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Residential Solid Fuel Use in Ireland and the Transition Away from Solid Fuels

Authors: John Eakins, Bernadette Power, Niall Dunphy and Gordon Sirr





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EPA RESEARCH PROGRAMME 2021–2030

Residential Solid Fuel Use in Ireland and the Transition Away from Solid Fuels

(2018-CCRP-MS.58)

EPA Research Report

Prepared for the Environmental Protection Agency

by

University College Cork

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The EPA Research Programme addresses the need for research in Ireland to inform policymakers and other stakeholders on a range of questions in relation to environmental protection. These reports are intended as contributions to the necessary debate on the protection of the environment.

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Executive Summary

The Environmental Protection Agency (EPA) has highlighted instances of poor air quality in urban centres, with emissions of particulate matter, attributable to the burning of solid fuels, being a particular cause of concern. This research project examines the residential solid fuel heating market in Ireland using existing and new sources of data on solid fuel use, including a strong focus on quantifying the use of non-traded solid fuels (informally traded or own indigenous produce). In doing this, the project provides a deeper understanding of the sector to support the continued transition away from the use of solid fuels.

Analysis of existing data sets shows that solid fuels are used as a primary space heating fuel and to supplement a primary non-solid fuel source of space heating. It is for the latter reason that it is more commonly used in households. Primary users of solid fuels tend to have specific characteristics, such as lower levels of educational attainment and lower incomes (or related income measures), and to live in older dwellings. In contrast, the characteristics of those using solid fuels as a supplementary fuel are more diverse. Location – specifically living in rural areas and certain regions – is also a strong factor determining use. Data from the two most recent censuses show that the number of households switching to solid fuels is greater than the number switching away from solid fuels. Changes in occupancy were found to be the most common factor determining switching away from solid fuels, while location and age of the dwelling were the most common factors determining switching to solid fuels.

In a new survey of residential solid fuel users in Ireland, 54% of households indicated that they used solid fuels for space heating purposes. Of these households, 16% recorded a solid fuel as their primary source of space heating and a further 38% used solid fuel(s) to supplement their primary non-solid fuel source of space heating. Low-smoke coal and sod peat were the most prevalent solid fuels used for primary heating, and low-smoke coal and wood logs/briquettes were the most prevalent fuel for supplementary heating. The survey found the level of supplementary solid fuel use relative to primary use to be significant, with the average consumption of a supplementary solid fuel user being approximately three-quarters that of primary solid fuel user. On an energy use basis, the non-traded sector was estimated to account for approximately one-quarter of all solid fuel energy use, with sod peat, wood logs/briquettes and foraged wood being the most common non-traded solid fuels. Stated levels of knowledge of the environmental and health risks associated with using solid fuels were found to be low, especially among primary users. Policy options to reduce solid fuel use were more supported than opposed by survey respondents, including grants to financially aid a change in heating system or appliance and regulations on the use of smoky solid fuels.

Interviews with households examining their lived experiences of using solid fuels highlighted the strong affinity with burning solid fuels, particularly among rural dwellers. Rural dwellers also placed a high value on access to non-traded fuels, which they indicated was a significant part of the way in which they provided fuel for themselves. Measures to prevent householders falling into energy poverty would be key to acceptance if such activities were restricted. Some householders recognised the need to change their heating systems and engage in a transition away from solid fuels, but informational issues and assurances on performance would need to be addressed.

Experience in Ireland and other countries indicates that the development of new solid fuel regulations for Ireland should include multiple support measures making tailored, stepwise improvements to the current situation, while accounting for the heterogeneity of each solid fuel. The fact that primary and supplementary users of solid fuels have different characteristics and motivations for using solid fuels is also important for policy design. This report has also provided a pathway for examining the non-traded solid fuel sector and how statistical agencies and policymakers can monitor and respond to changing trends in this area. Education and awareness campaigns can equally play an important role in encouraging a transition, especially regarding the environmental and health impact of solid fuels and the uncertainty surrounding the adoption of sustainable heating alternatives.

1 Introduction

This research report provides an account of the work completed by the project entitled Residential Solid Fuel Use in Ireland and the Transition Away from Solid Fuels. The project's objective was to develop a better understanding of the solid fuel sector, including examining the factors that influence choices regarding residential heating and the barriers to transitioning from solid fuels. The quantification of the extent of the solid fuel residential heating market, with a strong focus on resolving the quantification of the use of non-traded solid fuels, was a key goal of the project. This was achieved by using existing data sets on household solid fuel use and developing new data sets that updated and broadened the extent of knowledge of solid fuel use in the residential sector. An in-depth understanding of people's lived experiences of solid fuels and how sociodemographic attributes shape people's views and the heating choices they make has also been developed, along with an examination of the policy instruments that could be used to promote the transition away from solid fuels.

There are several motivations for the research undertaken in the project. The Environmental Protection Agency (EPA) has reported on localised air quality issues in some cities, towns and villages (EPA, 2020) in recent years. Particulate matter (PM) emissions and specifically $PM_{2.5}$ (PM with a diameter of 2.5 µm or less) – the dominant source of which is the burning of solid fuels such as coal, peat and wood – is one such issue. This is a cause for concern, as estimates by the European Environment Agency (EEA) indicate that exposure to $PM_{2.5}$ emissions caused 1300 premature deaths in Ireland in 2018 (EEA, 2020). Recent research has also found that indoor emissions from open fires could pose a substantial hazard, particularly to the health of older people (Maher *et al*., 2021). Government policy has responded to the growing evidence of this problem. The smoky coal ban, which has been in existence since 1990, was extended in September 2020 to cover all towns with populations over 10,000 people and there is a commitment in the current Programme for Government (Department of the Taoiseach, 2020) to extend the ban nationwide as part of a National Clean Air Strategy. Complementary regulatory measures are planned to address other smoky fuels, including peat briquettes, sod turf and wet wood. The National Ambient Air Quality Monitoring Programme, operated by the EPA, has brought about an expansion and upgrade to air quality monitoring stations across the country, which has helped to provide real-time updates on the level of air quality.

This research project is therefore timely given the concerns surrounding the use of solid fuels on air quality and health and the wider environmental policy efforts to combat climate change. However, the residential solid fuel sector is complex on account of the heterogeneity of fuels being used and the lack of reliable and periodic data sources. One specific issue is the quantification of non-traded solid fuel use. This refers to the proportion of solid fuel use that does not originate from official commercial sources, such as fuel retailers or merchants, and thus is not required to meet any minimum standards regarding health or the environment. Attempts to estimate the extent of this market have previously been made by the Sustainable Energy Authority of Ireland (SEAI) (2013, 2018) but, even with this, there is still significant uncertainty regarding the amount of non-traded solid fuel use in the residential sector (SEAI, 2018). Another feature of residential solid fuel use in Ireland that has not been examined in detail to date is its use as a supplementary fuel. Census data (CSO, 2017) provide information on the use of solid fuels for central heating purposes, but less is known about their use for additional or supplementary heating purposes (e.g. through an open fire or stove to heat a single room). This is important because, although solid fuels may be supplementary in terms of the heat provided, in many instances they are likely to be the primary source of household air pollution in the form of PM.

The research project will also contribute to the existing literature in the area. International literature on the use of so-called traditional home heating fuels, such as firewood, coal and other solid fuels, has grown in recent years, especially as the need to examine ways to transition away from these traditional fuels becomes ever more urgent. Much of it has emerged

from surveys from developing countries (see van der Kroon *et al*., 2013, and Muller and Yan, 2018, for surveys) and uses theoretical frameworks such as the energy ladder model (Leach, 1992) and the energy stacking model (Masera *et al*., 2000) to support the research. The energy ladder model emphasises the role that income plays in shifting households' fuel usage to cleaner, more efficient fuels as they move up the ladder. In contrast, the energy stacking model assumes that households use a combination of fuels, which may include those fuels at both the bottom and top of the energy ladder. It views "modern" fuels as partial rather than as perfect substitutes for primitive fuels (van der Kroon *et al*., 2013).

Research from developed countries generally examines the determinants of heating system choices or consumption of solid fuels in relation to a range of socioeconomic, dwelling and household characteristics. The age of the head of household or household occupants plays an important, albeit sometimes contradictory role; some studies show a positive relationship with age (Démurger and Fournier, 2011; Song *et al*., 2012, 2018) while others show a negative relationship (Lillemo and Halvorsen, 2013; Özcan *et al.*, 2013; Rouvinen and Matero, 2013). In the case of the latter, health concerns and ease of use were noted as two explanations as to why older household members did not choose traditional solid fuels. The education level of household members is also found to be an important determinant, with higher levels of educational attainment usually negatively associated with solid fuel choice and consumption (Démurger and Fournier, 2011; Laureti and Secondi, 2012; Song *et al*., 2018). In line with the energy ladder theoretical model, most studies find that higher income households are more likely to choose cleaner fuels such as natural gas or electricity than solid fuels (Laureti and Secondi, 2012; Özcan *et al.*, 2013) or have a negative association with the consumption of solid fuels (Shi *et al.*, 2009; Démurger and Fournier, 2011; Couture *et al.*, 2012; Song *et al.*, 2012; Zhang *et al.*, 2014). The age, size and type of dwelling can also influence the choice and level of use of solid fuels. Newly built houses tend to have modern heating systems, which are less likely than older properties to use solid fuels or other fossil fuels such as oil (Song *et al.*, 2012).There is also evidence that larger dwellings and houses are more likely to use solid fuel than apartments (Couture et *al.*, 2012; Lillemo and Halvorsen, 2013; Özcan et *al.*, 2013).

The location of a household is another key factor affecting the choice and consumption of solid fuels, particularly those that are more likely to be non-traded. For several studies, a clear urban–rural divide is present, with rural households more likely to consume solid fuels than those in urban areas (Arabatzis and Malesios, 2011; Song *et al*., 2012). Other studies have sought to examine specific attributes of a household's location and have found, for example, that households with a mains gas connection are less likely to use solid fuels than those without (Couture *et al*., 2012), while households living in or near mountainous or forested areas are more likely to use firewood than households not in or near these areas (An *et al*., 2002; Peng *et al*., 2010; Zhang and Kotani, 2012). A UK survey on domestic wood use found that the proportion of wood sourced from informal markets was greater in rural areas than in urban areas (DBEIS, 2016), while a similar survey of Australian households found that respondents living in Australian cities reported high levels of firewood purchases whereas those living in more remote locations reported high levels of self-collection (Romanach and Frederiks, 2020).

In addition to the factors determining the choice and consumption of solid fuels, researchers have also examined what determines the extent of switching from fossil fuels to renewable residential heating systems. Michelsen and Madlener (2016) found that environmental protection, a lower dependency on fossil fuels and a higher degree of residential heating system-related knowledge were key drivers of change, whereas old habits and perceptions of how a residential heating system works and operates were principal barriers. Sopha *et al*. (2010) found that sociodemographic factors, communication among households and the perceived importance of heating system attributes, such as fuel supply security and operational cost, influence the choice of a sustainable heating system in the future. Curtis *et al*. (2018) examined heating systems upgrades using survey data from households in Ireland and found fuel-switching behaviour to be driven by convenience, especially in terms of proximity to a fuel source. The authors warn of a "lock-in" to fossil fuels including solid

fuels because of this. This supports earlier research from Fu *et al*. (2014), which found that households in areas close to bogs have the highest resistance to change from solid fuels to other fuels.

The role of social practices can also inform the household's choices on energy use. A number of researchers have found comfort considerations to be a significant determinant of residential heating fuel choice (Sopha *et al*., 2010; Decker and Menrad, 2015; Michelsen and Madlener, 2016). As well as comfort, other emotional motives can play a role. In a recent study of householders in Sweden, Karlsson *et al*. (2020) investigated the emotions people associate with the use of fireplaces. Their results suggest that watching a fire can help reduce stress and provide a pleasant atmosphere for socialisation. They reference the Nordic concept of "hygge", as part of which fireplaces can be used to create a cosy, comforting home. Emotional motives can sometimes outweigh other concerns. Reeve *et al*. (2013), for example, examined how households justified their use of wood heaters in a location with a severe air pollution problem by describing wood burning as a natural and traditional activity promoting comfort and cohesion. Lynn (2014) found that when an individual was exposed to a video of an open fire, a significant drop in blood pressure was observed, indicating that the sight and sound of a fire induce a feeling of relaxation. Couture *et al*. (2012) found in their study that high-income households are more likely to use wood for pleasure.

In proportionate terms, Ireland is a large user of solid fuels among European countries. The Eurostat final energy consumption figures for 2019 show that solid fuels account for 17.6% of energy space heating in the residential sector in Ireland, a figure which ranks second behind Poland (40.2%) among the 28 EU Member States (EU-28) (Eurostat, 2021). Ireland is also somewhat unique in the extent of heterogeneity of solid fuel use. In addition to imported coal, there is a substantial amount of solid fuel use from indigenous sources relative to other countries, specifically peat (harvested sod peat or manufactured peat briquettes) and wood. Existing Irish research (e.g. Fu *et al.*, 2014) has, however, tended to treat solid fuels as one homogeneous product, an assumption which limits the analysis, especially when the factors determining their use, location being a prime example, are likely to differ by solid fuel. Overlooking the heterogeneity of solid fuel use can result in limited policy prescription to address the public health impacts of air pollution from solid fuel use.

