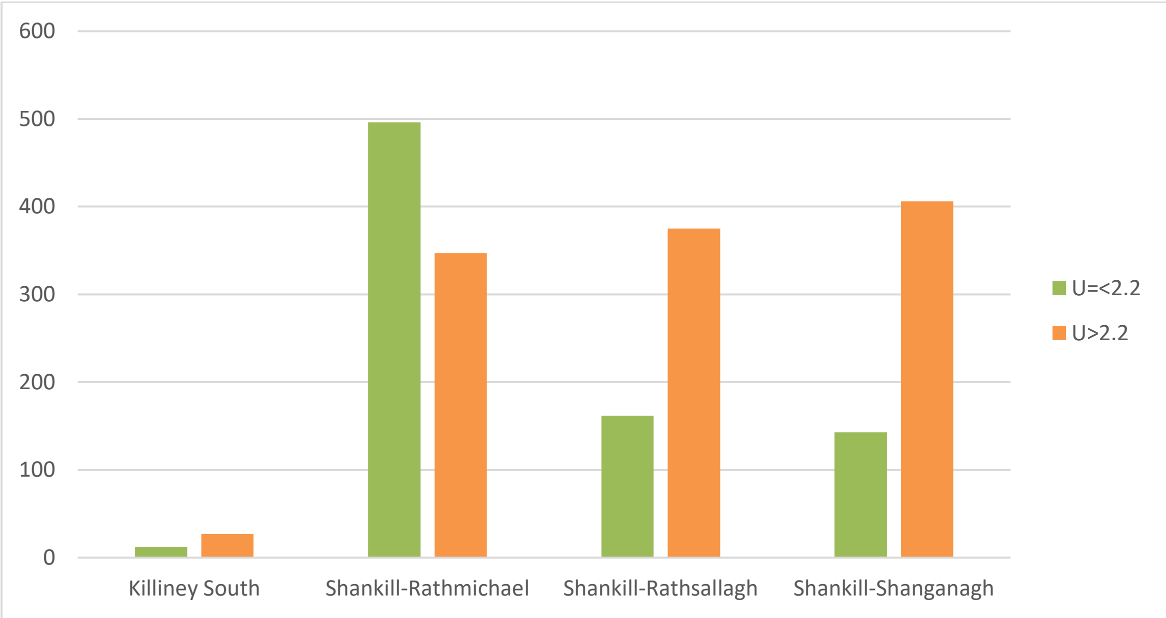
Table 8: Windows U Value Analysis

Row Labels	U=<2.2	U>2.2	Grand Total
Killiney South	12	27	39
Shankill-Rathmichael	496	347	843

Shankill-Rathsallagh	162	375	537
Shankill-Shanganagh	143	406	549
Grand Total	**813**	**1155**	**1968**

The same data is illustrated in figure 10, showing Rathsallagh & Shanganagh have the highest proportion of older window types.

Figure 10. Window U Value Analysis

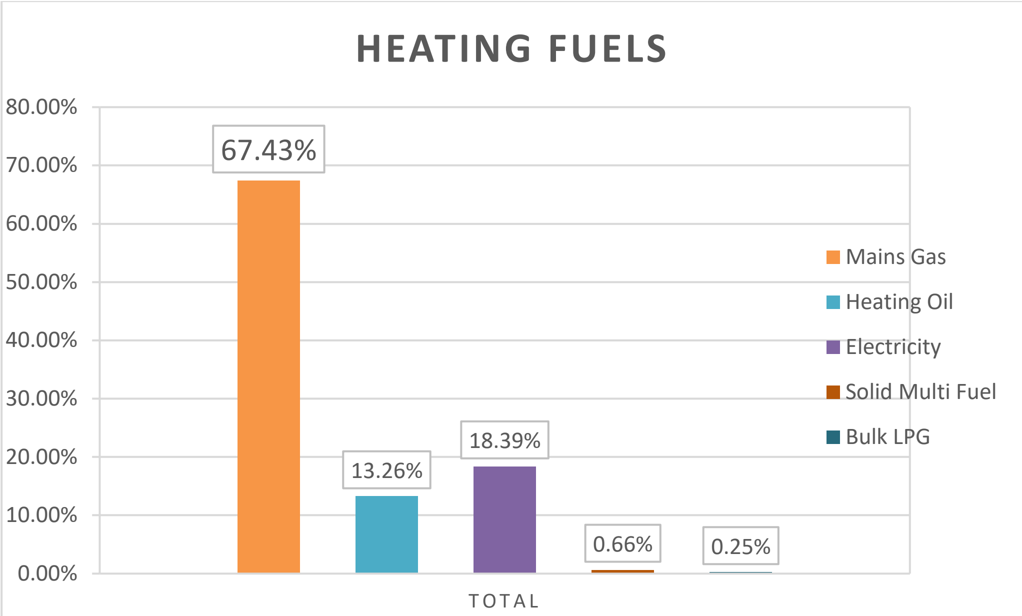


4.6 Fuel Types

The main fuel types are shown in Figure 11, 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 11. Main Heating Fuel Types



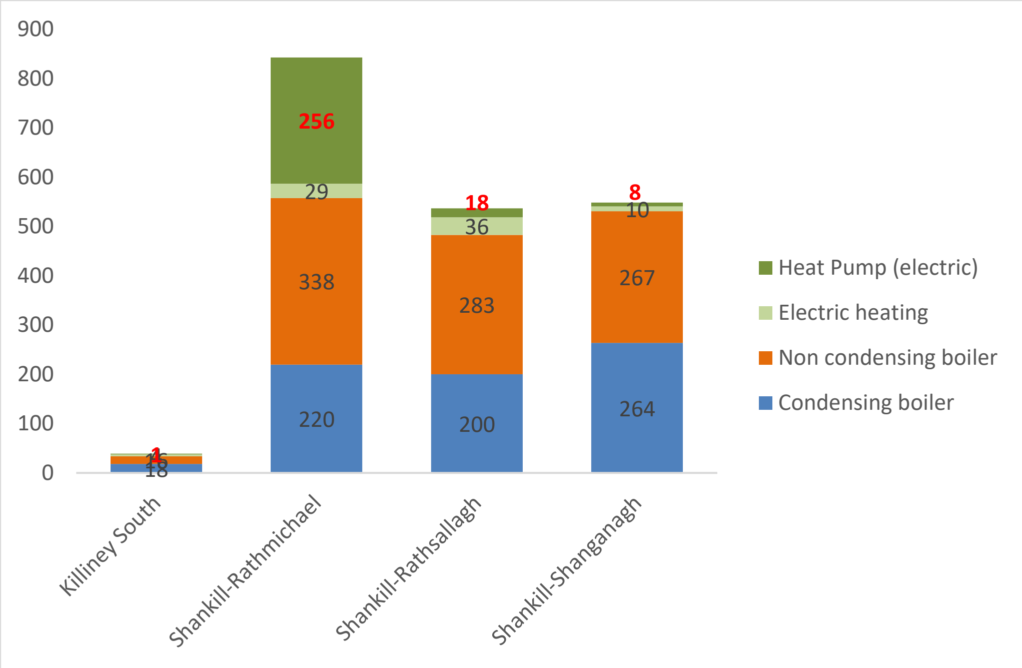
4.7 Heating System Types

Table 9 and figure 12 show heating system types used in houses and apartments, spread across the 4 electoral districts.

Table 9: Main Space Heating Types by ED

Row Labels	Condensing boiler	Non-condensing boiler	Electric heating	Heat Pump (electric)	Grand Total
Killiney South	18	16	4	1	39
Shankill-Rathmichael	220	338	29	256	843
Shankill-Rathsallagh	200	283	36	18	537
Shankill-Shanganagh	264	267	10	8	549
Grand Total	**702**	**904**	**79**	**283**	**1968**

Figure 12: Space Heating Types for Houses, Apartments



It is notable that 283 dwellings have heat pumps (powered by electricity) and 79 have direct electric or storage heaters.

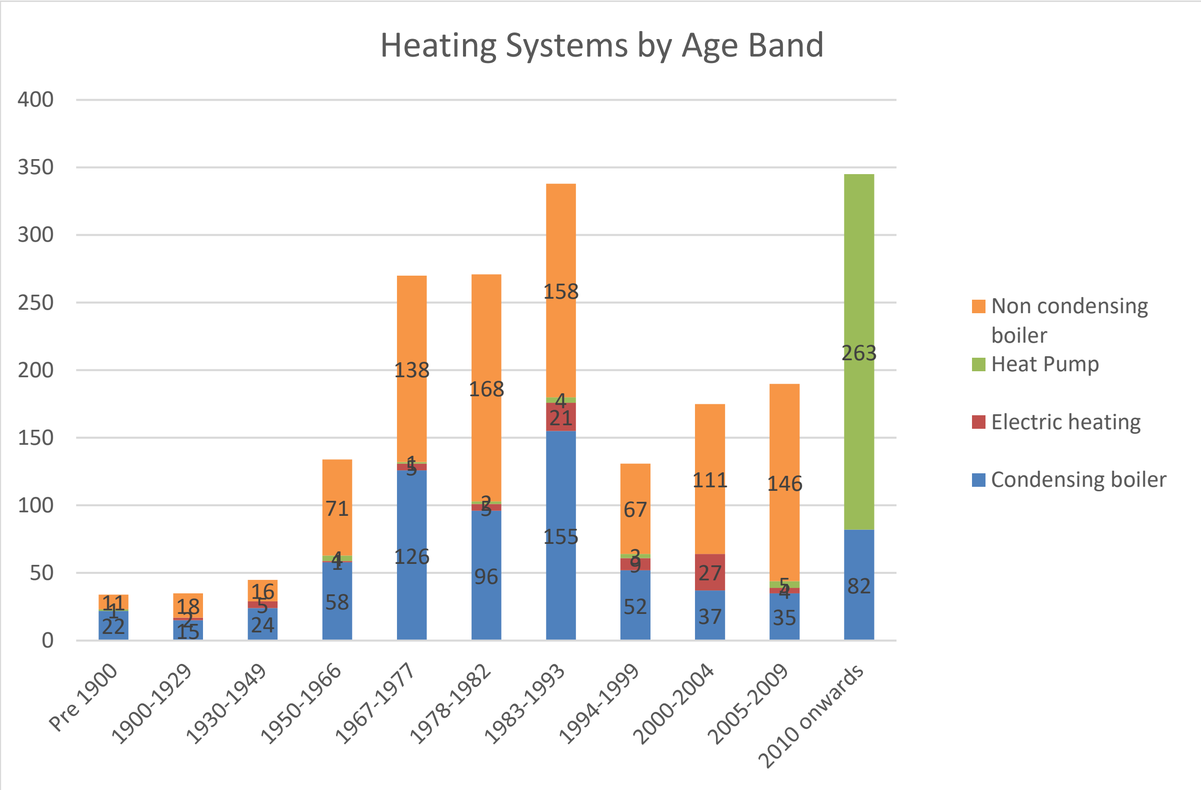
For regular oil and gas boilers, almost 50% of existing boilers are inefficient non-condensing types. These boilers are candidates for replacement in the future retrofit strategy.

Table 10: Main Space Heating Types by Age Band

Row Labels	Condensing boiler	Electric heating	Heat Pump	Non-condensing boiler	Grand Total
Pre 1900	22		1	11	34
1900-1929	15	2		18	35
1930-1949	24	5		16	45
1950-1966	58	1	4	71	134
1967-1977	126	5	1	138	270
1978-1982	96	5	2	168	271
1983-1993	155	21	4	158	338
1994-1999	52	9	3	67	131
2000-2004	37	27		111	175
2005-2009	35	4	5	146	190
2010 onwards	82		263		345
Grand Total	**702**	**79**	**283**	**904**	**1968**

The associated chart shows that non-condensing boilers are present in all age band up to 2009.

