Tipperary Housing Strategy: Baseline Analysis

Retrofit Strategy 2020-2050

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1. Executive Summary

This housing strategy has been developed to track the retrofit of Tipperary homes, as well as analyzing the current state of housing in Tipperary. This analysis was also conducted to help plan Sustainable Tipp's upcoming actions to reduce emissions from Tipperary's housing sector.

SEAI's database of published BER's was used to assess Tipperary's housing stock.

As building regulations have grown progressively more demanding, and awareness of climate change has increased, Irish homes have become more energy efficient. In SEAI's Energy in Ireland 2018 report, it was found that primary energy consumption from the residential sector has fallen 13.5% in the past twelve years, despite the increase in population over that timeframe.

This strategy aims to map out a path for improving the BER of the average Tipperary home to a B2 standard (125 kWh/m^2/yr), which is equivalent to the NZEB retrofit standard

With 59,276 private households in county Tipperary (source: CSO, 2016), the task to improve the residential sector as a whole is a challenging one. SEAI's domestic BER database has a record of all BER's published, including over 27,000 for county Tipperary, which equates to over 45% of all housing.

The average BER rating for houses constructed pre 1919 in County Tipperary is 458 kWh/m^2/yr, which corresponds to a G rating. It decreases with each age band, down to 90 kWh/m^2/yr for homes constructed in 2011 or later, which corresponds to a B1 rating. The vast majority of homes built from 2011 onwards achieve an A or B rating. Overall, the average BER for Tipperary houses is 287 kWh/m^2/yr, which corresponds to a D2 BER score

To bring this average up to an NZEB standard of B2, 41,452 of Tipperary's 59,276 homes would need to be retrofitted. To achieve this target by 2050, 1,382 homes would need to be retrofitted on average per year. The number of deep retrofits in Tipperary has grown from less than 5 per year up to 2015, to an average of 115 across 2017 and 2018. While substantial growth has been seen, far more is needed to get to the yearly average of 1,382.

In 2018, 86 homes underwent a "Deep Retrofit to NZEB". A "Deep Retrofit to NZEB" is defined here as a home where the BER is conducted on an existing house, for the purpose of grant support, a B2 BER rating or better is achieved, and a substantial portion of it's energy is from renewable resources (i.e. in this case a heat pump is most likely, although a pellet boiler may also be installed.)

2. Introduction

This housing strategy has been developed to track the retrofit of Tipperary homes, as well as analyzing the current state of housing in Tipperary. SEAI's database of published BER's was used to assess Tipperary's housing stock.

2.1 European Context

In their 2016 report on Household Energy Consumption, the European Environment Agency found that Ireland's per capita residential energy consumption was marginally higher than EU average. In that same report they note that;

> *"reducing energy consumption in existing buildings presents a major challenge as the turnover of the building stock is slow. Progress can be achieved by making better use of climate finance and revenues from energy taxation, for instance, to support large-scale renovation and local authorities" – European Environment Agency*

2.2 Irish Context

As building regulations have grown progressively more demanding, construction methods have advanced, and awareness of climate change has increased, Irish homes have become more energy efficient. In SEAI's Energy in Ireland 2018 report, it was found that primary energy consumption from the residential sector has fallen 13.5% in the past twelve years, despite the increase in population over that timeframe. Residential primary energy has fallen from a 24.8% share of Ireland's primary energy demand to 23.6% over that same time period.

	Overall Growth %	Average Annual Growth %					Quantity (ktoe)		Shares %	
	2005 – 2017	'05 – '17	'05 – '10	'10 - '15	'15 - '17	2017	2005	2017	2005	2017
Industry	-3.1	-0.3	-2.1	0.4	2.9	1.5	3,635	3,523	22.9	24.4
Transport	-0.8	-0.1	-2.1	0.8	2.8	2.0	5,181	5,138	32.7	35.6
Residential	-13.5	-1.2	1.5	-4.1	-0.5	-2.9	3,928	3,398	24.8	23.6
Services	-21.5	-2.0	-3.0	-3.2	3.7	1.8	2,647	2,079	16.7	14.4
Agriculture / Fisheries	-37.8	-3.9	-5.2	-5.1	2.9	2.6	468	292	3.0	2.0

Figure 1; Sectoral Energy Consumption - Energy in Ireland Report 2018, SEAI

2.3 Tipperary Context

In 2017 Tipperary's Sustainable Energy Action Plan (SEAP) was formally adopted by Tipperary County Council. This plan was created following Tipperary's commitment to The Covenant of Mayors, the world's largest movement for local climate and energy action. This plan describes the steps that need to be taken to reduce Tipperary's CO_2 emissions by 30% by 2020. The actions in the plan cover a wide range of sectors including residential, agriculture, education, planning, local authority and the commercial sector.

3. County Tipperary Housing Strategy

With 59,276 private households in county Tipperary (source: CSO, 2016), the task to improve the residential sector as a whole is a challenging one. Careful planning and foresight is needed. It is said that something can only be managed if it can be measured. It is with this in mind, that this strategy was compiled.

SEAI's database of domestic BER's was used to compile a county wide plan for retrofitting Tipperary's homes. This "baseline" of houses is described in the following section.

This strategy aims to map out a path for improving the BER of the average Tipperary home to a B2 standard (125 kWh/m^2/yr), which is equivalent to the NZEB retrofit standard. The database can also be used to track the progress of the retrofit of Tipperary homes

Firstly the "gap" to that end target must be quantified. To find that gap, the current state of Tipperary's housing stock must be assessed.

4. Tipperary Housing Baseline

SEAI's domestic BER database has a record of all BER's published, including over 27,000 for county Tipperary, which equates to over 45% of all housing. The makeup of this database is broken down by age band in Figure 2.