Much of existing Irish research supports international studies, particularly with regard to the inverse relationship between solid fuel use and income (Conniffe, 2000; Eakins, 2013). Fu *et al*. (2014) used area-level deprivation as a proxy for income and found a significant negative effect of the variable on the likelihood of using solid fuel for central heating. The authors also suggested that deprivation was a barrier to changing from solid fuels to other fuels. A separate report by the North South Ministerial Council (NSMC) examined the link between deprivation and residential air pollution hotspots on the island of Ireland (Abbott *et al*., 2016). It identified a clear link between the two, with almost all of the identified pollution hotspots in Ireland being located in deprived or very deprived areas. The effect that proximity to a fuel resource and legislated fuel restrictions has on household fuel choices is another topic examined by several Irish researchers (Fu *et al*., 2014; Curtis *et al.*, 2018; McCoy and Curtis, 2018). All found strong positive effects for the proximity to a solid fuel resource, such as a peat bog, and negative effects for the presence of legislated solid fuel sale restrictions, such as the smoky coal ban, and the availability of the gas network in the locality.

The report is set out as follows. Chapter 2 presents the results from a statistical analysis of residential solid fuel in Ireland using existing and bespoke survey data sets on household energy use. The purpose of this chapter is to identify the extent of the solid fuel residential market in Ireland, including its use as a supplementary fuel; to provide an overview of the characteristics of the solid fuel residential market; and to examine recent trends in household solid fuel use. Chapter 3 presents results from a survey of residential solid fuel users in Ireland. The survey addressed several aspects relating to residential solid fuel use in Ireland, including a broader examination of the types of solid fuels used and a quantification of non-traded solid fuel use to better inform national estimates of energy use in the sector. Chapter 4 develops an in-depth understanding of the relationship people have with solid fuels through an examination of the sociocultural,

economic and structural drivers that contribute to the complex meshing of human values and identities with solid fuel use. Chapter 5 examines the potential for a selection of policy instruments to either directly or indirectly promote the transition away from solid fuels, drawing on international research and the research carried out in Chapters 2, 3 and 4. Chapter 6 provides overall conclusions and recommendations arising from work completed, demonstrating the relevant findings of the project in relation to policy questions and outlining key messages for policymakers and the public.

2 Existing Data Sets on Residential Solid Fuel Use

This chapter presents an analysis of existing data sets that include information on residential solid fuel use in Ireland. The data sets examined in this chapter focus on surveys of households in Ireland that elicit information about the occupants and/or the dwelling and their choice of fuels used for home heating. Data on the share of central heating fuels across households are examined first using the Census of Population survey published by the Central Statistics Office (CSO) (CSO, 2017). The share of primary and supplementary heating fuels across households is examined next, using data from the CSO's Survey on Household Environmental Behaviours (CSO, 2016) and the SEAI's Building Energy Rating (BER) data set. The main objectives of this chapter are to identify the extent of the solid fuel residential market in Ireland, including its use as a supplementary fuel, to provide an overview of the characteristics of the solid fuel residential market and to examine recent trends in solid fuel use in the sector with census data.

2.1 Primary Heating Fuels in the Residential Sector in Ireland

The Census of Population, carried out by the CSO every 5 years, includes a question on the main type of fuel used by the central heating system in the household's dwelling. This question was included in the 2011 and 2016 censuses, but not in previous surveys, when only information about the presence of central heating (and not fuels used) was elicited. Table 2.1 displays the number and share of private households by type of central heating fuel recorded in the 2011 and 2016 censuses. Solid fuels (coal, peat and wood) were used by 12.4% of households for central heating purposes in 2016, an increase from 10.9% in 2011. The share of each individual solid fuel also increased between 2011 and 2016. This is likely to have been at the expense of oil for central heating, which decreased from a share of 43.1% in 2011 to 40.4% in 2016.

2.1.1 Determinants of solid fuel use for central heating using Census 2016 data

Fu *et al*. (2014) previously used Census 2011 data to examine the characteristics of the solid fuel market. However, this research was based on data at the electoral division level rather than at the household level and the data examined solid fuels as one homogeneous group. This section presents an updated analysis using the Census 2016 data set at the household level, provided by the CSO. It also examines coal, peat and wood separately on the assumption of heterogeneity of solid fuels. Econometric techniques are employed to relate the likelihood of choosing a solid fuel for central

Table 2.1. Number and share of private households by fuel for central heating from Census 2011 and Census 2016 data

Category	2011 (number)	2016 (number)	2011 (share, %)	2016 (share, %)	Change (share, %)
All households	1,649,408	1,697,665			
No central heating	26,952	23,174	1.6	1.4	–0.2
Oil	711,330	686,004	43.1	40.4	–2.7
Natural gas	550,215	569,166	33.4	33.5	0.1
Electricity	140,419	146,302	8.5	8.6	0.1
Coal (including anthracite)	79,145	86,611	4.8	5.1	0.3
Peat (including turf)	78,638	90,029	4.8	5.3	0.5
Liquid petroleum gas	10,452	9990	0.6	0.6	0.0
Wood (including wood pellets)	21,395	33,976	1.3	2.0	0.7
Other fuels	8524	11,068	0.5	0.7	0.2
Not stated	22,338	41,345	1.4	2.4	1.0

Table 2.2. Estimated coefficients from econometric analysis using Census 2016 data

Household characteristic	Solid fuel type		
	Coal	Peat	Wood
Age of HRP (years)			
15–24 (ref)			
25–44	0.059	0.091	0.223
45–64	0.057	0.047	0.263
65–74	–0.316	–0.220	–0.105
75+	–0.794	–0.500	–0.593
Education of HRP			
No formal education (ref)			
Primary	0.085	0.173	0.084
Secondary	–0.388	–0.278	–0.119
Post leaving	–0.659	–0.545	–0.084
Tertiary	–1.192	–0.969	–0.144
Socio-economic group of HRP			
Professional (ref)			
Managerial and technical	0.248	0.218	ns
Non-manual	0.568	0.526	ns
Skilled manual	0.713	0.775	0.302
Semi-skilled	0.852	0.849	0.340
Unskilled	1.179	1.172	0.546
Other socio-economic groups	1.150	0.882	0.304
Living on a farm			
No (ref)			
Yes	–0.223	0.515	0.580
Year dwelling built			
Pre 1960 (ref)			
1961–1970	–0.321	–0.186	–0.522
1971–1980	–0.350	–0.229	–0.561
1981–1990	–0.123	ns	–0.454
1991–2000	–0.401	–0.473	–0.746
2001–2005	–0.808	–0.841	–0.607
2006 or later	–0.768	–0.367	0.096
Not stated	–0.441	–0.764	–0.614
Dwelling type			
Detached (ref)			
Semi-detached	0.665	0.107	–0.099
Terraced house	1.176	0.418	0.211
Flat/apartment	0.764	ns	0.770
Not stated	0.815	0.440	0.287
Regional location			
Dublin (ref)			
Mid-East	0.259	1.008	ns
South-East	1.258	–1.134	0.269
South-West	0.902	0.759	0.112
Mid-West	0.838	1.069	0.259

Table 2.2. Continued

Household characteristic	Solid fuel type		
	Coal	Peat	Wood
Midlands	0.435	3.018	0.348
West	0.556	2.406	–0.527
Border	1.084	1.275	–0.403
Urban/rural location			
Urban area, >50,000 population (ref)			
Urban area, 10,000–50,000 population	0.256	0.672	ns
Urban area, 1500–10,000 population	0.248	1.511	0.303
Urban area, <1500 population	0.370	1.807	0.630
Rural area, <1 km to urban area	0.255	2.136	1.056
Rural area, 1 km–5 km to urban area	0.346	2.360	1.229
Rural area, >5 km to urban area	0.404	2.768	1.419
Total number of observations	1,666,266		

The dependent variable is choice of fuel for central heating.

HRP, household reference person; ns, estimated coefficient is not statistically different from the reference category; ref, reference.

heating to a set of explanatory variables.[1] These include household characteristics (e.g. the age of the household occupants), dwelling characteristics (e.g. the age and type of dwelling) and other location characteristics (e.g. regional location and the urban–rural divide). Table 2.2 presents the estimated coefficients from the econometric analysis. A positive/negative value implies an increase/decrease in the probability that households in that category will use a solid fuel relative to households in the reference category (denoted by "ref" in the table). The relative size of the positive or negative values indicates the magnitude of this relationship.

The main results from Table 2.2 can be summarised as follows:

- Households with a household reference person (HRP) aged 65 years and over are less likely to possess any type of solid fuel central heating system than a household with a younger HRP. The level of education has a strong negative association, with more educated HRPs being less likely to use solid fuel, particularly coal and peat, than less educated HRPs. A similar effect is found for socio-economic group, with HRPs from higher socio-economic groups (professional, managerial and technical workers) being less likely to use coal and peat than HRPs from lower socio-economic groups (semi-skilled, unskilled professions).
- Householders who live on a farm are more likely to use peat and wood for central heating than those not living on a farm. The opposite effect is observed for coal central heating.
- Solid fuel-based central heating systems are more likely to be present in older, pre-1960 built dwellings. A positive association is found for wood in new dwellings built after 2006, perhaps illustrating the use of wood chip or wood pellet boilers for central heating purposes, which were grant-aided for a period at this time.[2] There is also a strong positive association for the presence of coal-based central heating systems in terraced houses relative to detached houses.
- The likelihood of a dwelling owning a coal-based central heating system is comparable across mid-sized to small urban centres and rural areas,

1 An econometric model, known as a multinomial logit model, was used. The model in this instance estimates coefficients that represent the effect that a household or dwelling characteristic has on the probability of choosing a solid fuel.

2 The SEAI's Greener Homes Scheme (GHS) ran from 2006 to 2011 and supported householders who were installing or replacing their heating system to install a renewable energy heating technology, including wood pellet/chip stoves and boilers, solar panels and geothermal heat pumps. The zero emission renewable technologies, solar panels and geothermal heat pumps are still grant-aided by the SEAI.

suggesting a similar prevalence in these settings. In contrast, both peat- and wood-based central heating systems are more common in rural households, with an increasing effect the further away a household is from an urban area. Peat-based central heating systems display large rural and regional coefficients, highlighting the importance of location in determining the use of this solid fuel. Strong regional effects are also present for coal in the South-East and Border regions, the latter probably due to cross-border trading. There is less evidence of a strong regional effect for wood use except for the West and Border regions, where wood is less likely to be used than other solid fuels (presumably peat mostly).

These findings are consistent with much of the previous literature showing that solid fuel users tend to have lower levels of educational attainment, are from lower socio-economic groups and live in older dwellings than those not using solid fuel. Notably, these effects are stronger for coal and peat users than wood users, highlighting evidence of heterogeneity among solid fuel users. The fact that older HRPs are less likely than younger HRPs to possess a solid fuel central heating system is perhaps a little surprising but, as stated in the literature, alternative heating options may be easier to manage for older HRPs from the perspective of sourcing, storing and maintenance. The size of the location effects, particularly for peat use, highlights the importance of this variable in determining the choice of solid fuel used for central heating. This supports the research carried out by Fu *et al*. (2014), who found proximity to a solid fuel resource to be the most significant factor in determining solid fuel use.

2.1.2 Switching behaviour evidence using Census 2011 and 2016 data

As shown in Table 2.1, an increasing share of households are indicating that they possess a solid fuel-based central heating system. To examine the extent of possible switching between fuels, a bespoke data set was created by the CSO, matching households from Census 2011 and Census 2016 and allowing households that have switched central heating fuels to be identified (CSO, 2020).[3] Only occupied private households were included in the matched data set, giving a total of 1,406,382 households. Table 2.3 shows the number of households (in thousands) using a central heating fuel in Census 2011 alongside the number of the same households using a central heating fuel in the 2016 Census (excluding non-stated in both censuses). Values along the shaded diagonal show the number of households that have the same central heating fuel in both censuses. Concentrating on the solid fuels, approximately 39 K[4] households stated that they use coal for central heating in the 2011 and 2016 censuses. This represents approximately 57% of households using coal for central heating in Census 2011. The figures for peat and wood are 47.4 K (69.7%) and 8.9 K (49.1%), respectively. The high percentage of households that continued to use peat between 2011 and 2016 is an indication that households were more willing to continue using this fuel than other solid fuels.

The off-diagonal values show the number of households that changed their stated central heating fuel between the 2011 and 2016 censuses. For example, and again concentrating on the solid fuels, 14.8 K households using coal for central heating in Census 2011 (or 21.7% of households using coal in 2011) stated that they use oil for central heating in Census 2016. Similarly, high values can be seen for the switch from peat to oil (12.6 K households or 18.5% of households using peat in 2011) and from wood to oil (4.8 K households or 26.3% of households using wood in 2011). One can observe switching between the solid fuels, especially from wood to coal (1.8 K households or 9.8% of households using wood in 2011) and wood to peat (1.3 K households or 7.2% of households using wood in 2011). These instances of switching are not that surprising given that oil- and solid fuel-based central heating systems are perhaps the ones that are the most interchangeable.[5]

3 The CSO released a report in October 2020 that provided an analysis of this data set (CSO, 2020). Much of the discussion here will build on this report.

4 Thousands have been rounded to one decimal place.

5 It could be further suggested that these may represent temporary switches due to changing economic circumstances, such as price and household income changes.

Table 2.3. Number[a] of private households by fuel for central heating using Census 2011 and Census 2016 data

	Central heating fuel type (2016)								
Central heating fuel type (2011)	**None**	**Oil**	**Gas**	**Electricity**	**Coal**	**Peat**	**LPG**	**Wood**	**Other**
None	6.2	2.8	1.9	3.2	3.1	1.7	0.1	1.0	0.2
Oil	2.4	544.2	10.2	4.4	23.2	22.5	1.2	11.2	1.6
Gas	1.5	4.6	451.5	11.3	2.5	0.6	1.8	0.8	0.5
Electricity	3.7	4.1	9.2	70.5	2.4	1.0	0.1	0.7	1.6
Coal	2.4	14.8	2.4	1.9	39.0	4.0	0.2	3.4	0.5
Peat	1.1	12.6	0.3	0.7	3.6	47.4	0.1	1.8	0.4
LPG	0.1	1.0	2.4	0.2	0.2	0.2	4.3	0.2	0.2
Wood	0.5	4.8	0.3	0.3	1.8	1.3	0.1	8.9	0.2
Other	0.1	1.0	0.4	1.6	0.4	0.4	0.2	0.2	2.4

Excludes non-stated in Census 2011 and Census 2016.