Figure 13: Space Heating Types by Age Band



4.8 Space Heating System Efficiency Ranges

The average space heating efficiency values from the BER datasets is shown in table 11 below.

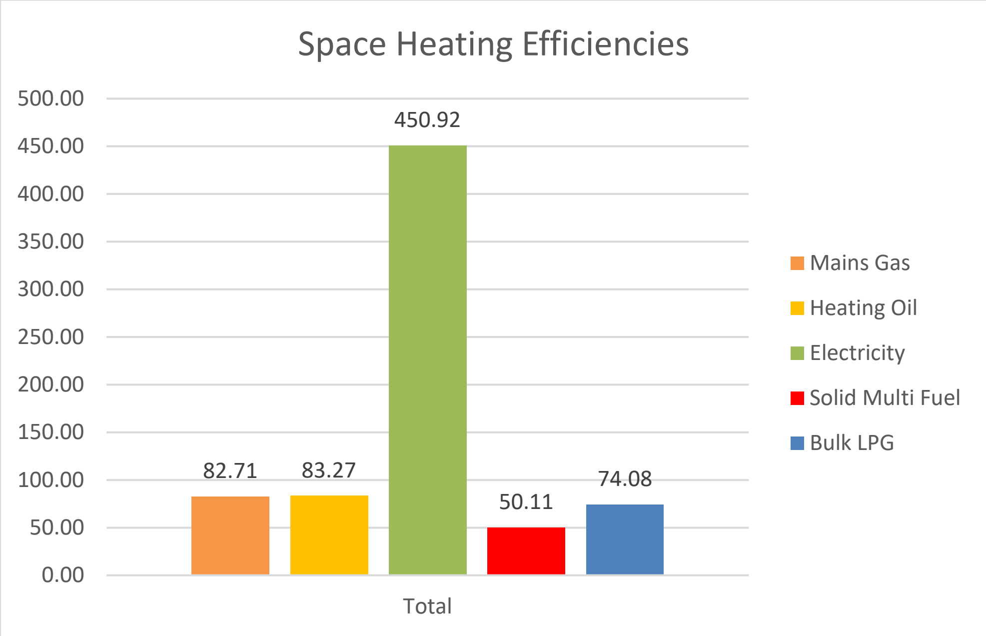
Table 11: Average Space Heating Efficiencies by Fuel Type

	Mains Gas	Heating Oil	Electricity	Solid Multi Fuel	Bulk LPG
Average of HS_Main_System_Efficiency (%)	82.71	83.27	450.92	50.11	74.08

The efficiency levels associated with heat pumps are even more pronounced when viewed in figure 14 below.

The efficiency of heat pumps for space heating are in excess of 400% - this compares to just 100% for direct electric or storage heating. The efficiency of heat pumps for water heating is generally in excess of 200%.

Figure 14: Space Heating Types by Age Band



4.9 Heat Loss Indicator (HLI)

In relation to residential buildings, the Climate Action Plan 2023 is seeking to get 500,0000 Irish homes upgraded to a B2 BER by 2030 and to have 400,000 heat pumps installed in existing Irish homes. SEAI provides a €6,500 grant for heat pump installations in houses and €4,500 for heat pump installations in apartments.

SEAI wants to ensure that heat pumps are only retrofitted in homes where heat loss is equivalent to a new home built in 2005, so that the heat pump will perform satisfactorily. Thus, all older homes will need to have significant insulation upgrades if applying for the grant. The level of heat loss (fabric and ventilation losses) is specifically measured in the BER software and this value is called the Heat Loss Indicator (HLI). The HLI is required to be less than or equal to 2 W/Km2 in order to qualify for the heat pump grant. An HLI up to 2.3 is allowed if certain criteria are met.

Table 10 above shows that there are currently 283 heat pumps installed in the SAGE area based on published BER certificates.

HLI data extracted from the SAGE BER database extract shows that 727 dwellings (or 37% of those with BER certs already) have an HLI < 2 and so the dwellings are ideally suited for heat pumps. A further 290 dwellings (or 15% of those with BER certs already) have an HLI between 2 and 2.3 and could be close to being "heat pump ready".

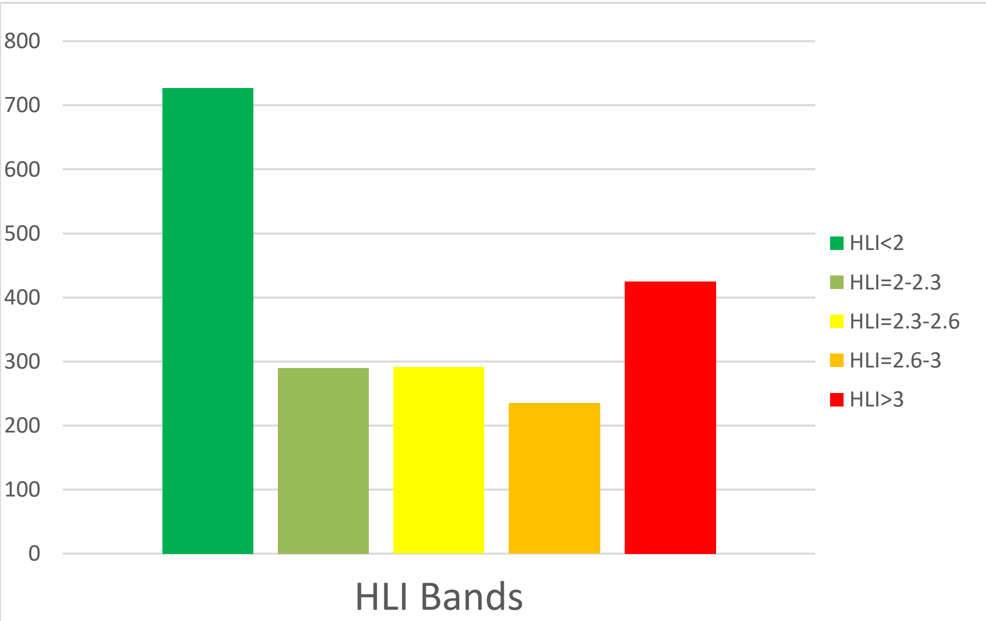
Table 12: HLI banding by Age of Construction

Row Labels	HLI<2	HLI=2-2.3	HLI=2.3-2.6	HLI=2.6-3	HLI>3	Grand Total
Pre 1900	4	2	1	4	23	34
1900-1929	3	3	2	3	24	35
1930-1949	3		2	5	35	45
1950-1966	12	12	11	17	82	134
1967-1977	22	23	19	43	163	270
1978-1982	59	74	39	61	38	271
1983-1993	35	62	129	79	33	338
1994-1999	28	43	42	11	7	131
2000-2004	75	41	31	9	19	175
2005-2009	144	28	14	3	1	190
2010 onwards	342	2	1			345
Grand Total	**727**	**290**	**291**	**235**	**425**	**1968**
	37%	15%	15%	12%	22%	100%

Table 12 shows that 342 dwellings built from 2010 onwards have HLI<2. Table 10 shows that 263 of these dwellings have heat pumps with 82 having condensing boilers.

For those dwellings built from 2005 -2009, 144 dwellings have HLI <2 with just 5 having heat pumps. It appears the majority of these dwelling have condensing boilers so heat pump upgrades would appear to be a “no brainer” for these owners. A communication initiative would be important to educate such owners to prepare to switch to heat pumps, either when the boiler needs replacement or as a planned upgrade.

Figure 15: Dwelling counts per HLI Band



5 Baseline of Electrical, Thermal and Transport Demand

The baseline energy demand comprises energy used in the 4,031 residential buildings, 55 commercial/ public buildings, sports clubs and transport. The energy use in each of these sectors is outlined in the following sections.

5.1 Residential Buildings

From the BER database analysis of 1,968 published BER certs, we can derive the following:

- The average primary energy value of a Shankill dwelling is 203.6 kWh/ m^2/year, equivalent to a D1 rating.
- The average floor area of a Shankill dwelling is 114m^2.

As shown in table 13, the average primary energy per dwelling in Shankill is 23,313 kWh per year based on published BER data. 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. (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%).

Table 13: Average Primary Energy Per Dwelling

Average Primary Energy (from 1968 BERS)	Average Floor Area (from 1968 BERs)	Average Primary Energy per dwelling (kWh/ annum)
203.61	114.5	23,313

Expanding this to the total stock of 4,031 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 14.

Table 14: Total Estimated Annual Primary Energy of all Dwellings

Total Number of Dwellings	Total Primary Energy (kWh - all Dwellings)
4031	93,976,094

Another useful metric is the annual energy spend. The SEAI publication Energy in the Residential Sector 2018 advised the average Irish household spend for heating and electricity was €1990. If we assume current costs are costs are 50% higher as advised by SEAI, this would equate to an annual spend per home of €2,985. For the 4,301 dwellings in Shankill, this indicates an annual energy spend of €12m (table 15).

The SEAI data indicates that space heating is by far the largest energy demand in the DEAP analysis and this is reflected in the breakdown of actual fuel type usage of 75% gas to 25% electricity. It's clear that focusing on the areas of highest consumed energy may not result in as much savings in the cost of running a home than focusing on even small reductions in the most expensive fuel types. This strategy may also provide greater incentives to homeowners to engage with renewable energy technologies and to further reduce their space heating demands by pursuing a fabric first approach to upgrading the insulation in their homes.

Table 15: Total Estimated Annual Energy Spend - all Dwellings

Total Dwellings (Source: SA summary)	Annual Energy Bill (heating & electricity) *SEAI	Annual Residential Energy Costs
4031	€2,985	€12,032,535

The Central Statistics Office (CSO) provides basic statistics that describe the housing stock at the local electoral area level. A total of 4,031 dwellings are recorded as occupied in the census, while a further 143 are recorded as 'temporarily absent' or holiday homes, there are also a number of 'other vacant dwellings', 139 in total.

Amongst these 280 dwelling there could be vacant and derelict properties this represents a potential opportunity for the community to avail of Vacant property refurbishment grant to bring vacant, underused or derelict buildings back into residential use this should be further explored with the county council. As our baseline is 2016, these homes are excluded from our analysis; however, if now occupied, they will impact on 2020 energy demand. About 70% of households in the census are owner occupied, which is positive, as owner occupiers have a clearer incentive to reduce energy consumption.

5.2 Commercial and Public Buildings

In an ideal world, a register would be available listing the annual energy use and energy costs data for all commercial and public businesses/ buildings. While this is rarely available, it is a process that all SECs should aspire to create.

As part of the Charter, annual kWh energy use and cost data was recorded for St Anne's National School, the SJOG Centre and the Shankill Business Centre.

To assist EMP modelling, SEAI defines three business categories namely small medium and large. The SEAI publication SEC Partnership – Guidance Notes for EMP funding Application process (October 2021), 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). SEAI latest advice suggests these figures should be scaled up by 50% to give a better indication of current fuel prices. Using current prices per kWh for electricity and gas, the equivalent kWh of energy and associated CO2 emissions can be calculated.

The SAGE team kindly conducted a census of business premises in Shankill. In additional to the three audited buildings, it identified 55 small, 3 medium and 2 large businesses namely Woodbrook Golf Club and the LIDL supermarket.