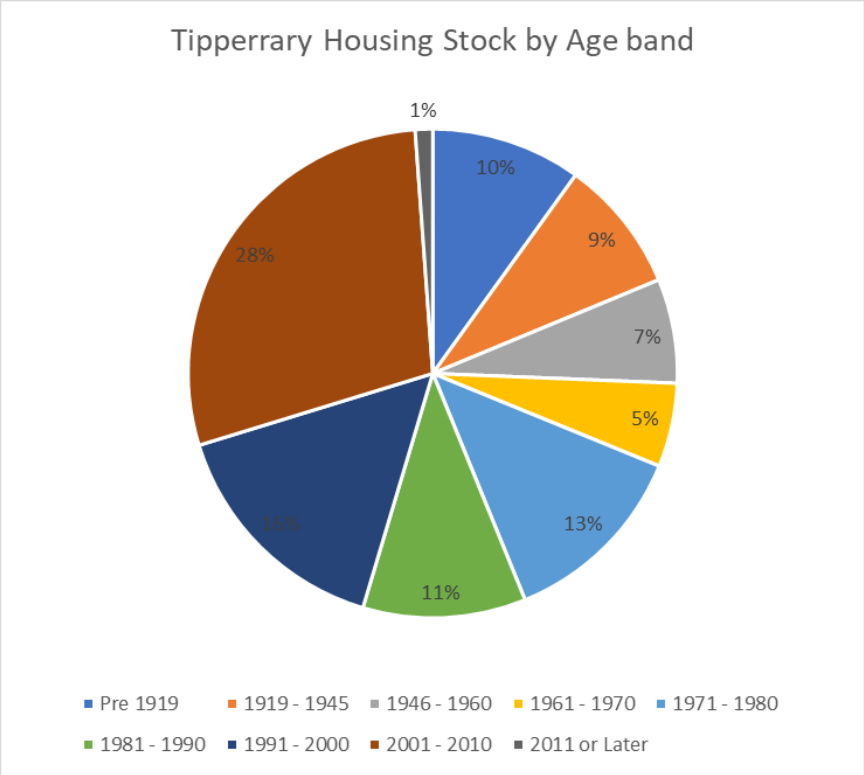


Figure 2; Tipperary Housing Stock by Age band

The database does not provide location data beyond county level, so individual comparisions of regions/areas within Tipperary cannot be made. The database does have information on each individual BER, including year of construction, date of assessment, floor area, U-Values and areas of walls, doors, windows, roofs and floors, space heating and water heating fuel source, and ventilation strategy.

It also provides the motivating factor for BER rating, ie for sale, for grant support, etc. These variables can be tracked over time as a means of monitoring the progress of the retrofit of Tipperary's housing stock. An excel tool was developed to analyse the BER dataset, and track these variables. The excel tool is also adaptable, datasets for other counties can be input to allow the analysis be replicated. Instructions for use of the tool can be found in the Appendix. The results from the tool for county Tipperary can be found in the next section of this report.

5. Gap to Target Analysis

To determine the gap to Sustainable Tipp's target of bringing the average Tipperary house to an NZEB standard of B2, we must assess the current state of the housing stock.

The average BER rating for houses constructed pre 1919 in County Tipperary is 458 kWh/m^2/yr, which corresponds to a G rating. It decreases with each age band, down to 90 kWh/m^2/yr for homes constructed in 2011 or later, which corresponds to a B1 rating. The vast majority of homes built from 2011 onwards achieve an A or B rating. Overall, the average BER for Tipperary houses is 287 kWh/m^2/yr, which corresponds to a D2 BER score. This data is displayed in Figure 3.

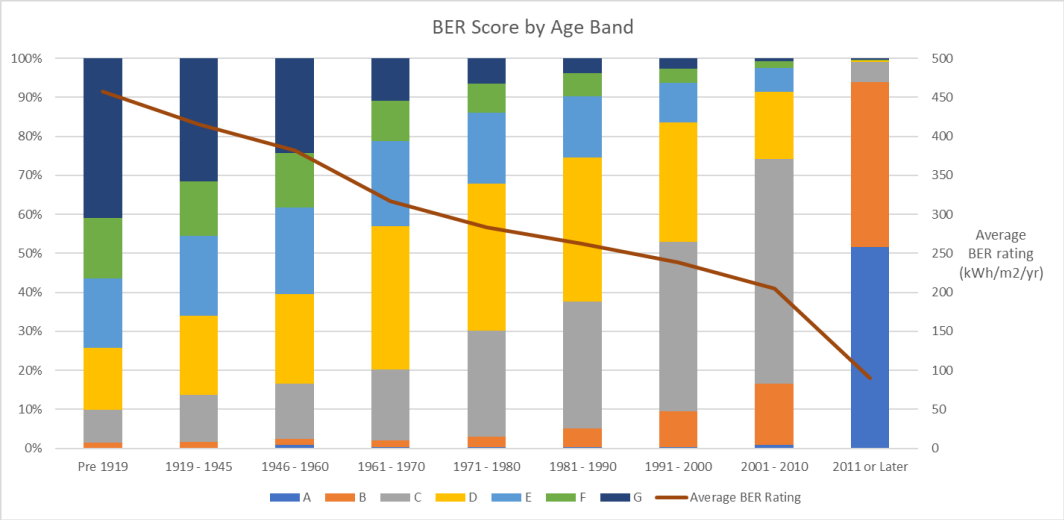


Figure 3; Tipperary BER score by Age Band

The average deep retrofit in County Tipperary takes houses with a pre-works BER of 312 kWh/m^2/yr, an E1 rating, and brings them up 80 kWh/m^2/yr, a B1 rating. This corresponds to an "uplift" (reduction in BER score) of 232 kWh/m^2/yr. Taking this figure as a guide, to bring the average BER in Tipperary up to a B2, 41,452 of Tipperary's 59,276 homes would need to be retrofitted. This corresponds to 1,382 homes retrofitted on average per year.

In 2018, 86 homes underwent a "Deep Retrofit to NZEB". A "Deep Retrofit to NZEB" is defined here as a home where the BER is conducted on an existing house, for the purpose of grant support, a B2 BER rating or better is achieved, and a substantial portion of it's energy is from renewable resources (i.e. in this case a heat pump is most likely, although a pellet boiler may also be installed.)