[a]Figures are given in thousands of households.

LPG, liquid petroleum gas.

The table can also be examined in the context of switching **to** a solid fuel for central heating in 2016 **from** a different central heating fuel in 2011. On this point, what is noticeable is the extent of switching from oil to solid fuels. For example, 23.2 K households using oil for central heating in Census 2011 stated that they use coal for central heating in Census 2016. Similarly, for peat and wood, 22.5 K and 11.2 K households, respectively, switched to these solid fuels from oil. These figures show that the amount of switching from solid fuels into oil (32.2 K households in total) is offset to a greater extent by the switching from oil to solid fuels (56.9 K households in total). The influence of relative price changes in oil and solid fuels during this period may be an underlying driver for some of this switching. Figures from the CSO show that the Consumer Price Index (CPI) for home heating oil increased significantly between 2010 and 2012 while the CPI for solid fuels remained stable during the same period.[6] This price shock in heating oil may have persuaded some households to switch to solid fuel as their primary fuel, thus accounting for the higher shares reported in Census 2016. Economic conditions at the time, particularly high unemployment levels, may have been a further driver. This may be a temporary switch, as new solid fuel users are likely to retain alternative heating options, such as oil, and could switch back when conditions are more favourable.

To further investigate the underlying patterns in switching from oil to solid fuels and from solid fuels to oil, a comparison can be made between the characteristics of the group of households that make a switch (e.g. from coal to oil) and those that remain with the same fuel (e.g. remain with coal). Six different instances of switching are examined: (1) from coal to oil, (2) from peat to oil, (3) from wood to oil, (4) from oil to coal, (5) from oil to peat and (6) from oil to wood. An econometric analysis was applied to examine the factors that statistically significantly determine the probability of switching fuels. The following is a summary of the main results from this analysis:

- A change in dwelling occupants between the 2011 and 2016 censuses positively and significantly explains the prevalence of switching between fuels. However, the effect is much larger for switching from solid fuels to oil than for switching from oil to solid fuels. This suggests that a change in occupants between the 2011 and 2016 censuses was a strong factor in explaining switching from solid fuels to oil but not such a strong factor in explaining switching from oil to solid fuels.
- Households that were more likely to switch from oil to solid fuels include occupants in dwellings built before 1960, HRPs with less educational attainment and unemployed HRPs.

6 The CPI for home heating oil increased by 49.93% between 2010 and 2012 while the CPI for solid fuels increased by only 0.81% (see https://data.cso.ie; accessed 8 December 2021).

- Instances of switching were more likely in rural areas. A household living in a rural area was more likely to switch from coal to oil, from oil to peat or from oil to wood than a household in an urban area.
- There are also strong regional effects for certain instances of switching. Households in the Border, Midlands and West regions were more likely to switch from oil to peat, and households in the Border and South-East regions were more likely to switch from oil to coal.

The fact that switching away from solid fuel occurs predominantly as a result of a change in occupancy suggests a strong habitual effect for existing solid fuel users. It is also interesting that the characteristics of those switching to solid fuel central heating systems are similar to the characteristics of those households that already possess solid fuel central heating systems (as described in section 2.1.1). Thus, households that transition to solid fuels have similar characteristics to those already using solid fuels. Finally, the influence of location in determining the choice of solid fuel central heating systems is further emphasised in these results. The instances of switching from oil to peat and from oil to coal clearly reflect the availability of that fuel resource in these areas, namely bogs in the case of peat and cross-border trading in the case of coal.

2.2 Primary and Supplementary Heating Fuels in the Residential Sector in Ireland

When examining the extent of the residential solid fuel market, its use as a supplementary fuel to a central or primary heating system often receives less attention. Two data sets provide information on the prevalence of solid fuels as a primary fuel and as a supplementary fuel. The first is the CSO's *Survey on Household Environmental Behaviours* (CSO, 2016), which examines the behaviours of households in Ireland in relation to environmental awareness, waste management and energy use. The survey was carried out between April and June 2014 using a sample of 13,032 households. The survey asked respondents to identify the primary fuel or energy source used to heat their home and then whether or not any supplementary heating is used to heat their home.[7] For the latter question, both the heating equipment through which the supplementary heating is used and the fuels used are specified.

The second data set is based on information recorded when a dwelling receives a BER certificate. A BER certificate and advisory report is compulsory for all homes being sold or offered for rent and for new dwellings that apply for planning permission since 2007. It is also required to avail of the grants for energy efficiency improvements to the home. The BER is calculated by an independent assessor, who collects detailed information relating to the dwelling to measure the dwelling's energy efficiency on a scale from A to G, with A-rated homes being the most energy efficient. Importantly for this report, details regarding the fuel used by the primary and supplementary space heating systems in the dwelling at the time the BER is conducted are also collected. The data were obtained from the SEAI and cover the period from January 2009 to September 2020 (SEAI, 2020b). The data comprise over 900,000 individual dwelling observations using the most recent BER audit for each dwelling. However, the sample of BER dwellings in the data set is not representative of the population of all dwellings in Ireland. Dwellings with a BER are not randomly selected and it is likely that both older dwellings and dwellings in rural settings are under-represented, as they are less likely to be sold or rented than newer and urban dwellings, respectively.

2.2.1 Primary and supplementary heating fuels in the 2016 CSO Survey on Household Environmental Behaviours

Table 2.4 displays the share of households using various fuels as their primary or supplementary fuel and the most common primary and supplementary fuel combinations. The majority of households use either oil or natural gas as their primary source of home heating (41.0% and 34.2%, respectively). In total, 16.2% of households use solid fuels, of which 6.8% use coal, 6.9% use peat and 2.5% use wood logs. A sizeable share of households (56.8%) uses at least one solid fuel to supplement their primary heating fuel. Over one-third of households use coal (38.5%) or wood logs (37%) for supplementary

7 The specific questions that were asked were "What is the main fuel or energy source used to heat your home?" and "Is any additional heating used to heat your home?"

Table 2.4. Share of households using a primary fuel and supplementary fuel for heating

Heating and fuel type	Share (%)
Primary heating	
Coal/low-smoke coal	6.8
Peat (sod turf, briquettes)	6.9
Wood logs	2.5
Natural gas	34.2
Oil	41.0
Electricity	6.4
Other	2.2
Total	100.0
Supplementary heating	
Solid fuel	56.8
Non-solid fuel	16.3
None	26.9
Total	100.0
Primary and supplementary heating combinations	
Solid fuel, primary users	16.2
Gas primary, solid fuel supplementary	12.4
Oil primary, solid fuel supplementary	32.0
Other primary, solid fuel supplementary	2.6
Non-solid fuel users (primary or supplementary)	36.8
Total	100.0

Source: CSO (2016) data set.

heating purposes while one-quarter of households use peat (24.2%).[8] Using oil for primary heating and solid fuels for supplementary heating is the most common combination of fuels used and over one-third of households (36.8%) do not use a solid fuel for either primary or supplementary heating.

Figure 2.1 displays the share of households using solid fuels for primary and supplementary heating at the county level. The results closely match the findings in Table 2.2, with a high prevalence of coal as a primary fuel in counties in the South-East and North-West regions and a high prevalence of peat as a primary fuel in counties in the Midlands, West and North-West regions. The choice of wood logs as a primary fuel is reasonably evenly distributed across the country.

Figure 2.1 illustrates that household use of solid fuels is more prevalent for supplementary heating than for primary heating across Ireland. Almost all counties, apart from Dublin, Offaly and Donegal, have a share above 30% (with Offaly and Donegal having high prevalence of solid fuels as a primary heating fuel). Some counties in the South-East and Border regions have shares of between 60% and 70% of overall solid fuel usage is for supplementary heating. The use of solid fuels for supplementary heating purposes appears to be less location specific than their use as primary heating fuels. For example, in many southern counties coal accounts for a high share of supplementary fuel but not of primary fuel. Similarly, the pattern of usage of wood logs as a supplementary fuel is quite different to its use as a primary fuel. The implication of this is that although location is an important determinant of primary fuel choice it may not be as important a determinant of supplementary fuel choice.

The determinants of primary and supplementary fuel choice were examined in further detail using econometric methods and a number of notable differences were observed:

- Having a lower level of educational attainment and being unemployed were both found to be positively associated with the probability of choosing solid fuels for primary heating. However, these effects were not present in the supplementary solid fuel models. If one takes these variables as proxies for income, this suggests that supplementary solid fuel users are more spread across the income distribution than primary solid fuel users.
- As indicated previously, location effects are less pronounced in determining supplementary fuel choice. That is, rural and regional effects for choosing solid fuels were present in both the primary fuel and supplementary fuel models. However, the size of the estimates, and thus their importance, is smaller in the supplementary fuel model results.
- Variables representing the extent of adoption of energy-saving products and awareness of environmental initiatives were also included in both models. These were found to be unrelated to the choice of solid fuel as a primary fuel, but positively related to the choice of solid fuel as a supplementary fuel. This suggests that,

8 As respondents could select multiple fuels for supplementary heating, the sum of these figures does not equal the total share of solid fuel use for supplementary purposes of 56.8%.

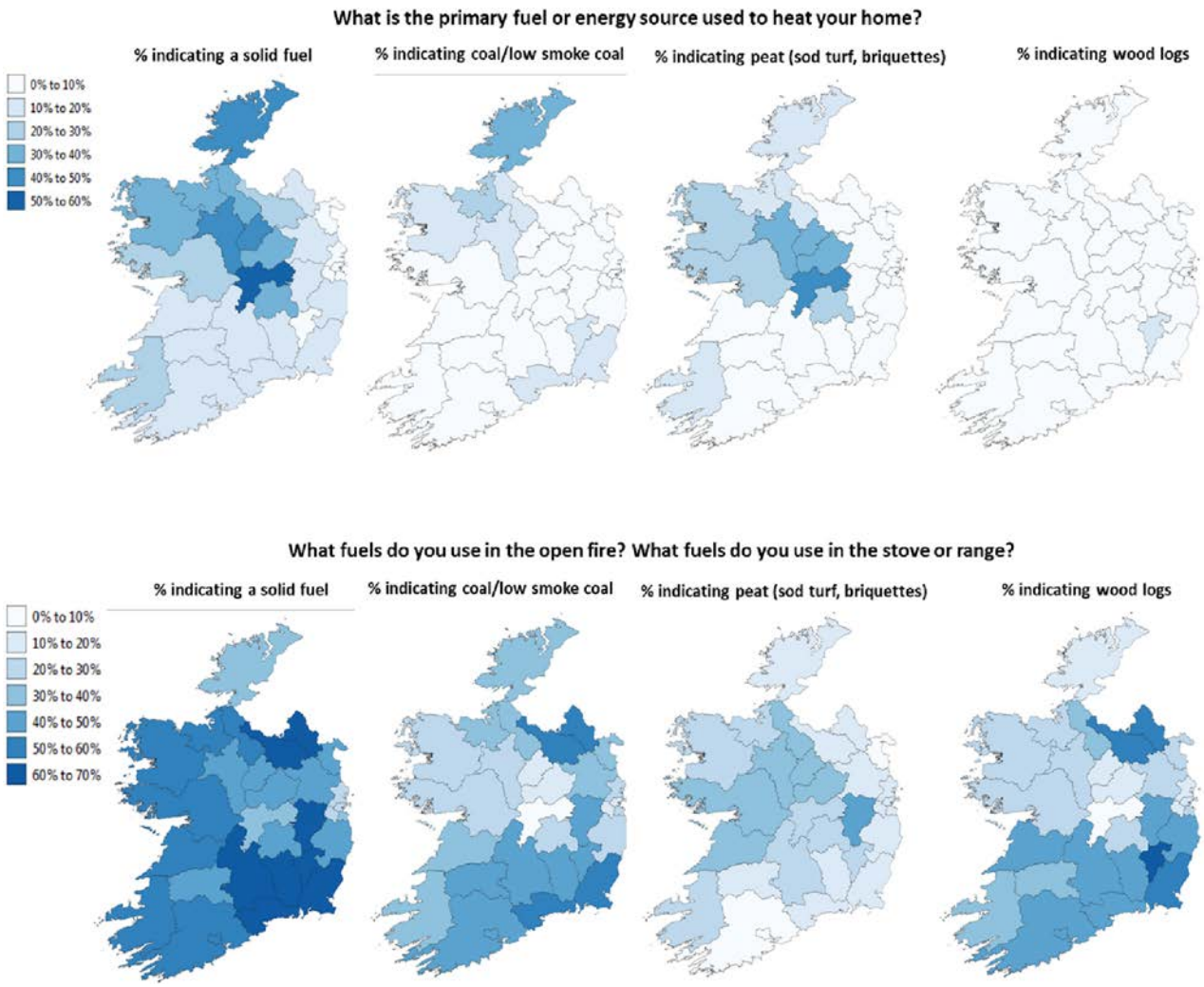


Figure 2.1. Share of households using solid fuels for primary (top) and supplementary (bottom) heating by county. Source: CSO (2016). Reproduction licensed under CC BY 4.0 (https://creativecommons.org/licenses/by/4.0/).

although solid fuel primary users do not exhibit positive environmental behaviours, solid fuel supplementary users do.