The estimated annual energy/ fuel costs for all non-domestic buildings are summarised in Table 16 below.

Table 16: Total Estimated Annual Energy Spend – Commercial & Public Buildings

	Number	Annual Energy Bill (heating & electricity)	Annual Business Energy Costs
Small businesses	55	€22,950	€1,262,250
Medium business	2	€54,225	€108,450
Large businesses	1	€85,500	€85,500
Shankill Business Centre	1	€9,187	€9,187
St Josephs	1	€185,779	€185,779
St Anne's NS	1	€16,934	€16,934
Total			€1,668,100

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

	Electricity	Fossil Fuel	Total
Total Primary Energy (kWh)	6,482,437	39,295,079	45,777,516
Total CO2 (tonnes)	3,364,385	8,094,786	11,459,171

Note: The commercial energy use baseline calculation includes significant assumptions that need to be treated with caution. It is likely that these numbers are higher than the reality, but these can only be challenged if additional energy use data can be provided.

The SEAI benchmark assumes a 33%:67% cost split for electricity and gas. As natural gas is just one quarter the price of electricity, this implies an 11% (electricity) and 89% (gas) kWh split respectively.

In the case of one large supermarket in Shankill, the kWh split is 76% (electricity) and 24% (gas) out of total annual consumption of 965,000 kWh. This highlights the need for improved energy usage datasets for non-domestic buildings.

A simple template is shown in Appendix D. This can be provided in excel format and modified for use by any business.

5.3 Transport

According to the 2016 Census (still the best source of data available), there were 5,794 cars in the selected Shankill Small Areas community per CSO 2016. At an assumed average spend of €1602 according to Codema guidelines (average spend for petrol cars is €1,525 with the diesel spend at €1,680), the total spend on car fuel transport is €9.28m.

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/aa05b-irish-bulletin-of-vehicle-and-driver-statistics-2020/

Table 18 indicates the national split of vehicles by fuel type applied to the Shankill vehicle stock.

Table 18: Vehicles by Type

Shankill 2020	petrol	diesel	BEV
Cars split (DOT-2020)	38.2%	58.0%	3.8%
5794	2,211	3,363	220

National statistics on average distances travelled, kWh/km and GCO_2/km are shown in Table 19.

Table 19: 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 19 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 17 and Table 18 enables the annual energy use and CO_2 emissions for the Shankill transport fleet to be estimated in Table 20.

Table 20: Transport: Annual kWh and CO_2 emissions estimate

Total Cars (5,794)	**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 CO2 per car/annum	2,023	3,287	842	
total Cars split	2,211	3,363	220	
kWh -all cars/a	19,551,783	46,327,770	1,083,880	66,963,434
CO2 - all cars/a	4,472,805	11,052,482	185,401	15,710,688

The average annual carbon emissions per car per year are 2,712kg and CO_2 or 2.7 tonnes CO_2.

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 on 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.

5.4 Summary Baseline CO_2 emissions, Energy Usage and Spend

The baseline energy and CO_2 emissions for Shankill across all sectors is summarised in Table 21.

Table 21: Baseline EMP Summary – Shankill

	CO2 (tonnes)	Total (kWh)	Energy Cost
Residential	25,242	**93,976,094**	€12,032,535
Non-residential	11,459	**45,777,516**	€1,668,100
Transport	15,711	**66,963,434**	€9,281,988
Total	**52,412**	**206,717,043**	**€22,982,623**

6 Energy Audits of Residential Buildings

6.1 Methodology

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

It was decided to conduct energy audits on 5 house types in addition to 3 public/ commercial buildings.

The full list of residential buildings is shown in Table 22 below representing some of the common house types in Shankill.

Table 22: Survey addresses

	Year Built	Description
Athgoe Drive	1982	semi 2 storeys
Quinn Road	1965	semi 2 storey dormer style
Olcovar	2005	townhouse
Shrewsbury Road	1950	semi 2 storeys
Dorney Court	1988	semi 2 storeys

Energy retrofit analysis was done on each of the 5 house types and the impact of 3 levels of upgrade measure packages were assessed in each case apart from Olcovar where two levels were considered. 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:

- Insulate other roof types (sloped and/or flat roofs)
- External wall insulation
- A condensing boiler (90%+ efficient)
- 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:

  - Internal or external wall insulation
  - Insulate suspended timber floors where present
  - Upgrade windows to triple glazing and install high specification doors
  - 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

Keeping houses warm has always been a challenge to electrify at scale because of the high cost and complexity involved. The industry has responded and with developments in heat pump technology. Heat pumps have become an increasingly effective way to heat buildings and for buildings to decarbonize due to operating, equipment, and installation costs becoming more competitive in certain markets.

A heat pump uses refrigerant and electricity to transfer heat from outdoor air or the ground to the inside of a building, even in colder temperatures. Today's models are 4 to 5 times more energy efficient than gas/oil boilers. It is clear that using heat pumps instead of traditional boilers and furnaces have significant potential to cut CO2 emissions and SEAI is actively encouraging the change with a range of grants available to homeowners to install them.

- **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.

6.2 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 Shrewsbury Road house type is shown in Appendix B. This brochure can be adapted for use as required.

6.3 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

The costs of measures used in the retrofit calculator were sourced by IHER in 2022 from an independent quantity surveying expert. The typical industry average costs are listed in Appendix C.

Final contractor quotations will naturally vary from these industry average costs.

Calibration Factors and Payback Analysis

Care needs to be taken when using BER-based energy usage results to calculate annual energy costs. The BER calculation method (known as DEAP) is an asset rating that does not take account of operational differences of households. Nevertheless, DEAP is still useful tool, that can be used on the majority of Irish stock to return a baseline asset rating.

DEAP simplifies the complexity of a dwelling significantly, by making many assumptions and having default inputs. Occupancy is too variable to model; the daily task of occupants varies significantly and thus cannot be modelled by assumptions. In DEAP the occupancy is determined by the total floor area, which is not an accurate representation for the Irish building stock. This occupancy value then dictates the volume hot water required by the household, which is directly related to the number of occupants, therefore should not be based on the total floor area of a dwelling. In addition to this, to define the typical activity of occupants is difficult, as, some occupants may be active, using a low volume of appliances, whereas another occupant may work from home full-time and use lots of appliances. Therefore, their impact on delivered energy would also differ significantly. **In DEAP** the external environment of the dwelling is an estimate. The DEAP models use a standardized annual mean temperature (SEAI, 2012), rendering the location unimportant and as we all know the Irish climate differs significantly between the west and east of Ireland and this will have a major impact on the energy efficiency of a building. Additionally, the continuous impact to the climate, causes significant variation between the winters and summers over the years. The BER methodology assumes the house is heated from October to May for 8 hours per day with the living room heated to 21oC and the rest of the habitable rooms heated to 18oC. This same assumption applies equally to a G-rated house or an A-Rated house.

A major influence on the delta between electricity calculated in DEAP and reality is the exclusion of electrical appliances from the DEAP model. A large volume of the Irish building stock has poorly rated appliances, and additionally the user interaction with these appliances can vary significantly.

While there is no major study in Ireland (https://link.springer.com/article/10.1007/s12053-021-09960-1) there are some in a 2013 paper, a study found that the actual energy savings were approximately 36 - 38 % less than predicted by DEAP [4]. [4] Quantification of energy savings from Ireland's home energy saving ... (no date). Available at: https://www.researchgate.net/publication/257768210_Quantification_of_energy_savings_from_Ireland's_Home_Energy_Saving_scheme_An_ex_post_billing_analysis (Accessed: December 16, 2022). [6] How accurate are energy performance certificates indicated energy ... (no date). Available at: https://www.researchgate.net/publication/311519472_How_accurate_are_Energy_Performance_Certificates_indicated_energy_savings_of_building_retrofits (Accessed: December 16, 2022).

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.

If we were to assess the true energy consumption of identical houses, for instance in a housing estate where the dwelling's details, materials and systems are replicated, across a variety of demographics, such as a family home, a professional couple and a retiree, you would note significant differences in the energy consumption. In order to get a true sense of the performance of Ireland's housing stock, these differences in operational use cannot be ignored.

It is clear that caution needs to be exercised when analysing BER statistics. The variation between the model and reality is significant, therefore, it should be stated that the delivered energy is an estimate in the model and not an exact reading. As a baseline DEAP provides an estimate delivered energy value and as such we should use this only as a baseline and not a definitive value

For the Shankill SEC analysis, a calibration factor in included into the BER-based energy costs calculation within the retrofit calculator.

Energy Costs

SEAI publishes updated energy costs on a quarterly basis. Using a combination of the SEAI domestic fuel price values (01 July, 2022) and market analysis of electricity and gas prices in October 2022, the fuel prices listed in Table 20 were established and used in the retrofit calculator.

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 23: Energy Prices (per kWh delivered) - 2022

Gas	€0.13
Oil	€0.14
Electricity	€0.43
Smokeless	€0.09
El.HP.Water	€0.31
El.HP.SH	€0.38

Better Energy Homes Grants

SEAI provides grants to homeowners through two main schemes:

- The Better Energy Homes (BEH) scheme – single measures grants https://www.seai.ie/grants/home-energy-grants/individual-grants/
- The One Stop Shop Service https://www.seai.ie/grants/home-energy-grants/one-stop-shop/

The current BEH grants are listed in Table 22. It should be noted that oil & gas condensing boilers no longer receive any grant funding.

Table 24: BEH Grants – 2022

	Detached	Semi/ End Terrace	Terrace	Apartment
Roof insulation- ceiling level	€1,500	€1,300	€1,200	€800
Cavity Wall insulation	€1,700	€1,200	€800	€700
External Wall Insulation	€8,000	€6,000	€3,500	€3,000
Internal Wall Insulation	€4,500	€3,500	€2,000	€1,500
Heat Pump - A2W, exhaust A2W, W2W, ground source	€6,500			€4,500
Heat Pump - air to air	€3,500			
Heating Controls	€700			
Solar Water Heater	€1,200			
Solar PV	0 to 2kWp, 900 per/kWp, 2 to 4 kWp 400/kWp			
BER	€50			
Technical Assessment	€200			

SEAI launched the National One Stop Shop (OSS) service in February 2022. Homeowners must submit their applications to one of the registered OSS providers in order to avail of this scheme. A wider range of grant support is available as indicated by the figures in red in Table 25.

The OSS scheme has two key criteria:

- The post works BER must achieve a B2 rating or better, i.e. <= 125/m^2/ year
- There must be an uplift of a minimum of 100 kWh/m^2/year from the pre-works BER primary energy value

Table 25: One Stop Shop Scheme Grants – 2022

	Detached	Semi/ End Terrace	Terrace	Apartment
Roof insulation- rafter	€3,000	€3,000	€2,000	€1,500
Roof insulation- ceiling level	€1,500	€1,300	€1,200	€800
Cavity Wall insulation	€1,700	€1,200	€800	€700
External Wall Insulation	€8,000	€6,000	€3,500	€3,000
Internal Wall Insulation	€4,500	€3,500	€2,000	€1,500
Floor insulation	€3,500			
Windows	€4,000	€3,000	€1,800	€1,500
External doors (per door)	€800			
Heat Pump - A2W, exhaust A2W, W2W, ground source	€6,500			€4,500
Central heating system for heat pump	€2,000			€1,000
Heat Pump - air to air	€3,500			
Heating Controls	€700			
Mechanical ventilation	€1,500			
Air Tightness	€1,000			
Solar Water Heater	€1,200			
Solar PV	0 to 2kWp, 900 per/kWp, 2 to 4 kWp 400/kWp			
BER	€50			
Home Energy Assessment	€350			
Project Management	€2,000	€1,600	€1,200	€800
OSS Bonus for B2 with heat pump	€2,000			

6.4 Key Survey Findings & Presentation of Results

Wall & Floor Insulation:

Many of the houses in Shankill were constructed prior to the first Draft Building Regulations in 1976. Thus, these houses were built originally without wall insulation or floor insulation.

