Athboy Energy Master Plan

Final Report

IHER Energy Services Ltd

Report by IHER Energy Services, 25th November 2024

Authors: Michael Hanratty, Keer Xu & Jose Ramirez

Version: 05

Contents

1 Executive Summary

The Government's Climate Action Plan (2023) CAP 2023 re-establishes the target to achieve a 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

The EPA reported that at the end of 2023, Ireland had achieved a 7.8% reduction from national greenhouse gas emissions from the 2018 baseline. So, progress has been poor to date overall and a huge amount of work needs to be done to get on track to achieve the 2030 target.

Athboy comprises 1965 residential units including the hinterland according to the SEAP BER mapping database (2023), two national schools, one secondary school and 76 non-domestic buildings. Its boundaries sit within seventeen Small Areas as defined for Census purposes.

This Energy Master Plan (EMP) addresses how the Athboy community can respond to the 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.

Baseline Methodology

The Athboy baseline for energy use and CO_2 emissions was established by looking at the residential housing stock, non-domestic buildings and transport. The desk research used the SEAI national BER dataset (707 dwellings have current BERs) and relevant available data from the Central Statistics Office.

Energy use in the 3 schools and the 73 non-domestic premises were estimated according to energy use benchmarks provided by SEAI. Actual annual energy billing data was used for three of these non-domestic buildings.

Energy use for transport has been estimated using mode data available from the 2022 Census, the Department of Transport's Irish Bulletin of Vehicle and Driver Statistics (2021) and national transport data provided by Codema.

All data inputs were collated into an excel model that produced the summary baseline for Athboy SEC in the table below.

	CO2 (tonnes)	Total (kWh)	Energy Cost
Residential	14,433	**58,526,142**	€7,467,000
Non-residential	20,148	**82,166,258**	€2,150,424
Transport	5,561	**23,747,161**	€3,316,140
Total	**40,141**	**164,439,560**	**€12,933,564**

Pathway to 2030 GHG Emissions Reduction Targets

As 2024 will be the first year of action, this study is presenting targets for a 10-year period out to 2033. However, 2030 target data is also presented for information purposes. Separate modelling has been done for residential buildings, non-domestic buildings and transport to establish energy and CO_2 emissions reduction targets.

Residential Energy Saving Targets

Based on the BER data available, the carbon emissions for all dwellings have been estimated at 14,433 tonnes per annum, equivalent to 7.33 tonnes per dwelling.

From a BER perspective, the BER score for a dwelling is based on the calculated kWh needed per square metre of floor area for space and water heating, pumps and fans and lighting. In Athboy, the average primary energy across 707 BERs in 230.6 kWh/m2/year, equivalent to a D1 rating.

A 3.85% reduction in average BER primary energy per annum would result in an 18% cumulative reduction by 2028 and a 32% reduction by 2033 with respective primary energy values shown in the table below.

Average BER-based Reduction Scenario

Year	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**
Primary Energy (GWh/m2/year)	58.53	56.27	54.11	52.02	50.02	48.09	46.24	44.46	42.75	41.10	39.52
		-4%	-8%	-11%	-15%	-18%	-21%	-24%	-27%	-30%	-32%

To get on this track, the EMP model assumes that approximately 20% of the 1965 dwellings would need to be retrofitted between now and 2028 through a selection of measures such as heat pumps and solar PV panels. These measures are detailed in Section 9 of this report and are also laid out in the Register of Opportunities (ROO).

The 2022 Census 66% of homes are heated by oil, whereas electricity heats at 14%, solid fuel including wood pellets heating 13%, LPG heats 2% and 6% is not stated or none.

Most homes in Athboy are heated by boilers, both non-condensing and condensing types with 69 homes heated by heat pumps. Despite the mixed age of the housing stock, approximately 250 dwellings with boilers have HLI values below 2.3 indicating that they are heat pump ready.

The step up to switch to heat pumps is logical and progressive in terms of carbon emissions reduction and is totally in line with the Climate Action Plan.

Today's heat pump models are 4 to 5 times more energy efficient than gas/oil boilers though electricity prices are higher than gas or oil (which is factored into the case studies created for Athboy). Using heat pumps instead of traditional boilers will have significant potential to cut CO_2 emissions and SEAI is actively encouraging this measure with grants available of €6,500 for houses and €4,500 for apartments.

SEAI's One Stop Shop scheme does insist on an air permeability value of 5m3/hour/m2 being achieved via air tightness testing of a dwelling if seeking grant support for air tightness measures. 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 to be installed in a retrofit project.

Solar PV is also now very attractive to enable homes to generate their own electricity and reduce utility bills and grants are available also. The Government recently announced in 2023 that VAT will no longer apply to PV projects which is a further incentive.

As the carbon content of electricity will reduce continually into the future as more renewables are added to the mix, this will make a further contribution to energy and CO_2 emissions reductions by 2032.

As shown in the table below, these modified electricity factors will enable a 33% energy reduction scenario by 2030 and a 44% reduction by 2033.

Residential Energy Reduction Projection (2023-2033)

Residential - Year	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Primary Energy (GWh/m2/year)	58.53	56.27	54.11	52.02	50.02	48.09	46.24	44.46	42.75	41.10	39.52
Primary Fossil Fuel (GWH/m2/yr)	46.82	45.02	43.29	41.62	40.02	38.48	36.99	35.57	34.20	32.88	31.62
Primary electricity use (GWh/m2/yr)	11.71	11.25	10.82	10.40	10.00	9.62	9.25	8.89	8.55	8.22	7.90
Adjusted Primary Electricity (GWh/m2/year)	10.09	8.93	7.84	6.82	5.87	4.98	4.15	3.38	2.66	1.99	1.37
Adjusted Total Primary Energy (GWh/m2/year)	**56.91**	**53.95**	**51.12**	**48.44**	**45.89**	**43.46**	**41.15**	**38.95**	**36.86**	**34.87**	**32.99**
Reduction with Modified Electricity factor		-8%	-13%	-17%	-22%	-26%	-30%	-33%	-37%	-40%	-44%

Commercial / Public Building Usage & Targets

Energy use data was only available for 3 non-domestic buildings. Otherwise, SEAI industry benchmark energy use data, (which is not considered accurate), had to be factored into the model for all other non-domestic buildings which is far from ideal. The estimated total annual energy usage for commercial and public buildings in estimated at 82,166,0000 kWh or 82.16 GWh (gigawatt-hours).

It is proposed that a 3% annual energy reduction target also be set for commercial and public buildings. This is equivalent to 2,465,000 kWh reduction per annum. This would result in a 26% reduction in energy use by 2033.

3% reduction in Commercial/ Public Building Energy Usage

Year	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Primary Energy (GWh/m2/year)	82.17	79.70	77.31	74.99	72.74	70.56	68.44	66.39	64.40	62.47	60.59
		-3%	-6%	-9%	-11%	-14%	-17%	-19%	-22%	-24%	-26%

One key action item would be to secure the commitment of all non-domestic building owners/ tenants to submit their energy use data annually to the SEC team to record and track energy use changes. This task would be very useful for each business but would also engage the businesses in the goals of the SEC. The commercial baseline estimate could also be revised and treated with greater confidence. A further step would be to promote energy auditing and setting of long-term energy saving targets by local businesses to follow up on initial energy savings measures.

Transport Target

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

Avoid encourages fewer journeys using fossil fuel-based transport and **Shift** encourages less carbon-intensive modes of transport.

Improve suggests reducing the carbon intensity of our transport fleets. In 2021, 5.7% of the vehicles in Athboy were estimated to be Battery Electric Vehicles (BEVs) based on national ratios. 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 2070 vehicles in Athboy (from 2022 Census), 621 of these would be EVs by 2030. Achieving this level of EV market share by 2030 would equate to a 3.75% annual reduction in energy use in transport, dropping from 23.75 GWh to 18.17 GWh. The net result would be a 23.5% reduction in transport energy emissions by 2030 (and 32% by 2033).

Year	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Primary Energy (GWh/m2/year)	23.75	22.86	22.00	21.17	20.38	19.61	18.88	18.17	17.49	16.83	16.20
		-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. Thus, a 47% reduction in CO_2 emissions from transport is projected by 2033.

A strategy for the deployment of EV charging points is expected to be established by Meath County Council in 2025.

Summary Projections

The total energy use across all three sectors is projected to decrease from 164.4 GWh in 2023 to 109.8 GWh by 2033, equivalent to a 33% reduction in energy use.

The total CO_2 emissions across all three sectors is projected to decrease from 40.85 kTonnes in 2023 to 24.74 kTonnes by 2033, equivalent to 39.4% reduction.

Summary Adjusted Carbon Dioxide Emissions – All Sectors

Total KiloTonnes Carbon Dioxide	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Residential	17.52	14.82	14.14	13.48	12.86	12.26	11.69	11.14	10.62	10.12	9.64
Commercial & Public	17.77	16.51	15.96	15.42	14.91	14.41	13.92	13.46	13.01	12.57	12.15
Transport	5.56	5.42	5.26	5.09	4.90	4.68	4.43	4.15	3.81	3.42	2.95
Total	**40.85**	**36.75**	**35.36**	**34.00**	**32.66**	**31.35**	**30.04**	**28.74**	**27.43**	**26.10**	**24.74**
		10.0%	13.4%	16.8%	20.0%	23.3%	26.5%	29.6%	32.8%	36.1%	39.4%

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.

The assumptions used to create this EMP model are quite ambitious and show the scale of action that will be needed at a local level countrywide to reach our Climate Action goals.

Deployment of Renewables

Following the 2022 budget, there was an announcement by Government that a new programme would be introduced for the installation of PV arrays on all schools.

Athboy SEC could consider a community initiative to promote renewable energy installations both for individual dwellings and businesses. The Solar/ Heat Pump Meitheal idea would be to bring numbers of households together to install these technologies 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.

Mobilisation

This Energy Master Plan sets out the baseline and then scopes out a viable roadmap to 2030/ 2033 indicating the level of investment and change that will be needed to achieve the carbon reduction targets. The next challenge for Athboy SEC 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 several tangible projects that might be taken on by the Athboy community in the short term. Many Government supports including funding mechanisms are available to help the SEC in this work. It will also be important to work closely with key stakeholders, including Meath County Councillors and other public representatives.

2 Introduction

The Athboy Energy Master Plan (EMP) study was commissioned 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 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. The 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 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.

Located within the Kells Municipal District in the northwest of county Meath, Athboy is a small town situated near the border with County Westmeath. Athboy is one of 4 medieval walled towns in Meath.

Athboy is located approximately 17km west of Navan and 11km northwest of Trim. Dominated by the convergence of national, regional and third-class roads the town is well connected to the surrounding hinterland, with the Main Street comprising the N51 national secondary road.

With a relatively compact Main Street, the amenity, heritage qualities and character of Athboy are largely derived from development fronting onto the elongated Main Street of the town. There are significant infill opportunities to the rear of the Main Street, as the backland area has not experienced any significant redevelopment and largely retains its 19th Century footprints. The town in recent times has extended along the main approach roads, with significant residential development evident on the Oldcastle, Kells, Frayne and Mullingar roads. Whilst residential growth and development has been strong, development within lands identified for enterprise and employment uses off the Trim Road has been limited.

Athboy also services a large rural hinterland which we have included in our SEC area. The SEC believes that the inclusion of this extended area will encourage further engagement with residents of the locality and place the urban section as an exemplar of best practice. The Athboy EMP area has a housing stock consists of 1773 residential units including the hinterland according to the 2022 Census.

Figure 1 Athoboy EMP Area

Based on the 2022 Census, the Athboy EMP catchment area contains 1773 residential units (houses, apartments and six caravans). Based on a local survey, it is estimated that there are 76 non-domestic energy consuming buildings. Vacant buildings were not included. This non-domestic total includes two primary schools and one secondary school.

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 the Athboy SEC in July 2023 to prepare an Energy Master Plan and Register of Opportunities.

The deliverables required included the following:

1. Quantify the current energy consumption of Athboy – baseline of electrical, thermal and transport energy demand.
2. Carry out Energy Audits of 5 x domestic, 2 x public/ commercial buildings
3. Create a Register of Opportunities (RoO)
    - Identifying projects that can avail of the Communities Energy Grant *and*
    - Identifying projects that can avail of the Better Energy Homes grant
    - Propose actions, based on baseline figures, to achieve a 50% reduction in energy usage/ CO_2 emissions by 2030.

The practical outputs Athboy SEC was seeking from the EMP are as follows:

- Consultants to conduct a Desktop Review and assess baseline energy usage for Athboy town and hinterland as defined in this application.
- Undertake a Residential Review to establish housing archetypes and current retrofit opportunities from selected housing estates. Select and review other common "one off" houses in the catchment area to assess retrofit opportunities.
- Conduct an Energy Audit of identified community buildings to inform retrofitting opportunities (in partnership with Athboy Development Forum)
- Research and identify Renewable Energy Projects in Athboy town and hinterland that the SEC could engage with as part of our overall 5-year plan (liaise with businesses and other community groups)
- Increase energy awareness and carbon awareness in the community
- Develop a ranked Register of Opportunities by cost, potential payback, emissions. This register will inform planning, priorities and action planning over a five-year period
- Develop and deliver Communications for our community outreach campaigns

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 design of data gathering and analysis tools that will facilitate the on-going energy baseline review for the Community
- The EMP will explore long-term goals and will advise on establishing additional car charging points and improving the energy efficiency of shared community buildings.

The EMP is to be developed as a working tool rather than simply a 'finished' report.

2.2 Methodology

The analysis presented in this report is based on a mix of desk research using publicly available data from the Central Statistics Office, SEAI and elsewhere, as well as energy audits on residential and commercial buildings.

The main focus of the report 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 residential buildings housing analysis. These are data extracted from the SEAI Building Energy Rating database[1] subset for dwellings within the Athboy SEC area and the predicted energy performance based on BER analysis of archetypal homes that are representative of the local area. BER audits were conducted on five representative homes and proposed energy efficiency upgrades are

[1] https://ndber.seai.ie/BERResearchTool/ber/search.aspx

presented in each case.

Data from Census 2022[2] for the Athboy Electoral Divisions and Small Areas provide statistical data on the local population and housing stock from 2022.

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.

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].

[2] https://www.cso.ie/en/releasesandpublications/ep/p-cpsr/censusofpopulation2022-summaryresults/keyfindings/

[3] City of Dublin Energy Management Agency

3 Athboy Small Areas / CSO Map

3.1 Athboy Small Areas

The CSO provides detailed census data at different geographical boundaries. All population and building data maps are available at 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 Athboy committee provided a list of all Small Areas (**Table 1**) contained within the EMP catchment area.

Table 1 Athboy Small Areas List

Athboy Small Areas	
1	167006001
2	167006002
3	167006003
4	167006004
5	167006005
6	167006006
7	167006007
8	167006008
9	167006009
10	167006010
11	167035001
12	167035003
13	167035004
14	167076001
15	167076002
16	167076003
17	167035002/5005

By clicking on the CSO mapping tool, the Athboy Small Areas can be displayed in map format as shown in Figure 2.

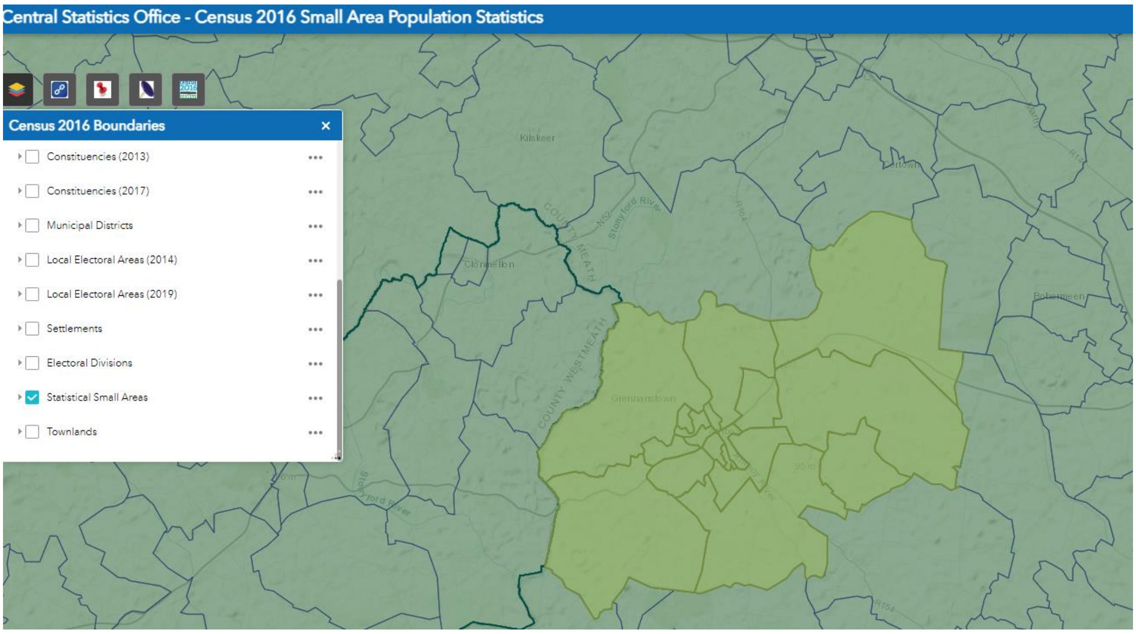


Figure 2 Athboy Small Areas Map

3.2 National BER Mapping Application

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

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 Athboy area is shown in Figure 3 below. The map is colour coded to the BER colour scale and the boundary conditions refer to small Area.