- There is partial evidence to support the energy ladder theory, with households living in very old dwellings (built before 1960) being most likely to use solid fuels for primary heating, households living in dwellings built between 1960 and 2000 being most likely to use an oil–solid fuel heating combination, and households living in newer dwellings being most likely to use a natural gas–solid fuel heating combination or non-solid fuels.

The results support the view that the characteristics of the two markets, primary solid fuel users and supplementary solid fuel users, are different in certain aspects. Although primary solid fuel users are a specific cohort of households, the characteristics of those using solid fuel for supplementary heating purposes appear to be more diverse. For example, supplementary solid fuel users represent a more spatially diverse cohort than primary solid fuel users. In addition, given that solid fuel supplementary users exhibit positive environmental behaviours, they may respond more favourably to policy initiatives in this sphere. This may have implications for the design of policy to enable the transition away from solid fuel use.

2.2.2 Primary and supplementary heating fuels in the SEAI BER data set

Table 2.5 displays the share of households that recorded the various fuels as their primary fuel and supplementary fuel in the BER data set. The figures

Table 2.5. Share of households using a primary fuel and supplementary fuel – BER data

Heating and fuel type	Share (%)
Primary heating	
Solid fuel	4.6
Mains gas	40.0
Electricity	17.0
Heating oil	36.7
Other	1.7
Total	100.0
Supplementary heating	
Solid fuel	57.6
Mains gas	10.6
Electricity	11.6
Heating oil	1.0
Other	1.5
None	17.7
Total	100.0
Primary and supplementary heating combinations	
Solid fuel, primary users	4.6
Gas primary, solid fuel supplementary	17.2
Oil primary, solid fuel supplementary	32.5
Other primary, solid fuel supplementary	5.5
Non-solid fuel users (primary or supplementary)	40.2
Total	100.0

Source: BER data (SEAI, 2020b).

present solid fuels as one category owing to the way in which the BER data set records the use of this energy source. Unless the dwelling possesses a heating appliance that is designed to burn a specific solid fuel, the BER assessor records the dwelling as using "solid multi-fuel". Compared with the figures from the *Survey on Household Environmental Behaviours* (CSO, 2016) and the census data in the previous section, the shares using solid fuel as the primary fuel for space heating are clearly underrepresented, while figures for mains gas and electricity are slightly over-represented. However, the shares for supplementary solid fuel heating are comparable, with 57.6% of households using solid fuel as a supplementary source of space heating in the BER data set [compared with 56.8% in the CSO (2016) *Survey on Household Environmental Behaviours*]. The main implication is that the BER data set also shows a substantial proportion of households that use solid fuels for supplementary heating purposes.

The BER data set records information concerning only the dwelling and not the occupants.[9] However, the BER data do provide information on the BER rating and more detailed spatial information.[10] The spatial information can help to analyse the effect of urbanicity, i.e. the extent to which the size of urban areas is associated with the choice of primary and supplementary fuel. It can also help to analyse the association between area-level deprivation and the choice of main and supplementary fuel. As indicated previously, the link between income and the choice of solid fuels is well established. The 2016 Pobal HP Deprivation Index (Haase and Pratschke, 2017) is a commonly used measure of deprivation in Ireland and is available at detailed geographical levels. Table 2.6 provides a breakdown of some characteristics for the sample of BERs with solid fuel primary users, the sample of BERs with solid fuel supplementary users and further subsamples of primary and supplementary solid fuel combinations.

Unsurprisingly, solid fuel primary users are most likely to be located in rural areas; solid fuel supplementary users are equally likely to be located in rural areas and large cities. Solid fuel primary users show a trend towards older dwellings while solid fuel supplementary users are mostly found in newer dwellings built from 1991 onwards. Solid fuel primary users live in energy-inefficient houses and in very deprived areas, according to the average deprivation index value, while solid fuel supplementary users live in marginally deprived areas. The primary fuel used by supplementary solid fuel users has an influence on these statistics: gas–solid fuel users predominantly live in large urban areas, in more energy-efficient

9 The CSO plans to link the census and BER microdata using Eircodes, which would make information on the occupants available. This would also allow BER data to be linked with other survey and administrative microdata. There is also a possibility of retrospectively adding Eircodes to the historical BER data set using Eircodes by ESB Networks during the roll-out of the Smart Meter Programme.

10 Independent of this research project, the SEAI carried out an analysis that linked a BER assessment to a small area (SA), a geographical area of population between 80 and 120 dwellings, used by the CSO as the basis for the enumeration in each census. For ~74% of dwellings in the BER data set used in this project, the location can be attached to a SA. For the other ~26% of dwellings, the location can be attached to an area at the county level.

Table 2.6. Descriptive statistics for solid fuel primary and supplementary users – BER data

Characteristic	Fuel type and fuel combinations (% of sample)					
	Solid fuel primary user	Solid fuel supplementary user	Gas–solid fuel user	Oil–solid fuel user	Other fuel–solid fuel user	Non-solid fuel user
Urbanicity						
City ≥50,000 persons	8.72	24.84	60.05	8.63	18.17	51.76
Town 10,000–50,000 persons	13.82	15.08	20.57	12.95	11.8	14.88
Town 1500–10,000 persons	14.86	10.57	7.69	11.94	10.08	7.53
Rural	35.63	26.02	7.98	34.28	28.55	10.45
Unknown	26.96	23.57	3.71	32.2	31.4	15.39
Year dwelling constructed						
Before 1971	38.01	26.74	29.85	24.62	26.41	17.47
1971–1990	31.5	25.51	24.49	27.19	14.55	12.77
1991–2000	15.73	17.18	16.26	17.95	15.8	15.86
2001–2010	14.51	27.07	26.07	28.94	24.89	39.18
2011 onwards	0.25	3.50	3.33	1.3	18.36	14.72
BER rating						
A	0.10	3.22	2.66	0.75	20.81	14.31
B	0.27	10.16	11.92	9.73	11.5	14.21
C	2.74	39.41	47.14	42.7	12.19	33.62
D	18.49	23.57	22.39	26.16	14.95	20.49
E	26.71	11.19	9.33	10.53	12.64	9.35
F and G	51.70	12.45	6.56	10.12	27.91	8.02
Average deprivation index value	–3.629	–0.648	1.541	–1.634	–0.362	2.232
Sample size of dwellings	42,341	525,691	157,196	296,245	50,469	366,209

dwellings and in affluent areas while oil-solid fuel users predominantly live in rural or small urban areas, in less energy-efficient dwellings and in deprived areas. Households that do not use solid fuels as a primary or supplementary fuel predominantly live in large urban areas, newly built dwellings and more energy-efficient dwellings. Moreover, of all the cohorts shown in Table 2.6, households not using solid fuels live in the most affluent areas. It has been previously suggested that differences exist between primary and supplementary solid fuel users, and the figures in this table further suggest that there are differences among the cohort of supplementary solid fuel users, based on the primary fuel that is used.

2.3 Conclusions

The extent of the solid fuel residential market for primary heating purposes in Ireland varies from 12.4% to 16.2% of households, depending on the data set examined. Coal and peat are the most popular solid fuels for primary heating. However, it is as a supplementary fuel that solid fuels are most commonly used across households in Ireland. The *Survey on Household Environmental Behaviours* (CSO, 2016) and the SEAI (2020b) BER data set both indicate prevalence of solid fuel supplementary use at approximately 57% of households. Coal and wood logs are the most chosen supplementary solid fuels. These figures suggest that any focus on primary fuel use statistics may miss out on a significant share of users in the supplementary market.

The characteristics of those using solid fuel for primary heating follow much of previous literature in this area. Those with lower levels of educational attainment, in lower socio-economic groups and living in older dwellings are all more likely to use solid fuels for primary heating. Notably, these associations are stronger for coal and peat users than for wood users, highlighting evidence of heterogeneity among solid

fuel users. Location is also an important explanatory factor with strong effects for peat use, especially proximity to a peat bog. In contrast, the characteristics of those using solid fuel for supplementary purposes are more diverse. Education, employment status and location, for example, have less influence in determining the extent of use in the supplementary solid fuel than in the primary fuel market. In addition, evidence of differences among the characteristics of supplementary solid fuel users exist, dependent on the primary fuel used by the household. These findings suggest that treating solid fuel users as one homogeneous group would be inappropriate for any design of policy to support the transition away from solid fuels.

Census data show an increase in the share of solid fuel central heating systems between 2011 and 2016, with instances of switching to solid fuels outweighing instances of switching away from solid fuels. Instances of switching away from solid fuels are strongly determined by changes in occupancy, although this, in turn, shows substantial habit effects in solid fuel use. BER data do indicate that dwellings built after 2011 are much less likely to use solid fuels, suggesting that it is the occupants in older dwellings who are driving the switching towards solid fuels seen between the 2011 and 2016 censuses. Where these householders are located and how they were affected by recession-related events is also likely to have contributed to the extent of switching to solid fuels.

3 Survey on Residential Solid Fuel Use in Ireland

The introduction has outlined examples of where data gaps currently exist in published statistics on residential solid fuel use. This chapter presents an effort to bring some clarity to these issues through a survey of households in Ireland, conducted in early 2020. As well as the results of the survey, the methodology put forward to generate new data sources where deficiencies exist can provide a pathway for further understanding in the area. A key objective of the survey was to quantify the extent of solid fuel use, with a focus on quantifying the use of non-traded solid fuels, to help inform the SEAI's current estimates of the sector through its annual energy balance statistics. The survey also examined other elements, including estimating the prevalence of solid fuel heating appliances among households, identifying the reasons for using solid fuels, investigating the relationship between solid fuel use and knowledge about the effect of solid fuels on air pollution and health, and examining the level of support for policy measures that promote a transition to cleaner energy sources. The survey focused on the use of solid fuel for space heating purposes and was administered online by market research company Dynata (www.dynata.com). Although several similar surveys have been carried out in other European countries, and especially in the UK, this survey represents the first attempt to carry out a detailed bottom-up survey of residential solid fuel use in Ireland.

The questionnaire was developed based on an examination of the literature and previous surveys of solid fuel use that were carried out and tested using a series of pilot surveys. Respondents were recruited using a quota sampling technique and 1823 households completed the final version of the survey, which was administered during February and March 2020. To ensure a sufficient sample of non-traded solid fuel users, households that live in areas with a high incidence of solid fuel use for primary space heating were targeted (i.e. those that indicated a solid fuel to be their most important fuel or energy source for space heating purposes). Consequently, the final sample of households over-represented primary solid fuel users and a weighting procedure was applied to account for this oversampling.[11] Key results based on the weighted survey data are presented in the following sections, while, for clarity, the unweighted sample size (Uwtd *n*) on which the results are based will also be indicated.[12]

3.1 Shares of Residential Solid Fuel Use

The survey asked all households (Uwtd $n = 1823$) to indicate all fuels or energy sources that they used to space heat their homes and to identify which one was their primary fuel or energy source.[13] The list presented to households included the following solid fuels: low-smoke coal, other coal, peat briquettes, peat (sod turf), wood pellets or chips, wood logs or briquettes, and other wood.[14] Over half of households in the weighted sample (53.8%) recorded the use of at least one solid fuel, with 16.2% of those households indicating that a solid fuel was their primary fuel or energy source. Of this figure, 5.9% used just one solid fuel as their primary fuel or energy source and 10.3% used multiple solid fuels, i.e. one solid fuel for primary heating and at least one other solid fuel for supplementary purposes. A weighted sample share of 37.5% used solid fuels for

11 A detailed description of the survey approach is provided in Appendix 1.

12 To be precise, a weighted proportion of 50% based on an unweighted sample of 100 households does not necessarily correspond to 50 households. It is an adjusted figure to account for oversampling of primary solid fuel users. The unweighted sample size is presented to inform the reader of the number of actual observations on which the weighted proportion is based.

13 This may not necessarily be the households' central heating fuel (which the census data record). We took this approach to give flexibility to the respondent in identifying their primary fuel. It also follows the approach taken by the CSO in its *Survey on Household Environmental Behaviours* (CSO, 2016).

14 Other coal is taken to mean predominately smoky coal while other wood refers to waste wood, branched wood or foraged wood. For brevity, the shorter titles are used throughout Chapter 3. Low-smoke solid fuels were formerly referred to as "smokeless" fuels and are still sometimes marketed as such. However, the term "smokeless" is somewhat of a misnomer, as these fuels still result in PM emissions.

supplementary space heating purposes only.[15] Most supplementary users in our sample use home heating oil for primary heating (71.9%), while a lower share use natural gas (17.3%) and electricity (excluding heat pumps) (8.8%). Supplementary solid fuel use is negligible among households that use other fuels or energy sources for primary heating.

The figures can be compared with the CSO (2016) *Survey on Household Environmental Behaviours* data set examined in Chapter 2, while bearing in mind the differences in the methodologies for collecting the sample data in both data sets. Although the share of households using solid fuel as their primary fuel in this survey is comparable with the figure from the CSO (16.2% in that survey), the share of households using solid fuel as a supplementary fuel in this survey is lower than the CSO figure (37.5% compared with 47.0%).[16] This may be the result of the way the question was asked in this survey, which allowed households to rank their fuels. Traditional forms of supplementary heating (i.e. solid fuels in open fires and stoves) may be given a higher perceived importance in this survey, particularly if the household has a strong affinity for using solid fuels in open fires and stoves.

Figure 3.1 displays the weighted share of all households (Uwtd $n = 1823$) that use the various types of solid fuels listed for primary and supplementary heating. Among all households, wood logs/briquettes (30.3%) are the most prevalent solid fuel, followed by low-smoke coal (27.8%) and peat briquettes (20.6%). The solid fuel types most commonly used for primary heating are low-smoke coal, peat (sod turf) and other coal. For supplementary heating, wood logs/briquettes, low-smoke coal and peat briquettes are the most popular choices.