The building stock for Shankill is a mixture of traditional solid masonry, cavity wall, mass masonry, single leaf block and timber frame. Houses built from 1977 onwards will have varying levels of wall insulation. The upgrade solution for these wall types is external or internal wall insulation or a mixture of both. External is preferred where physically possible as it ensures intermediate floors and dividing walls are fully insulated and minimises the effect of thermal bridges. No one solution will work for all dwellings in the area and every case will need to analysed separately and no doubt in some of the older houses with poor levels of insulation/maintenance there will be condensation and mould risks that need to be identified and specific case solutions proposed to remedy this. This is of course not limited to old houses as even well insulated houses can suffer from high relative humidity and high moisture content with the resulting interstitial condensation and mould in their building assemblies. A holistic approach will be followed assessing options for upgrading the thermal fabric of these buildings and the health of the occupants will be the primary focus of such analysis.

Where boundary issues or sensitive brick finishes present a challenge, internal insulation can be considered but, in such cases, a Hygrothermal Risk analysis (HRA) should be used to assess the risk of interstitial condensation and mould. Older buildings in the area would have traditional stone walls and again a hygrothermal risk analysis (HRA) would be recommended before proceeding with either IWI or EWI as more than likely unsympathetic building materials/decorative finishes may have been used in subsequent upgrades which may or may not be contributing to the problem. Cavity built walls may have had their cavities pumped previously thermal imagery may be required to determine the adequacy of the installation.

Olcovar was built in 2005 with timber frame construction. No additional wall insulation would typically be recommended for such relatively new housing. However, there may be local issues that may be identified by the homeowners and by site inspection. Any issues arising relating heat loss should be addressed. As outlined in the following section, an air tightness test would be strongly recommended ahead as part of a heat pump assessment. Overall, assuming the buildings are performing well in terms of heat loss and air tightness, all houses in this development are heat pump ready and the residents should be made aware of this as the vast majority of the gas boilers installed will be coming to the end of their serviceable life.

Many older house types have suspended timber floors which should be insulated whenever the opportunity arises. This also represents an opportunity to address air tightness and any thermal bridges at this junction.

Ventilation and Air Tightness

The question of adequate ventilation, air tightness and indoor air quality (IAQ) in the houses will need to be addressed alongside any proposed insulation upgrades. The majority of the houses in the BER certificates issued that we analysed are using natural ventilation. While a natural ventilation system ensures sufficient fresh air is supplied to the living space, as the stale heated indoor air is replaced by fresh possibly cooler external air, the heat from the outgoing indoor air is lost. This is referred to as a “ventilation loss”.

A mechanical ventilation system with heat recovery not only exchanges the stale indoor air with fresh outdoor air, but it also recovers the heat from the outgoing stale air and exchanges this into the cool fresh incoming air. Hence the “ventilation losses” can be dramatically reduced. If a building is very “leaky”, then cool external air will leak into the building, which will then dramatically reduce the efficiency of the heat exchange unit. In this way ventilation and airtightness should be considered collectively.

With increasing levels of insulation and air tightness, there are a number of factors to consider when evaluating ventilation options for a building. First and foremost is to recognise the level of uncontrolled background air leakage (infiltration via gaps, cracks and holes in the building fabric). This should be reduced as far as practicable and then offset this with purposed provided, controllable ventilation. This can take many forms but can include Intermittent Extract Ventilation (IEV), Mechanical Extract Ventilation (MEV), Positive Input Ventilation (PIV), Mechanical Ventilation with Heat Recovery (MVHR) etc..

Ignoring an assessment of the background ventilation (or indeed simply assuming about how much of it there is) can lead to properties either being over ventilated (excess air changes and thus heat loss) or mechanical ventilation systems not working efficiently because the leakiness of the building does not allow the systems to balance and effectively draw and expel air from the property itself.

The first port of call when considering the ventilation strategy for a building therefore is to conduct an air tightness test. This is important not only as a simple means of assessing fabric efficiency i.e. less leaky equals good but also because it provides that all important assessment of the level of uncontrolled background air leakage and thus what the optimal ventilation strategy is likely to be. Of course, the funding isn’t always there to go to added lengths to reduce the air leakage or specify advanced ventilation systems and therefore again, this is why it’s important to use the air tightness testing as a means of assessing risk and at the very least ensuring that the installed ventilation solution is at least proportionate to the level of air tightness.

The Air tightness test is the only real quality control measure that the homeowner has at their disposal and can provide the homeowner with a lot of information on actual leakage areas in their dwelling which can be quantified. Thermal imagery can also be used to assist the homeowner identify heat loss paths such as missing insulation, moisture saturated insulation, thermal bridges at junctions, point thermal bridges and poor airtightness.

An Airtightness test, thermal imagery and if necessary a Hygrothermal Risk analysis are all valuable tools which the homeowner can avail of when assessing upgrade options and when combined with a BER can provide the homeowner with clear pathway to achieving an energy efficient home.

SEAI’s grant schemes do not insist on specific air tightness levels being achieved. However, the pilot SEAI deep retrofit scheme in 2017/2018 insisted on an air permeability of $5m^3/hour/m^2$ being achieved via air tightness testing for a dwelling in order to obtain grant funding. This is also the air permeability target required for new buildings and would represent a good target to aim for if a heat pump is being installed in a retrofit project.

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.

7 Energy Audits of Non-Domestic Buildings

7.1 Methodology

Energy audits were conducted on three large buildings:

- Station House Business Centre
- St. Joseph's Nursing Home
- St. Anne's National School

Detailed energy audit reports were conducted, and a separate report has been produced for each building. The three energy audit reports are standalone documents that have been forwarded separately.

7.2 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, Shankill 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-term Energy Master Plan, one proposal to consider would be that each non-domestic business should conduct its own energy audit in order 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.

An excel template is provided in Appendix D as an example that could be used by all business to record their annual energy usage and to report on CO_2 emissions. It could be adapted to perhaps include annual energy costs and/ or oil or other fuel usage. This idea could then be developed further to enable summary data to be placed on the SAGE webpages or to be uploaded to a specific portal for reporting on non-domestic buildings.

8 Community Renewable Energy Initiative

The Government's Climate Action Plan (2023) CAP 2023 establishes a commitment to support at least 500 MW of local community-based renewable energy projects and increased levels of new micro-generation and small-scale generation

8.1 Community Renewable Projects

In 2018 the Irish Government approved the high-level design of the Renewable Electricity Support Scheme (RESS) including its ambitious community provisions. The design was based on two public consultations:

- The ambition set out in Ireland's Energy White Paper to support communities,
- The emergence of energy communities as a key function of the recast Renewable Energy Directive within the EU Clean Energy Package.

The Government decision noted that the scheme would deliver on a broad range of policy objectives, including "the provision of pathways and supports for communities to participate in renewable energy projects".

Renewable electricity is a central element of Ireland's action on climate disruption as set out in the Programme for Government, the Climate Action Plan 2019, and the National Energy and Climate Plan 2021-2030. The RESS scheme ensures that Ireland is on a pathway to meet our ambitious climate targets and lays the foundations of a thriving and cost-effective renewable electricity market. This will support the growth of the green economy, create both sustainable work opportunities and communities, and ultimately benefit the consumer as renewables become more cost effective.

Overview of RESS

The Renewable Electricity Support Scheme (RESS) has been designed to promote investment in renewable energy generation in Ireland. Ireland has set a target of 80% renewable electricity, and an EU-wide renewable energy target of 32%, by 2030. This competitive auction based, cost effective framework will help us achieve these targets.

In addition, RESS will help deliver

- Community ownership and partnership and
- Increased renewable technology diversity

RESS Auctions

RESS auctions will be held at frequent intervals throughout the lifetime of the scheme. These auctions will be designed in line with trajectory targets identified in Ireland's National Energy and Climate Plan (NECP).

Community aspects of RESS

There are two aspects of community participation in RESS.

- Community-Led Projects
- Community Benefit Funds

Community-Led Projects

Community-led projects can apply for RESS if they meet the following criteria:

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

An application for a Community-Led Project must be made in conjunction with a Sustainable Energy Community member. The SEC must be identified in the Declaration of a Community-Led Project, together with a description of the relationship between the Applicant and the Sustainable Energy Community.

*In February 2021 it was announced that Community-led projects seeking to apply to future RESS auctions, must be 100% owned by the community, as opposed to being majority owned as was the case for RESS-1.

Community Benefit Funds

A mandatory Community Benefit Fund must be provided by all projects successful in a RESS auction. The contribution is to be set at €2/MWh. The Fund will be aligned to incentivise investment in local renewable energy, energy efficiency measures and climate action initiatives. The community benefit funds under RESS-1 will deliver approximately €4.5million a year to sustainable community initiatives targeted at those communities living in close proximity to the RESS-1 Projects.

Supporting Communities

SEAI is offering support to communities interested in developing their own renewable electricity generation projects and who are seeking to bid in the Community Category of RESS auctions. SEAI helps SECS navigate their way through the journey. SEAI's website has an **Expression of Interest form** for inquiries regarding Community RESS or interest in developing a community renewable energy project.

Can Shankill participate as a Community in RESS?

As Community RESS projects must be in range 500kW (0.5MW) to 5000kW (5MW), the SAGE committee are aware that there is no area large enough available in Shankill to accommodate a community solar PV project of minimum 500kW size nor are there sites available that could accommodate a wind energy project.

As an alternative, SAGE will indicate its willingness to participate as shareholders in another community energy project, for example in Wicklow.

8.2 Solar PV on School Roofs or other Public / Commercial Buildings

SAGE has identified the following potential location for solar PV installations:

- The roofs of the three primary schools and 1 secondary school
- Rathmichael Church/ Resource Centre
- Brothers' land beside Woodbrook College
- Conduct a feasibility study for installing PV above the cemetery walkways

It is also noted that LIDL have applied for 150KWH PV installation on the roof of their store.

With regards to grants, PV on schools can access the non-domestic Microgen Grant (NDMG): https://www.seai.ie/business-and-public-sector/business-grants-and-supports/commercial-solar-pv/ . In addition, it was widely reported on 22nd September 2022 in national media that every school in the country will have solar panels put on it, under plans discussed by Cabinet. Ministers discussed a proposal to put photovoltaic panels on all schools throughout the country in a bid to help protect schools against rising energy prices into the future. We have received an update on the 17th of February from the Department that this scheme is in motion and will be rolled out in the coming months. It would be prudent to contact the principals and the board of directors in each school to update them on this and to encourage them to act on it as early as possible.

Grants are available for systems up to a maximum 6kWp (Approx. 16 Panels or 25m^2) with potential savings of between €2,000 - €3000 annual electrical costs (depending on installation size and current utility rates). The maximum installation of 6kWp (kilowatt peak) is calculated by adding the rated output of all the panels on your building. If you have a 400W rated panel, you can have a maximum of 15 panels (400 x 15 = 6000W (6kWp))

The grant amount is capped at €2,400. This grant is available to:

- Businesses
- The agricultural sector
- Public sector bodies
- Schools
- Community centres
- Non-profit societies

8.3 Solar Meitheal

SAGE proposes to promote renewable energy installations for residential dwellings. The **Solar Meitheal** idea is to bring numbers of households together to install Solar PV on a group basis.