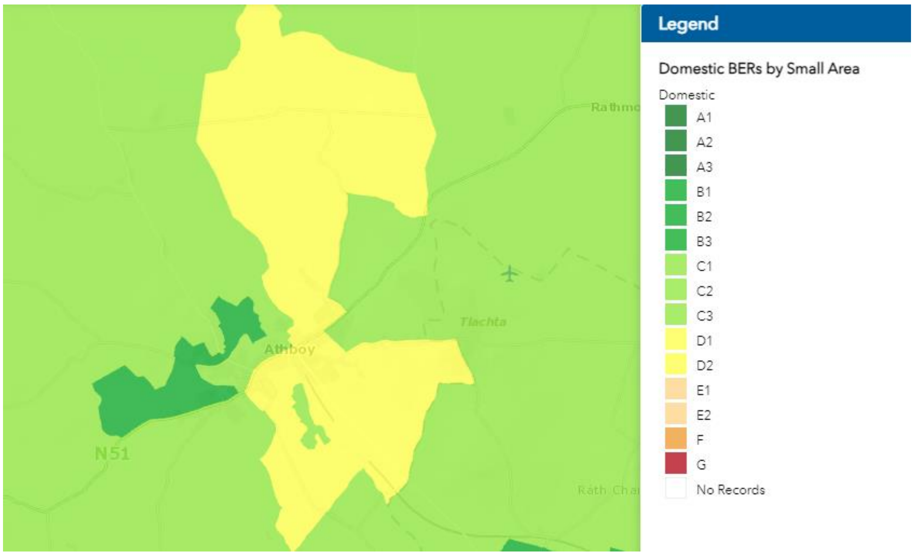


Figure 3 Extract from National Residential BER map

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

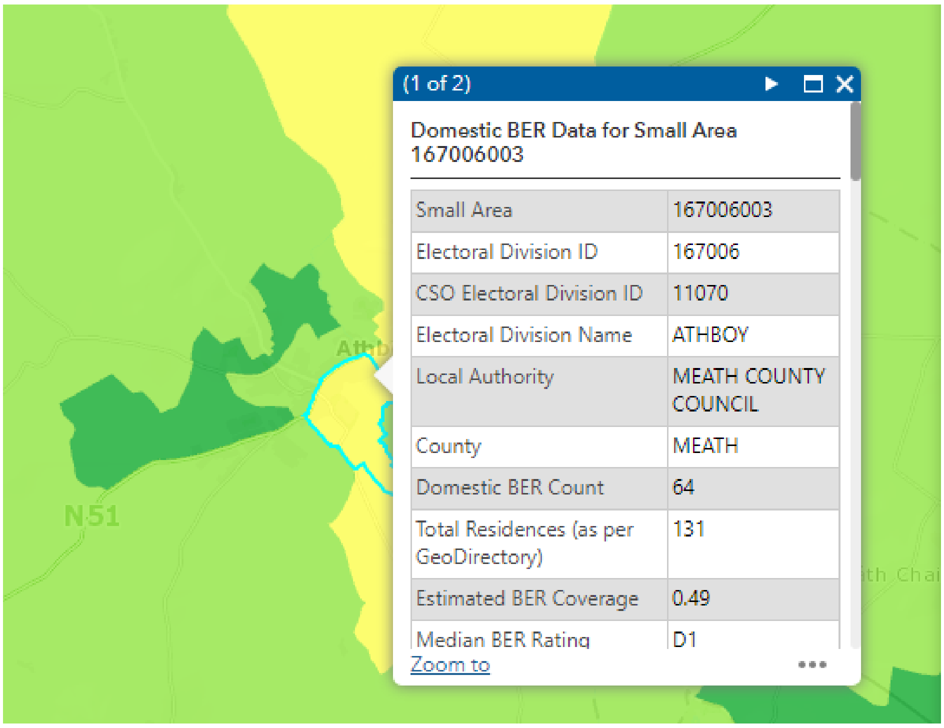


Figure 4 Small Area Details -National Residential BER map

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 Athboy was collated.

A similar map is also available via the BERWOW application.
https://www.sseairtricity.com/ie/home/home-upgrade-calculator/

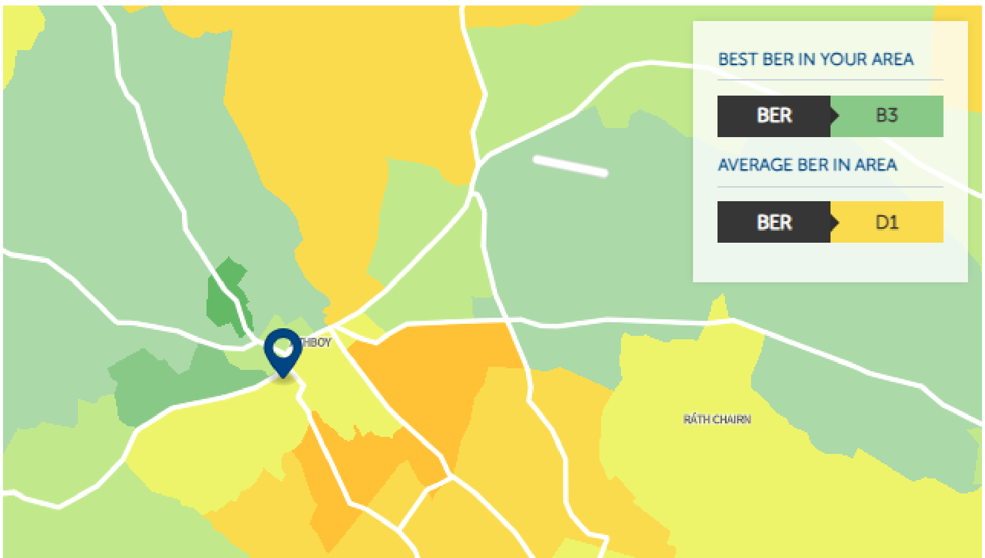


Figure 5 BER Map via BERWOW tool

4 Residential BER Database Analysis

From the supporting table behind the BER map provided by SEAI in September 2023, the percentage of dwellings with BERs is shown for each Small Area. Overall, 36% of the dwellings have BER certs.

Table 2 Small Area list with published BER Totals[4]

SMALL AREA	ED_NAME	BER COUNT	Total Dwellings	% with BER Certs	MEDIAN_BER_RATING
167006001	ATHBOY	32	104	31%	C3
167006002	ATHBOY	86	147	59%	C3
167006003	ATHBOY	64	131	49%	D1
167006004	ATHBOY	42	129	33%	D1
167006005	ATHBOY	58	123	47%	C2
167006006	ATHBOY	43	81	53%	C2
167006007	ATHBOY	53	109	49%	B3
167006008	ATHBOY	23	87	26%	D2
167006009	ATHBOY	57	142	40%	D1
167006010	ATHBOY	33	83	40%	C2
167035001	GRENNANSTOWN	35	138	25%	C2
167035003	GRENNANSTOWN	32	117	27%	C3
167035004	GRENNANSTOWN	39	88	44%	B3
167076001	RATHMORE	23	115	20%	C2
167076002	RATHMORE	23	103	22%	C3
167076003	RATHMORE	30	158	19%	C3
167035002/167035005	GRENNANSTOWN	31	110	28%	C3
		704	**1965**	**36%**	

4.1 National BER Database – Athboy

While this national BER map dataset is helpful, it only 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 950,000 published and current residential BER certificates. The BER database is publicly available, but it does not list actual addresses.

For this EMP study, a subset of the SEAI BER Database was created containing the data files for the 707 current BER records within the relevant Small Areas. (Note that SEAI supplied two complementary BER datasets – one dataset listed 704 BERs whereas the other more significant dataset listed 707 BERs. The latter is used for the analysis presented below).

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.

Of the 707 dwellings with BER certs, the average BER rating is D1, which is in line with the national average as shown in Table 3. The average floor area of the dwellings with BERs is 130m^2.

Table 3 Average Residential BER for Athboy

Average Primary Energy kWh/m2/yr	230.6	D1
Average Floor Area (m2)	129.16	

Figure 6 below shows that the distribution across the BER bands .

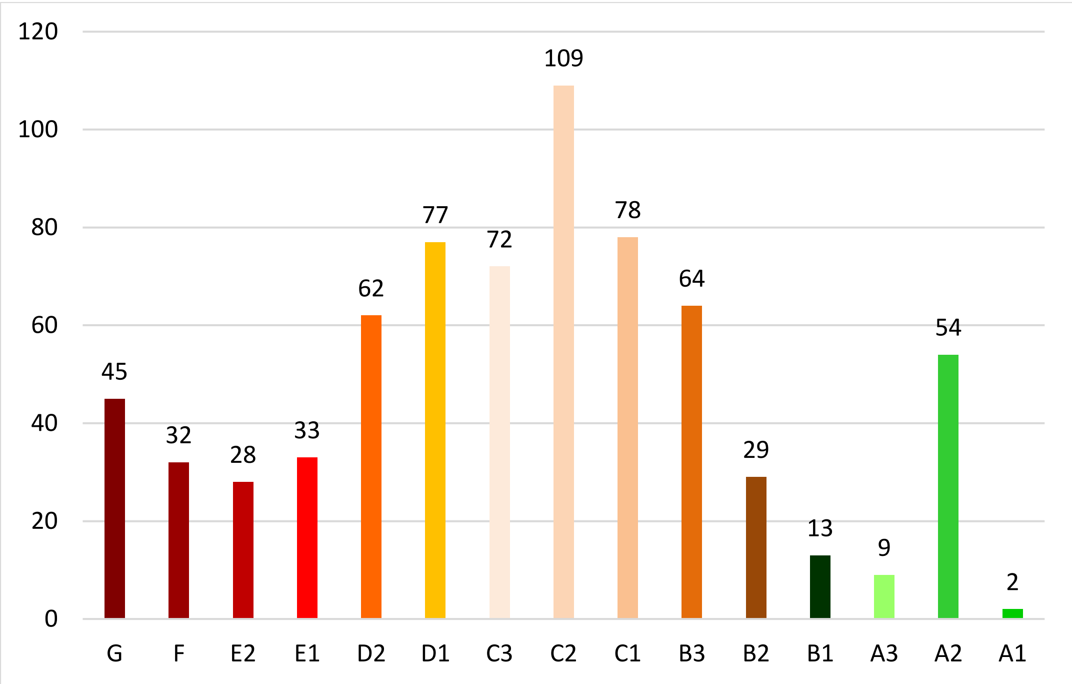


Figure 6 Spread of BER Ratings

The following table and charts will dig deeper into the BER dataset and provide further insights.

4.2.1 Building Stock by Type and Age

Figure 7 shows stock by year of construction and dwelling type.

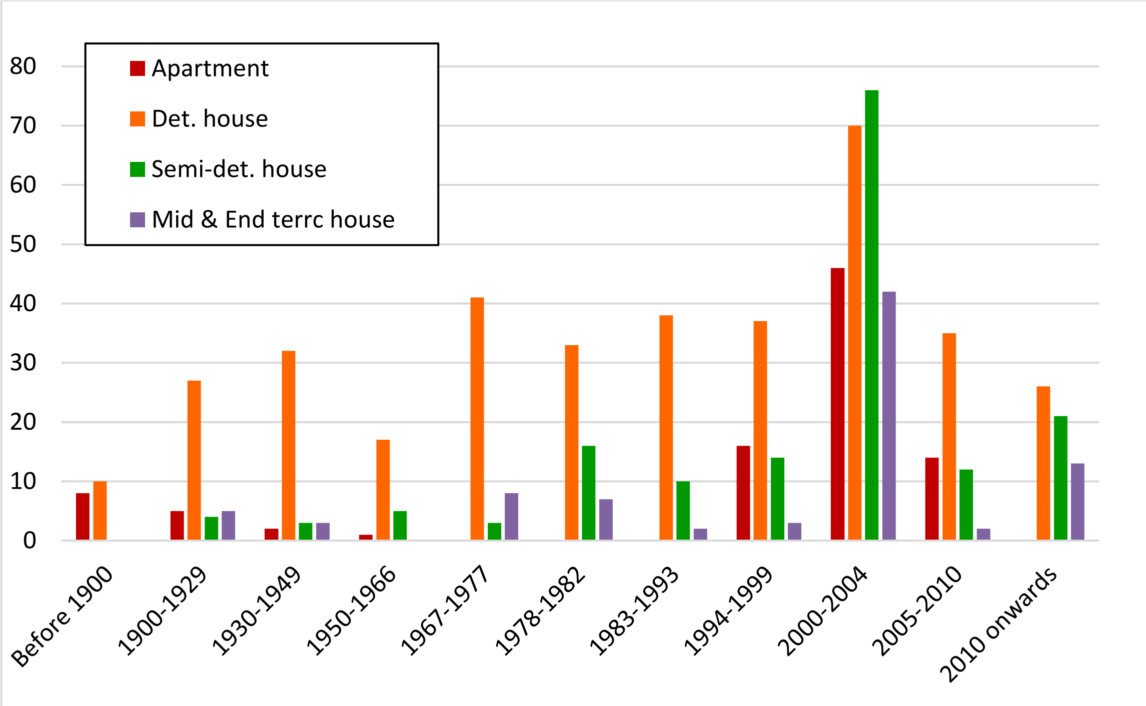


Figure 7 Dwelling Type by Age Band

The main dwelling type (as recorded in BERs) from pre 1900 to the late 1990s was the detached house. From the 1980s onwards, semi-detached houses are a constant feature with apartments and terraced houses prominent from 2000 onwards.

As shown in Table 4, detached houses comprise more than 50% of the homes with BERs.

Table 4 Dwelling Type by Age Bands

Row Labels	Apartment	Det. house	Semi-det. house	Mid & End terrc house	Grand Total
Before 1900	8	10			18
1900-1929	5	27	4	5	41
1930-1949	2	32	3	3	40
1950-1966	1	17	5		23
1967-1977		41	3	8	52
1978-1982		33	16	7	56
1983-1993		38	10	2	50
1994-1999	16	37	14	3	70
2000-2004	46	70	76	42	234
2005-2010	14	35	12	2	63
2010 onwards		26	21	13	60
Grand Total	**92**	**366**	**164**	**85**	**707**

However, it is important to also take account of the housing stock counts from Census 2022.

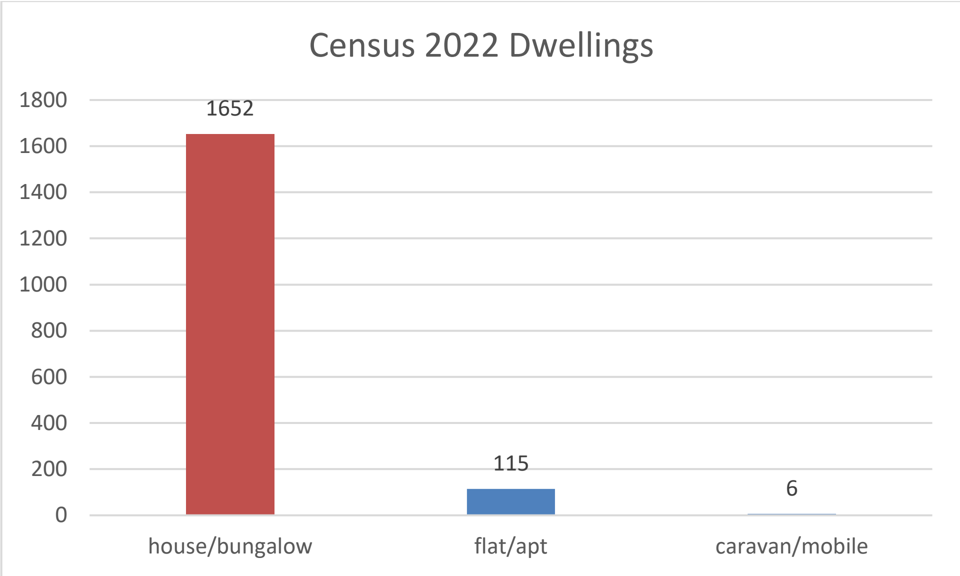


Figure 8 Dwelling Type Counts – Census 2022

The 2022 Census in Figure 8 shows that 93.2% of dwellings are houses/bungalows, with 6.5% being apartments/flats and 0.4% as caravan/mobile.

Table 4 can also be summarised in chart format in Figure 9, by combining all dwellings up to 1977 (before Building Regulations) in a single group.

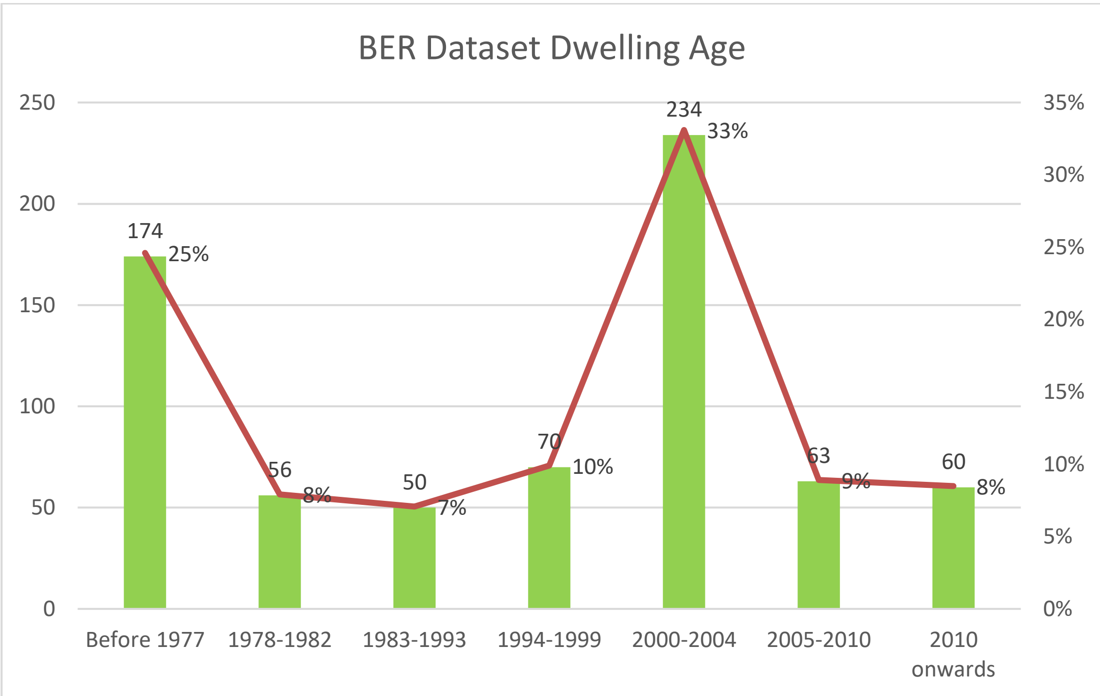


Figure 9 Dwelling Total by Age Band- BER Dataset

While the BER age bands and the Census age bands are not exactly aligned, some useful observations can be made, nonetheless.