Once again, these figures can be compared with the corresponding values from the CSO (2016) *Survey on Household Environmental Behaviours* data set, although this survey recorded the coal items and peat items as one category and did not provide the "other wood" option to respondents. The shares of primary use for coal, peat, wood pellets/chips and wood logs in the CSO survey (6.8%, 6.9%, 0.4% and 2.5%, respectively) correspond reasonably well with the composite figures in this survey; only the values for peat were sizably lower than the CSO data set. Relative to the shares of supplementary use for coal, peat, wood pellets/chips and wood logs in the CSO survey (38.5%, 24.2%, 1.5% and 37.0%, respectively), this survey records lower levels of prevalence for the supplementary use of coal and wood logs and higher levels of prevalence for the supplementary use of peat and wood pellets/chips. If other wood is included with wood logs, however, the figure is much higher than the CSO data set.

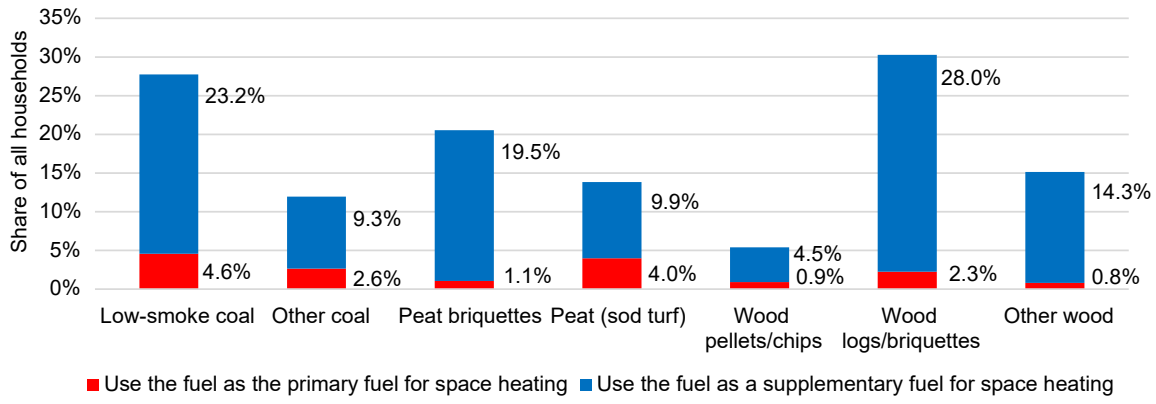


Figure 3.1. Share of all households using various solid fuel types (Uwtd $n = 1823$). The values for supplementary users of each solid fuel type also include households that use either a solid fuel or a non-solid fuel or energy source for primary heating.

15 The analysis carried out throughout Chapter 3 will consider both types of primary users as one group unless otherwise stated. Supplementary users are therefore those who use solid fuels but not for primary purposes, i.e. they do not rank it as their primary fuel.

16 The CSO figure of 47.0% refers to the proportion of households that are solid fuel supplementary users only, so an appropriate comparison can be made.

Another interesting feature is that many households use multiple solid fuels in their overall space heating mix. Of the share of households that use solid fuels in the survey sample (Uwtd $n = 1043$), 29.6% use one solid fuel, 32.2% use two solid fuels, 22.5% use three solid fuels and the rest (15.6%) use four or more solid fuels. The combinations chosen by households in the sample are quite varied (98 combinations in total), with low-smoke coal only, low-smoke coal–wood logs and low-smoke coal–peat briquettes–wood logs being the three most popular.

3.2 Quantifying Household Solid Fuel Use

3.2.1 Estimating average levels of consumption per household

The survey asked respondents to estimate the amount of solid fuel their household uses for space heating purposes. For each type of solid fuel that a household uses, respondents were asked to approximate the total number of standard fireside buckets of the fuel consumed on a typical day across the seasons of the year. To help elicit accurate estimates, respondents were provided with a picture and the dimensions of the standard fireside bucket on which to base their approximations (see Figure 3.2). Volume to weight conversions were applied subsequently to respondents' approximations using kilogram estimates of the weight of a bucket of each solid fuel type. The weight estimates for a bucket of each type of solid fuel were as follows: low-smoke coal (8.3 kg), other coal (8.3 kg), peat briquettes (6.6 kg), peat (sod turf) (4.3 kg), wood pellets/chips (5.5 kg), wood logs/briquettes (5.0 kg) and other wood (3.2 kg).[17]

Estimating consumption using a volume measure (i.e. a standard fireside bucket) was preferred over alternative approaches such as eliciting consumption based on solid fuel purchases or the quantities of solid fuel obtained by bulk delivery. These approaches can present issues affecting the accuracy of consumption estimates and particularly the estimates of non-traded



Figure 3.2. Picture of standard fireside bucket used in household survey. Approximate dimensions of bucket: height 30 cm × width 30 cm × depth 30 cm.

solid fuel consumption. These issues include the following:

- difficulties for respondents in recalling quantities of solid fuel purchased/delivered when the purchases were made or the fuel was received some time ago;
- difficulties for respondents in giving accurate estimates, as the quantities of solid fuel purchased/delivered vary in weight and size by fuel supplier;
- difficulties determining actual consumption levels of solid fuel, as purchases/deliveries are made in anticipation of heating requirements and thus are not directly related to the quantities used; and
- difficulties determining non-trade solid fuel consumption based on the quantities of solid fuel purchased.

Using a standard fireside bucket was preferred, as it is an item commonly found in Irish homes and as a measure of consumption is less susceptible to the issues mentioned previously. The approach of using a standard volume measure such as a fireside bucket to collect data on solid fuel consumption has

17 The weights were estimated by the project team using a standard fireside bucket with the dimensions specified and the fuels involved. The weighting procedure was replicated a number of times to ensure that the final estimated weight converged to an accurate average value. The final weights correspond reasonably closely to the bulk density conversion factors used by Defra in its report to quantify domestic solid fuel use (see Annex A, Appendix 7.3; Defra, 2020). Despite this, the data are still subject to error and this must be borne in mind when interpreting the findings.

been previously adopted by Kantar in their research report on *Burning in UK Homes and Garden* and subsequently used by the Department for Environment Food and Rural Affairs in the UK to quantify domestic solid fuel use (Defra, 2020).

The approach is not without its limitations, however. There may be a lack of precision in using a standard volume measure, as it will not adequately capture quantities above or below this standard (i.e. a little less than a bucket or a little more than a bucket, although in theory these errors should be equal on both sides and cancel each other out. Equally, having a small standard volume measure should minimise these errors). By asking respondents to recall fuel use based on a receptacle, there may also be a tendency to recall use rather than non-use and this may lead to an overestimation of the consumption values. There is also the more obvious issue of the lack of conformity of receptacle that is used by households. Some households may use a slightly smaller or larger bucket than the one specified and some may not use a bucket at all. However, the issues outlined above must be weighed up against the simplicity of the method for respondents and the ability to compare consumption levels across each solid fuel.

To consider consumption on an energy basis rather than a mass basis, the kilogram values were converted to megajoules (MJ) using net calorific conversions provided by the SEAI. The following were the net calorific values used for each solid fuel type: low-smoke coal (32.00 MJ/kg), other coal (27.84 MJ/kg), peat briquettes (18.55 MJ/kg), peat (sod turf) (13.10 MJ/kg), wood pellets/chips (15.30 MJ/kg), wood logs/briquettes (15.20 MJ/kg) and other wood (13.11 MJ/kg). The household's total solid fuel consumption in MJ was then calculated by summing the MJ estimates for each solid fuel. Figure 3.3 presents the weighted average daily energy consumption of solid fuels (in MJ) by all solid fuel users and by primary and supplementary solid fuel users. As can be seen, there are clear seasonal effects, with higher levels of energy use in the winter heating season. Not surprisingly, primary users use more energy than supplementary users on average. What is interesting, however, is the relatively high level of energy usage of solid fuels among supplementary users, whose average consumption is close to three-quarters of that of primary users across most of the seasons. While the analysis in Chapter 2 showed that the supplementary use of solid fuels was high in proportionate terms, the findings here suggest that the supplementary use of solid fuels in energy terms is also significant. This reinforces the point that policy design to support a transition away from solid fuel use must target both cohorts of users.[18]

Figures 3.4 and 3.5 present the average daily consumption levels of various types of solid fuel by households that use each fuel type and by primary and supplementary users of each type of fuel. On an energy basis, low-smoke coal and other coal are used

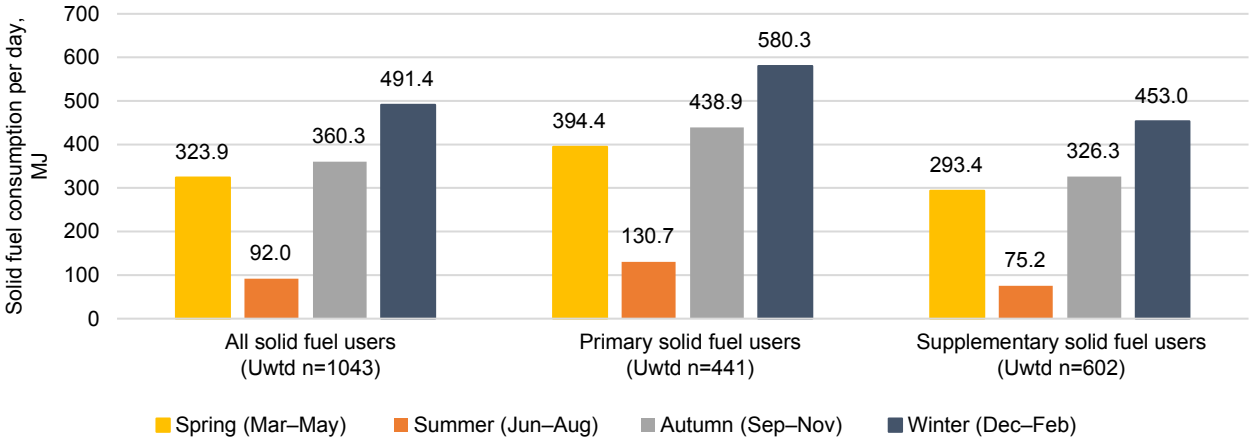


Figure 3.3. Average daily household consumption of solid fuels by season (MJ).

18 Supplementary users of solid fuels commonly use a mix of solid fuels, which may also partly explain the high energy use values in this cohort. It should also be noted that estimates of supplementary solid fuel consumption elicited fuel by fuel have the potential to produce higher overall estimates than if they were elicited as a whole.

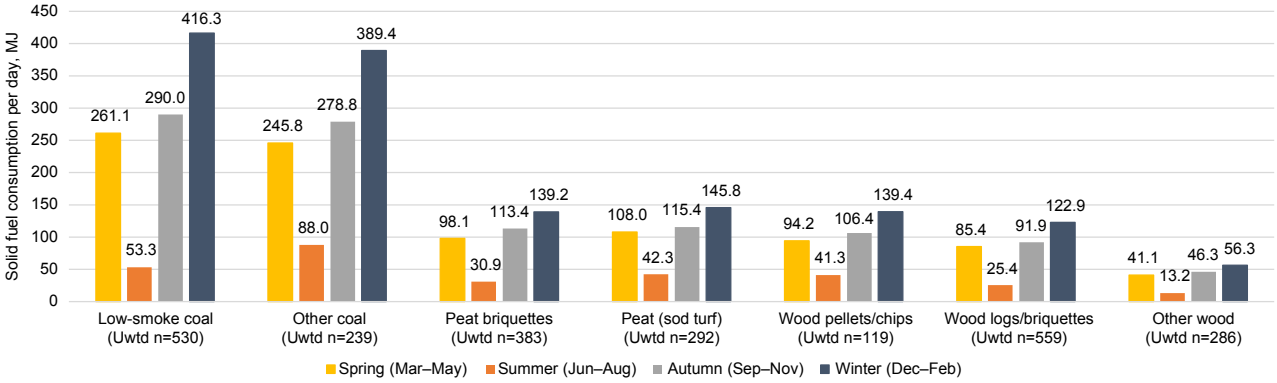


Figure 3.4. Average daily household consumption of individual solid fuels by season (MJ).