Benefits of this would include shared knowledge and resources among the group, the possibility of bulk discounts (estimated 5% of between approx. €500-€1,000), peace of mind that you are getting good value and decent quality.

This approach is being adopted currently by three SEC communities in Wicklow. Local SEC groups have approached their communities about this and have received about 50 expressions of interest to date. This is very promising and matches the level of interest being seen by Solar companies due the combined desire to adopt renewable technologies and to hedge against rising electricity costs.

Steps

For Shankill, a plan would be required into order to put the Solar Meitheal into action.

A suggested plan would be:

- SAGE to conduct a market sounding exercise. SAGE to contact several PV providers and establish how the providers would like to see works procured and the preferred contract structure etc... From the process, SAGE will then establish a formal tender document detailing the technical packages required (e.g. a 2kW, 3kW, 4kW system, battery storage options etc)
- SAGE should then issue the Tender document/ Request for Quotation and seek replies from a minimum of three PV installer companies. SAGE could then agree a bulk discount rate that would arise for a cluster of homes.
- SAGE could then promote the preferred supplier package(s) to the wider Shankill community. SAGE would need to appoint a project leader to co-ordinate the contractor selection, promotion and leads co-ordination etc.
- Installations: Once the contractor is chosen the individual householders need to deal directly with them under the terms of what has been agreed, i.e. payment and contract is between the householder and the contractor as per a normal transaction. The role of the SEC is as a facilitator here and not as project manager for the installation phase.

For homeowners, industry sources indicate that 6 and 8 panels systems are most common. Assuming 385W panels are used, this equates to a 2.3kW system for 6 panels or a 3.1kW system for 8 panels.

More information on typical PV systems sizing, annual kWh produced and SEAI grant amounts are shown in table 26.

Table 26

	Energy Produced (kWh)	SEAI Grant
6x385Wp - PV (2.31 kW)	1666.3	€1,893
8x385Wp - PV (3.08 kW)	2221.7	€2,124
10x385Wp - PV (3.85 kW)	2777.1	€2,355
16x385Wp - PV (6.16 kW)	4443.4	€2,400

Sizing Solar PV Installations for Homes and Businesses

There is quite limited advice available to homeowners and building owners to enable them understand and the determine the optimum number of PV panels for their installation. For example, what is the current electricity load profile of the house on typical day throughout the year? If there is a gas boiler is the immersion element used at times of the year? Is there electric cooking? Is there a hear pump or electric vehicle charging?

To provide an example of best practice, the services of Tim Cooper, Conservation Engineering Consultant, timcooper.ie, were engaged to conduct a PV sizing exercise on one home in Shankill. A separate report has been prepared that is highly informative.

9 2027 & 2032 EMP Modelling

9.1 Assumptions

The National Energy and Climate Action Plan 2021-2030 has set a target to reduce greenhouse gas emissions by 7% per year by 2030, equivalent to a 51% reduction.

On 12th December 2020, at the UN Climate Summit, the EU committed to a 55% cut in greenhouse gas emissions by 2030.

9.2 2027/ 2030/ 2032 Residential Target

As this EMP is being developed in 2022 with final publication in early 2023, 2022 will be used as the base year for modelling purposes.

The residential energy baseline was established in Section 5.1. For modelling purposes, an initial annual energy reduction target of 3.5% is proposed.

As shown in Table 27, the average dwelling in Shankill has a primary energy of 204 kWh/ m^2 /year.

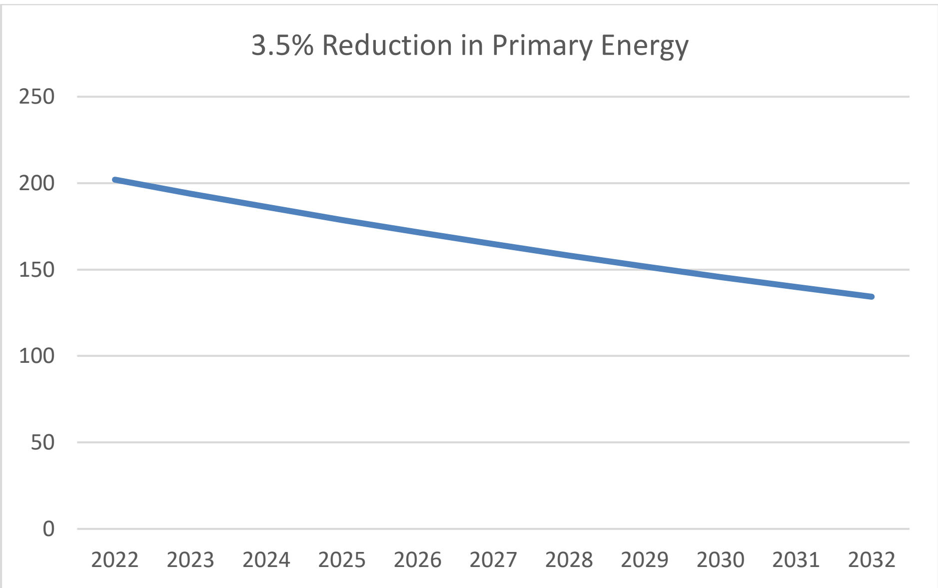
A 3.5% reduction per annum would result in a 16% cumulative reduction by 2027 and 30% reduction by 2032 with respective primary energy values shown in Table 27.

Table 27: 3.5% reduction in Residential BER average

Year	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Primary Energy (kWh/m2/year)	204	196	190	183	177	170	164	159	153	148	143
		-3%	-7%	-10%	-13%	-16%	-19%	-22%	-25%	-27%	-30%

The trend is illustrated in Figure 16.

Figure 16: 3.5% Reduction Trend Per Annum



9.3 Residential Strategy for 5 Year Plan (2022-2027) & Retrofit Targets

The focus of the Energy Master Plan for the residential sector will be spread across all age bands.

While the older stock is suited to multiple measures including a full deep retrofit, much of the stock post 2000 would be suited to converting to heat pumps when replacing boilers from hereon.

To create a strategy model for 2027 and beyond, the following needs to be considered:

- **Current state**: 1968 dwellings have BER certs with an average primary energy value of 204 kWh/ m^2/annum.

- **Additional BER per annum (2023-2027)**:

  The number of new BERs published per annum over the last 5 years are shown in Table 28. On average, 200 new BERs (approx.) were published per annum over the last 5 years in Shankill.

Table 28: BERs published each year- last 5 years

Year	New BERs per Annum
2017	172
2018	157
2019	170
2020	157
2021	365
Average	**204**

Thus, it is reasonable to assume, 1000 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 165 kWh/ m^2/annum.

Residential Retrofit Scenario -

The residential scenario is based on the following assumptions:

- 1000 additional residential BERs will be published each year over the next 5 years. Assumed average primary energy is 165 kWh/ m^2/year.
- 25% of existing dwellings with BERs of C1 or worse will be upgraded from 2023-2027 (= total number 349) - thus reducing the count of C1 or worse homes
- 659 additional dwellings will be upgraded. Thus 1008 dwellings in total (349 + 659) will be upgraded falling into four separate categories of measures as indicated in Table 29. Note that 1008 dwellings equate to 25% of the residential housing stock.

Table 29: Retrofit Targets 2023-2027

Category	Measure	Number of homes upgraded	New Rating
1	**PV only**	**100**	C3
2	Roof insulation, new condensing boiler and heating controls	**100**	C3
2A	**Roof insulation, new condensing boiler and heating controls &PV**	**100**	C2
2A	Roof insulation, new condensing boiler and heating controls &PV	**108**	B3
3	Standard measures package (roof insulation, internal or external wall insulation, boiler and heating controls, wood stove)	**150**	B2
3A	Standard measures package (roof insulation, internal or external wall insulation, boiler and heating controls, wood stove) &PV	**150**	B1
4	Advanced Measures (Standard with heat pump and whole house ventilation)	**200**	A3
4A	Advanced Measures (Standard with heat pump and whole house ventilation) &PV	**80**	A2
4A	Advanced Measures (Standard with heat pump and whole house ventilation) &PV	**20**	A1
	Total Dwellings upgraded	**1008**	

The impact of this combination of assumptions would be to achieve an average primary energy per dwelling at 170 kWh/m^2 /year by 2027. This is equivalent to a 16% primary energy reduction per table 24.

The Retrofit Targets (2023-2027) listed in Table 26 have been separately added into the Register of Opportunities spreadsheet.

Table 30: 2027 Residential Scenario

Row Labels	G	F	E2	E1	D2	D1	C3	C2	C1	B3	B2	B1	A3	A2	A1	Grand Total
2022 total	**46**	**56**	**67**	**87**	**206**	**268**	**220**	**233**	**212**	**153**	**60**	**14**	**158**	**188**		**1968**
Upgrades on 25% of C1 or worse: 2023-2027	**-12**	**-14**	**-17**	**-22**	**-52**	**-67**	**-55**	**-58**	**-53**							**-349**
Altered 2022 Total	**35**	**42**	**50**	**65**	**155**	**201**	**165**	**174.75**	**159**	**153**	**60**	**14**	**158**	**188**		**1619**
2023-2027 - additional BERs									**1000**							**1000**
2023-2027 upgrades only							200	100	108	150	150	200	80	20	20	1008
2027 - Estimated BER Count	35	42	50	65	155	201	365	274.75	1267	303	210	214	238	208	20	**3627**
Primary Band (kWh/m2/year)	**680**	**415**	**360**	**320**	**280**	**245**	**215**	**185**	**165**	**135**	**115**	**85**	**65**	**35**	**20**	
Primary Band (kWh/m2/year) - all	23,460	17,430	18,090	20,880	43,260	49,245	78,475	50,829	209,055	40,905	24,150	18,190	15,470	7,280	400	617,119
Average Primary Energy (kWh/m2/year)																**170.13**

The data is Table 30 is shown in full in Appendix D.

Summary:

Looking at the residential scenario provides a useful understanding of the scale of work required to upgrade the existing stock.

If new dwellings are added to the model, they can substantially impact the average primary energy values – however 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.

9.4 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 5.2. The current total annual energy usage for commercial and public buildings in estimated at 45,777,0000 kWh or 45.77 GWh (gigawatt-hours). As stated in Section 5.2, the commercial baseline estimate needs to reviewed once actual energy use data becomes available.

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 31.

Table 31: 4% reduction in Commercial/ Public Building Energy Usage

Year	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Primary Energy (GWh/m2/year)	45.78	43.95	42.19	40.50	38.88	37.33	35.83	34.40	33.02	31.70	30.43
		-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. It is recommended that SAGE engage a consultant to carry out high level assessment of energy use in businesses 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.
- All business and public building should be encouraged to record their annual kWh usage for their main fuels.

9.5 Transport Strategy

The Climate Action Plan 2023 promotes the **Avoid-Shift-Improve** approach.

Improve relates to the transition for petrol and diesel vehicles to electric vehicles.

The Irish Bulletin of Vehicle and Driver Statistics 2020[1] produced by the Department of Transport states that were 84,000 battery electric vehicles estimates on Irish roads – about 3.8% of the total of 2.6 million private cars and goods vehicles in the country.

[1] https://www.gov.ie/en/publication/aa05b-irish-bulletin-of-vehicle-and-driver-statistics-2020/

In late November 2022, Minister Eamonn Ryan and the Department of Transport stated that the new Climate Action plan will set a target of replacement of 30% of the entire fleet with electric vehicles, equivalent to 950,000 EVs by 2030.