When the Census 2022 dwellings count are shown in Figure 10, it is interesting to note that 39% of dwellings are dated up to 1980. This compares with 25% of dwellings in the BER dataset being aged up to 1977. This finding is quite logical as older homes would only require BER certs if sold or rented or if they availed of SEAI grants. By comparison, all new homes post 2007 require a BER at point of sale. So, it is reasonable to assume that the average BER score for the whole stock might be worse than indicated by average from the BER dataset.

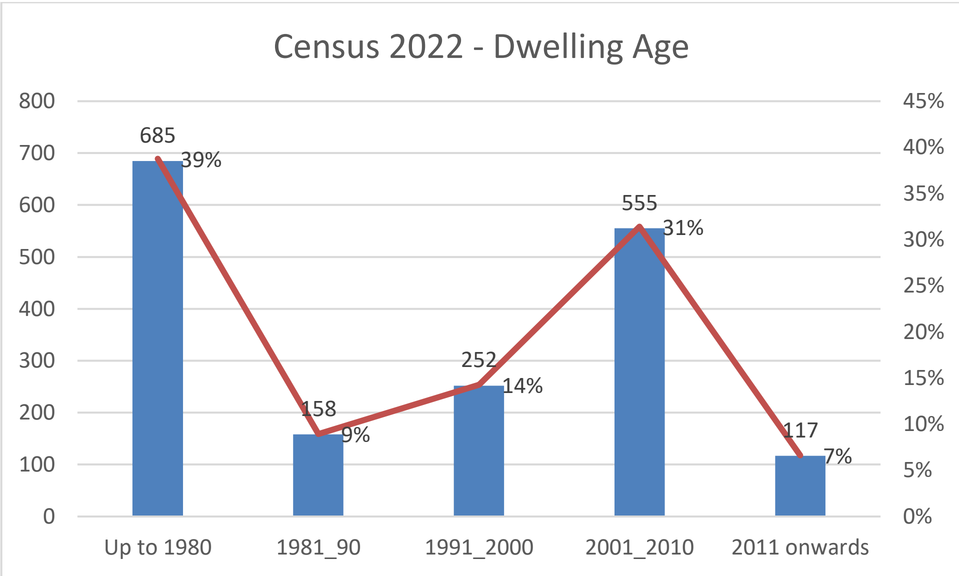


Figure 10 Dwelling Total by Age Band- Census 2022

Some anomalies also appear. From Table 4/ Figure 9, 357 BER certs are dated in dwellings from 2001 onwards. Yet the Census records 672 dwelling aged from 2001 onwards. As BERs only became mandatory for new dwellings for sale in 2007, this would partially explain the difference in numbers.

4.2.2 BER Rating By Age Band

Table 5 shows stock by year of construction and BER rating band.

Table 5 BER Ratings by Age Band

Row Labels	Before 1900	1900-1929	1930-1949	1950-1966	1967-1977	1978-1982	1983-1993	1994-1999	2000-2004	2005-2010	2010 onwards	Grand Total
A1											2	2
A2						1				1	52	54
A3			2		1				3		3	9
B1			1		2	1		1	1	6	1	13
B2		1	2	1	2	1	2	2	10	8		29
B3	1	2	1		5	3	5	4	25	17	1	64
C1	2	1	2	2	2	4	6	6	42	10	1	78
C2	2		3	1	3	9	8	16	56	11		109
C3	1	2	2	1	7	5	7	11	31	5		72
D1	2	3	4	1	5	7	6	9	40			77
D2	1	1		4	8	9	8	10	17	4		62
E1	1	1	5	1	4	7	5	3	5	1		33
E2	3	4	3		5	7	1	4	1			28
F		6	8	6	5	1	1	3	2			32
G	5	20	7	6	3	1	1	1	1			45
Grand Total	**18**	**41**	**40**	**23**	**52**	**56**	**50**	**70**	**234**	**63**	**60**	**707**

It is interesting that 71 dwellings built between 2000 and 2010 have rating of D1 or worse. Many are electrically heated apartments (which are generally the worst performers) and some are houses with oil boilers.

The same data is shown graphically in Figure 11 BER Ratings by Age Band.

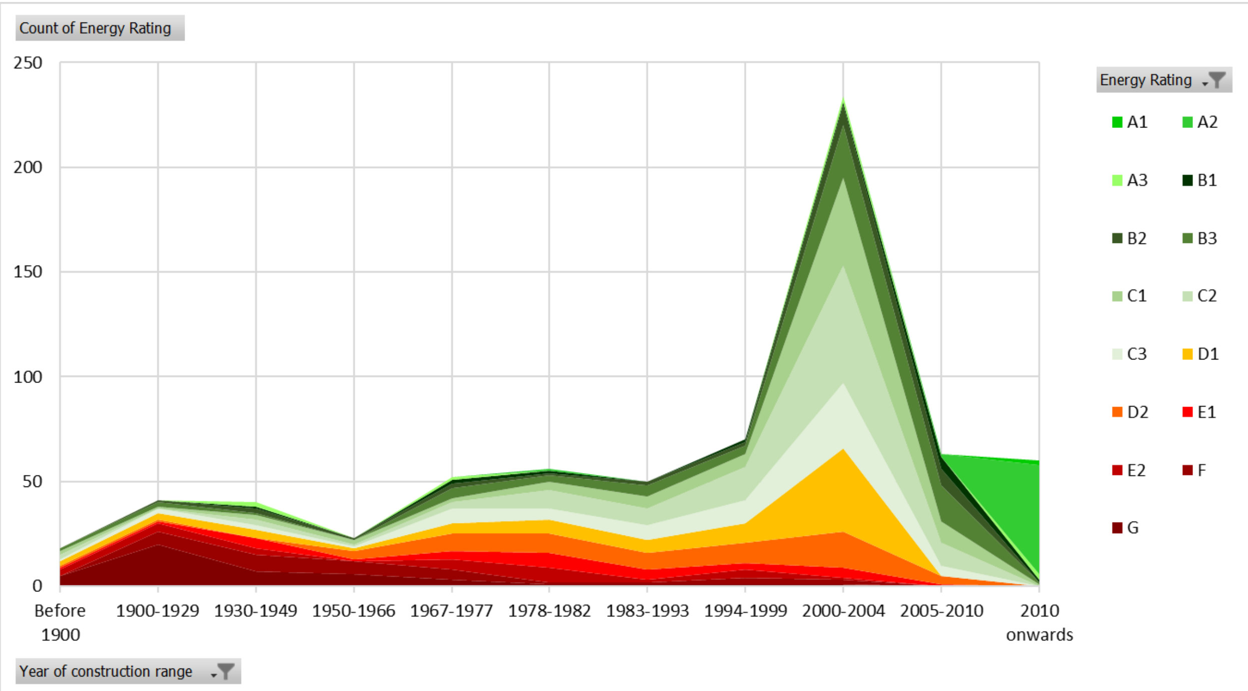


Figure 11 BER Ratings by Age Band

4.3 Wall Types

The BER dataset also records the main wall type for each of the 707 dwellings with BER certs.

Pre 1977 solid block or stone walls are most common. Then from 1978 onwards, cavity wall construction is most prevalent in homes with BER certs as shown in figure 11.

Timber frame is prominent in over 40 homes built from 2000-2004 with minimal counts outside of this period.

Hollow block (9" hollow blocks) construction is recorded in homes built from 1994-2004. These homes would be built with internal wall insulation.

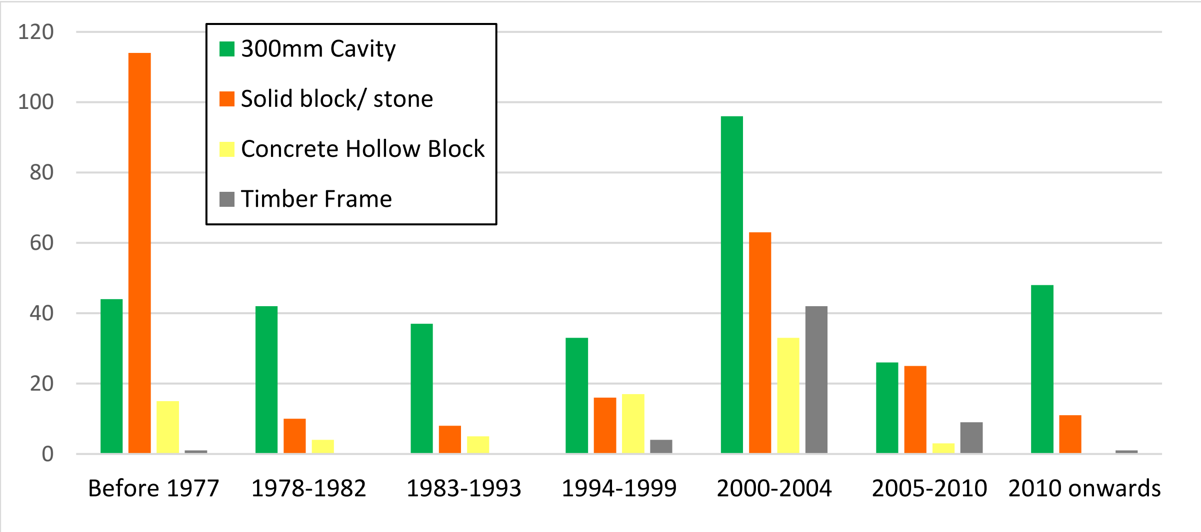


Figure 12 Stock by Wall Types

4.4 Wall Insulation Levels

BER data files also provide information on the levels of wall insulation by indicating the U value (in W/m^2K).

Draft Building Regulations were first introduced in Ireland in 1976 and there were revisions in 1981 (draft also), leading to full Building Regulations in 1991 with subsequent revisions in 1997, 2002, 2005, 2008 and 2011. Allowing 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 deemed 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 6.

Table 6 Exposed Wall U-values (Appendix S, DEAP v3.2.1)

Age Band	A	B	C	D	E	F	G	H	I	J	K
Wall type	Before 1900	1900-1929	1930-1949	1950-1966	1967-1977	1978-1982	1983-1993	1994-1999	2000-2004	2005 -2009	2010 onwards
stone	2.1	2.1	2.1	2.1	2.1	1.1	0.6	0.55	0.55	0.37	0.27
225mm solid brick	2.1	2.1	2.1	2.1	2.1	1.1	0.6	0.55	0.55	0.37	0.27
325mm solid brick	1.64	1.64	1.64	1.64	1.64	1.1	0.6	0.55	0.55	0.37	0.27
300mm cavity	2.1	1.78	1.78	1.78	1.78	1.1	0.6	0.55	0.55	0.37	0.27
300mm filled cavity	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.55	0.55	0.37	0.27
solid mass concrete	2.2	2.2	2.2	2.2	2.2	1.1	0.6	0.55	0.55	0.37	0.27
concrete hollow block	2.4	2.4	2.4	2.4	2.4	1.1	0.6	0.55	0.55	0.37	0.27
timber frame	2.5	1.9	1.9	1.1	1.1	1.1	0.6	0.55	0.55	0.37	0.27

For Age Band K (2010 onwards), the default wall U value is 0.27.

To determine if walls are insulated to a reasonable standard, analysis was done on all dwellings to divide them into 3 categories based on limits decided by SEAI within the standard advisory reports:

- **Well insulated**: wall U values of 0.46 W/ m^2 or less
- **Not well insulated**: wall U values >0.46W/m2K and < 0.72 W/ m^2K
- **Poorly insulated** or Uninsulated: wall U values > 0.72 W/ m^2K

The results of the analysis are shown in Figure 13 and listed in Table 7.

Table 7 Wall Insulation Analysis

Count of Wall Insulation	Column Labels			
Row Labels	**Well insulated**	**Not well insulated**	**Poorly Insulated**	**Grand Total**
Before 1900	4	2	12	18
1900-1929	3	1	37	41
1930-1949	9	7	24	40
1950-1966	6	1	16	23
1967-1977	21	8	23	52
1978-1982	14	22	20	56
1983-1993	11	39		50
1994-1999	20	49	1	70
2000-2004	61	169	4	234
2005-2010	56	7		63
2010 onwards	60			60
Grand Total	**265**	**305**	**137**	**707**
Percentage	**37.48%**	**43.14%**	**19.38%**	

The same data is shown in graph format in Figure 13.

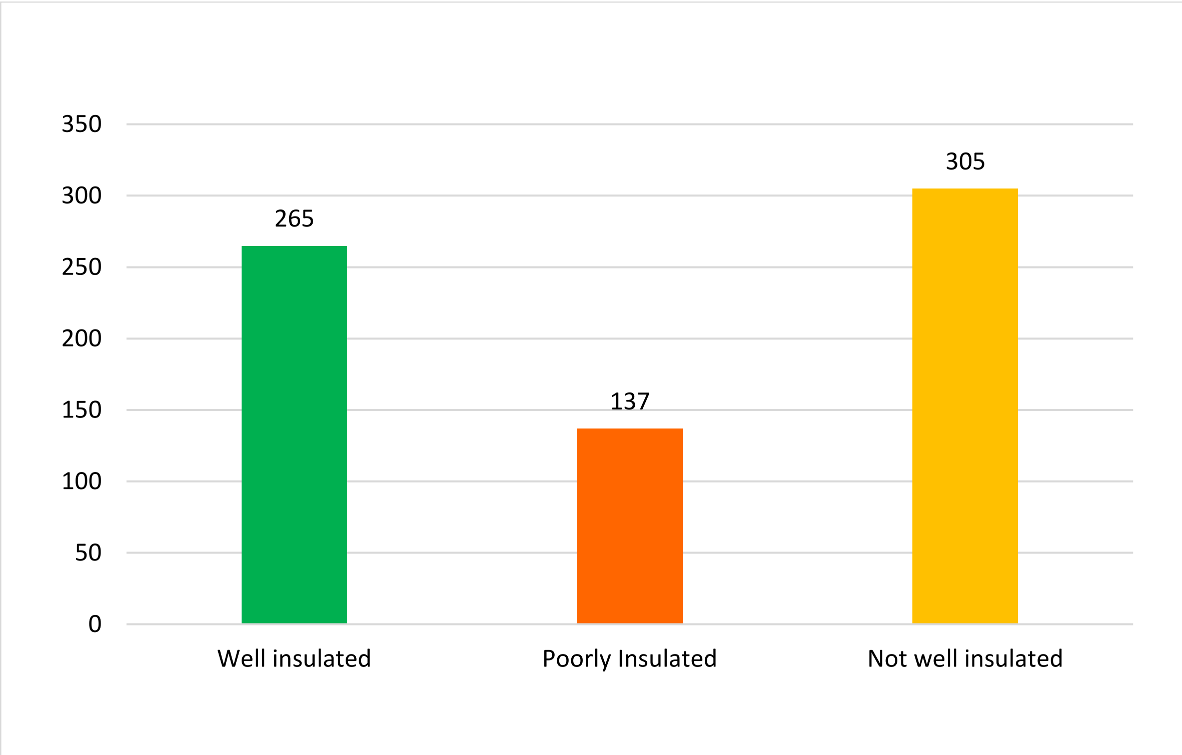


Figure 13 Wall U-Value Analysis

This is also shown by age-band in Figure 14 below.

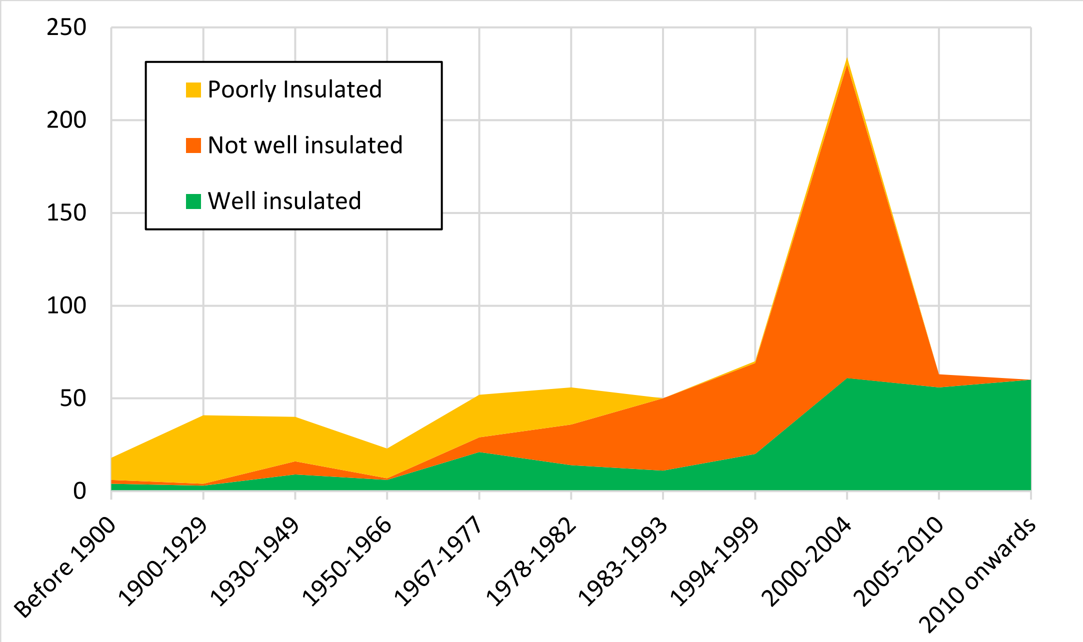


Figure 14 Wall Insultation Analysis by Age Band

4.5 Windows

For a new house or a retrofit, the BER assessor is normally provided with test certificates for windows that states their U value performance.

When a BER assessor surveys an existing dwelling, typically such test certs are not available. In such cases, the BER Assessor will select the U value based on the age on the dwelling, glazing type and the frame type. The default U values for double glazing are shown in Table 8.