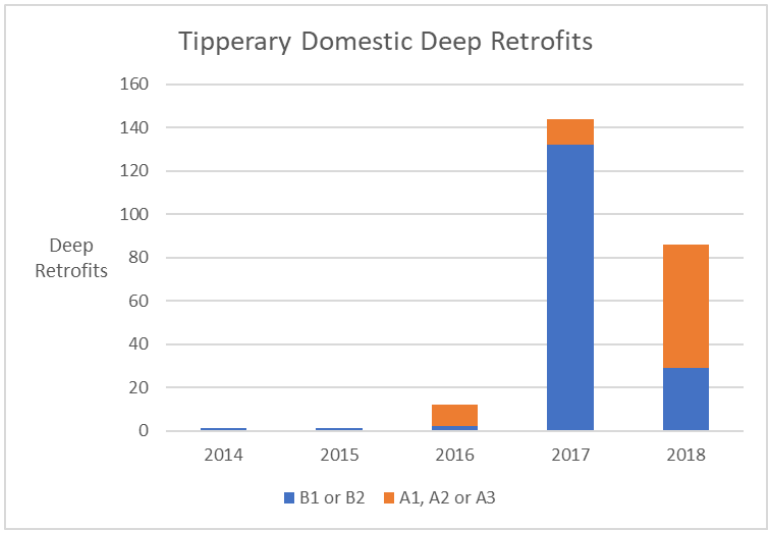


Figure 4; Tipperary Domestic Deep Retrofit Tracker

The number of dwellings which underwent a deep retrofit fell from 2017 to 2018, but overall the area has grown enormously in the last 5 years. However, substantial growth is required to get to that average rate of 1,382 houses deep retrofitted per year.

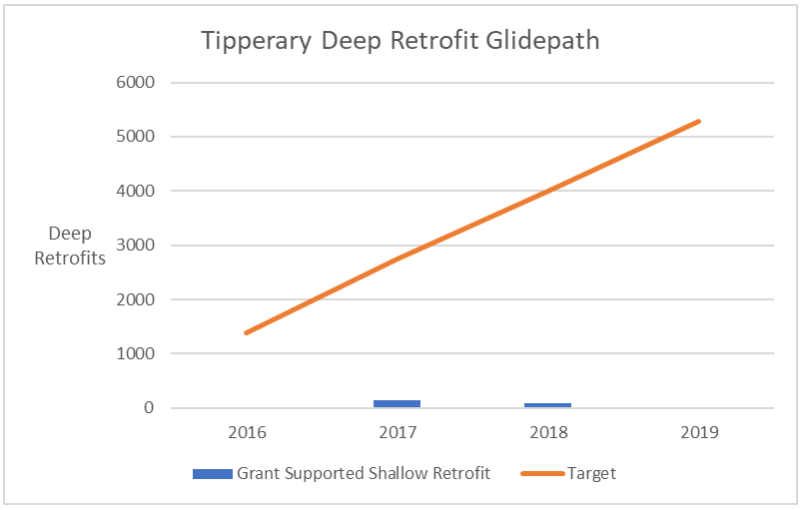


Figure 5; Tipperary Deep Retrofit Glidepath

It should be noted that for every year which the annual target isn't met, the target for the following years becomes more challenging, as the defecit needs to be made up in the future. Nonetheless, there is 30 years to the 2050 target, and there has been considerable progress in recent years.

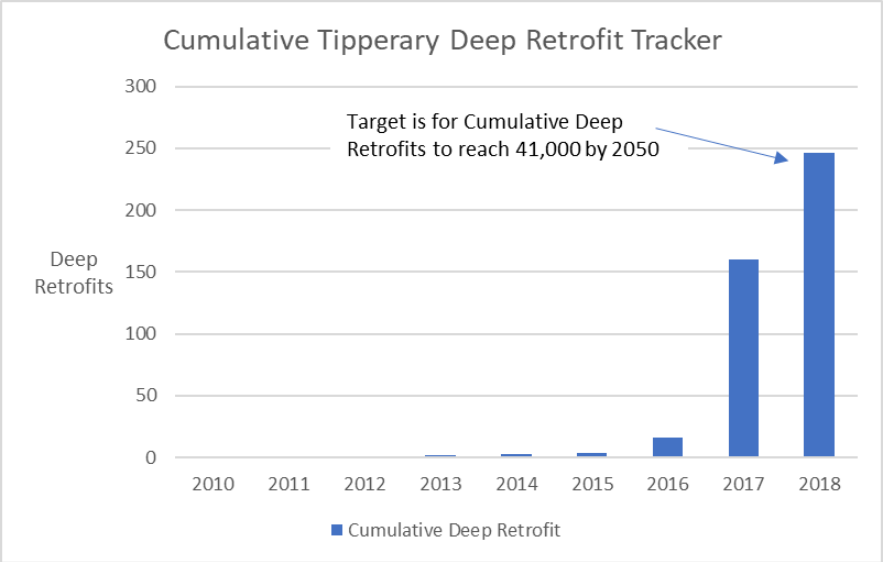


Figure 6; Cumulative Tipperary Deep Retrofits

This tool can be updated annually to track progress towards the 2050 target of retrofitting Tipperary's building stock to an NZEB standard. It can also be used for other counties in Ireland to track the rate of retrofit in their own county.

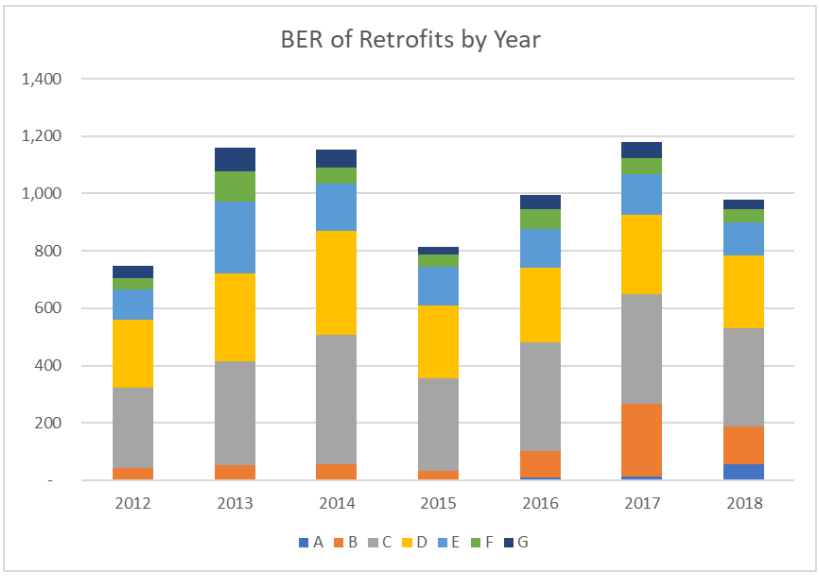


Figure 7; BER of Retrofits by Year

The total number of retrofits (defined as BER entries where the motivation is for grant support) is shown in figure 7. It can be seen that the number of homes retrofitted to an A rating increased dramatically in 2018, although most retrofits are shallow rather than deep, achieving a final grade of C or worse.