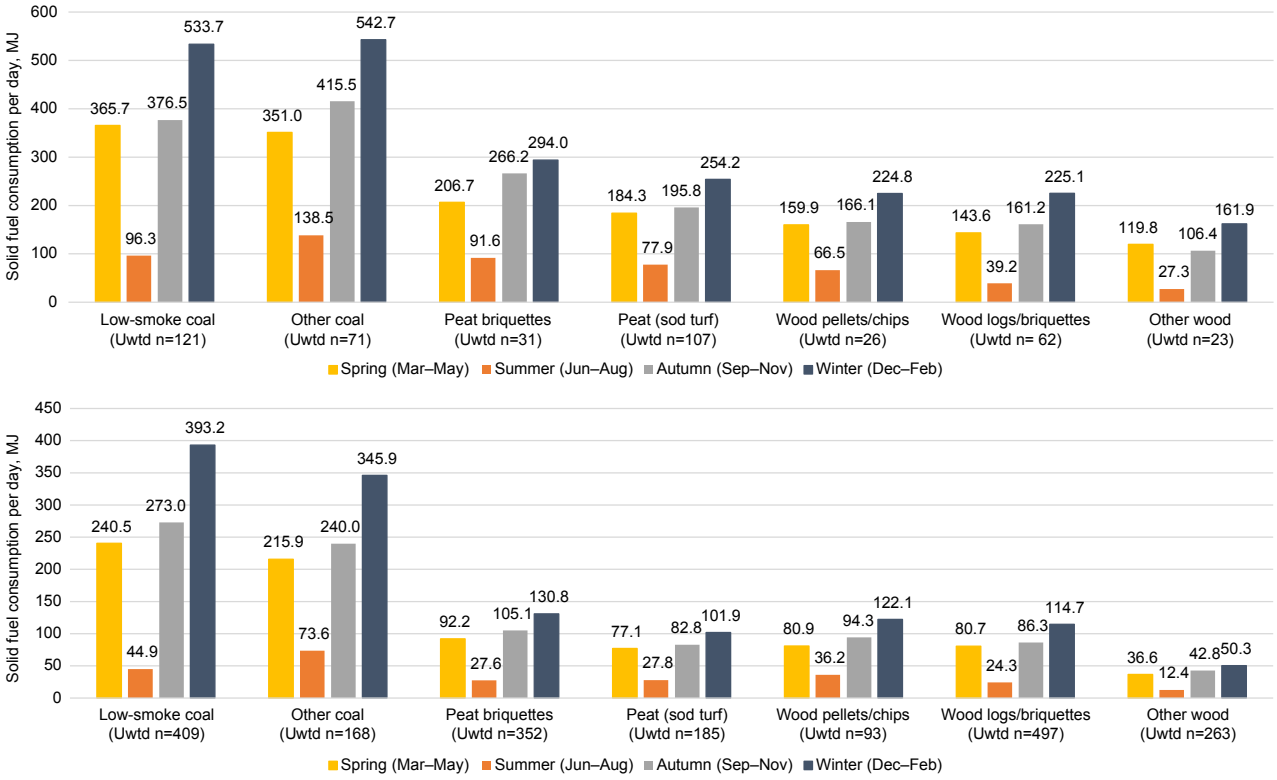


Figure 3.5. Average daily household consumption of individual solid fuels by season and by primary (top) and supplementary (bottom) solid fuel user (MJ).

the most intensely, with reasonably similar levels for the other fuels (with the exception of other wood). Other coal has higher levels of energy consumption for primary heating and low-smoke coal for supplementary heating. Both types of peat solid fuels are more important fuels for primary heating than the wood products, but the pattern is slightly reversed for supplementary heating, especially for peat (sod turf).

A methodology could be applied to scale up these figures to provide an estimate of the overall national residential solid fuel use. There may be some limitations to carrying out this approach, however. As previously mentioned, the use of a standard volume measure may create imprecisions that would only be exacerbated with a scaling-up approach. A possible way around this might be to ask respondents for their consumption estimates for different time periods, e.g. per day, per week or per month, which would help respondents to reconcile their daily usage (which is easier to recall) with long-term estimates based on a bulk delivery or harvest. Using different standard receptacles (which can be converted to kg or MJ) for each solid fuel may also be an option, but although the

choice is easy for some solid fuels, e.g. bags of coal, it may not be easy for others, e.g. peat (sod turf) or foraged wood. The choice of receptacle is also crucial, particularly its size and familiarity to the respondent, hence the use of a standard fireside bucket, which is likely to be regularly used by most households.

Another difficulty in scaling up the survey figures is finding an estimate for the number of households in the population that use each of the solid fuels above. An option would be to use census data, but this gives estimates only for the number of households using solid fuels for primary purposes. Using the CSO (2016) *Survey on Household Environmental Behaviours* is another option, as it gives information on both primary and supplementary use, but it does not provide the same detail of solid fuels as given above. One could potentially use the proportions given in Figure 3.1, but the actual sample sizes for some of the solid fuels on which these proportions are based are small. Another complexity, mentioned previously, is the fact that households tend to use a mix of solid fuels. The approach taken in this survey was to elicit the consumption estimates for a wide variety of solid fuel types, whereas an alternative approach would have been to combine similar solid fuel types into broader categories and ask households to state their consumption of these solid fuels. Although using a smaller range of solid fuels (e.g. coal, peat and wood) to generate estimates may help to increase the sample size for each solid fuel type, the trade-off in following this approach is that less detail is obtained about specific solid fuels, for example information about the consumption of low-smoke coal versus other coal, peat (sod turf) versus peat briquettes, or wood logs/ briquettes versus other wood.

3.2.2 Burning hours estimates per household

The survey also asked respondents to estimate the number of hours per week that each fuel or energy source was used for space heating.[19] The survey provided households with a list of options that approximated the number of hours of use per week based on guideline values for the number of hours of use per weekday and per weekend day (e.g. 84 hours per week was approximated to be equal to 12 hours per day every day, 54 hours per week was approximated to be equal to 6 hours per day on weekdays and 12 hours per day on weekends, and 42 hours per week was approximated to be equal to 6 hours per day every day). Figure 3.6 shows the proportion of households that stated they used a space heating fuel for 42 hours or more per week across the seasons of the year, for primary and supplementary heating. As well as the list of solid fuels, data for hours of use of natural gas and home heating oil were also included for comparison purposes.

Of the solid fuels used as primary fuels, peat (sod turf) is burned the most intensely across all seasons. A weighted sample share of almost 94% of households that use peat (sod turf) as a primary fuel in winter use it for 42 hours or more per week. The weighted share figures are also high for all the other solid fuels in winter, and relatively high for other coal and peat (sod turf) in the spring and autumn. Interestingly, all the solid fuels are burned for longer hours than natural gas and home heating oil, especially in the autumn, winter and spring months. All solid fuels are used for shorter periods of time as supplementary fuels than as primary fuels. Wood pellets and chips, peat (sod turf), low-smoke coal and wood logs are burned the longest (in hours) by households using them as supplementary fuels. However, both natural gas and home heating oil are used for longer by a higher weighted share of supplementary households. This possibly reflects the fact that some households in this survey have designated natural gas and home heating oil as supplementary fuels, even though they use these fuels at much the same intensity as primary users of natural gas and home heating oil.

Another noteworthy point is the difference in the use of solid fuels across the seasons depending on whether they are being used as a primary fuel or as a supplementary fuel. A significant proportion of primary users of solid fuels use them for a considerable number of hours across all the seasons, excluding the summer, whereas there is a significant proportion of households using supplementary solid fuel for long hours only during the winter months. Therefore, the heating season is more elongated for primary

19 This question was only asked for the top four fuels or energy sources that each household specified they used and not all fuels. This approach was taken to reduce the complexity of the survey and on the assumption that the top four fuels or energy sources would cover most of a household's space heating needs.

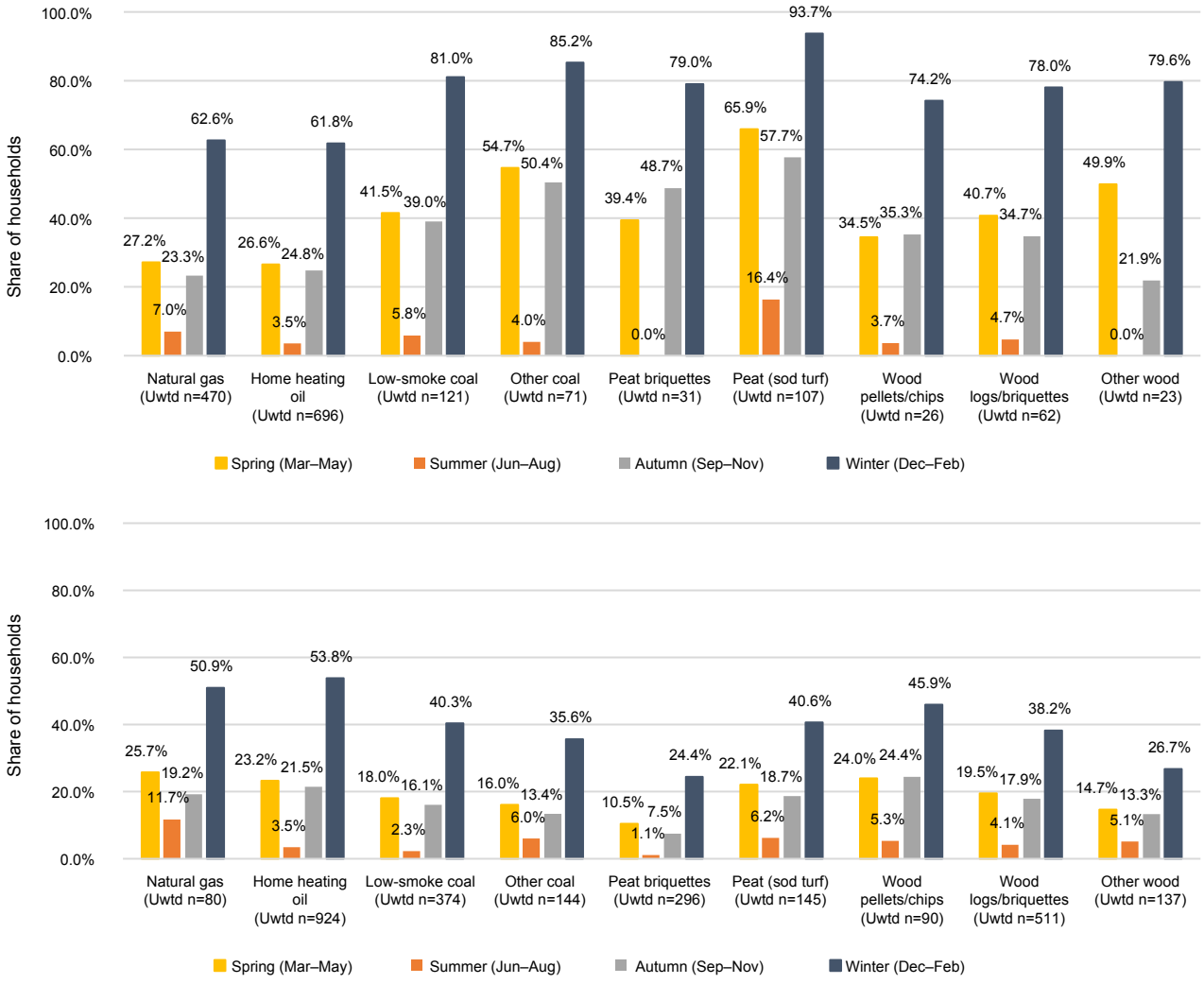


Figure 3.6. Weighted share of households stating >42 hours of burning per week by primary (top) and supplementary (bottom) fuel and by season.

users of solid fuels than for supplementary users. The burning hours estimates can also be examined in the context of the energy use estimates in the previous section. A feature that stands out is that high usage levels of peat (sod turf) and some wood products do not translate into high levels of useful energy (as per MJ estimates in previous section). This highlights the energy inefficiency that is a characteristic of the use of solid fuels.

3.3 Quantifying Traded and Non-traded Sources of Household Solid Fuel Use

As previously mentioned, a key objective of the survey was to quantify the extent of the non-traded solid fuel market. The approach taken in this report was to quantify the proportion of solid fuel use that does not originate from official commercial sources, such as fuel retailers or merchants. To do this, the survey asked about the sources of the solid fuels used by households for space heating purposes. For each solid fuel type used, a list of possible sources was provided, and respondents approximated the proportion of the fuel obtained from each source. The list of possible sources varied by fuel type and included what can be defined as trade and non-trade sources.

Figures 3.7–3.9 show the average weighted daily consumption levels of various types of solid fuel (in MJ) by households using each fuel type and by specific source. Households that use low-smoke coal, other coal and peat briquettes acquire most of these fuels from a local supermarket, garage or other company that specialises in supplying fuel. Peat (sod turf) is sourced mostly from a household's own bog

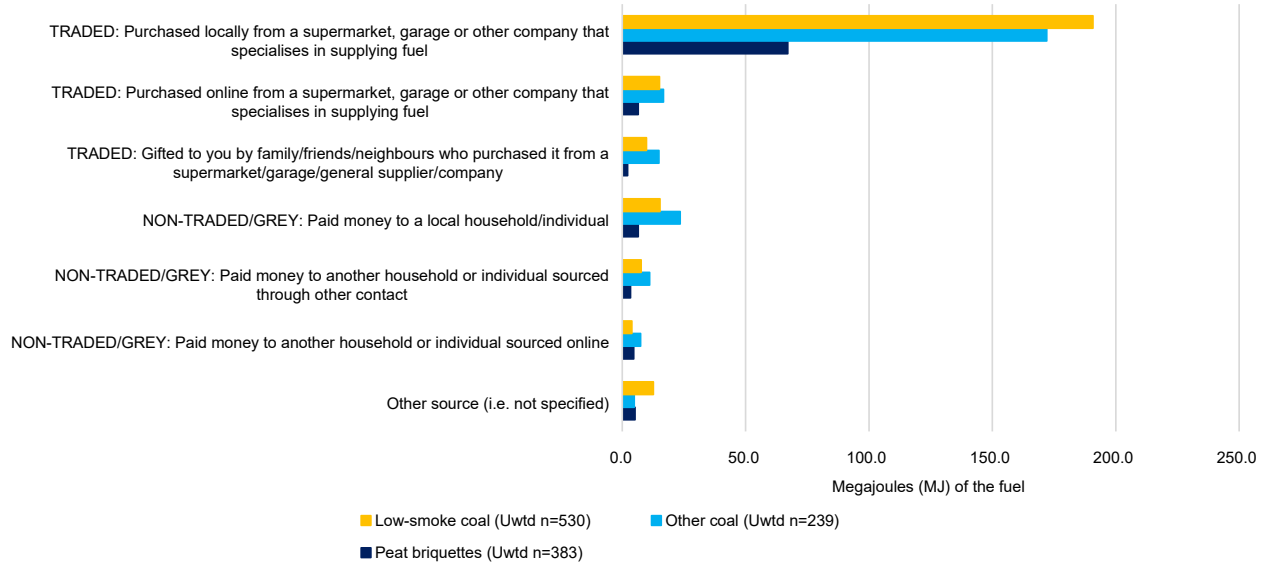


Figure 3.7. Average daily household consumption of low-smoke coal, other coal and peat briquettes by stated source (MJ).