Table 8 Double Glazing Default U-values

Double Glazing	U Value (Metal-frame)	U Value (Wood/PVC frame)
Pre 2004	3.7	3.1
2004-2009	2.7	2.2
2010 onwards	2.5	2.0

In analysing window performance, windows were subdivided into three categories:

- **Good**: U =< 1.9 W/m2K
- **Fair**: 2.5 W/m2K >= U < 1.9 W/m2K
- **Poor**: U > 2.5 W/m2K

The window type counts are shown in Table 9. The analysis shows just 13.4% of the dwellings with BERs are rated as having good quality windows, i.e. with window U values less than or equal to U=1.9.

Table 9 Windows U-Value Analysis

Count of Windows-value	Column Labels			
Row Labels	**Poor**	**Fair**	**Good**	**Grand Total**
Before 1900	12	2	4	18
1900-1929	35	5	1	41
1930-1949	23	13	4	40
1950-1966	16	3	4	23
1967-1977	33	8	11	52
1978-1982	42	9	5	56
1983-1993	41	8	1	50
1994-1999	64	2	4	70
2000-2004	180	51	3	234
2005-2010	4	58	1	63
2010 onwards		3	57	60
Grand Total	**450**	**162**	**95**	**707**
Percentage	**63.6%**	**22.9%**	**13.4%**	

The same data is shown in figure 15.

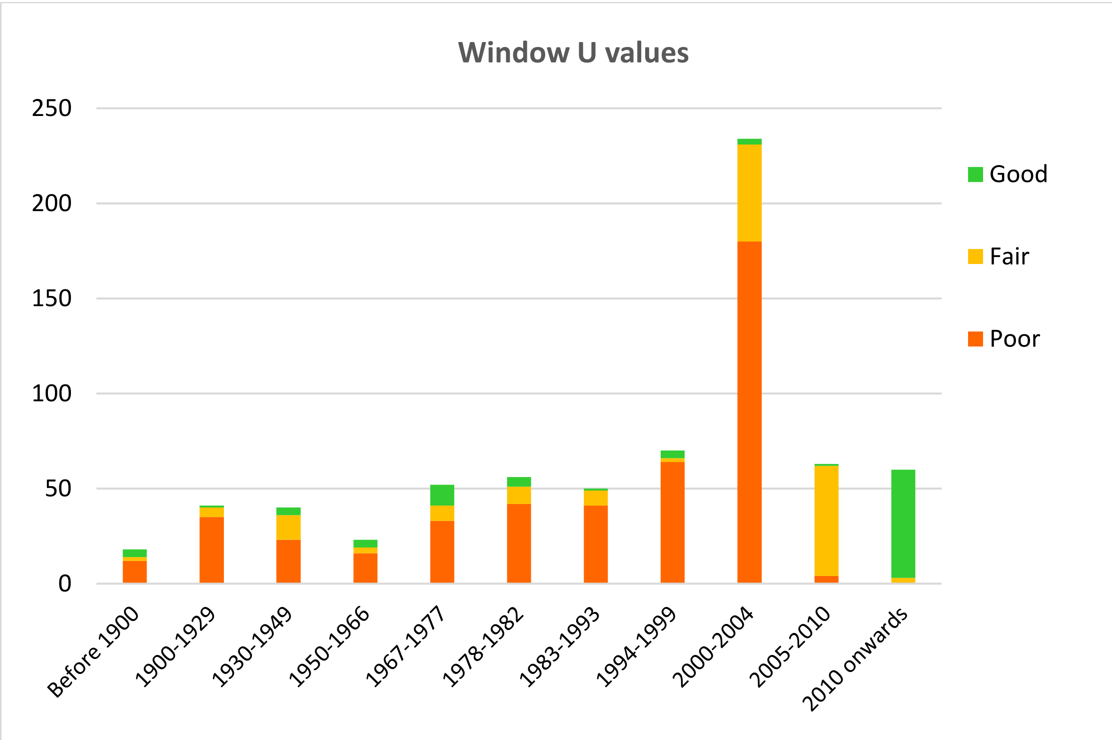


Figure 15 Windows U-Value Analysis

4.6 Fuel Types

The main fuel types are shown in Table 10 and Figure 17, with oil dominating at 67% , followed by electricity at 25%. Mains gas is listed for 9 dwellings which may be in error. As there is no mains gas in Athboy, it's likely that these dwellings are heated by LPG.

Table 10 Main Space Heating Fuel (BER dataset)

Row Labels	Solid Smokeless Fuel	Heating Oil	Bulk LPG	Mains Gas	Electricity	Grand Total
ATHBOY	28	307	7	8	144	494
GRENNANSTOWN	3	114	4		16	137
RATHMORE	6	54	1	1	14	76
Grand Total	**37**	**475**	**12**	**9**	**174**	**707**
Percentage	**5%**	**67%**	**2%**	**1%**	**25%**	**100%**

The natural gas pipeline is shown in the map below.

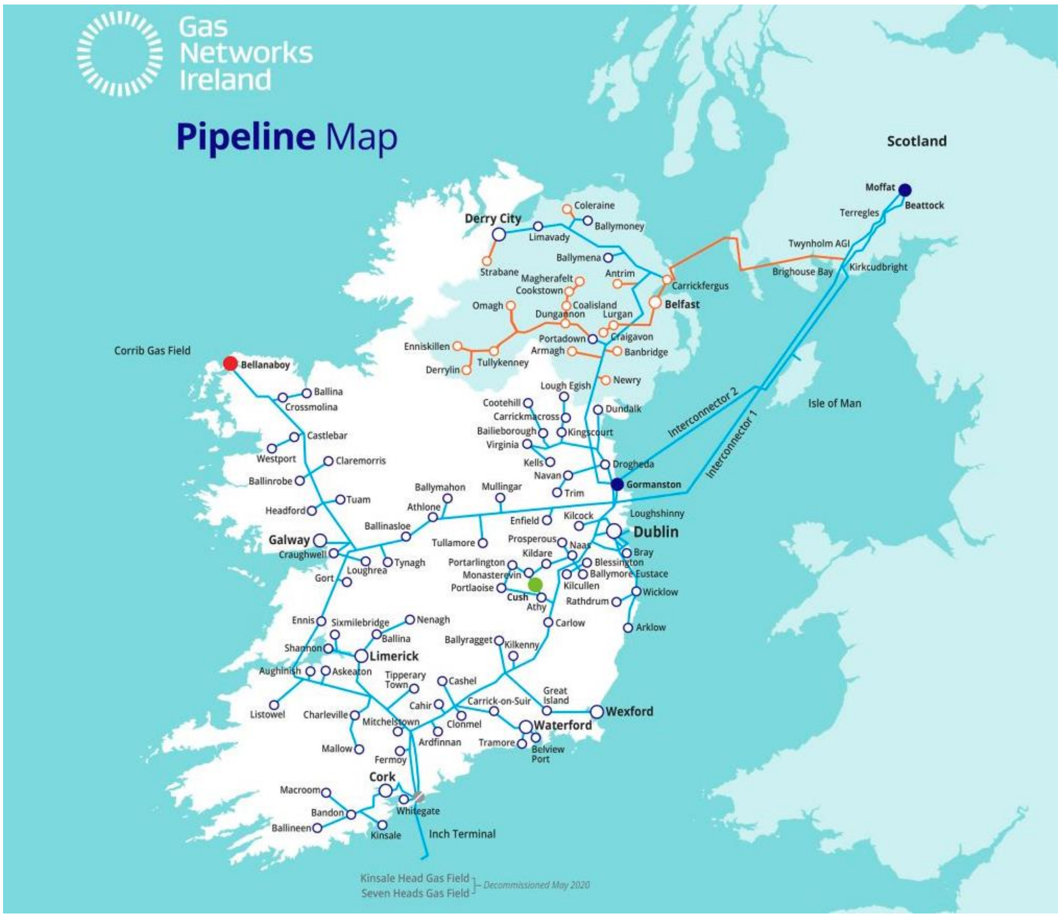


Figure 16 Gas Pipline Map Ireland

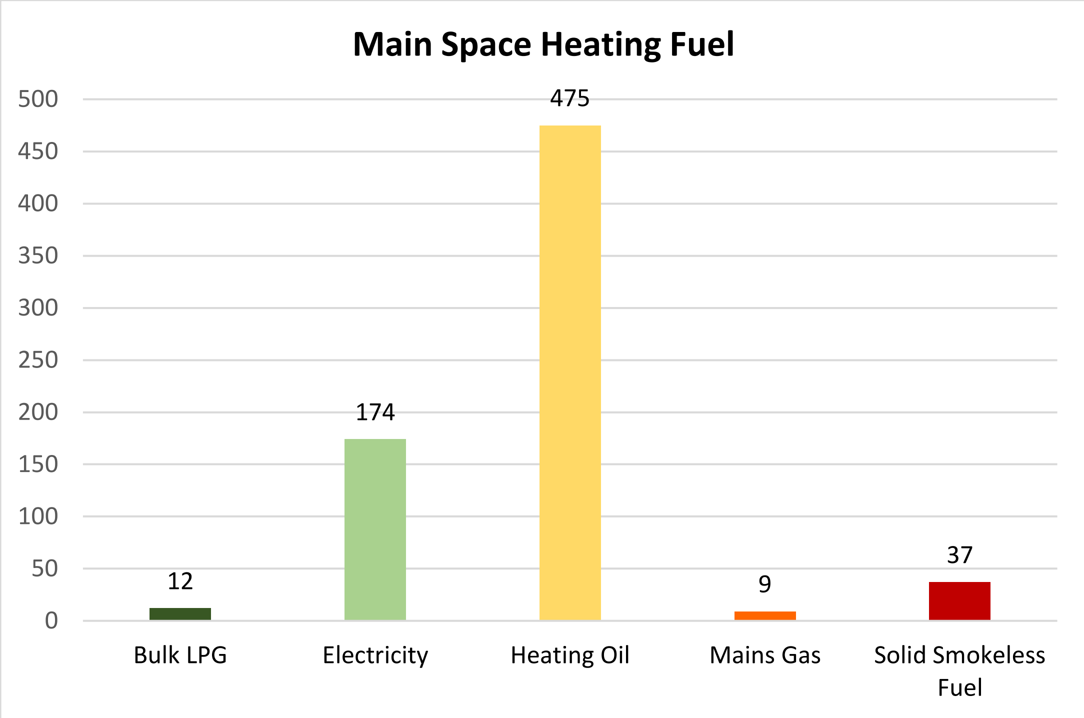


Figure 17 Main Heating Fuel Types

The 2022 Census results are shown in Table 11 below for 1,767 dwellings in Athboy. Interestingly the proportion with oil heating is similar at 66% , whereas electricity is down at 14% with solid fuel including wood pellets up at 13%.

Table 11 Main Space Heating Fuel (Census 2022)

Oil	Electricity	Wood pellets	Coal/Peat	Other/ Not stated	LPG	None
1165	241	47	182	89	28	15
66%	14%	3%	10%	5%	2%	1%

These comparative results are again explained with a higher proportion of older dwellings with older heating system types not having BER certs.

4.7 Heating System Types

Table 12 shows heating system types used in houses and apartments.

Table 12 Main Space Heating Types by Age Band

Row Labels	Non-Condensing Boiler	Condensing Boiler		Electric Heating (100%)	Heat Pump	Grand Total
Before 1900	5	8		5		18
1900-1929	33	5		1	2	41
1930-1949	19	18			3	40
1950-1966	15	6		2		23
1967-1977	34	15			3	52
1978-1982	34	21			1	56
1983-1993	33	16		1		50
1994-1999	37	14		18	1	70
2000-2004	123	41		66	4	234
2005-2010	32	17		13	1	63
2010 onwards	1	5			54	60
Grand Total	**366**	**166**		**106**	**69**	**707**

The associated chart in Figure 18 shows that more than 50% of the dwellings have non-condensing boilers. One third of these occur in dwellings built from 2000 -2004. (It is likely that some may have been replaced since the BER was published).

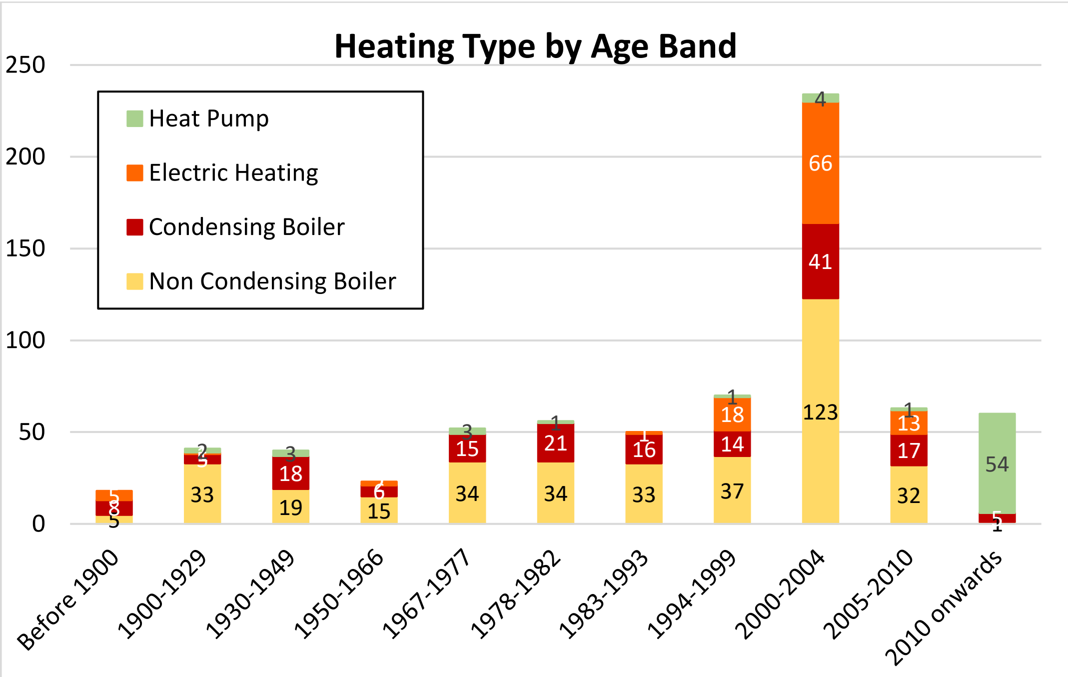


Figure 18 Main Heating Type by Age Band

69 homes have heat pumps and 8 of these are in homes built before 1983.

4.8 Space Heating System Efficiency Ranges

The average space heating efficiency values from the BER datasets is shown in Figure 19 below.

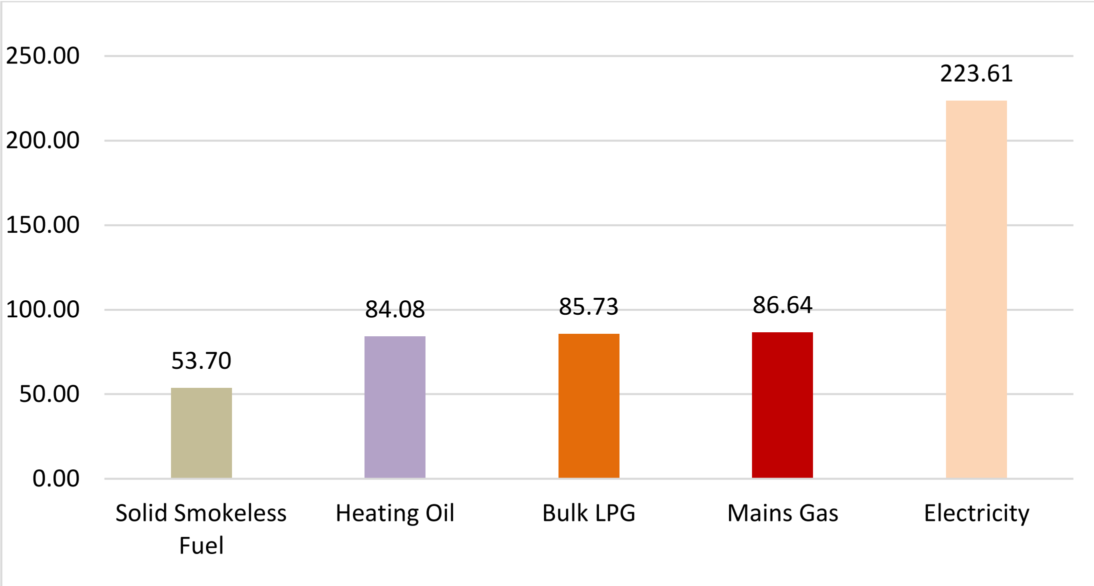


Figure 19 Average Space Heating Efficiencies by Fuel Type

The efficiency of heat pumps for space heating typically exceeds of 400%. When blended with dwellings with direct acting heating or storage heating which have 100% efficiency values, this gives an average efficiency of 223% for electrically-heated dwellings. This compares to just an average efficiency of 84% - 85% for gas and oil boilers.

4.9 Heat Loss Indicator (HLI)

In relation to residential buildings, the Climate Action Plan 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 to qualify for the heat pump grant. An HLI up to 2.3 is allowed if certain criteria are met.

Table 9 above shows that there are currently 69 heat pumps installed in the Athboy area based on published BER certificates.

As shown in Table 13 below, HLI data extracted from the Athboy BER database extract shows that 189 (or 27% of those with BER certs already) have a HLI < 2. So, where these dwellings have boilers, they are ideally suited for changing over to heat pumps, assuming their building performance is confirmed as satisfactory. A further 136 dwellings (or 19% of those with BER certs already) have a HLI between 2 and 2.3 and could be close to being “heat pump ready”.

Table 13 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
Before 1900		2	2		14	18
1900-1929		2	3	2	34	41
1930-1949	3	2	2	4	29	40
1950-1966	3		2		18	23
1967-1977	4	7	5	9	27	52
1978-1982	3	5	10	16	22	56
1983-1993	2	4	15	21	8	50
1994-1999	12	14	27	10	7	70
2000-2004	71	81	55	17	10	234
2005-2010	32	19	3		9	63
2010 onwards	59				1	60
Grand Total	**189**	**136**	**124**	**79**	**179**	**707**
Percentage %	**26.7%**	**19.2%**	**17.5%**	**11.2%**	**25.3%**	

It is also likely that many dwellings built from 2000-2006 which do not have BER certs, may have HLI values below 2.3.