Taking the average cost of deep retrofitting a home to be €500/m^2, the average Tipperary home will cost €57,658. As 1,382 homes will need to be retrofitted per year on average between now and 2050, the average annual cost required will be €79.6 million.

6. Tipperary Housing Detail

With 84% of primary energy demand attributable to space and water heating (the remaining 16% is ascribed to pumping and lighting), the fuel source chosen has a considerable impact on energy performance. It was found that in homes constructed between 1981-1990, very few had a renewable heating system. In homes constructed in 2011 or later, there is a significant portion of homes heated by renewable heat source. It's clear that more stringent building regulations have had a profound impact on housing design. One can expect that this share of the market will continue to grow as awareness of renewables increases. Solid Fuel (coal, peat, etc) as the main heat source has reduced from 6% in homes constructed in 2000 – 2010, to a negligible amount in homes built since 2011. Of the 20 newly constructed homes with BERs published in 2018, 55% had a renewable heat source (all of which were heat pumps). The number of homes heated by fossil fuel heat source has decreased from over 95% in homes built between 2000-2010, to under 70% in homes built in 2011 or later. This can be seen in figure 8.

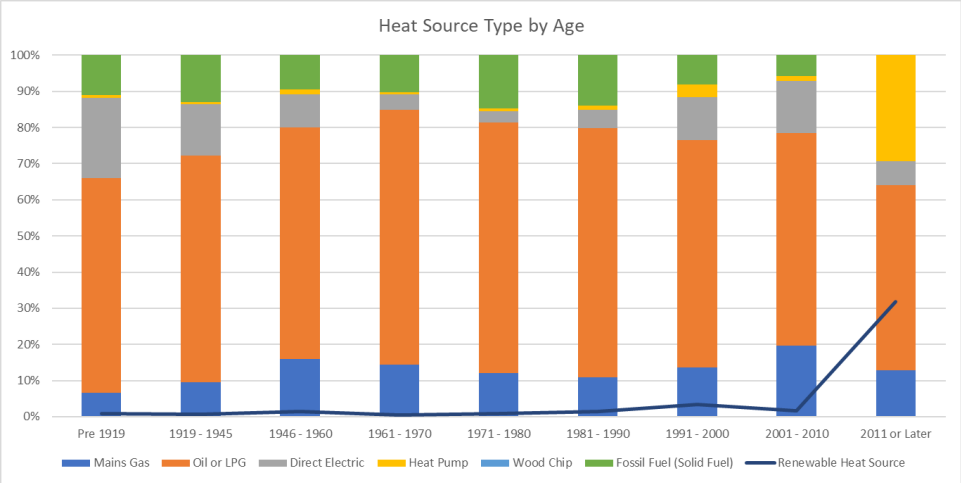


Figure 8; Tipperary Heat Source type by Age & Renewable Heat Source share

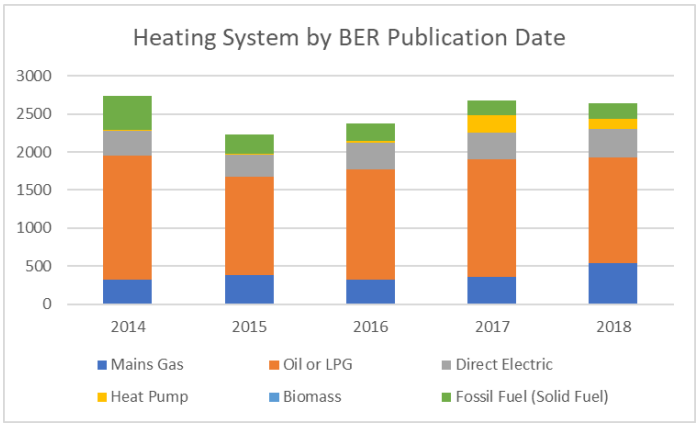


Figure 9; Heating System by BER publication date

The heating system installed by year of publication of BER can be seen in figure 8 above. The number of houses with heat pumps has increased from just 0.5% in 2014, up to 5.1% in 2018.

It was found that of the average Tipperary home constructed from 2001 onwards in the BER dataset, 1,125 kWh are consumed by Pumping and Lighting, and 14,060 kWh are consumed by heating (Total Final Consumption).

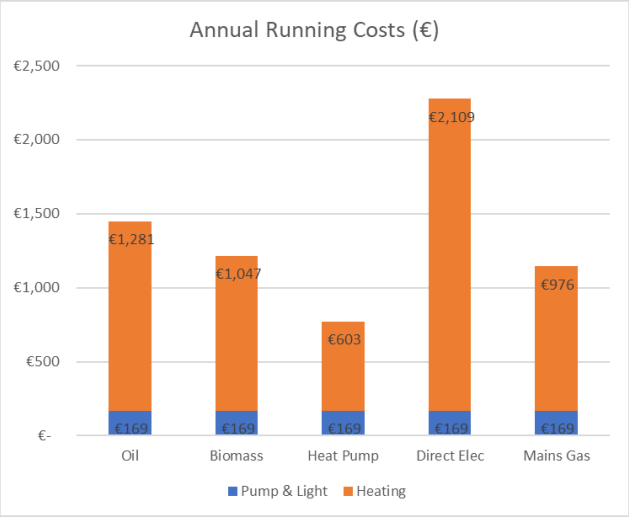


Figure 10; Annual Running cost, fuel type comparison

Using domestic fuel costings from SEAI, it was found that homes with a heat pump had the lowest running costs, 37% lower than the next most economical fuel source, natural gas. This is shown in Figure 10.