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 will increase to 30% by 2030.
- 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 19 estimates current energy use for transport at 66,850,000 kWh or 66.85 GWh.

Assuming a 30% EV market share by 2030, Table 32 shows the results split in car types.

Table 32: Vehicles by Type (2030)

Shankill 2030	petrol	diesel	BEV
2030 Target Split	28.0%	42.0%	30%
Revised Cars split	1,622	2,433	1,738

Combining the data in Table 19 and Table 32 (including a 15% improvement in the efficiency of petrol/ diesel vehicles) enables the annual energy use and CO_2 emissions for Shankill transport fleet by 2030 to be estimated in Tables 33 and 34 respectively.

Table 33: Transport: 2030 Annual kWh estimate

Total Cars (5,794)	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	4,924.04	
kg CO2 per car/annum	1,719	2,794	842	
Total cars split	1622	2433	1738	
kWh -all cars/a	12,193,546	28,496,525	8,558,966	**49,249,038**

The net result would be a 26% reduction in transport energy emissions by 2030 (and 32% by 2032).

This is equivalent to a 3.75% reduction in transport energy use per annum as shown in Table 31.

Table 34: 3% reduction in Transport Energy Usage

Year	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Primary Energy (GWh/m2/year)	66.85	64.35	61.93	59.60	57.37	55.21	53.14	51.15	49.23	47.38	45.60
		-3.75%	-7.37%	-10.84%	-14.19%	-17.41%	-20.51%	-23.50%	-26.37%	-29.13%	-31.79%

The corresponding CO2 projection is shown in table 35.

Table 35: Transport CO_2 Emissions Model

Year	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Petrol/Diesel	96.2%	95.1%	93.6%	91.7%	89.1%	85.9%	81.7%	76.2%	69.0%	59.7%	47.6%
BEV	3.8%	4.9%	6.4%	8.3%	10.9%	14.1%	18.3%	23.8%	31.0%	40.3%	52.4%
Cars (petrol/dsl)	5574	5508	5422	5310	5165	4977	4731	4412	3998	3459	2759
BEVs	220	286	372	484	629	817	1063	1382	1796	2335	3035
kgCO2 - BEVs/ annum	14,935,327	14,758,338	14,528,254	14,229,143	13,840,300	13,334,804	12,677,659	11,823,370	10,712,795	9,269,047	7,392,175
kgCO2 - prtl/dsl cars	185,444	241,078	313,401	407,421	529,647	688,542	895,104	1,163,635	1,512,726	1,966,544	2,556,507
Total kgCO2 all vehicles	15,120,771	14,999,416	14,841,654	14,636,564	14,369,947	14,023,345	13,572,763	12,987,005	12,225,521	11,235,591	9,948,682
kTonnes kgCO2 all vehs	15.12	15.00	14.84	14.64	14.37	14.02	13.57	12.99	12.23	11.24	9.95

EV Charging Points:

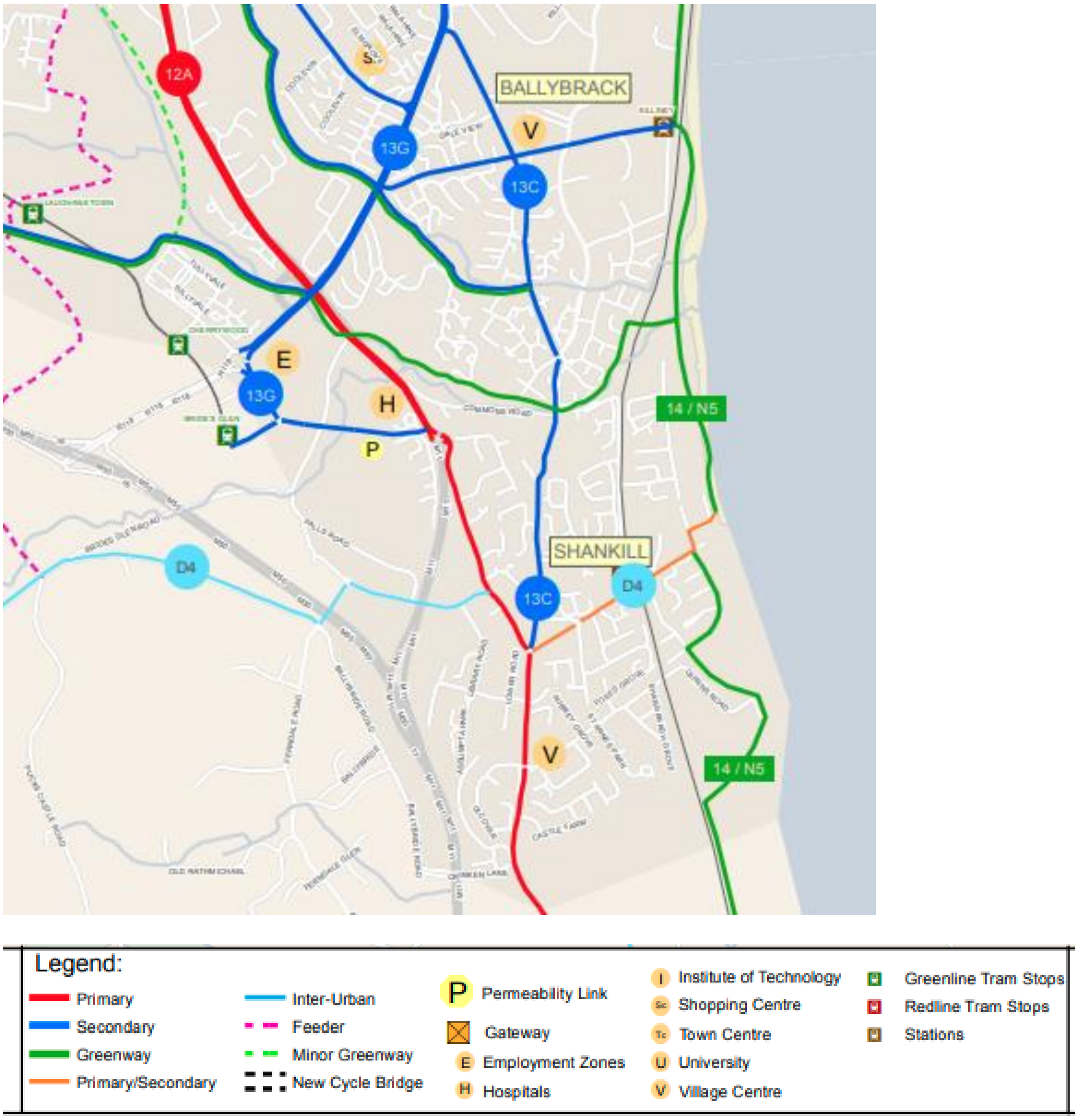
One way to achieve public buy in to EV transition is to propose to DLR Co Co to use lampposts as charging points as has been done in Scotland.

Cycling Strategy

For the **Avoid-Shift** aspects of the transport strategy, the ambition is to reduce the need for travel, shifting to public transport, walking and cycling.

Within the Greater Dublin Area (GDA) Cycle Network there are routes for this area as shown in the map below.

There are not live projects at the moment (and some sections are existing). A primary route (red route) would carry more cyclists. The annual funding allocation is given by the National Transport Authority.



9.6 EMP Energy Reduction Target Summary

The individual targets are summarised in Table 36 and presented in figure 17.

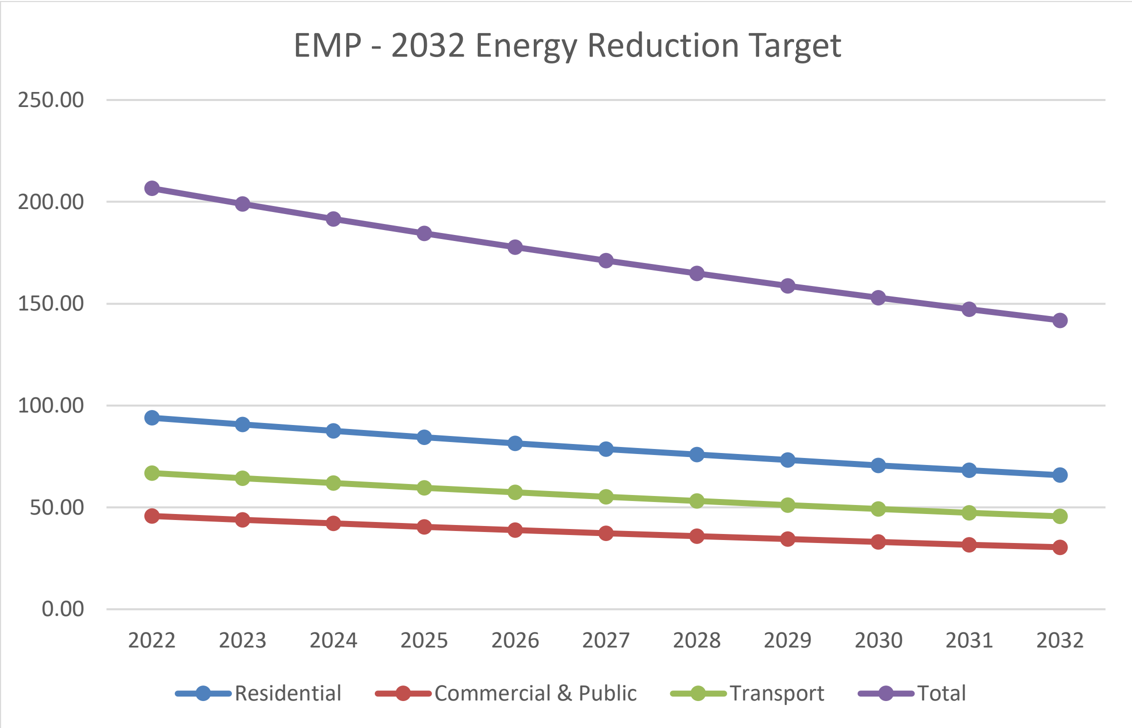
Table 36: Summary of Annual Energy Reduction Model Targets.

Primary Energy (GWh/m2/year)	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Residential	93.98	90.69	87.51	84.45	81.49	78.64	75.89	73.23	70.67	68.20	65.81
Commercial & Public	45.78	43.95	42.19	40.50	38.88	37.33	35.83	34.40	33.02	31.70	30.43
Transport	66.85	64.35	61.93	59.60	57.37	55.21	53.14	51.15	49.23	47.38	45.60
Total	**206.61**	**198.98**	**191.63**	**184.56**	**177.74**	**171.18**	**164.86**	**158.78**	**152.92**	**147.28**	**141.84**

The net overall reduction from 206 GWh to 142 GWh by 2032 is 32%.

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 17: 2032 Energy Reduction Target



9.7 EMP CO_2 Reduction Target Summary

When modelling the CO_2 reduction roadmap, there are a number of important factors to bring into the equation.

As renewable outputs primarily from windfarms has increasingly been added to the national generation mix, the carbon content of electricity has reduced. this can be seen from the reducing primary conversion factor in the SEAI DEAP method since 2011 – figure 18.