5 Baseline of Electrical, Thermal and Transport Demand

The baseline energy demand comprises energy used in the 1965 residential dwellings, 76 commercial units/ public buildings 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 707 published BER certs, we can derive the following:

- The average primary energy value of a Athboy dwelling is 230.6 kWh/ m^2/year, equivalent to a D1 rating. This shows Athboy matches the national average of D1.
- The average floor area of a Athboy dwelling is 129m^2.

As shown in Table 14, the average primary energy per dwelling in Athboy is 29,784 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. (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%). So, the average Athboy home is estimated to use 4 times more energy per annum than a new house built to current building regulations.

Table 14 Average Primary Energy Per Dwelling

Average Primary Energy (from 707 BERS)	Average Floor Area (from 707 BERs)	Average Primary Energy per dwelling (kWh/ annum)
230.6	129.16	29,784

Expanding this to the total stock of 1965 dwellings, the total estimated primary energy consumption of all dwellings is 58,526,000 kWh per annum or also expressed as 58.5 GWh (gigawatt hours) – see Table 15.

Table 15 Total Estimated Annual Primary Energy of all Dwellings

Total Number of Dwellings	Total Primary Energy (kWh - all Dwellings)
1965	58,526,142

Another useful metric is the annual energy spend. The SEAI SEC Guidelines advise the average Irish household spend for heating and electricity is €3800 per annum.

For the 1965 dwellings in Athboy, this indicates an annual energy spend of €7.47 (Table 16).

Table 16 Total Estimated Annual Energy Spend - all Dwellings

Total Dwellings (Source: SA summary)	Annual Energy Bill (heating & electricity) *SEAI 2024	Annual Residential Energy Costs
1965	€3,800	€7,467,000

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 the kick-of meeting, the SEC committee were asked to provide a list of all non-domestic energy consuming buildings/ businesses in Athboy to enable a rough estimate to be calculated. It was hoped that actual energy data could also be provided by some of the non-domestic buildings. As there was no success with this request, IHER conducted its own site survey of non-domestic buildings in April 2024.

To assist non-domestic energy and CO2 emissions 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's 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 CO_2 emissions can be calculated.

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

However, Athboy is not on the natural gas network. So, non-domestic businesses in Athboy will use either electricity, LPG or oil for space and water heating.

For the Athboy baseline model, it has been assumed that most smaller businesses like shops, pharmacies, offices etc are likely to primarily use electricity. Larger business premised are assumed to LPG or oil for space and water heating.

For modelling purposes, the split across different fuels depending on business category is shown in Table 17.

Table 17 Energy Costs Split by business size

	Elec	Gas/oil	Elec	Gas/oil	Total
Small businesses	90%	10%	€20,655	€2,295	€22,950
Medium business	36%	64%	€19,521	€34,704	€54,225
Large businesses	36%	64%	€30,780	€54,720	€85,500

Then assuming 38.72 cents / kWh for electricity and 14c/ kWh for LPG or oil, the annual kWh for the respective fuel sources for all business types is shown in Table 18.

Table 18 Energy Use (kWh) Split by business size

	Elec price/kWh	Elec units (kWh)	Gas/Oil per kWh	Gas/oil units (kWh)
Small businesses	0.3872	53,345	0.14	16,393
Medium business	0.3872	50,416	0.14	247,886
Large businesses	0.3872	79,494	0.14	390,857

The census of business premises in Athboy yielded the summary listing in Table 19 of 76 non-domestic energy users and assigned usage categories.

Table 19 Business/ Public Buildings List

	Number
Small businesses	66
Medium business	4
Large business	3
Ecological Building Services	1
Darnley Lodge	1
Athboy EMTB	1
Total	**76**

The estimated annual energy/ fuel costs for all non-domestic buildings are summarised in Table 20 below.

Table 20 Total Estimated Annual Energy Spend – Commercial & Public Buildings

	Number	**Annual Energy Bill (heating & electricity)**	**Annual Business Energy Costs**
Small businesses	66	€22,950	€1,514,700
Medium business	4	€54,225	€216,900
Large business	3	€85,500	€256,500
Ecological (BS 2023)	1	€38,220	€38,220
Darnley Lodge	1	€124,104	€124,104
Athboy EMTB	1	€15,681	€15,681
Total	**76**		€2,150,424

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 21).

Table 21 Total Estimated Annual Energy Use and CO2 emissions – Commercial/ non-domestic

	Electricity	Fossil Fuel	Total
Total Primary Energy (kWh)	15,870,940	66,295,318	82,166,258
Total CO2 (tonnes)	5,920	18,032	23,952
Total Spend (€)	1,677,361	488,744	€2,150,424

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 actual case, but these can only be challenged if actual energy use data can be provided.

A simple template is shown in Appendix D that could be shared with businesses to submit their annual kWh usage across different fuel types. This can be provided in excel format and modified for use by any business.

5.3 Transport

According to the 2022 Census, there were 2070 cars in the Athboy EMP catchment area. 127 dwellings reported having no car.

Table 22: 2022 Census Car Count

	no_car	1_car	2_car	3_car	4_plus_car	
Addresses surveyed	127	572	513	100	43	1355
Total Cars		572	1026	300	172	**2070**

Table 23 of the Department of Transport's Irish Bulletin of Vehicle and Driver Statistics (2021) provides national figures for the total number of vehicles by fuel type.

https://www.gov.ie/en/publication/f392d-bulletin-of-vehicle-and-driver-statistics/

Table 23 2022 National Car split by fuel type

	Petrol & Other cars	Diesel cars	BEVs	Total
Private Cars	807,673	1,272,840	175,458	2,255,971
Total (%)	35.8%	56.4%	7.8%	

SEAI's EMP guidelines (Update 24-10-2022) advise average annual spend for petrol cars of €2,287 with annual average diesel spend at €2,520 and BEVs at €476 respectively.

Applying the national car split by fuel type and SEAI fuel spend data to the Athboy car count from the 2022 Census yields the summary data in Table 24.

Table 24 Vehicles by Type

Athboy 2022		petrol	diesel	BEV
Cars split (DOT-2022)		35.8%	56.4%	7.8%
No. of Cars	2070	741	1,168	161
Fuel spend per car p.a. (SEAI Oct Update 2022)		€2,287	€2,520	€476
Total Spend	€4,714,582	€1,694,878	€2,943,142	€76,562

National statistics on average distances travelled, kWh/km and GCO_2/km are shown in Table 25.

Table 25 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 25 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 24 and Table 25 enables the annual energy use and CO_2 emissions for the Athboy transport fleet to be estimated for 2022 in Table 26.

Table 26 Transport: Annual kWh and CO2 emissions estimate

	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	741	1,168	161	2,070
kWh -all cars/a	6,553,103	16,089,993	792,741	23,435,837
kg CO2 - all cars/a	1,499,134	3,838,613	135,601	5,473,348

Public Transport Links

Athboy is served by the 111 bus route to Dublin and by the 188 local link bus.

Commuting Patterns to **work, school, college or childcare**

Table 11_1 of Census 2022 provides useful data on the means of travel work, school, college or childcare. The Census results for Athboy are presented in the pie chart in Figure 20 below.

Green modes such as walking, bike, bus and train are grouped together. Then private transport (by car, motorbike, van) is also grouped together.

In time, the private transport will increasing be switching over to electric vehicles so that should be factored into future models.

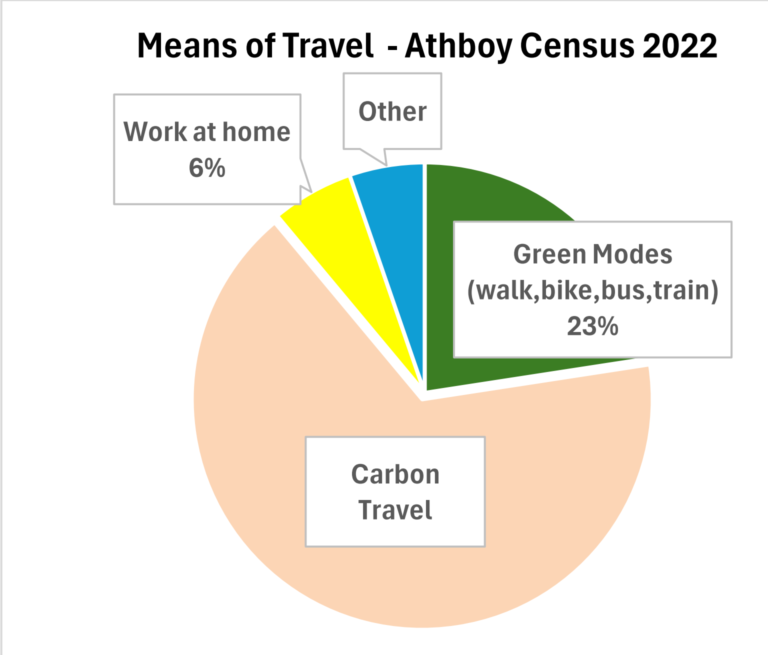


Figure 20 Means of Commuting - Census 2022 Athboy

Duration of Commute

Table 11_3 of Census 2022 provides useful data on the duration of commute. The Census results for Athboy are presented in the pie chart in Figure 21 below.

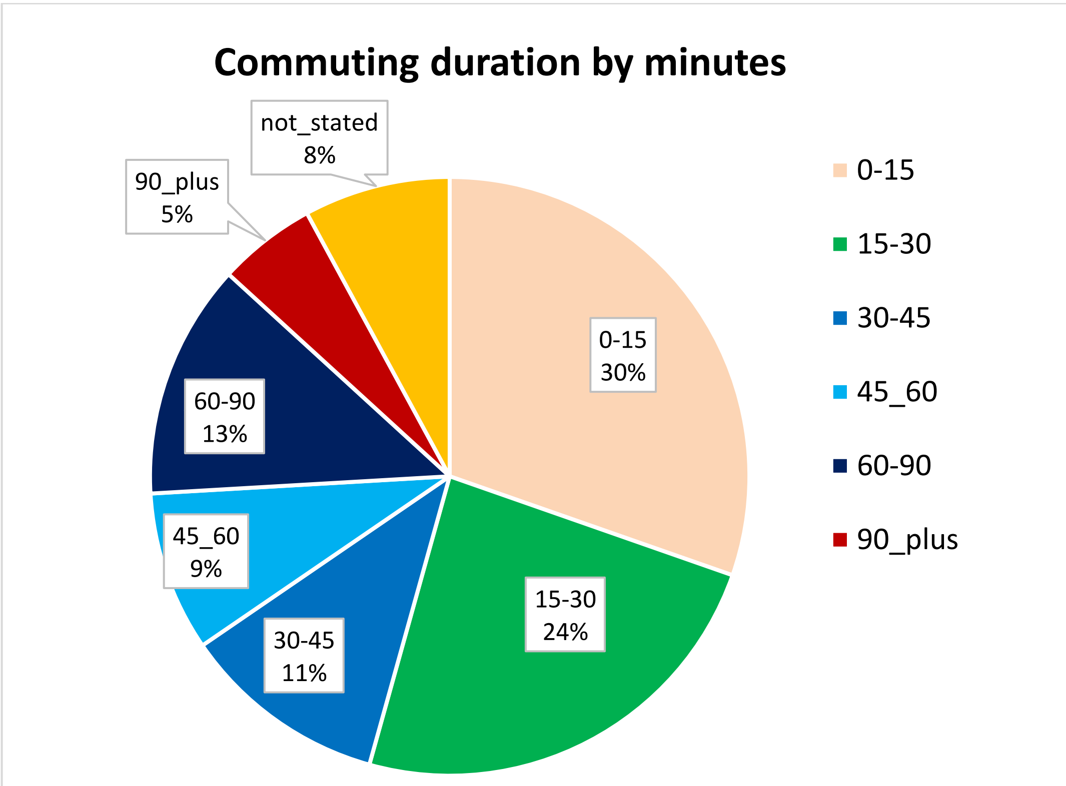


Figure 21 Duration of Commute Census 2022 Athboy

5.4 Summary Baseline CO_2 emissions, Energy Usage and Spend

The baseline energy and CO_2 emissions for Athboy across all sectors is summarised Table 27.

Table 27 Baseline EMP Summary – Athboy

	CO2 (tonnes)	Total (kWh)	Energy Cost
Residential	17,523	**58,526,142**	€7,467,000
Non-residential	24,524	**82,166,258**	€2,150,424
Transport	5,473	**23,435,837**	€4,714,582
Total	**47,520**	**164,128,236**	**€14,332,006**

6 Energy Audits of Residential Buildings

6.1 Methodology

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

It was decided to conduct energy audits on 5 house types.

The full list of residential buildings is shown in Table 28 below representing some of the common dwelling types in Athboy.

Table 28 Survey addresses

	Address	Year Built	Description
1	Park View	1976	Two-storey detached, concrete block with internal insulation
2	Castle Lawns	1979	Two-storey detached, cavity walls
3	Fairgreen	1920s	single storey semi-detached cottage
4	Beechgrove	1976	Two-storey detached, cavity walls
5	Otterstown (rural)	1940s	extended in 1990

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. The three retrofit packages were as follows:

Starter Package

The starter package typically includes roof insulation and heating controls measures.

These include:

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

Standard Package

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

- Internal or external wall insulation
- Upgrade windows and doors to higher specification double glazing
- 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 measures to the standard package but moves away from the boiler solution to a heat pump providing space heating and hot water. The advanced package would include:

  - Insulate suspended timber floors where present
  - 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

Note: Triple glazing could also be considered.

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.

- **PV Only**

While not included in the case studies, many homeowners are choosing PV panel installations as a stand-alone measure to offset high imported electricity prices and to make their own contribution to reducing greenhouse gas emissions.

In our case study analyses, we consider 6 x 400W panel arrays, i.e. 2.4kW. Some homes are getting 4kW and higher systems. Additional PV options can also be explored on the BERWOW tool - see www.berwow.ie.

6.2 Retrofit Calculator & Brochure for each House Type

A retrofit calculator was used to calculate all of the key metrics for the retrofit options for all five 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 were placed into a separate 2-page brochure for each of the five dwelling types. The brochure for all five house types are shown in Appendix B. These brochures 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 such as attic conversions or new boilers were not considered for the basic case studies.

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 2023 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 methodology assumes the house is heated from October to May for 8 hours per day with the living room heated to 21^{o}C and the rest of the habitable rooms heated to 18^{o}C. This same assumption applies equally to a G-rated house or an A-Rated house. While there is no major study in Ireland exploring this topic, several EU studies have shown that a G-rated house might only use 50% of the energy predicted by the BER calculation as it would be too expensive to heat it to the assumed heating pattern. This calibration factor should then be applied to the BER-calculated energy values to reflect more accurately running costs and savings arising from upgrade measures.

Energy Costs

SEAI publishes updated energy costs on a quarterly basis. Using the SEAI domestic fuel price values (01 January, 2024) the fuel prices listed in Table 29 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 29 Energy Prices (per kWh delivered) - 2024

Gas	€0.13
Oil	€0.10
Electricity	€0.33
Smokeless	€0.10
El.HP.Water	€0.20
El.HP.SH	€0.26

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 single measures grants are listed in Table 30. It should be noted that oil & gas condensing boilers no longer receive any grant funding.

Table 30 SEAI Better Energy Homes Grants

	Detached	Semi/ End Terrace	Terrace	Apartment
Roof insulation- rafter	€1,500	€1,300	€1,200	€800
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 to avail of this scheme. A wider range of grant support is available through the One Stop Shop scheme as indicated by the figures in red in Table 31.

The OSS scheme has two key criteria that must be met to qualify for these higher grant amounts :

- The post works BER must achieve a B2 rating or better, i.e. <= 125 kWh/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 31 SEAI One Stop Shop Scheme Grants

	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, grnd sce	€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

According to Census 2022 (figure 9), 39% of the Athboy housing stock was built before 1980 so this stock pre-dates Building Regulations and will perform poorly overall. At the other end of the scale, 37% of the stock dates from 2000 onwards and so will be built to reasonably good energy efficiency standards.

Wall & Floor Insulation:

Approximately 39% of the houses in Athboy were constructed prior to the first Draft Building Regulations in 1976. Thus, these houses were built originally without wall insulation or floor insulation.

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

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 be analysed separately. 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.

Houses built from 1977 onwards will have varying levels of wall insulation. Each house would need to be assessed on a case-by-case basis to determine if adding additional or replacement internal insulation, adding external insulation or cavity wall insulation would be recommended.

Some older house types may have suspended timber floors which should be insulated whenever the opportunity arises.

Ventilation and Air Tightness

The question of adequate ventilation, air tightness and indoor air quality (IAQ) in dwellings will need to be addressed alongside any proposed insulation upgrades. Most houses have 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 several 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 One Stop Shop schemes requires that an air permeability of $5m^3/hour/m^2$ be achieved via air tightness test for a dwelling to obtain the air tightness grant listed in Table 25. 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.

7 Energy Audits of Non-Domestic Buildings

7.1 Methodology

Energy audits to Ashrae* Level 1 were conducted on two non-domestic buildings:

- The Darnley Lodge Hotel
- Ecological Building systems

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

*The American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) outlines three different levels of energy audits. The audit levels differ based on how intensive they are and what type of outcome you can expect.

An ASHRAE Level 1 audit is the most basic level of audit, designed to give businesses a starting point for making changes or further in-depth auditing.

In a Level 1 audit, the auditor takes a high-level view of the commercial building's operations and energy usage.

This audit can include steps such as:

- Interviewing key operations personnel
- Reviewing facility utility bills
- Walking through the site

The goal of an ASHRAE Level 1 audit is to identify glaring areas of energy inefficiency. All gathered data is then compiled into a report detailing no-cost or low-cost changes that can be made to the building, as well as other potential capital improvements earmarked for further study.

A Level 1 audit can give stakeholders a picture of where the building currently stands, how it compares to other similar buildings, and what areas need further investigation or improvement. For businesses looking to just get started with improving energy efficiency, or for businesses who find it difficult to "sell" the need to energy improvements, a Level 1 audit is a good starting point.

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, Athboy 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 to set out its individual energy saving target looking out to 2030. See further recommendations in Section 9.4.