The carbon intensity of heat pumps (in kg of CO_2 per kWh of heat delievered) was estimated for 2030, 2040 and 2050, assuming grid renewable penetration of 70%, 80%, and 90% respectively. This is compared to carbon intensity of present day heat pumps, as well as oil, direct electric, and natural gas heating systems in Figure 11.

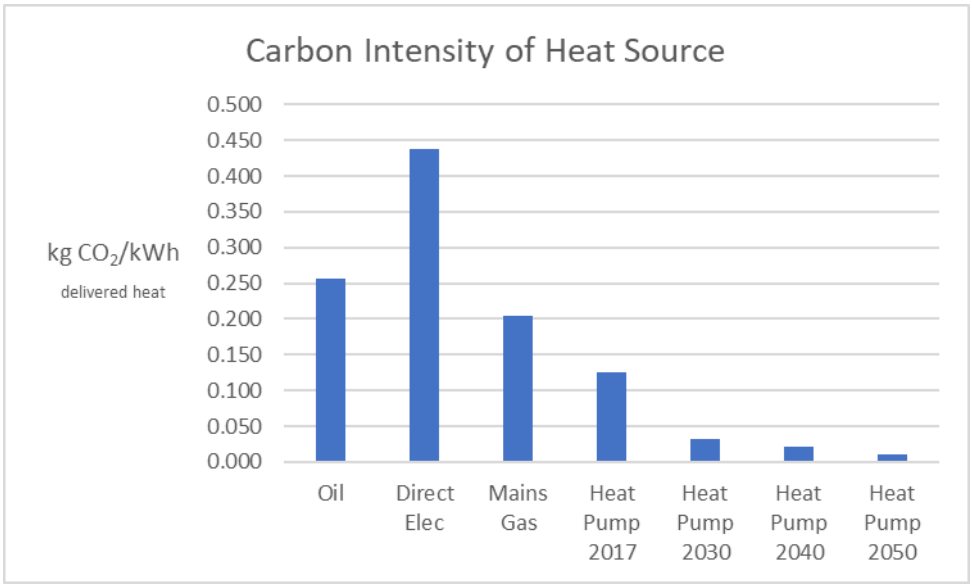


Figure 11; Carbon Intensity of Heat Source

Alongside the increasing portion of homes heated by a renewable source, a dramatic increase in houses with a mechanical ventilation system can be seen, the vast majority of which have heat recovery units.

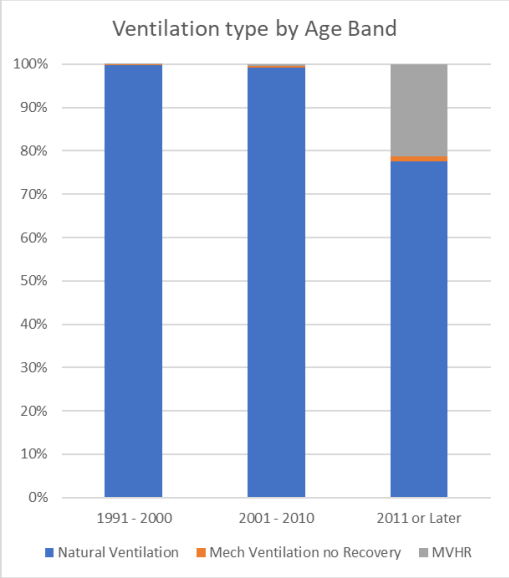


Figure 12; Ventilation type by age band

As illustrated in Figure 12, as late as the year 2000, homes with a mechanical ventilation system were a rarity, but amongst homes built in 2011 onwards a significant number have a mechanical ventilation heat recovery system. This development has occurred in step with improved air tightness of Irish homes.

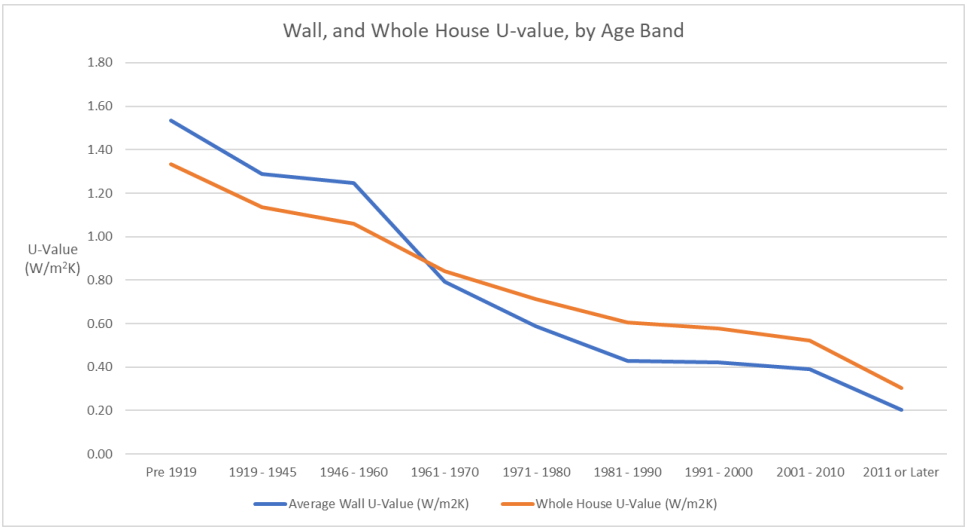


Figure 13; Wall and Whole House U-Value by age band

It can be seen in Figure 13 that the average Wall U-Value, and Whole House U-Value have fallen steadily, as one would expect as construction methods have improved, and building regulations have grown more strict.

One development which will have an adverse affect on Tipperary housing's energy performance is the increase in numbers of detached homes. As can be seen in figure 14, they have increased their share of the market over the years, and now comprise a

majority of all homes built in 2011 onwards, the highest of any period, for which data is available. Detached homes will typically have higher energy consumption than similar semi detached of terraced houses, as they have more exposed surface area per unit of volume, which leads to higher heat losses. The number of terraced houses has shrunk steadily over the years.