Figure 18: DEAP Electricity Factors

Current Fuel Factors

Primary Energy Factor	2.08
CO2 Emissions [kg/kWh]	0.409

Simulate assessment using previous years:

	Date	Energy	Emissions
☐	7th Jan 2016 - 6th Apr 2017	2.19	0.473
☐	17th Dec 2014 - 6th Jan 2016	2.37	0.522
☐	11th Dec 2013 - 16th Dec 2014	2.45	0.555
☐	11th Dec 2012 - 10th Dec 2013	2.42	0.524
☐	1st Dec 2011 - 10th Dec 2012	2.58	0.556
☐	Pre 30th Nov 2011 - 30th Nov 2011	2.7	0.643

So, a house or business heated by electricity would see a significant improvement in its BER and drop in its CO_2 emissions from 2011 to 2021 simply through the passage of time and without doing any upgrades.

The CO_2 factor for electricity will continue to reduce year on year out to 2030 and beyond due to the addition of more renewable generation to the national generation mix. In the "Our Zero emissions Future" study by Dr Paul Deane of the MaREI Institute, 2020, a value of 0.118 kgCO_2/kWh is the assumed carbon intensity in the 2030 Base Case Scenario. The study assumes 70% renewable electricity penetration by 2030.

Based on the assumptions of this MaREI study, the 2030 primary energy and CO_2 Factors in table 37 are assumed.

Table 37: Electricity Factors - 2030

	2020	2030
Primary Energy Factor- electricity	2.08	0.647
CO_2 emissions-electricity (kg/kWh)	0.409	0.118

The CO_2 emissions factor can be extrapolated out to 2030 as shown in Table 38.

Table 38 - CO_2 emissions factor to 2030

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
CO2 emissions (kG/kWh)	0.409	0.380	0.351	0.322	0.293	0.264	0.234	0.205	0.176	0.147	0.1180
CO2 Adjustment factor	1.00	0.93	0.86	0.79	0.72	0.64	0.57	0.50	0.43	0.36	0.29

Table 39 shows the continued extrapolation from 2022-2032.

Table 39 - CO_2 emissions factor to 2031

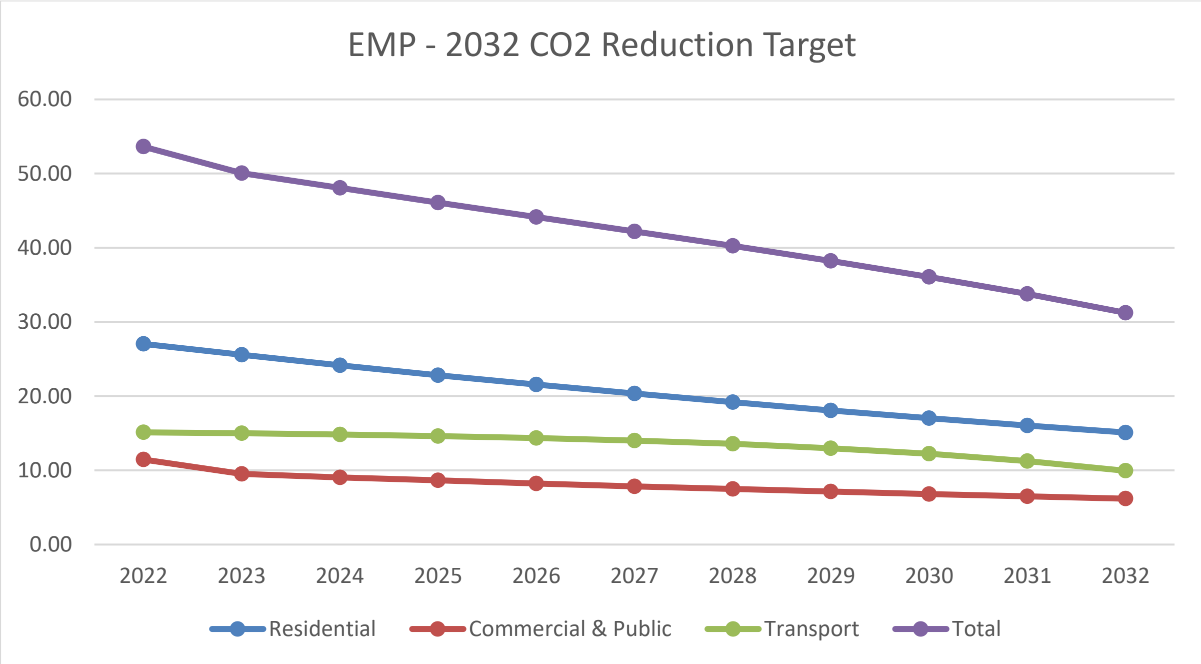
	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
CO2 emissions (kG/kWh)	0.351	0.322	0.293	0.264	0.234	0.205	0.176	0.147	0.118	0.089	0.060

By combining the CO_2 factors with the predicated energy use, the CO_2 reduction prediction out to 2032 in Table 40 is calculated. This equates to a 39% reduction in CO_2 emissions.

Table 40: Adjusted Carbon Dioxide Emissions – All Sectors

Total KiloTonnes Carbon Dioxide	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Residential	27.04	25.57	24.16	22.83	21.55	20.34	19.19	18.09	17.05	16.05	15.11
Commercial & Public	11.46	9.51	9.07	8.64	8.24	7.86	7.49	7.14	6.81	6.49	6.19
Transport	15.12	15.00	14.84	14.64	14.37	14.02	13.57	12.99	12.23	11.24	9.95
Total	**53.62**	**50.08**	**48.07**	**46.11**	**44.17**	**42.22**	**40.25**	**38.22**	**36.08**	**33.78**	**31.24**
		-7%	-10%	-14%	-18%	-21%	-25%	-29%	-33%	-37%	-42%

Figure 19: 2032 CO_2 Reduction Target



9.8 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 includes a table of actions, including behavioural measures.

The RoO template has been populated 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 SAGE including the behavioural measures. The cost estimates of additional consultant services are listed in the RoO for further potential work are indicative costs only purely to flag the key point that there are organisational costs associated with implementing the measures outlined.

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

Return on Investment (ROI)

The register of opportunities refers to the payback period for a range of upgrades. Some like PV will have a shorter payback period than that of say heat pumps. The ROI is metric that should be used when considering options as it is a tangible benefit, but the homeowner should also consider the intangible benefits that will occur from upgrading. Unfortunately, intangible benefits are often difficult to measure and monetise. This increase in the thermal comfort of the building to the occupants of building does not have a measurable metric as well as making the space more usable and to improved productivity of the space. Properly specified retrofits can provide substantial health benefits to occupants due to the improved indoor air quality (IAQ) which can be brought about by improving the airtightness of their buildings and introducing mechanical ventilation.

There are also societal benefits that will arise if this project successfully demonstrates the benefits of implementing an Energy Master Plan with the resultant reductions in emissions and other communities realise that they too have a role to play in meeting our Climate Action goals.

Mobilisation

The EMP sets out the baseline and then scopes out a viable roadmap to 2030/ 2032 indicating the level of investment and change that will be needed to achieve the carbon reduction targets. The next challenge for SAGE will be to put a framework into place to implement the actions suggested.

The Register of Opportunities, highlights a number of tangible projects that might be taken on by the SAGE in the short term. Many Government supports including funding mechanisms are available to help SAGE in this work and potentially via County Council.

The SAGE committee plans to meet Dun Laoghaire Rathdown County Council face-to-face as a next step to discuss how to initiate the action listed in the Register of Opportunities and to clarify synergies with the Council's own plans. They also plan to engage directly with local Councillors to enlist their support.

SAGE also commented that SEAI should create an additional service to assist SEC with mobilisation after their EMP has been completed.

10 Stakeholders

Key stakeholders and programme participants who can help drive the development, implementation, and success of the SAGE ENERGY Management Plan are outlined below.

The SAGE SEC group recognise the importance of these stakeholders and are seeking their active participation in formulating their activities and help to set goals and plan programmes for the area. For example, if SAGE are setting energy savings goals for the residential building in the area, they could engage with local business owners/self-employed contractor's residents etc who may have key contacts/information etc in the area that can be helpful/leveraged to get the best possible outcomes for the community. A call out for help/action should be included in the promotional literature been prepared. This type of collaborative goal-setting will increase buy-in from key stakeholders, encourage others to participate and ultimately will help to ensure that the targets are realistic, and create a road map for success with which all parties will be comfortable.

SAGE has links to many community groups in Shankill, some more developed than others. Representatives of most of these are signatories to our Community Charter.

Shankill Tidy Towns is a very active group. Shankill is an annual winner of Tidy Town awards in its category, in 2022 getting gold for the first time. Points are awarded for excellence in sustainability and biodiversity, and STT's association with SAGE is a real benefit for them, as it is for us.

Residents Associations:

There are two main residents groups in Shankill – South Shankill Residents Association and the Corbawn Residents Association. SAGE has met with both groups on many an occasion, including giving a presentation to the SSRA AGM. As the plan moves into the implementation phase the residents groups will be key players in engaging house owners in retrofitting.

Sports Clubs:

Shankill Tennis Club is a major community group in Shankill. They expressed an interest in upgrading their premises and floodlighting in the past. A proposal was presented to them by a consultant. However Covid brought the initiative to an end. Reviving this will be an objective of the EMP.

The Bowing Club is adjacent to the Tennis Club. They have a relatively new timber frame building housing an indoor bowling green. It possibly does not need retrofitting but they will be approached.

Other sports clubs – football etc – do not have significant premises.

Shankill Business Association:

SBA seems to be partially defunct. It was very active up to recent years. The EMP contains proposals to work with the business sector. It is possible that an initiative around energy conservation might bring the association back together and create "new energy".

The Churches:

There are three churches in Shankill – St James in Crinken and Rathmichael, both C. of I., and St Anne's which is R.C. In the first phase of SAGE, 2016 – 2018, both Crinken and St Anne's were active as part of Eco Congregations Ireland. Crinken has since implemented a major development of their parish buildings which are built to a very high standard. Rathmichael has not, so far, engaged. As SAGE is an open project initiated by St Anne's, we will endeavour to re-engage the other two churches in the EMP.

11 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.

11.1 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 wall insulation (EWI) or internal wall insulation (IWI) a Hygrothermal risk analysis (HRA) is recommended for older buildings or any buildings which are already exhibiting signs of surface condensation or mould. IWI if deemed appropriate best practice is to strip the walls back to bare, this also has the added benefit of enabling airtightness for the particular wall to be tackled. Liquid blower proof paint can be applied with extra attention being paid to junctions at walls and ceilings and windows 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 or where a vapour open system is recommended by an HRA a rockwool system should be used 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 EWI product installed must be NSAI Agrément CertifiedHouses

11.2 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. IWI should be treated with caution as mentioned above as incorrectly applied it has the potential to exacerbate an existing condensation/mould problem or its application may trigger one. The use of breathable vapour open insulation or renders or thin insulation (aerogel) or specialist render boards like calsitherm should be used in these cases. Another disadvantage of IWI is the loss of room space; this may be minimized by using high performance insulation products that are thinner. The opportunity to avail of applying airtightness is a major advantage in terms of reducing heat loss. While IWI 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 wall insulation option.

11.3 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. It is recommended that any existing cavity wall installation should be checked using thermal imagery to ensure that a full fill actually exists.

11.4 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.

11.5 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?