8 Community Renewable Energy Initiative

The Government Climate Action Plan for 2023 includes 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.

The ATHBOY committee should consider promoting a community renewable energy initiative. No singular large project is envisaged such as a windfarm or large solar farm given the urban environment. Instead, the preferred option is to promote photovoltaic generation on a large scale on both residential and commercial / public rooftops.

This will be achieved by simplifying the process and providing grants to homeowners. There are reasonable grants already for homeowners and the is a strong case that grants should be more attractive to ensure PV is installed on every available roof in the country.

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 32.

Table 32 Typical PV System Sizing and SEAI Grant Amounts

	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

9 2028 & 2033 EMP Modelling

9.1 Assumptions

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

For 2018, total national greenhouse gas emissions are estimated to be 60.93 million tonnes (EPA, 2020). As shown in Table 33 below the CSO reports total national greenhouse gas emissions to have been 65.77 million tonnes in 2018. So, there is a discrepancy between the national greenhouse gas emissions reported by separate national bodies. As the CSO also reports annual GHG emissions annually out to 2023, the CSO values will be considered in our EMP model.

In effect, Ireland had achieved a 78.3% reduction in national GHG emissions by end of 2023 compared to the 2018 baseline. Emissions dropped during Covid but increased again afterwards before dropping again in 2023.

Table 33 Ireland's reduction rate of greenhouse emissions - 2018 baseline [4]

	2018	2019	2020 (COVID-19)	2021	2022	2023	2030
Greenhouse Gas emissions incl LULUCF (Mt CO2eq)	65.77	64.03	62.76	64.82	62.99	60.62	31.20 (Target)
Reduction Rate (2018 Baseline)		2.65%	4.58%	1.44%	4.23%	7.83%	51.00%

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

9.2 2028/ 2030/ 2033 Residential Target

For the Athboy EMP, 2023 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% is proposed.

As shown in Table 34, the average dwelling in Athboy has a primary energy of 230.6 kWh/ m^2 /year, equal to a D1 rating.

4 https://www.epa.ie/publications/monitoring--assessment/climate-change/air-emissions/irelands-provisional-greenhouse-gas-emissions-1990-2023.php

A 3.85% reduction per annum would result in an 18.5% cumulative reduction by 2028 and 32% reduction by 2033 with respective primary energy values shown in Table 34. (The choice of the 3.85% reduction will become clearer in the next sections).

Table 34: 3.85% Reduction in Residential BER average

Year	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Primary Energy (GWh/m2/year)	58.53	56.27	54.11	52.02	50.02	48.09	46.24	44.46	42.75	41.10	39.52
		-3.85%	-7.55%	-11.11%	-14.53%	-17.82%	-20.99%	-24.03%	-26.95%	-29.77%	-32.47%

The trend is illustrated in Figure 22.

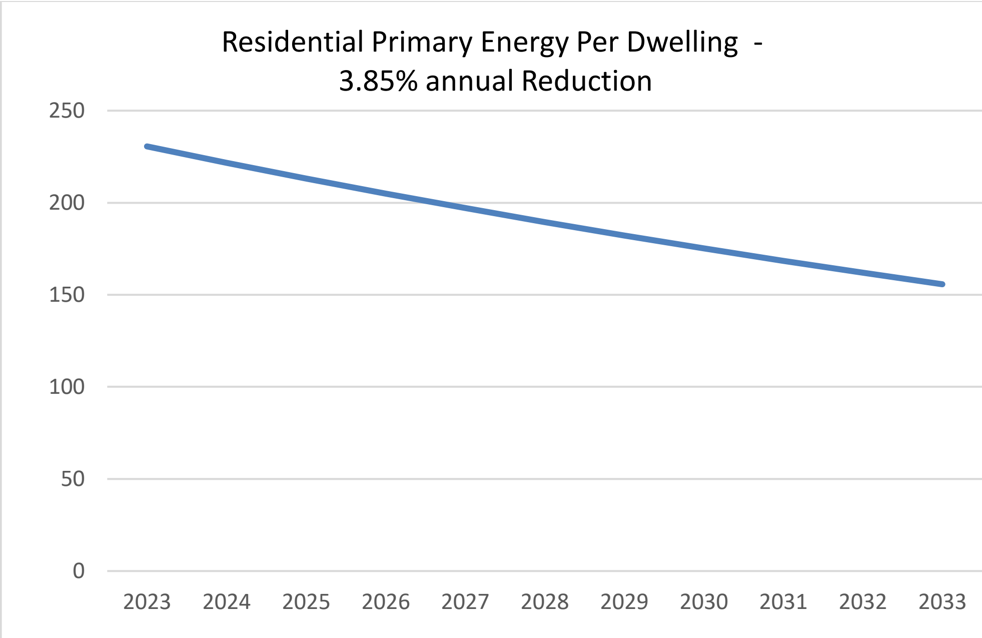


Figure 22: 3.85% Reduction Trend Per Annum

9.3 Residential Strategy for 5 Year Plan (2024-2028) & Retrofit Targets

As indicated in Section 6, 39% of the Athboy housing stock was built before 1980 so this stock pre-dates Building Regulations and will perform poorly overall. At the other end of the scale, 37% of the stock dates from 2000 onwards.

To create a strategy model for 2028 and beyond, the following needs to be considered:

- **Current state**: 707 dwellings have BER certs with an average primary energy value of 231 kWh/ m^2/annum.
- **Additional BER per annum (2024-2028)**: The number of new BERs published per annum over the last 5 years are shown in Table 35. On average, 77 new BERs (approx..) were published per annum over the last 5 years in Athboy.

Table 35 BER published in Athboy- last 5 years

Year	New BERs per Annum	Year Built	Averaged Primary Energy (KW/m2y)
2018	85	33	165
2019	89	6	199
2020	56	6	250
2021	70	2	244
2022	87	2	217
Average	**77**	**10**	**215**

Thus, it is reasonable to assume that 385 additional residential BERs (77*5) 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 215 kWh/ m^2/annum.

Residential Retrofit Scenario: 2024-2028

A residential buildings energy model from 2024 to 2028 is outlined below based on the following assumptions:

- 385 additional residential BERs will be published over the next 5 years. Assumed average primary energy is 215 kWh/ m^2/year.
- 25% of existing dwellings, i.e. 491 out of a total of 1965 (See Table 2), will be upgraded from 2024-2028.

The range of energy upgrade measures proposed for energy upgrades and the number of dwellings for each set of measures along with the predicted BER scores are shown in Table 36 to give an indication of what might be achievable. The Retrofit targets (2024-2028) listed in Table 36 below have also been separately added into the Register of Opportunities spreadsheet.

Table 36 Retrofit Measure Targets 2024-2028

Category	Measure	Number of homes upgraded	New Rating
1	**PV only**	**100**	C2
2	Roof insulation and heating controls	**41**	C3
2A	**Roof insulation, heating controls &PV**	**25**	C1
3	Standard measures package (roof insulation, internal or external wall insulation, boiler and heating controls, wood stove)	**50**	B2
3A	**Standard measures package (roof insulation, internal or external wall insulation, boiler and heating controls, wood stove) &PV**	**50**	B1
4	Advanced Measures (Standard with heat pump and whole house ventilation)	**100**	A3
4A	**Advanced Measures (Standard with heat pump and whole house ventilation) &PV**	**75**	A2
	Total Dwellings Upgraded	**441**	

The impact of this combination of assumptions would be to achieve an average primary energy per dwelling of 188 kWh/m^2 /year by 2028, which matches the 3.85% primary energy reduction trajectory shown in Table 37.

Table 37: 2028 Residential Scenario

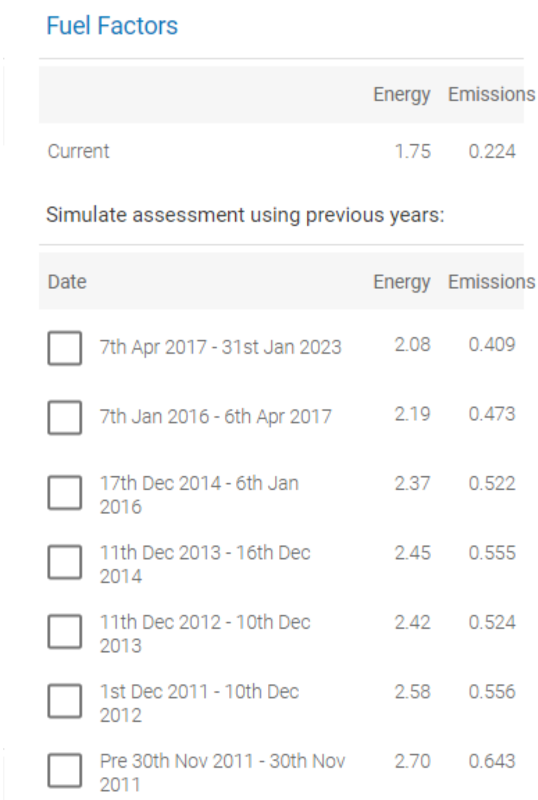
Row Labels	G	F	E2	E1	D2	D1	C3	C2	C1	B3	B2	B1	A3	A2	A1	Grand Total
2023 total	45	32	28	33	62	77	72	109	78	64	29	13	9	54	2	707
Upgrades on 20% of C1 or worse: 2024-2028	-9	-6	-6	-7	-12	-15	-14	-22	-16							-107
Altered 2023 Total	36	26	22	26	50	62	58	87	62	64	29	13	9	54		598
2024-2028 - additional BERs							385									385
2024-2028 upgrades only							41	100	25		50	50	100	75		441
2028 - Estimated BER Count	36	26	22	26	50	62	483.6	187.2	87.4	64	79	63	109	129	0	1424
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	24,480	10,624	8,064	8,448	13,888	15,092	103,974	34,632	14,421	8,640	9,085	5,355	7,085	4,515	-	268,303
Average Primary Energy (kWh/m2/year)																188.44

This data in Table 37 is shown in full in Appendix E.

Impact of Ongoing Decarbonisation of the National Electricity Grid

When modelling the energy and CO_2 reduction roadmap, there are several important factors to bring into the equation.

As renewable outputs primarily from windfarms have 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 23 DEAP Electricity Factors.



Fuel Factors

	Energy	Emissions
Current	1.75	0.224

Simulate assessment using previous years:

Date	Energy	Emissions
7th Apr 2017 - 31st Jan 2023	2.08	0.409
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	2.70	0.643

Figure 23 DEAP Electricity Factors

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

The energy and CO_2 factors 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 0.649 or electricity and 0.118 $kgCO_2/kWh$ is the assumed carbon intensity in the 2030 Base Case Scenario (page 27 of report). 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 38 are assumed.

Table 38 Electricity Factors - 2030

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

When these modified electricity factors are considered a more optimistic and realistic energy reduction scenario is produced. As shown in the Table 39 below, these modified electricity factors will enable a 46% energy reduction scenario by 2033 assuming 20% of residential energy use is electrical with 80% coming from fossil fuel heating sources.

Table 39 Residential Energy Reduction Projection (2023-2033)

Residential - Year	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Primary Energy (GWh/m2/year)	58.53	56.27	54.11	52.02	50.02	48.09	46.24	44.46	42.75	41.10	39.52
Primary Fossil Fuel (GWH/m2/yr)	46.82	45.02	43.29	41.62	40.02	38.48	36.99	35.57	34.20	32.88	31.62
Primary electricity use (GWh/m2/yr)	11.71	11.25	10.82	10.40	10.00	9.62	9.25	8.89	8.55	8.22	7.90
Adjusted Primary Electricity (GWh/m2/year)	11.71	10.15	8.69	7.33	6.07	4.89	3.79	2.77	1.82	0.94	0.12
Adjusted Total Primary Energy (GWh/m2/year)	**58.53**	**55.17**	**51.98**	**48.95**	**46.08**	**43.36**	**40.78**	**38.34**	**36.02**	**33.82**	**31.74**
Reduction with Modified Electricity factor		-6%	-11%	-16%	-21%	-26%	-30%	-34%	-38%	-42%	-46%

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 buildings are set out in Section 5.2. The current total annual energy usage for commercial and public buildings in estimated at 82,166,0000 kWh or 82.17 GWh (gigawatt-hours). As stated in Section 5.2, ***the commercial baseline estimate needs can be reviewed if and when actual energy use data becomes available.***

For EMP modelling purposes, It is proposed that a 3% annual energy reduction target also be set for commercial and public buildings. This is equivalent to 2,464,000 kWh reduction per annum.

This would result in the reduction target shown in Table 40.

Table 40: 3% reduction in Commercial/ Public Building Energy Usage

Year	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Primary Energy (GWh/m2/year)	82.17	79.70	77.31	74.99	72.74	70.56	68.44	66.39	64.40	62.47	60.59
		-3%	-6%	-9%	-11%	-14%	-17%	-19%	-22%	-24%	-26%

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

- For the commercial units, schools and public buildings, as a minimum, each non-domestic building should make a commitment to record and track their own energy use and CO_2 footprint annually.
- In addition, each non-domestic business should be encouraged to conduct its own energy audit to set out its individual energy saving target looking out to 2030.
- Provide a simple energy saving menu for local businesses in conjunction with local business association. It is recommended that the Athboy SEC engage a consultant to carry out high level assessment of energy use in businesses and prepare a menu of behavioural energy saving measures for businesses including tracking energy use.

9.5 Transport Strategy

9.5.1 Transition to EVS

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

Avoid encourages fewer journeys using fossil fuel transport and **Shift** encourages less carbon-intensive modes of transport.

Improve suggests reducing the carbon intensity of our transport fleets including the transition from petrol and diesel vehicles to electric vehicles.

The Irish Bulletin of Vehicle and Driver Statistics 2021[5] produced by the Department of Transport estimates that there were 127,000 battery electric vehicles estimates on Irish roads in 2021 equal to 5.7% of the total of 2.6 million private cars and good vehicles in the country.

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

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 cars 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 is already 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.

---

5 https://www.gov.ie/en/publication/6842c-irish-bulletin-of-vehicle-and-driver-statistics-2021/

Table 20 estimates current energy use for transport at 10,725,000 kWh or 10.73 GWh.

Assuming a 30% EV market share by 2030, Table 41 shows the projected split by car fuel types.

Table 41 Vehicles by Type (2030)

Athboy 2030	petrol	diesel	BEV	Total
2030 Target Split	28.0%	42.0%	30%	
Revised Cars split	580	869	621	2,070

The projected annual energy use and CO_2 emissions for Athboy transport fleet by 2030 is shown in Table 42.

Table 42 Projected 2030 Annual kWh and CO2 emissions estimate from Transport

Athboy 2030	Petrol	Diesel	Battery EV	Totals
National annual average km	12,113	19,681	12,958	
kWh per car/annum	7,516.12	11,710.20	4,924.04	
kg CO2 per car/annum	1,719	2,794	842	
Total cars split	**580**	**869**	**621**	2070
kWh -all cars/a	4,356,341	10,180,844	3,057,829	**17,595,013**
kg CO2 - all cars/a	996,588	2,428,858	523,050	**3,948,496**

The net result would be a 23.5% reduction in transport energy emissions by 2030 (and 31.8% by 2033). This is equivalent to a 3.75% reduction in transport energy use per annum as shown in Table 43.

Table 43: 3.75% reduction in Transport Energy Usage

Year	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Primary Energy (GWh/m2/year)	23.75	22.86	22.00	21.17	20.38	19.61	18.88	18.17	17.49	16.83	16.20
		-3.75%	-7.37%	-10.84%	-14.19%	-17.41%	-20.51%	-23.50%	-26.37%	-29.13%	-31.79%

9.5.2 EV Charging Points

EV Charging Points:

Meath County Council plans to publish its EV charger strategy in 2025.

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.

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 for all three sectors are summarised in Table 44 and presented in Figure 24.

Table 44 Summary of Annual Energy Reduction Model Targets

Primary Energy (GWh/m2/year)	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Residential - adjusted	58.53	55.17	51.98	48.95	46.08	43.36	40.78	38.34	36.02	33.82	31.74
Commercial & Public	82.17	79.70	77.31	74.99	72.74	70.56	68.44	66.39	64.40	62.47	60.59
Transport	23.44	22.56	21.71	20.89	20.11	19.36	18.63	17.93	17.26	16.61	15.98
Total	**164.13**	**157.42**	**151.00**	**144.84**	**138.93**	**133.28**	**127.85**	**122.65**	**117.67**	**112.90**	**108.32**
Reduction		4%	8%	12%	15%	19%	22%	25%	28%	31%	34%

The net overall reduction from 164 GWh to 108 GWh by 2033 is equal to a 34% reduction in energy usage.

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.