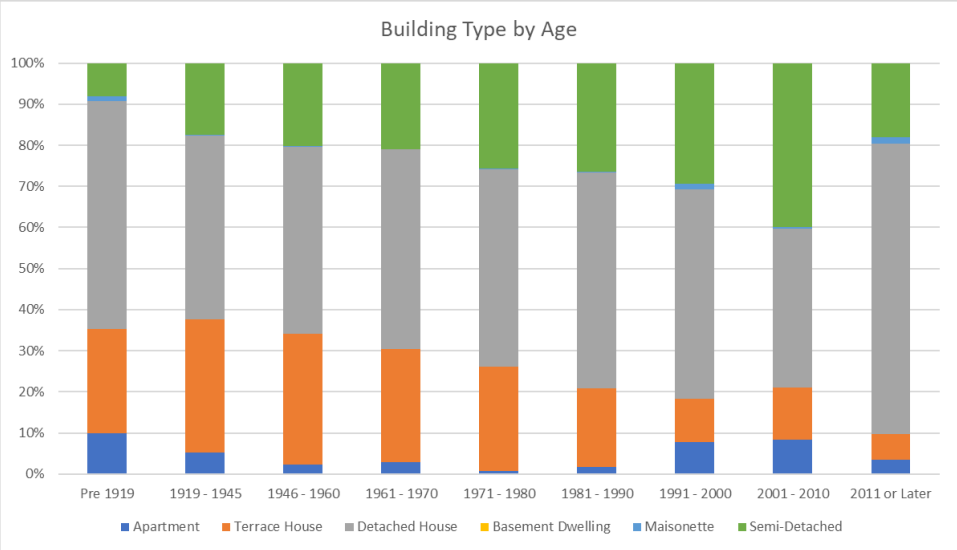


Figure 14; Dwelling Type by age band

Another factor which is easily overlooked when it comes to energy consumption in the residential sector, is the size of homes. It can be seen in Figure 15 that the number of 'small' homes (less than 100 m^2) has fallen dramatically. For most of the dataset, these 'small' homes make up between 40% and 60% of dwellings, but from 2011 onwards, they made up less than a quarter of homes. The aim of this strategy is to bring the average domestic Tipp BER up to a B2, but it should be noted that gains in energy efficiency could be counter balanced by an increase in house size.

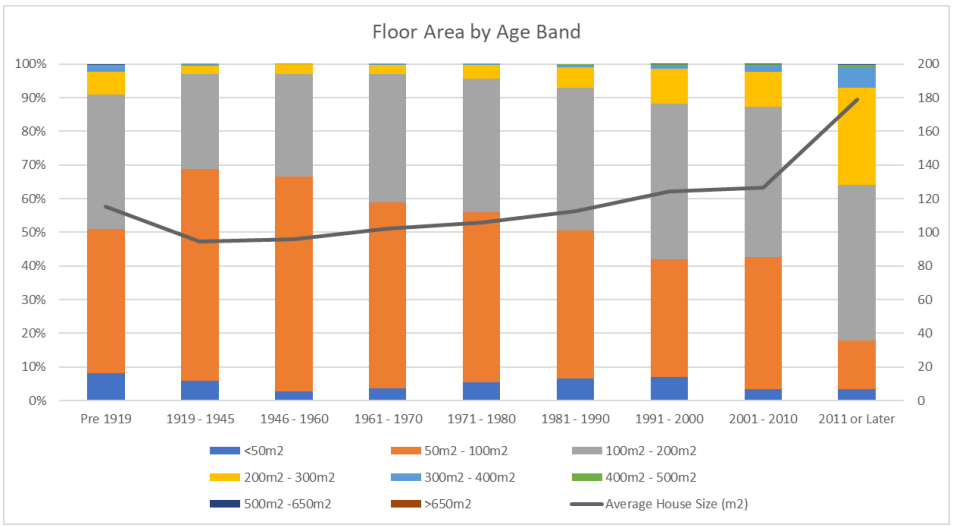


Figure 15; Floor Area by age band

7. Conclusions

The residential sector is a critical one, when considering Tipperary and Ireland's climate goals. Not only is there significant energy consumption attributable to the sector, but by making homes more energy efficient, awareness of the impact of energy consumption on climate change can be improved. Retrofitting Tipperary's housing stock to an NZEB standard by 2050 is a challenging task, however significant strides have been made in recent years. Nonetheless a coherent plan is needed, as well as a means of tracking progress, to ensure this trying target is met.

SEAI's database of domestic BER's is a valuable asset in this regard. All BER's published can be accessed and analysed as a dataset. The current state of Tipperary's housing stock has been analysed, and it was found that the average house has a BER of D2. To get the average BER up to an NZEB standard, (B2 on the BER scale), assuming an average 'uplift' in BER of 232 kWh/m^2/yr, 41,732 homes would need to be retrofitted. This averages out to 1,382 homes per year. While there has been significant growth in the number of deep retrofits in Tipperary in recent years, substantial further expansion is required to meet the goal. Taking the average cost of deep retrofitting a home to be €500/m^2, the average Tipperary home will cost €57,658. As 1,382 homes will need to be retrofitted per year on average between now and 2050, the average annual cost required will be €79.6 million.

Sustainable Tipp's SEAP runs through 2020, and a follow on action plan will be prepared in the coming months which will succeed the current SEAP. This assessment of Tipperary's housing stock will be used to inform the housing actions in the soon to be developed SEAP.

8. Appendix

8.1 Methodology

8.1.1 Overview

The entire national dataset of all domestic BER's was downloaded from SEAI's website (https://ndber.seai.ie/BERResearchTool/Register/Register.aspx). Results were filtered by county, with only county, County Tipperary analysed.

Column labels in green indicate columns where formulas have been created to amalgamate or further analyse raw data from other columns. Resulting data in these columns are analysed in the "Analysis" worksheet.

Column labels in purple indicate columns from which data is pulled and analysed in the "Analysis" worksheet.