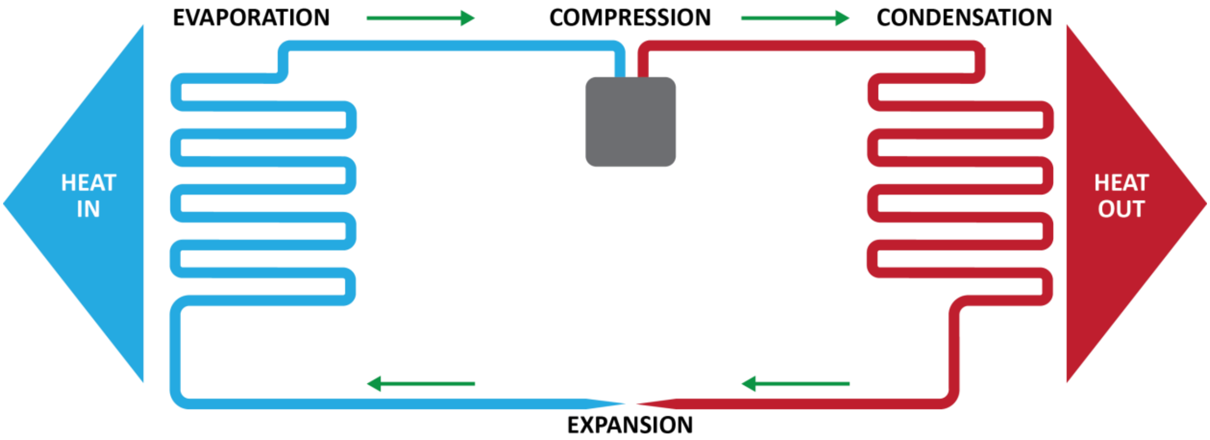
Heat Pump technology is being used in one of the most common appliances in our homes – the fridge. The principle of a heat pump is to move energy by the means of electricity, refrigerant gas and a compressor and in doing so, can provide both space heating, hot water and cooling.

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 transfers 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 is 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 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 considers the full heating system installed.

Does the type of heat emitter have an effect 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 considers 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/

11.6 Demand Control Ventilation

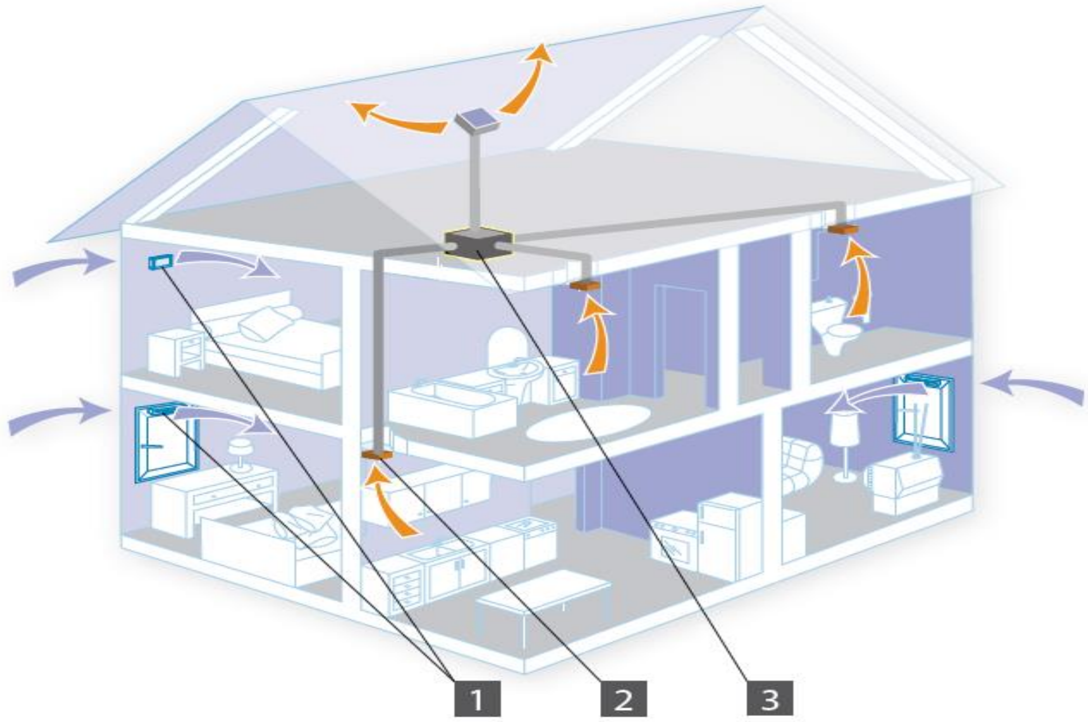
Demand control ventilation (DCV) provides a smart whole-house ventilation system. DCV is particularly appropriate in retrofit projects as it avoids the needs for extensive ductwork associated with mechanical heat recovery ventilation (MHRV) systems.

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



11.7 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 Shankill, 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.

11.8 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.

11.9 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)	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)	HLI
			Running Costs Calculation (kWh/y per fuel)													
Current state	C3	205.48	12934 Gas	0 Smokeless	3374 Gas	0 Electricity	809 Electricity	282 Electricity	1	€ 2,585	N.A.	N.A.	N.A.	N.A.	N.A.	2.91
Starter package	C1	173.01	11416 Gas	0 Smokeless	2126 Gas	0 Electricity	809 Electricity	228 Electricity	1	€ 2,202	€ 383	€ 2,810	€ 2,000	€ 810	2.1	2.80
Standard measures	B3	134.56	8040 Gas	0 Smokeless	2126 Gas	0 Electricity	809 Electricity	228 Electricity	1	€ 1,763	€ 821	€ 21,152	€ 6,500	€ 14,652	17.8	2.15
Advanced measures	B1	77.36	2433 El.HP.SH	0 Smokeless	845 El.HP.Water	0 Electricity	764 Electricity	228 Electricity	1	€ 1,615	€ 969	€ 35,052	€ 12,300	€ 22,752	23.5	2.15

Proposed measures & costs breakdown

Measure	Starter	Standard	Advanced	Area (m2)	Starter	Standard	Advanced
Attic insulation	☑	☑	☑	40	€ 1,110	€ 1,110	€ 1,110
Sloping Roof ins.	☐	☐	☐	0	€ -	€ -	€ -
Flat Roof ins.	☐	☐	☐	0	€ -	€ -	€ -
Cavity fill	☐	☐	☐	0	€ -	€ -	€ -
IWI	☐	☐	☐	0	€ -	€ -	€ -
EWI	☐	☑	☑	92	€ -	€ 18,342	€ 18,342
Susp. Floor insul.	☐	☐	☐	0	€ -	€ -	€ -
2G Windows	☐	☐	☐	0	€ -	€ -	€ -
3G Windows	☐	☐	☐	18	€ -	€ -	€ -
Doors	☐	☐	☐	4	€ -	€ -	€ -
Condensing Boiler	☐	☐	☐	N.A	€ -	€ -	€ -
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	€ -	€ -	€ -
Photovoltaics	☐	☐	☐	N.A	€ -	€ -	€ -
Project Mgt	☐	☐	☐	N.A	€ -	€ -	€ -
Low energy lights	☑	☑	☑	N.A	€ 100	€ 100	€ 100
					Starter	Standard	Advanced*
Totals:					€ 2,810	€ 21,152	€ 35,052
Grants					€ 2,000	€ 6,500	€ 12,300

Typical Current Conditions (modest upgrades only to date)

Type	Semi-D / Eo	1982	Sample House, Shankill	v1
Walls	Hollow Block - drylined			
Floor	Solid Floor			
Roofs	Insulated at ceiling level - 100mm			
Windows	PVC, double glazed, 16mm gap			
Doors	Solid			
Ventilation	Natural.2 x extract fans.			
Heating system	Central heating Gas boiler, 68% efficient,			
Space & Htg Controls:	Programmer and TRVs			
Hot water tank	95 Litre, 60mm lagging jacket , no cylinder thermostat			

Appendix B - Brochure

02_Sample House, Shankill

Typical House - Current Conditions (modest upgrades only to date)	
Type	Semi-detached
Year built	1982, extended 1997
Walls	Hollow block - drylined
Floor	Solid floor
Roofs	Insulated at ceiling level – 100mm
Windows	PVC, double-glazed, 16mm gap
Doors	Solid
Ventilation	Natural ventilation with 2x extract fans
Heating system	Central heating gas boiler, 68% efficient
Heating controls	Programmer and TRVs
Hot water	95 litre cylinder, 60mm lagging jacket, no cylinder thermostat

Upgrade Measures Package 1: The Starter

	Measures
1	Attic insulation
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	Attic insulation
2	Condensing boiler
3	External wall insulation
4	Heating controls
5	Low energy lights

Upgrade Measures Package 3: Advanced Measures/ Deep Retrofit*

	Measures
1	Attic insulation
2	External insulation to walls
3	3G windows
4	Doors
5	Air Source Heat Pump
6	Low energy lights

BER and Financial Analysis

Variant	BER	Energy Costs	Savings	Investment costs	SEAI Grants	Costs inc. grants	Payback (years)	HLI
Current state	D1	€ 3,227	N.A.	N.A.	N.A.	N.A.	N.A.	2.91
Starter package	C3	€ 2,770	€ 457	€ 2,810	€ 2,000	€ 810	1.8	2.80
Standard measures	B3	€ 1,762	€ 1,466	€ 23,852	€ 6,500	€ 17,352	11.8	2.15
Advanced measures	B1	€ 1,615	€ 1,612	€ 35,052	€ 12,300	€ 22,752	14.1	2.15

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. A review of ventilation strategy and an air tightness test is recommended with satisfactory results ahead of heat pump installation.
3. * For advanced measures, single measure grant amounts available from SEAI are used in this analysis. Higher grants would be possible if applying through an SEAI-approved One Stop Shop.

Appendix C

Industry-Average Cost of Measures

Measure Pricing (Industry Average)	
Attic insulation (m^2)	€ 28
Sloping roof insulation (m^2)	€ 150
Flat roof insulation (m^2)	€ 150
Cavity fill insulation (m^2)	€ 28
Internal wall insulation (m^2)	€ 145
External wall insulation (m^2)	€ 200
Suspended floor insulation (m^2)	€ 90
2G Windows (m^2)	€ 510
3G Windows (m^2)	€ 570
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	€ 4,500
Photovoltaic panels (6 units)	€ 8,500

Appendix D

Simple Annual Energy/ Billing Data Tables

Electricity

Electricity Meter Reading		Usage Year	Elec KWh pa	Elec kg/kWh	Elec CO2 pa
Jan-19	15877				
Jan-20	19931	2019	4054	0.409	1,658
Jan-21	23959	2020	4028	0.409	1,647
Jan-22	27441	2021	3482	0.409	1,424
Jan-23	30321	2022	2880	0.409	1,178

Natural Gas

Gas Meter Reading		Con Factor	Adjusted reading	Usage Year	Gas KWh pa	Gas kg CO2 pa
Jan-19	41	11	451			
Jan-20	479	11	5269	2019	7189	1,459
Jan-21	1183	11	13013	2020	7744	1,572
Jan-22	1872	11	20592	2021	7579	1,539
Jan-23	2514	11	27654	2022	7062	1,434

Appendix E

Definitions:

CODEMA: City of Dublin Energy Management Agency

EMP: Energy Master Plan

EWI: External Wall Insulation

kWh (kilowatt-hour) Standard unit of energy (1 kWh) where a 1kW (or 1000 watt load) is powered for 1 hour.

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

Tonnes CO_2: 1000kg CO_2

MTonne CO_2: 1000 Tonnes CO_2

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

IAQ: Indoor Air Quality

IEV: Intermittent Extract Ventilation

IWI: Internal Wall insulation

HGA: Hygrothermal Risk Assessment

MEV: Mechanical Extract Ventilation

MVHR: Mechanical Ventilation with Heat Recovery

PIV: Positive Input Ventilation (PIV)

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* (2023 values)	1.75	0.224
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