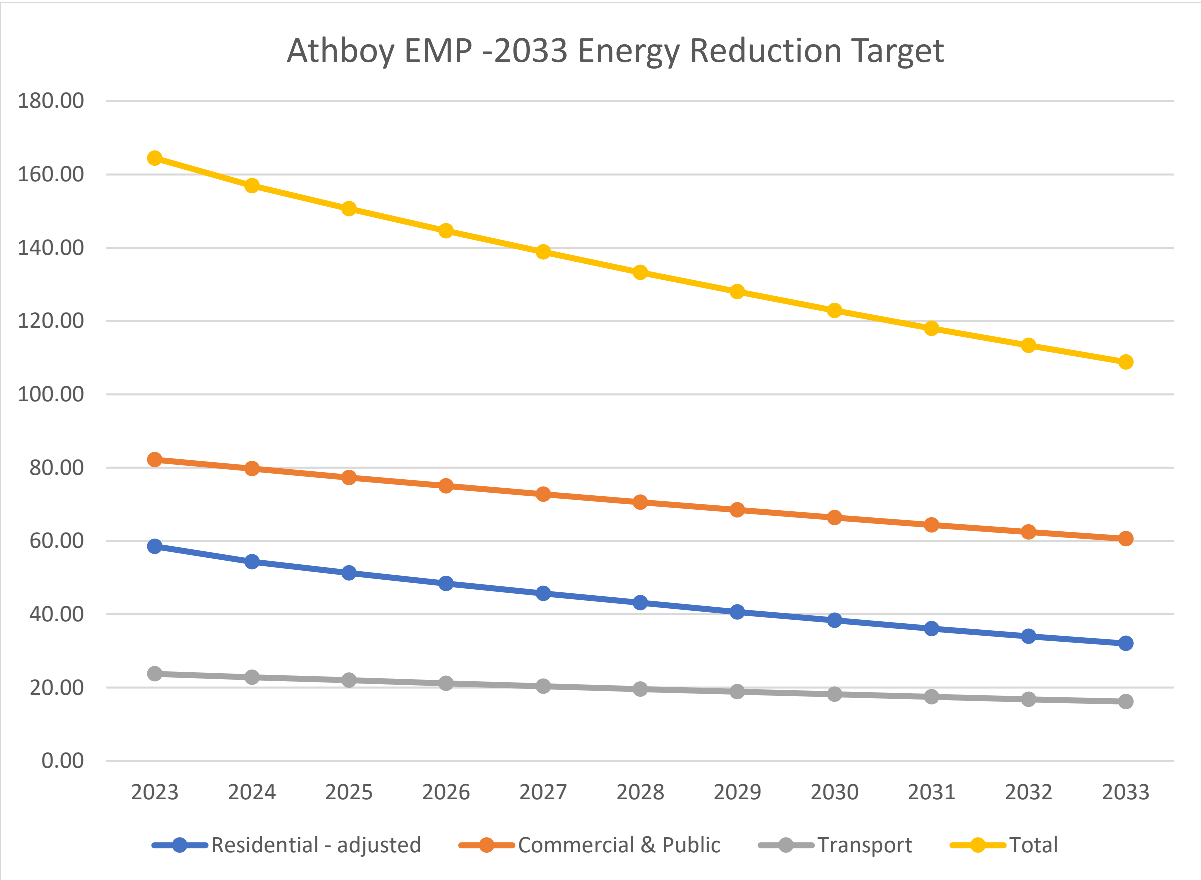


Figure 24 2032 Energy Reduction Target

9.7 EMP CO_2 Reduction Target Summary -All Sectors

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

As explained in section 9.3, the carbon content of electricity will continue to reduce annually as a higher proportion of renewable generation is added to the national electricity generation mix.

Table 45 shows the projected CO_2 emissions factor from 2022-2033 based on the assumptions of the MaREI study.

Table 45 CO2 emissions factor to 2033

	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Electricity-CO2 emissions (kG/kWh)	0.409	0.367	0.326	0.284	0.243	0.201	0.160	0.1180	0.0764	0.0349	-0.0067
CO2 Adjustment factor	1.00	0.90	0.80	0.70	0.59	0.49	0.39	0.29	0.19	0.09	-0.02

This is also illustrated more graphically in Figure 25 using the CO2 factor for electricity from the DEAP BER method of 0.224. So, it uses a slightly different reference point but illustrates a similar trend.

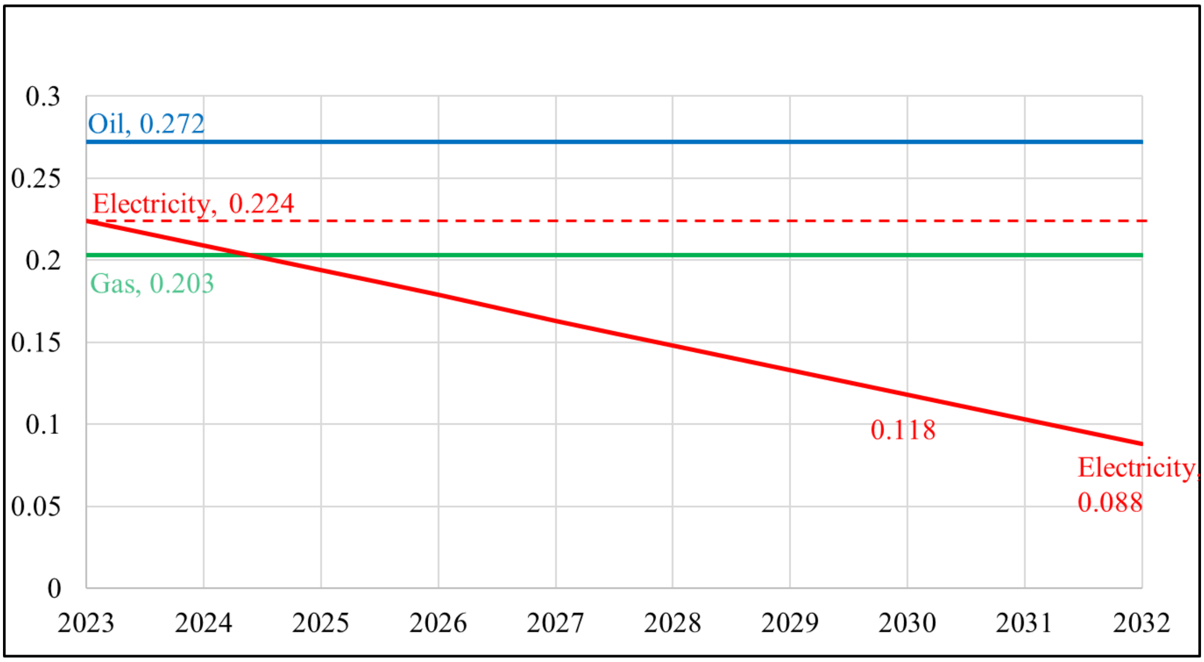


Figure 25 Projected Reduction in CO2 Emission (kg/kWh) in generated electricity in Ireland

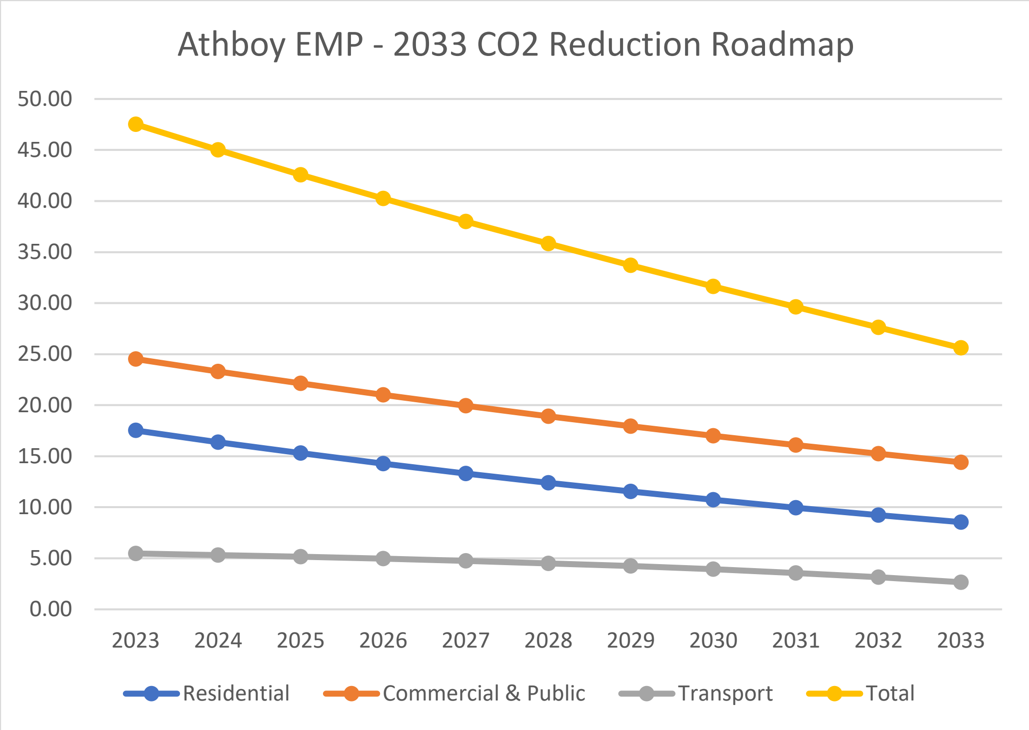
By combining the CO_2 factors with the predicted energy use, the CO_2 reduction out to 2033 is calculated in Table 46. This equates to a 46% reduction in CO_2 emissions.

Table 46 Adjusted Carbon Dioxide Emissions – All Sectors

Total KiloTonnes Carbon Dioxide	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**
Residential	17.52	16.38	15.30	14.28	13.31	12.40	11.54	10.72	9.96	9.23	8.55
Commercial & Public	24.52	23.30	22.14	21.02	19.95	18.92	17.94	17.00	16.09	15.23	14.41
Transport	5.47	5.32	5.15	4.96	4.75	4.51	4.24	3.93	3.57	3.15	2.66
Total	**47.52**	**45.00**	**42.58**	**40.25**	**38.01**	**35.83**	**33.71**	**31.65**	**29.62**	**27.61**	**25.61**
		5.3%	10.4%	15.3%	20.0%	24.6%	29.1%	33.4%	37.7%	41.9%	46.1%

This CO_2 reduction trajectory is shown in Figure 26 below.

Figure 26: 2032 CO2 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), which is a separate SEAI-formatted excel document.

The RoO contains two key elements:

1. Specific energy efficiency measures identified in the residential strategy and the rooftop PV studies.
2. Behavioural and organisational actions.

The RoO also summarises 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 elsewhere realise that they too have a role to play in meeting our Climate Action goals.

Mobilisation

This Energy Master Plan sets out the baseline and then scopes out a viable roadmap to 2030/ 2033 indicating the level of investment and change that will be needed to achieve the carbon reduction targets. The next challenge for Athboy SEC 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 Athboy community in the short term. Many Government supports including funding mechanisms are available to help the SEC in this work. It will also be important to work closely with key stakeholders including Meath County Councillors and public representatives.

10 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.

10.1 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.

10.2 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 provide 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.

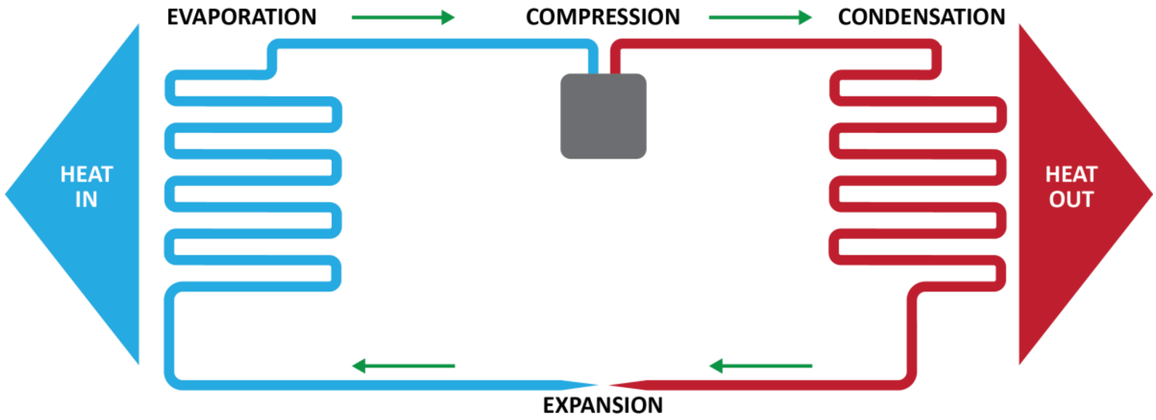


Figure 27 Heat Pump Diagram

What happens when outside temperature are very low?

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

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

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

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

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

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

Does the type of heat emitter have an 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 takes into account that most air-to-water heat pumps require an electrical immersion to raise the temperature in the tank to 60 °C, as an anti-legionella protection.

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

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

10.3 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

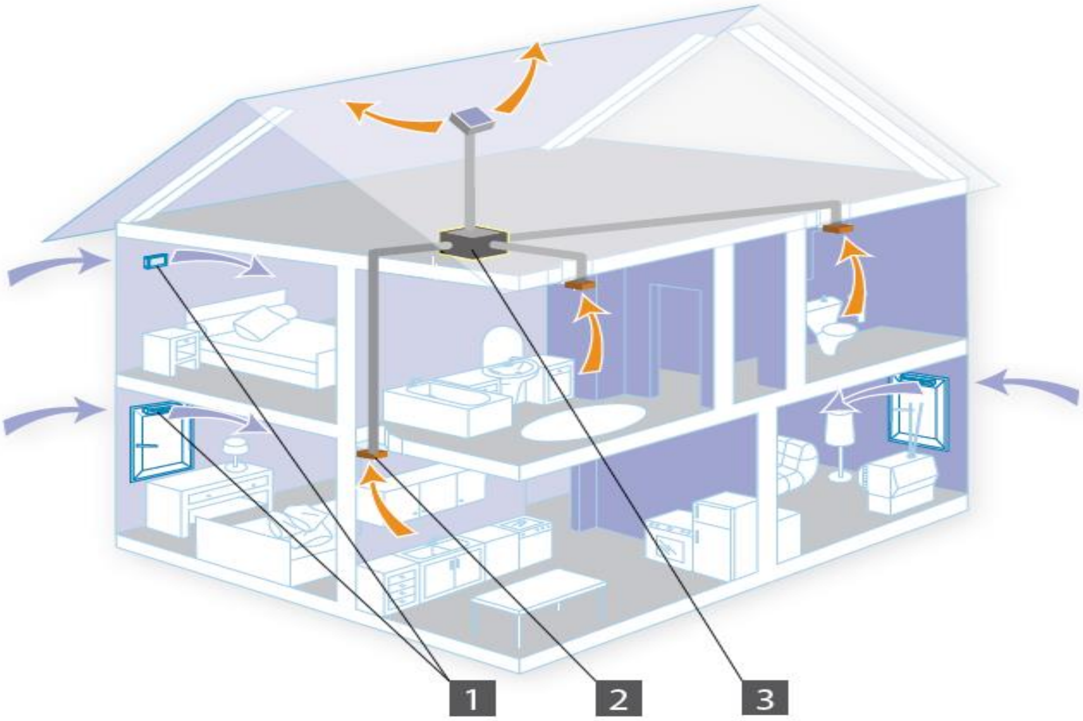


Figure 28 Ventilation System

10.4 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.

Before 15th Feb 2022, there was no feed-in tariff in Ireland. This meant that if you generated more electricity than you used, you gave the excess away for free to the grid. In early 2022, the CRU (Commission for Regulation of Utilities) introduced a new arrangement that allows micro-generation customers to get paid for the excess energy they export to the grid.

Under this initiative, all homes and businesses that generate their own electricity will receive a payment for the surplus electricity which they export to the grid. This payment, known as the Clean Export Guarantee (CEG) tariff, is available to both new and existing micro-and small-scale generators who fulfil the eligibility criteria. Feed-in tariffs for residential customers vary from supplier to supplier and are current about 18c – 20c /kWh exported.

10.5 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.

For BERs, SEAI advises on how best to prepare and present evidence to the BER assessor. See extract of SEAI advice below.

This actually can present a challenge if the dwelling was newly built in the recent past as the technical supporting data may not be available.

Step 3: Prepare your paperwork

Preparing all your documents and paperwork in advance of your BER assessment will reduce the time it takes to receive your BER Certificate and Advisory Report.

For an assessment of a **new building**, your assessor will need a considerable amount of documentation including for example, wall, roof and floor specifications and copies of certificates of performance for construction products and appliances installed in the property.

For an assessment of an **existing building**, you will need to provide your BER assessor with documentation of any upgrade works done to your property. Any documentation you may have regarding the original construction of the dwelling will also be beneficial.

Documentation includes certifications, receipts, invoices and/or specification documents from the architect, engineer or contractor who managed the works. These should clearly indicate the address of the property, the works carried out, and the products used.

If you cannot provide your BER Assessor with sufficient documentation of works on your home, they will use default values. Default values are based on construction type and the age of the building and are conservative estimates of the energy performance and as such, may result in your home receiving a lower BER rating than expected. Further information on how a BER is calculated is available here. Your BER assessor can advise you on the paperwork required to support your BER and you can download the homeowner's checklist to assist you in gathering the required documentation.

We recommend you retain a copy of all information and documentation supporting the inputs in your BER. This is important information and should be retained by you for use in any subsequent BER ratings.

Homeowner's checklist

Download this checklist to prepare for your BER.