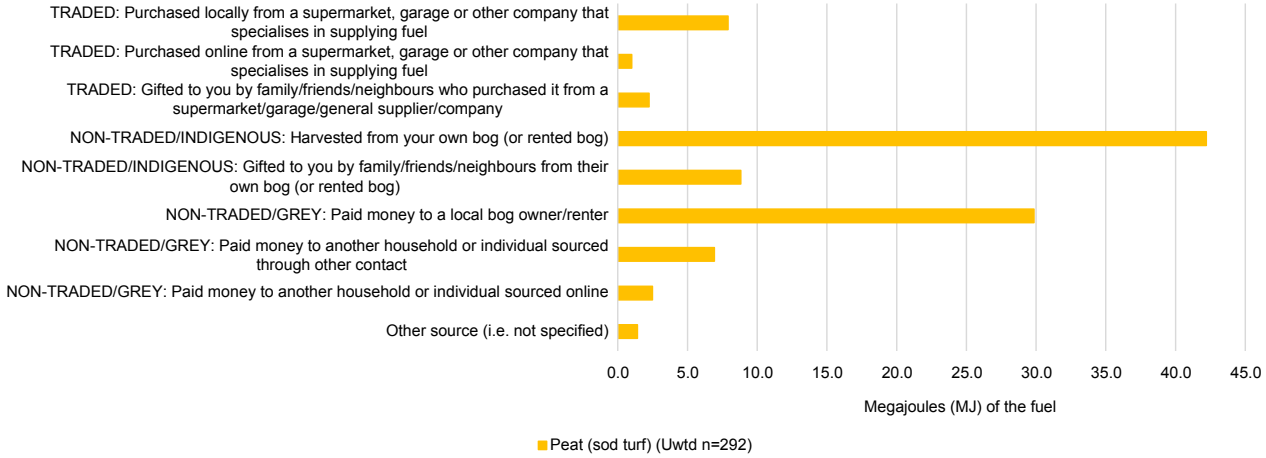


Figure 3.8. Average daily household consumption of peat (sod turf) by stated source (MJ).

(or rented bog) and from local bog owners/renters. The main source of wood pellets/chips and wood logs/briquettes is local retailers that specialise in supplying fuel. In the case of wood logs/briquettes, a household's own land (or rented land) is also an important source. The main sources of other wood are a household's own land (or rented land) and local woodlands.

The sources listed in Figures 3.7–3.9 were categorised into traded and non-traded, with traded sources defined as those involving receipted transactions when the fuel is obtained from a supermarket, garage or other company that specialises in supplying fuel. A further categorisation of non-traded sources is also provided, dividing these into grey and indigenous sources. Grey non-traded sources are taken to involve an actual payment of money, but one which is unaccounted for in official receipts. Indigenous sources are taken to mean those which involve no monetary transaction, either official or unofficial, even though a value is attached to the solid fuel, as reflected by its use to heat the home by the end user.

Table 3.1 displays the weighted estimates of energy consumption (in MJ) of each solid fuel divided by traded, non-traded/grey, non-traded/indigenous and other sources. The weighted estimates for solid fuels as a whole are also provided. Among all solid fuel users, the average daily energy consumption of traded solid fuel is 219.5 MJ, compared with 85.1 MJ for non-traded solid fuel (taking grey and indigenous sources together). Thus, non-traded sources are estimated

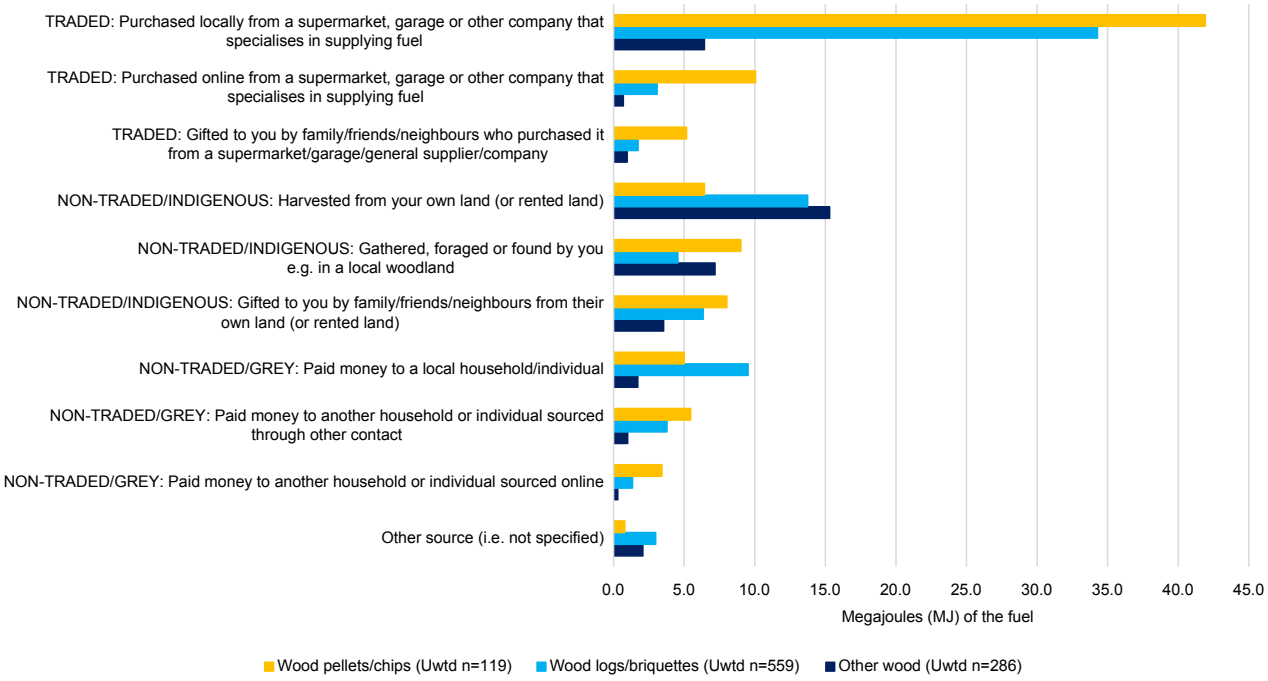


Figure 3.9. Average daily household consumption of wood pellets/chips, wood logs/briquettes and other wood by stated source (MJ).

Table 3.1. Average daily household consumption of solid fuels (MJ) and proportionate amounts by traded and non-traded sources

	Source, MJ (%)			
Solid fuel type	**Traded**	**Non-traded/grey**	**Non-traded/indigenous**	**Other**
Low-smoke coal (Uwtd *n* = 530)	215.7 (84.5%)	26.8 (10.5%)	–	12.6 (5.0%)
Other coal (Uwtd *n* = 239)	203.6 (81.3%)	42.1 (16.8%)	–	4.8 (1.9%)
Peat briquettes (Uwtd *n* = 383)	78.2 (81.9%)	12.0 (12.6%)	–	5.2 (5.5%)
Peat (sod turf) (Uwtd *n* = 292)	11.2 (10.8%)	39.3 (38.2%)	51.0 (49.6%)	1.4 (1.4%)
Wood pellets/chips (Uwtd *n* = 119)	57.2 (60.0%)	13.9 (14.6%)	23.5 (24.6%)	0.8 (0.8%)
Wood logs/briquettes (Uwtd *n* = 559)	39.1 (48.0%)	14.7 (18.0%)	24.7 (30.3%)	3.0 (3.7%)
Other wood (Uwtd *n* = 286)	8.1 (20.6%)	3.0 (7.6%)	26.1 (66.4%)	2.1 (5.3%)
All wood products[a] (Uwtd *n* = 734)	41.8 (45.2%)	14.6 (15.8%)	32.8 (35.5%)	3.3 (3.5%)
All solid fuels (Uwtd *n* = 1043)	219.5 (69.3%)	48.4 (15.3%)	36.7 (11.6%)	12.3 (3.9%)

A small proportion of households chose the "other" category, but they did not provide detail in the survey of what this source represented. It could be speculated that this is more likely to represent non-traded sources, but this cannot be verified.

[a]This includes all of the wood products listed, that is, wood pellets/chips, wood logs/briquettes and other wood.

to account for 26.9% of the solid fuel consumed by Irish households. Of this figure, the proportion of grey sources is slightly higher (15.3%) than the proportion of indigenous sources (11.6%). Across the various solid fuel types, there are considerable differences in consumption levels by traded and non-traded sources. Most low-smoke coal (84.5%), other coal (81.3%) and peat briquettes (81.9%) are obtained from traded sources, while over half of wood pellets (60.0%) and close to half of wood logs/briquettes (48.0%) are also obtained from traded sources. In contrast, only 20.6% of other wood and 10.8% of peat briquettes are obtained from traded sources, both of which are obtained predominantly from indigenous sources. The estimated proportions of traded (45.2%) and non-traded (51.3%) wood consumption for all wood products indicate slightly more stated usage of non-traded sources. Of the non-traded wood sector,

indigenous sources comprise approximately twice the amount relative to the grey non-traded sector. The SEAI has produced estimates for the non-traded wood sector, which could provide the basis for a comparison, bearing in mind that the SEAI methodology differs appreciably from the methodology put forward in its project. In its report on energy in the residential sector (SEAI, 2018), the SEAI proposed that non-traded wood accounted for 32% of wood energy use, a figure that is below the estimate given for all wood products in Table 3.1. Its most recent report on energy use in Ireland suggested that residential non-traded wood consumption accounted for approximately 45% of overall wood consumption in the sector (SEAI, 2020a). Although closer to the value in this report, the SEAI figure may still represent a slight underestimation of non-traded wood consumption.

An examination of the characteristics of non-traded users of solid users was also carried out. Non-traded solid fuel users were defined as those who stated they obtained most (>50%) of their solid fuel from non-traded sources. The characteristics of this subsample of solid fuel users (Uwtd $n=333$) were compared with the characteristics of the full sample of solid fuel users (Uwtd $n=1043$). Non-traded solid fuel users were found to be proportionally more common in the lowest income households (earning below €20,000 annually) and in households with lower levels of educational attainment than in the full sample of solid fuel users. Differences in the age of the oldest adult and dwelling age are not apparent, while owner occupiers are marginally more likely to use non-traded sources relative to all solid fuel users. There are also proportionally more non-traded solid fuel users in rural areas and in the Border, Midlands, West and Mid-West regions when compared with the full sample of solid fuel users.

3.4 Prevalence of Residential Solid Fuel Heating Appliances among Solid Fuel Users

The survey asked households to indicate the number of heating appliances present in the home, including those that traditionally use solid fuels such as open fires, stoves and ranges. Almost all solid fuel users[20] indicated that they possessed an open fireplace and/or a stove/range for consuming solid fuel. In total, 63.7% of solid fuel users possessed at least one open fire and 60.6% of solid fuel users possessed at least one stove/range. Figure 3.10 provides a more detailed breakdown of these figures. The majority possess either an open fireplace or a stove/range (58.9%) while less than one-third (30.6%) possess two solid fuel heating appliances (i.e. an open fireplace and stove/range or two open fireplaces or two stoves/ranges). Fewer solid fuel users (8.7%) possess more than two appliances that traditionally use solid fuels. The figure also provides a further breakdown of the type and number of solid fuel heating appliances that are present in the homes of primary and supplementary solid fuel users. Open fires are more prevalent among

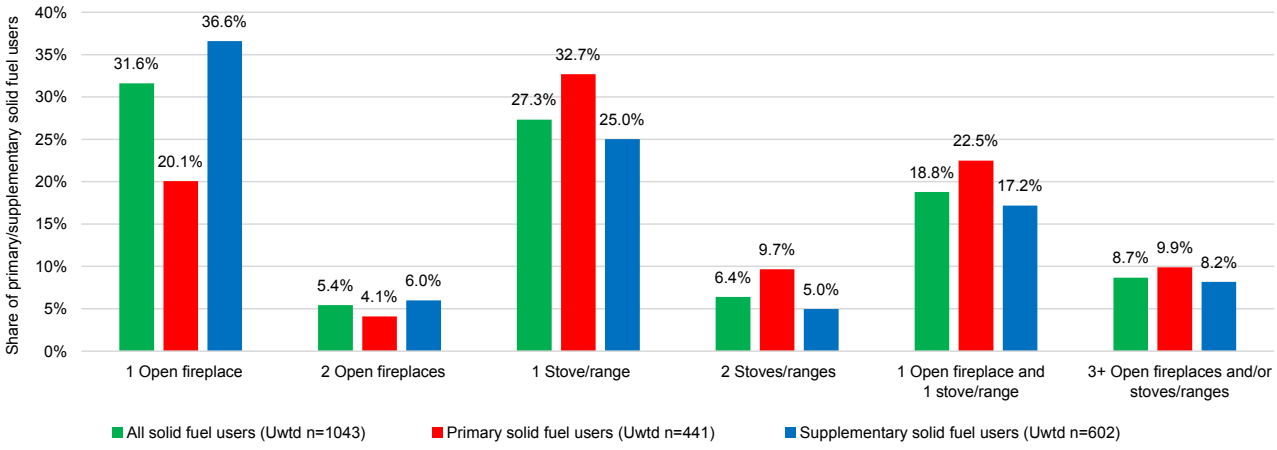


Figure 3.10. Share of solid fuel users by type and number of solid fuel heating appliances present in the home.