To analyse the housing stock of another County, or the nation as a whole the corresponding dataset can be pasted into the tool, and formulas in purple columns applied to the dataset.

8.1.2 Amalgamattions/reformatting

Certain amalgamations and reformats are done to make the raw BER data more readable.

1. There are 11 different dwelling descriptions, these are grouped into the following six dwelling description types in column H;
    - Detached House
    - Terrace House
    - Apartment
    - Semi-Detached
    - Maisonette
    - Basement Dwelling

2. Houses are grouped into the following age band's (which matches CSO's age bands) in column J;
    - Pre 1919
    - 1919 - 1945
    - 1946 - 1960
    - 1961 - 1970
    - 1971 - 1980
    - 1981 - 1990
    - 1991 - 2000
    - 2001 - 2010
    - 2011 or Later

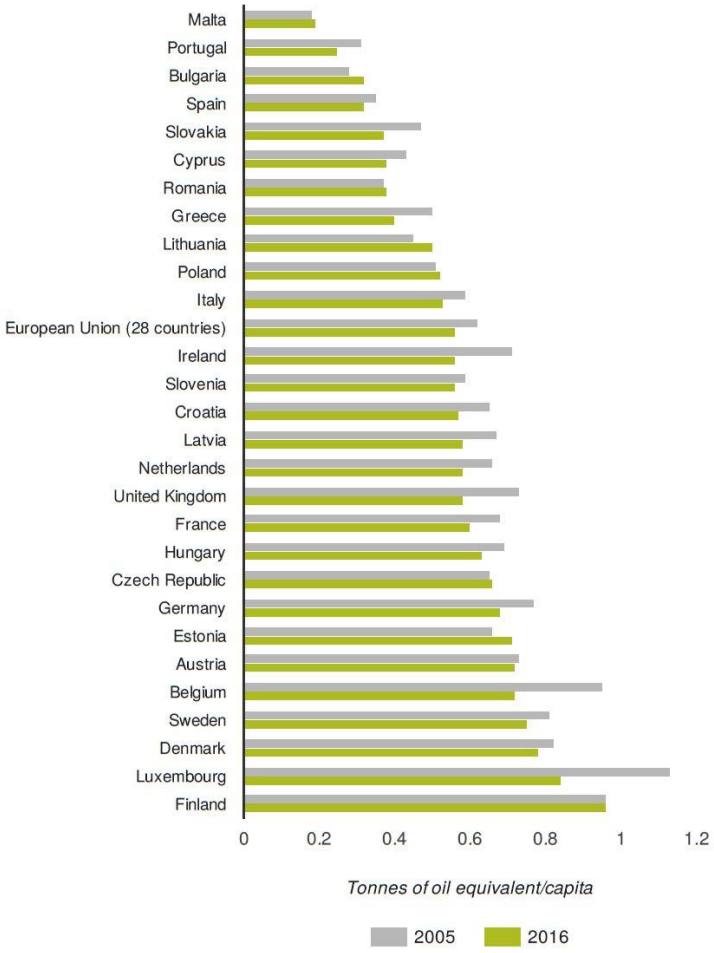
3. Column O generates a Whole House U-Value, which is the weighted average of all elements of the building; floor, roof, windows, doors and walls.

4. Columns AD through AL are used to amalgamate the main heating fuel source in the building into siz categories;
    - Biomass
    - Heat Pump
    - Direct Electric
    - Fossil Fuel (Solid Fuel)
    - Mains Gas
    - Oil or LPG

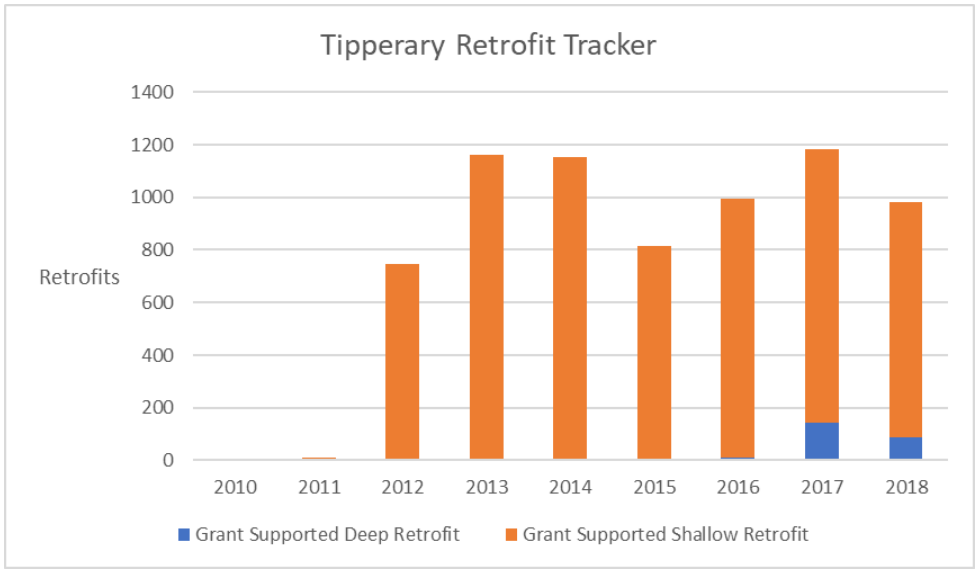
5. Column BF is used to amalgamate ventilation strategy types into one of three types;
    - Natural Ventilation
    - MVHR
    - Mech Ventilation no Recovery