Appendix A – Retrofit Calculator:

Variant	BER	Energy (kWh/m²/y)	Running Costs Calculation (kWh/y per fuel): Main SH	Sec SH	Main WH	Suppl WH	Pumps/fans	Lighting	Calib. Fac	Energy costs	Savings	Investment costs	SEAI Grants	Costs net of SEAI grants	Payback (years)	HLI
Current state	F	443.9	49916 Oil	5717 Smokeless	3946 Oil	0 Electricity	1157 Electricity	311 Electricity	0.8	€ 5,249	N/A	N/A	N/A	N/A	N/A	5.79
Starter package	E1	303.31	31034 Oil	4032 Smokeless	2414 Oil	0 Electricity	1118 Electricity	286 Electricity	0.8	€ 3,426	€ 1,823	€ 4,794	€ 2,200	€ 2,594	1.4	4.45
Standard measures	B2	118.77	9793 Oil	1659 Smokeless	1857 Oil	0 Electricity	1118 Electricity	286 Electricity	1	€ 1,816	€ 3,433	€ 58,294	€ 10,200	€ 48,094	14.0	2.02
Advanced measures	A2	34.36	1469 El.HP.SH	1533 Smokeless	694 El.HP.Water	0 Electricity	988 Electricity	286 Electricity	1	€ 1,091	€ 4,158	€ 73,844	€ 17,600	€ 56,244	13.5	2.00

Proposed measures & costs breakdown

Measure	Starter	Standard	Advanced	Area (m2)	Starter	Standard	Advanced
Attic insulation	☑	☑	☑	89.81	€ 2,694	€ 2,694	€ 2,694
Sloping Roof ins.	☐	☐	☐		€ -	€ -	€ -
Flat Roof ins.	☐	☐	☐		€ -	€ -	€ -
Cavity fill	☐	☐	☐		€ -	€ -	€ -
IWI	☐	☐	☐		€ -	€ -	€ -
EWI	☐	☑	☑	143	€ -	€ 28,600	€ 28,600
Exp/Susp. Floor insul.	☐	☐	☐		€ -	€ -	€ -
2G Windows	☐	☑	☑	32		€ 16,000	€ 16,000
3G Windows	☐	☐	☐		€ -	€ -	€ -
Doors	☐	☐	☑	2	€ -	€ -	€ 2,050
Condensing Boiler	☐	☑	☐	N.A	€ -	€ 4,500	€ -
Heating Controls	☑	☑	☐	N.A	€ 2,000	€ 2,000	€ -
Wood Stove	☐	☑	☑	N.A	€ -	€ 4,400	€ 4,400
AS Heat Pump	☐	☐	☑	N.A	€ -	€ -	€ 14,000
MVHR	☐	☐	☐	N.A	€ -	€ -	€ -
DCV & AT measures	☐	☐	☐	N.A	€ -	€ -	€ -
Photovoltaics	☐	☐	☑	N.A	€ -	€ -	€ 6,000
Project Mgt	☐	☐	☐	N.A	€ -	€ -	€ -
Low energy lights	☑	☑	☑	N.A	€ 100	€ 100	€ 100
					Starter	Standard	Advanced*
Totals:					€ 4,794	€ 58,294	€ 73,844
Grants					€ 2,200	€ 10,200	€ 17,600

Typical Current Conditions (modest upgrades only to date)

PARK VIEW		v1
Type	Detached	
Built	1976 with garage conversion	
Walls	Masonry concrete block with internal insulation	
Floors	Solid	
Roofs	100mm insulation at ceiling level, garage conversion roof unknown	
Windows	Mostly double-glazed PVC with 6mm gap	
Doors	Solid wood	
Ventilation	Natural ventilation with 1x chimney and 1x flue	
Heating system	Central heating oil boiler (70% eff.) + Stove (60% eff.) + Open Fire	
Space & Htg Controls	Programmer only	
Hot water cylinder	117 litre cylinder, 30mm factory insulated, no cylinder thermostat	

Appendix B - Brochures

Type 01 Park View, Athboy

Typical House - Current Conditions (modest upgrades only to date)	
Type	Detached
Year built	1976 with garage conversion
Walls	Masonry concrete block with internal insulation
Floor	Solid
Roofs	100mm insulation at ceiling level, garage conversion roof unknown
Windows	Mostly double-glazed PVC with 6mm gap
Doors	Solid wood
Ventilation	Natural ventilation with 1x chimney and 1x flue
Heating system	Central heating oil boiler (70% eff.) + Stove (60% eff.) + Open Fire
Heating Controls	Programmer only
Hot water	117 litre cylinder, 30mm factory insulated, no cylinder thermostat

Upgrade Measures Package 1: The Starter

	Measures
1	Attic insulation – increase to total thickness of 300mm
2	Heating controls (to SEAI grant standard)*
3	Low energy lights

Optional step 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

Optional step B: Upgrade existing double glazing with new low e glass

Replace double-glazing windows 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 heat pump is installed later

Upgrade Measures Package 2: Standard Retrofit

	Measures
1	Attic insulation – increase to total thickness of 300mm
2	External insulation to all external walls (U= 0.27)
3	New double-glazed windows (U=1.4)
4	Condensing boiler
5	Heating controls (to SEAI grant standard)*
6	Replace fireplace by stove
7	Low energy lights
	*Heating controls would need to be further upgraded if heat pump is installed later

Upgrade Measures Package 3: Advanced Measures/ Deep Retrofit*

	Measures
1	Attic insulation – increase to total thickness of 300mm
2	External insulation to all external walls (U= 0.27)
3	New double-glazed windows and doors (U=1.4)
4	Air to Water Heat Pump (including full heating controls)
5	Replace fireplace by wood-burning stove
6	Photovoltaic panels (2kW)
7	Low energy lights

BER and Financial Analysis

Variant	BER	Energy Cost	Savings	Investment Cost	SEAI Grants	Costs inc. grants	Payback (years)
Current state	**F**	**€ 5,249**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**
Starter package	**E1**	**€ 3,426**	**€ 1,823**	**€ 4,794**	**€ 2,200**	**€ 2,594**	**1.4**
Standard measures	**B2**	**€ 1,816**	**€ 3,433**	**€ 58,294**	**€ 10,200**	**€ 48,094**	**14**
Advanced measures	**A2**	**€ 1,091**	**€ 4,158**	**€ 73,844**	**€ 17,600**	**€ 56,244**	**13.5**

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. Higher grants would be possible if applying through an SEAI-approved One Stop Shop. A home is eligible for the One Stop Shop Scheme if the home:
    a. Was built before 2010
    b. Will achieve a minimum B2 after upgrades
    c. Achieves reduction in primary energy in excess of 100 kWh/m2 /yr. as measured in BER.
4. A formal survey would be required for each individual dwelling for to accurately scope out each project. Single measure grant amounts available from SEAI are used in this analysis.
5. Explore further options on www.berwow.ie

Type 02 Castle Lawns, Athboy

Typical House - Current Conditions (modest upgrades only to date)	
Type	Detached
Year built	1979 with later garage conversion
Walls	Masonry cavity wall
Floor	Solid
Roofs	100mm insulation at ceiling level, garage conv. roof insulation unknown
Windows	Mostly double-glazed PVC with 6mm gap
Doors	Solid wood
Ventilation	Natural ventilation with 1x chimney and 1x flue
Heating system	Central heating oil boiler (70% eff.) + Stove (60% eff.) + Open fire
Heating Controls	Programmer only
Hot water	95 litre cylinder, 30mm factory insulated, no cylinder thermostat

Upgrade Measures Package 1: The Starter

	Measures
1	Attic insulation – increase to total thickness of 300mm
2	Heating controls (to SEAI grant standard)*
3	Low energy lights

Optional step 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

Optional step B: Upgrade existing double glazing with new low e glass
Replace double-glazing windows 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 heat pump is installed later

Upgrade Measures Package 2: Standard Retrofit

	Measures
1	Attic insulation – increase to total thickness of 300mm, Flat roof insulation (U= 0.22)
2	Cavity insulation to all external walls (U= 0.35)
3	New double-glazed windows (U=1.4)
4	Condensing boiler
5	Heating controls (to SEAI grant standard)*
6	Replace open fire by wood-burning stove
7	Low energy lights
	*Heating controls would need to be further upgraded if heat pump is installed later

Upgrade Measures Package 3: Advanced Measures/ Deep Retrofit*

	Measures
1	Attic insulation – increase to total thickness of 300mm, Flat roof insulation (U= 0.22)
2	Cavity insulation to all external walls (U= 0.35)
3	New double-glazed windows and doors (U=1.4)
4	Air to Water Heat Pump (including full heating controls)
5	Replace open fire by wood-burning stove
6	Photovoltaic Panels (2kW)
7	Low energy lights

BER and Financial Analysis

Variant	BER	Energy Cost	Savings	Investment Cost	SEAI Grants	Costs inc. grants	Payback (years)
Current state	**D2**	**€ 3,613**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**
Starter package	**D1**	**€ 2,919**	**€ 694**	**€ 3,990**	**€ 2,200**	**€ 1,790**	**2.6**
Standard measures	**B3**	**€ 1,841**	**€ 1,772**	**€ 32,008**	**€ 3,900**	**€ 28,108**	**15.9**
Advanced measures	**A2**	**€ 1,064**	**€ 2,549**	**€ 49,608**	**€ 11,300**	**€ 38,308**	**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. Higher grants would be possible if applying through an SEAI-approved One Stop Shop. A home is eligible for the One Stop Shop Scheme if the home:
    a. Was built before 2010
    b. Will achieve a minimum B2 after upgrades
    c. Achieves reduction in primary energy in excess of 100 kWh/m2 /yr as measured in BER.
4. A formal survey would be required for each individual dwelling for to accurately scope out each project. Single measure grant amounts available from SEAI are used in this analysis.
5. Explore further options on www.berwow.ie

Type 03_Fairgreen, Athboy

Typical House - Current Conditions (modest upgrades only to date)	
Type	Semi/End Terrace
Year built	1920 with later extension in 1990's
Walls	Mix of stone walls and concrete block walls
Floor	Solid
Roofs	100mm insulation at ceiling level
Windows	Mostly double-glazed PVC with 6mm gap.
Doors	Solid wood
Ventilation	Natural ventilation with 1x chimney
Heating system	Central heating oil boiler (70% eff.) + Open Fire
Heating Controls	Programmer only
Hot water	117 litre cylinder, 30mm factory insulated, no cylinder thermostat

Upgrade Measures Package 1: The Starter

	Measures
1	Attic insulation – increase to total thickness of 300mm
2	Heating controls (to SEAI grant standard)*
3	Low energy lights
Optional step 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	
Optional step B: Upgrade existing double glazing with new low e glass Replace double-glazing windows 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 heat pump is installed later	

Upgrade Measures Package 2: Standard Retrofit

	Measures
1	Attic insulation – increase to total thickness of 300mm, Flat roof insulation (U= 0.22)
2	Internal wall insulation (U= 0.27)
3	New double-glazed windows (U=1.4)
4	Condensing boiler
5	Heating controls (to SEAI grant standard)*
6	Close unused chimney or replace by wood-burning stove
7	Low energy lights
	*Heating controls would need to be further upgraded if heat pump is installed later

Upgrade Measures Package 3: Advanced Measures/ Deep Retrofit*

	Measures
1	Attic insulation – increase to total thickness of 300mm, Flat roof insulation (U= 0.22)
2	Internal wall insulation (U= 0.27)
3	New double-glazed windows and doors (U=1.4)
5	Air to Water Heat Pump (including full heating controls)
6	Close unused chimney and install wood-burning stove
7	Photovoltaic panels (2kW)
8	Low energy lights

BER and Financial Analysis

Variant	BER	Energy Cost	Savings	Investment Cost	SEAI Grants	Costs inc. grants	Payback (years)
Current state	**G**	**€ 3,656**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**
Starter package	**E2**	**€ 2,880**	**€ 776**	**€ 3,990**	**€ 2,000**	**€ 1,990**	**2.6**
Standard measures	**C1**	**€ 1,663**	**€ 1,993**	**€ 33,832**	**€ 5,500**	**€ 28,332**	**14.2**
Advanced measures	**A3**	**€ 1,297**	**€ 2,359**	**€ 49,382**	**€ 13,100**	**€ 36,282**	**15.4**

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. Higher grants would be possible if applying through an SEAI-approved One Stop Shop. A home is eligible for the One Stop Shop Scheme if the home:
    a. Was built before 2010
    b. Will achieve a minimum B2 after upgrades
    c. Achieves reduction in primary energy in excess of 100 kWh/m2 /yr. as measured in BER.
4. A formal survey would be required for each individual dwelling for to accurately scope out each project. Single measure grant amounts available from SEAI are used in this analysis.

Type 04_Beechgrove, Athboy

Typical House - Current Conditions (modest upgrades only to date)	
Type	Detached
Year built	1976
Walls	Masonry cavity wall
Floor	Solid
Roofs	100mm insulation at ceiling level
Windows	Mostly double-glazed PVC with 6mm gap.
Doors	Solid wood
Ventilation	Natural ventilation with 1 flue
Heating system	Central heating oil boiler (70% eff.) + Stove (60% eff.)
Heating Controls	Programmer only
Hot water	96 litre cylinder, 30mm factory insulated, no cylinder thermostat

Upgrade Measures Package 1: The Starter

	Measures
1	Attic insulation – increase to total thickness of 300mm
2	Heating controls (to SEAI grant standard)*
3	Low energy lights
Optional step 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	
Optional step B: Upgrade existing double glazing with new low e glass Replace double-glazing windows 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 heat pump is installed later	

Upgrade Measures Package 2: Standard Retrofit

	Measures
1	Attic insulation – increase to total thickness of 300mm
2	Cavity wall insulation (U= 0.35)
3	New double-glazed windows (U=1.4)
4	Condensing boiler
5	Heating controls (to SEAI grant standard)*
6	Low energy lights
	*Heating controls would need to be further upgraded if heat pump is installed later

Upgrade Measures Package 3: Advanced Measures/ Deep Retrofit*

	Measures
1	Attic insulation – increase to total thickness of 300mm
2	Cavity wall insulation (U= 0.35)
3	New double-glazed windows and doors (U=1.4)
4	Air to Water Heat Pump (including full heating controls)
5	Photovoltaic panels (2kW)
6	Low energy lights

BER and Financial Analysis

Variant	BER	Energy Cost	Savings	Investment Cost	SEAI Grants	Costs inc. grants	Payback (years)
Current state	E1	€ 2,153	N/A	N/A	N/A	N/A	N/A
Starter package	D1	€ 1,758	€ 395	€ 3,270	€ 2,000	€ 1,270	3.2
Standard measures	B3	€ 1,150	€ 1,002	€ 16,300	€ 3,200	€ 13,100	13.1
Advanced measures	A2	€ 832	€ 1,321	€ 35,950	€ 10,800	€ 25,150	19.0

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. Higher grants would be possible if applying through an SEAI-approved One Stop Shop. A home is eligible for the One Stop Shop Scheme if the home:
    a. Was built before 2010
    b. Will achieve a minimum B2 after upgrades
    c. Achieves reduction in primary energy in excess of 100 kWh/m2 /yr as measured in BER.
4. A formal survey would be required for each individual dwelling for to accurately scope out each project. Single measure grant amounts available from SEAI are used in this analysis.

Explore further options on www.berwow.ie

Type 05_Otterstown, Athboy

Typical House - Current Conditions (modest upgrades only to date)	
Type	Detached
Year built	Circa 1940's with later extension in 2009
Walls	Mix of original walls and recent extension with concrete block
Floor	Solid
Roofs	100mm insulation at ceiling level
Windows	Mostly double-glazed PVC with 6mm gap.
Doors	Solid wood
Ventilation	Natural ventilation with 1 x chimneys, 1 flue
Heating system	Central heating oil boiler (70% eff.) + Stove (60% eff.) + Open fire
Heating Controls	Programmer only
Hot water	117 litre cylinder, 30mm factory insulated, no cylinder thermostat

Upgrade Measures Package 1: The Starter

	Measures
1	Attic insulation – increase to total thickness of 300mm
2	Heating controls (to SEAI grant standard)*
3	Low energy lights

Optional step 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

Optional step B: Upgrade existing double glazing with new low e glass
Replace double-glazing windows 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 heat pump is installed later

Upgrade Measures Package 2: Standard Retrofit

	Measures
1	Attic insulation – increase to total thickness of 300mm, Sloping roof insulation (U= 0.20)
2	External wall insulation (U= 0.27)
3	New double-glazed windows (U=1.4)
4	Condensing boiler
5	Heating controls (to SEAI grant standard)*
6	Close unused chimney or replace by wood-burning stove
7	Low energy lights
	*Heating controls would need to be further upgraded if heat pump is installed later

Upgrade Measures Package 3: Advanced Measures/ Deep Retrofit

	Measures
1	Attic insulation – increase to total thickness of 300mm, Sloping roof insulation (U= 0.20)
2	External wall insulation (U= 0.27)
3	New double-glazed windows and doors (U=1.4)
4	Air to Water Heat Pump (including full heating controls)
5	Close unused chimney or replace by wood-burning stove
6	Photovoltaic panels (2kW)
7	Low energy lights

BER and Financial Analysis

Variant	BER	Energy Cost	Savings	Investment Cost	SEAI Grants	Costs inc. grants	Payback (years)
Current state	G	€ 6,128	N/A	N/A	N/A	N/A	N/A
Starter package	E2	€ 4,835	€ 1,293	€ 5,700	€ 2,200	€ 3,500	2.7
Standard measures	B3	€ 2,525	€ 3,603	€ 61,900	€ 10,200	€ 51,700	14.3
Advanced measures	A3	€ 1,830	€ 4,299	€ 80,525	€ 17,800	€ 62,725	14.6

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. Higher grants would be possible if applying through an SEAI-approved One Stop Shop. A home is eligible for the One Stop Shop Scheme if the home:
    a. Was built before 2010
    b. Will achieve a minimum B2 after upgrades
    c. Achieves reduction in primary energy in excess of 100 kWh/m2 /yr as measured in BER.
4. A formal survey would be required for each individual dwelling for to accurately scope out each project. Single measure grant amounts available from SEAI are used in this analysis.

Appendix C

Industry-Average Cost of Measures

Measure Pricing (Industry Average) - 2023	
Attic insulation (m^2)	€30
Sloping roof insulation (m^2)	€170
Flat roof insulation (m^2)	€123
Cavity fill insulation (m^2)	€30
Internal wall insulation (m^2)	€120
External wall insulation (m^2)	€200
Suspended floor insulation (m^2)	€120
2G Windows (m^2)	€500
3G Windows (m^2)	€520
Doors (m^2)	€1,025
Condensing boiler	€4,500
Heating controls package	€2,000
Wood stove	€4,400
Air-to-water Heat Pump	€14,000
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 - 2028 Residential Projection – Excluding New Build

Row Labels	G	F	E2	E1	D2	D1	C3	C2	C1	B3	B2	B1	A3	A2	A1	Grand Total
2023 total	**45**	**32**	**28**	**33**	**62**	**77**	**72**	**109**	**78**	**64**	**29**	**13**	**9**	**54**	**2**	**707**
Upgrades on 20% of C1 or worse: 2024-2028	**-9**	**-6**	**-6**	**-7**	**-12**	**-15**	**-14**	**-22**	**-16**							**-107**
Altered 2023 Total	**36**	**26**	**22**	**26**	**50**	**62**	**58**	**87**	**62**	**64**	**29**	**13**	**9**	**54**		**598**
2024-2028 - additional BERs							**385**									**385**
2024-2028 upgrades only							41	100	25		50	50	100	75		441
2028 - Estimated BER Count	36	26	22	26	50	62	483.6	187.2	87.4	64	79	63	109	129	0	**1424**
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	24,480	10,624	8,064	8,448	13,888	15,092	103,974	34,632	14,421	8,640	9,085	5,355	7,085	4,515	-	268,303
Average Primary Energy (kWh/m2/year)																**188.44**

Appendix F

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 primary energy to CO2 emisssions for most popular fuels are taken from Table 8[6] of the DEAP Manual 4.2.6, 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

[6] DEAP Manual 4.2.6, Table 8

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