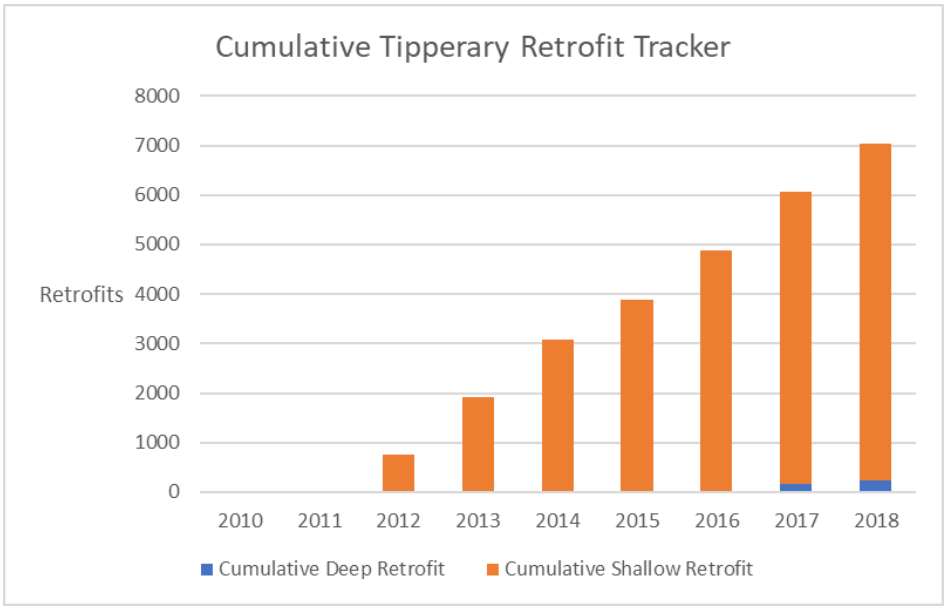
6. Columns FA and FB are used to reformat the Date of Assessment in column EZ. Column FA is used to pull the year from the date of assessment. Figures in column FA need to then be pasted *'as values'* by the users into column FB.

8.2 European Environment Agency Residential Consumption Rankings

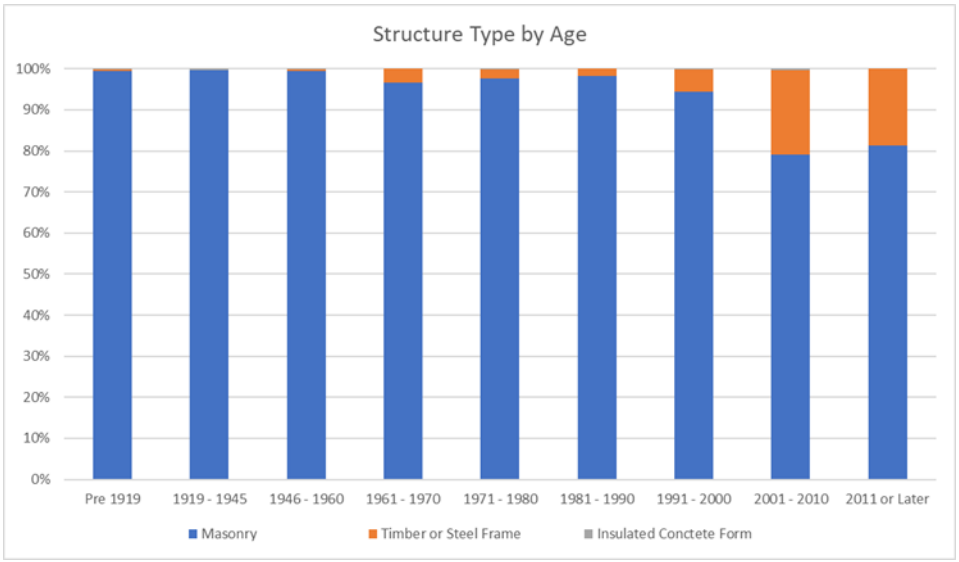


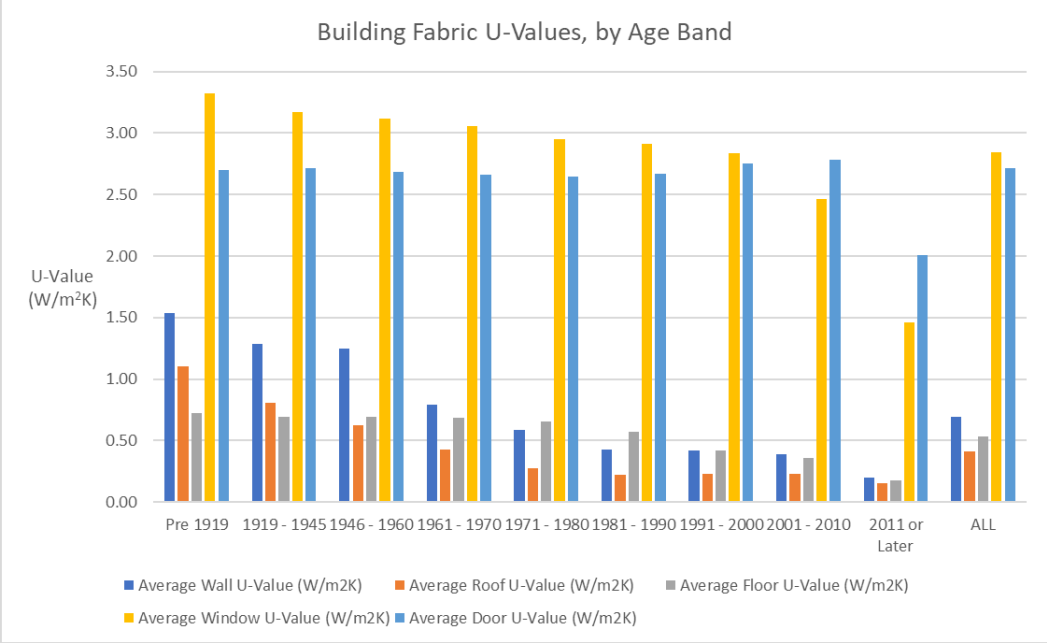
8.3 Retrofit Tracking





8.4 Development of Tipperary Housing Stock




Building Fabric U-Values, by Age Band
U-Value (W/m²K)
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Pre 1919
1919 - 1945
1946 - 1960
1961 - 1970
1971 - 1980
1981 - 1990
1991 - 2000
2001 - 2010
2011 or Later
ALL
Average Wall U-Value (W/m2K)
Average Roof U-Value (W/m2K)
Average Floor U-Value (W/m2K)
Average Window U-Value (W/m2K)
Average Door U-Value (W/m2K)