20 A small proportion of solid fuel respondents (1.8% weighted share) chose the "other" category for this question but did not give any more detail as to what this other heating system or appliance was.

supplementary solid fuel users than primary solid fuel users, while stoves/ranges are more common among primary solid fuel users. Overall, a higher share of primary solid fuel users possesses a stove/range (73.9%) than an open fireplace (55.3%), while among supplementary solid fuel users an open fireplace (67.3%) is more commonplace than a stove/range (54.8%).

The survey also asked if households had made any of the following changes to their stock of solid fuel heating appliances in the last 20 years or since they moved into their home: (1) replaced an open fireplace with a stove, (2) replaced an old stove with a new stove and (3) added a stove (without replacing an existing open fireplace or stove). Almost half of all solid fuel users (45.0%) had made at least one of these changes, and a higher share of primary (51.4%) than supplementary users (42.2%) had made such a change. Replacing an open fireplace with a stove was the most common change among solid fuel users (34.4%), while adding a stove was the least common (9.8%). Similar proportions existed between primary and supplementary users, except for replacing an old stove or adding a new stove, which were more common among primary users of solid fuels.

Figure 3.11 presents information on the age profile of recently installed stoves (replacements or additions) that are present in the homes of solid fuel users. Among all solid fuel users, 40.8% have installed a stove in the last 20 years. This share is higher among primary users of solid fuels (48.1%) than supplementary users of solid fuels (37.6%), reflecting that primary users have higher levels of usage and thus require more frequent heating appliance replacements and/or additions. Interestingly, the trend towards the acquisition of new stoves has been upwards in recent years if examining the figures on an annual basis.

The survey also asked respondents to identify their reasons for replacing an open fireplace with a stove (Uwtd $n = 353$), replacing an old stove with a new stove (Uwtd $n = 171$) and adding a stove (Uwtd $n = 108$). Increasing the heat output within the home was cited by the majority of respondents as the most important factor for replacing an open fire with a stove and for adding a stove, while it was the second most important factor for replacing an old stove with a new one. Reducing fuel costs, a desire for comfort or aesthetic effect and a failure in the existing appliance are also cited as important factors across all three changes to the appliance stock. These considerations were found to outweigh other factors such as environmental reasons or receiving advice from family and friends, energy professionals and government organisations.

3.5 Self-reported Reasons for Solid Fuel Use

The survey asked respondents to indicate the importance attached to a list of reasons as to why their household uses solid fuel for space heating purposes. The results are presented in Figure 3.12. Using solid fuels to create a pleasurable atmosphere in the home was clearly the most important reason, followed by their flexibility in heating only certain

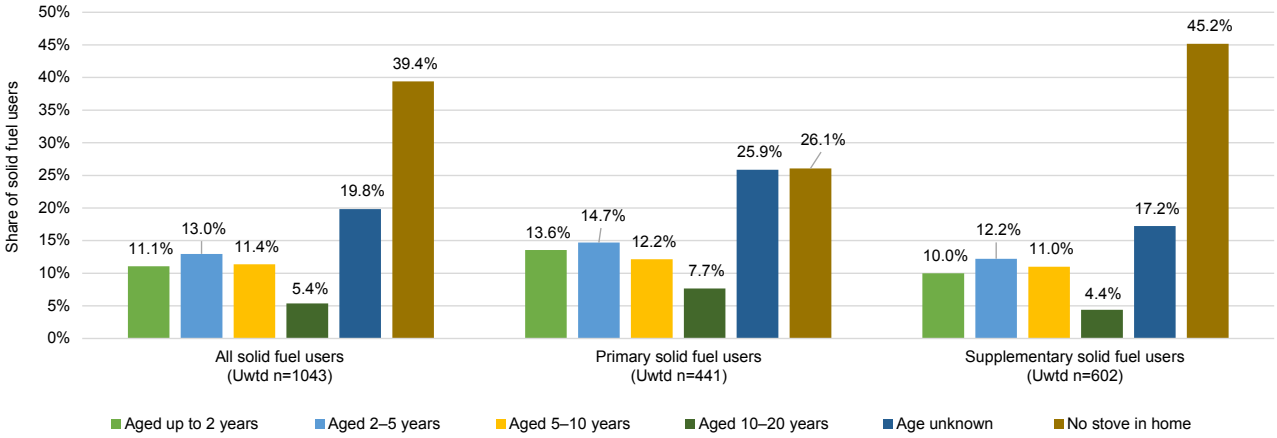


Figure 3.11. Share of solid fuel users by age of newest stove present in the home. Note that those households where the age of newest stove is unknown ("Age unknown") are those where the stove was not replaced in the last 20 years or since the household moved into the dwelling.

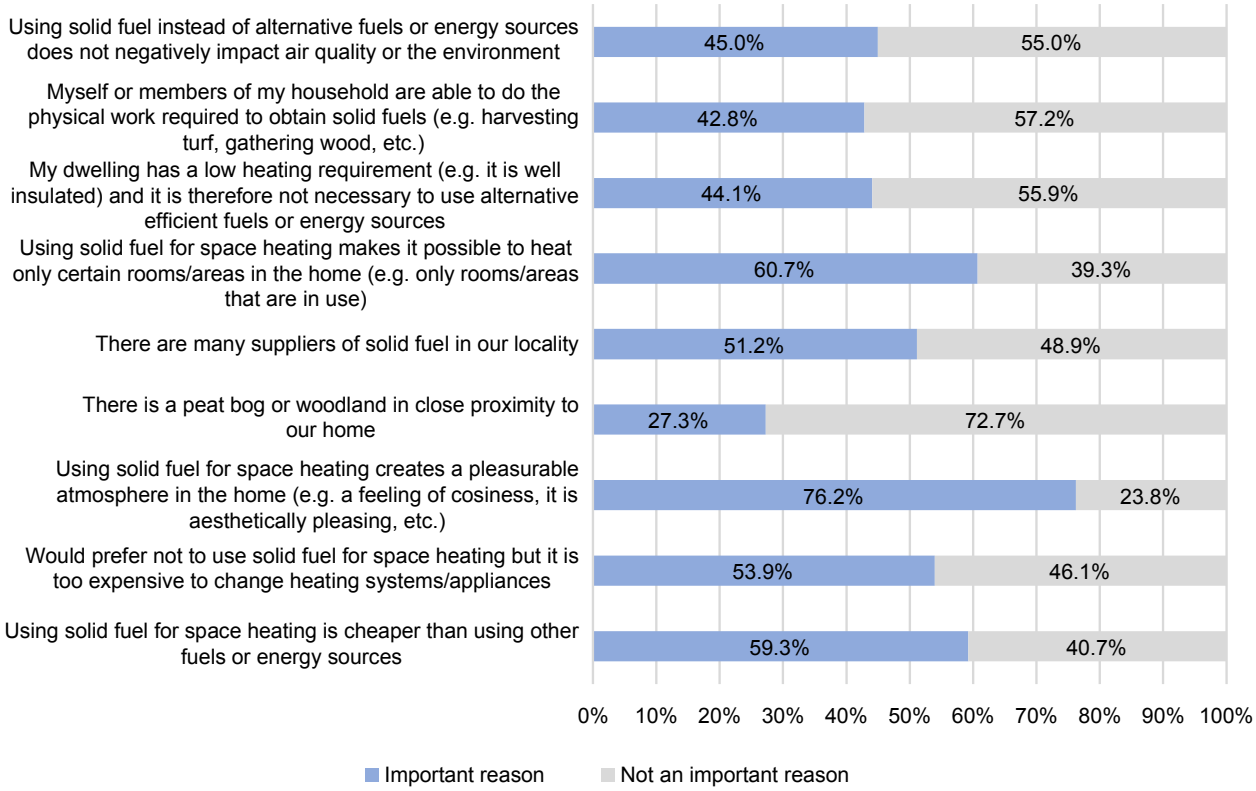


Figure 3.12. Self-reported reasons for using solid fuel (Uwtd *n* = 1043).

rooms/areas in the home and then by their perceived lower cost relative to using other fuels or energy sources. These reasons show that the motivations for using solid fuels are more than just their fundamental job of heating the home and provide a further rationale for why households with multiple heating options, including non-solid fuel central heating systems, consider them to be an important fuel option.

Across primary and supplementary solid fuel users, the importance of these reasons varied. A higher share of supplementary (79.6%) than primary (68.6%) users reported using solid fuel to create a pleasurable home atmosphere. The use of solid fuel for heating only certain rooms/areas in the home was also reported as important by a higher share of supplementary (64.4%) than primary (52.2%) users. In contrast, the perceived lower cost of solid fuels relative to other fuels and energy sources was indicated to be important by a higher share of primary (63.7%) than supplementary (57.3%) users. These results can be compared with the recent Defra survey on burning in UK homes (Defra, 2020), which also asked respondents about their reasons for burning solid fuels. Interestingly, the findings are very similar, with creating a homely feel cited as the most important reason in the Defra survey, followed by the ability to heat just one room, save money and/or because respondents liked the look of a fire.

3.6 Knowledge, Risk Perceptions and Solid Fuel Practices

3.6.1 Knowledge and risk perceptions about solid fuels

The survey asked questions assessing respondents' knowledge of the impact of solid fuels on air quality and health. In each question, respondents were presented with a choice between two solid fuel alternatives and were asked to choose the one they thought was the better choice from an air quality and health perspective. Specifically, respondents were asked to choose between (1) low-smoke coal and other coal (e.g. smoky coal), (2) dry/seasoned wood and green/unseasoned wood, and (3) dry/seasoned peat (sod turf) and waste products (e.g. household waste). The responses to these questions reveal that many solid fuel users (Uwtd *n* = 1043) lack knowledge about the adverse effects of solid fuel use. Almost one in three solid fuel users (30.5%) chose other coal (e.g. smoky coal) to be the better option

than low-smoke coal and almost two in five solid fuel users (38.5%) chose green/unseasoned wood instead of dry/seasoned wood. A large proportion also chose waste products (e.g. household waste) over peat (sod turf) (44.8%), even though the burning of waste is illegal and hazardous to health (EPA, 2021). In total, only 39.0% of solid fuel users answered all three questions correctly.

Knowledge about the impact of solid fuels on air quality and health appears to be associated with household choices about which solid fuels to use. About one in three other coal users (32.5%) are unaware that low-smoke coal is a better choice from an air quality and health perspective than other coal (e.g. smoky coal). In contrast, most low-smoke coal users (81.2%) are aware. Better knowledge about the impact of solid fuels on air quality and health also appears to translate into lower solid fuel consumption: among other coal users, those who answered correctly that low-smoke coal was a better option than other coal (e.g. smoky coal) use less other coal on average (226.1 MJ per day) than those who answered incorrectly (301.2 MJ per day).

The survey also assessed the risk perceptions of respondents with regard to the health risks associated with solid fuel use. Specifically, respondents were asked to indicate if they agreed with the statement "Air pollution from residential solid fuel use is a severe health threat for people all over Ireland". Out of the full sample of respondents in the survey (Uwtd $n = 1823$), 41.4% indicated that they agreed with the statement and they can therefore be classified as having high risk perceptions about the health consequences of solid fuel use. However, just over one in three of the subsample of solid fuel users (36.1%, Uwtd $n = 1043$) agreed with the statement, compared with close to half of respondents of the subsample that do not use solid fuel for space heating (47.5%, Uwtd $n = 780$). Moreover, a lower weighted share of primary (30.0%) than supplementary users (38.8%) agreed with the statement. The results demonstrate that solid fuel users tend to have low risk perceptions about the adverse health effects associated with solid fuel use, especially those using solid fuel for primary heating.

The lack of knowledge surrounding the impact of solid fuels on air quality and health does not appear to be a uniquely Irish phenomenon. Defra, in its survey on burning in UK homes (Defra, 2020), also asked respondents about their attitudes towards the impact that solid fuel burning has on health and the environment. Defra found that, although close to a half of solid fuel users agreed that burning in people's homes was a significant source of air pollution, only 3 in 10 expressed concerns about the impact their burning might have on their health and those around them. Most of the respondents also considered solid fuel burning to be "environmentally friendly" because they, incorrectly, saw it as carbon neutral (especially wood burning) and they tended to portray themselves as "responsible burners" and "burning the right stuff".

3.6.2 Solid fuel use behaviours and practices

In addition to knowledge and risk perceptions regarding solid fuel use, the survey also asked solid fuel users about their household's behaviours and practices with regard to solid fuel use. Respondents were asked if their household currently engages in the following behaviours/practices (or is likely to in the future) to save energy or deal with air pollution associated with the use of solid fuel:

- burning solid fuels less frequently;
- burning only low-emissions fuels (e.g. low-smoke fuels);
- burning well-seasoned peat/wood (with a low moisture content) instead of unseasoned peat/wood (with a high moisture content);
- sweeping the chimney regularly (e.g. at least once a year);
- keeping the home well ventilated (e.g. open doors or windows) to protect against air pollution from solid fuel heating appliances;
- using an indoor air pollution monitor;
- using a home air purifier to protect against air pollution from solid fuel heating appliances.

The results for the full sample of solid fuel users (Uwtd $n = 1043$) are presented in Figure 3.13. Almost half of solid fuel users (48.6%) indicated that they sweep the chimney regularly (e.g. at least once a year) and a similar proportion keep the home well ventilated (44.5%) to protect against air pollution associated with solid fuel use. Fewer than one in four solid fuel users (23.4%) indicated that they burn only low-emissions fuels, while only 1 in 10 have reduced their consumption by burning solid fuels less frequently. About one in four solid fuel users (25.6%) indicate

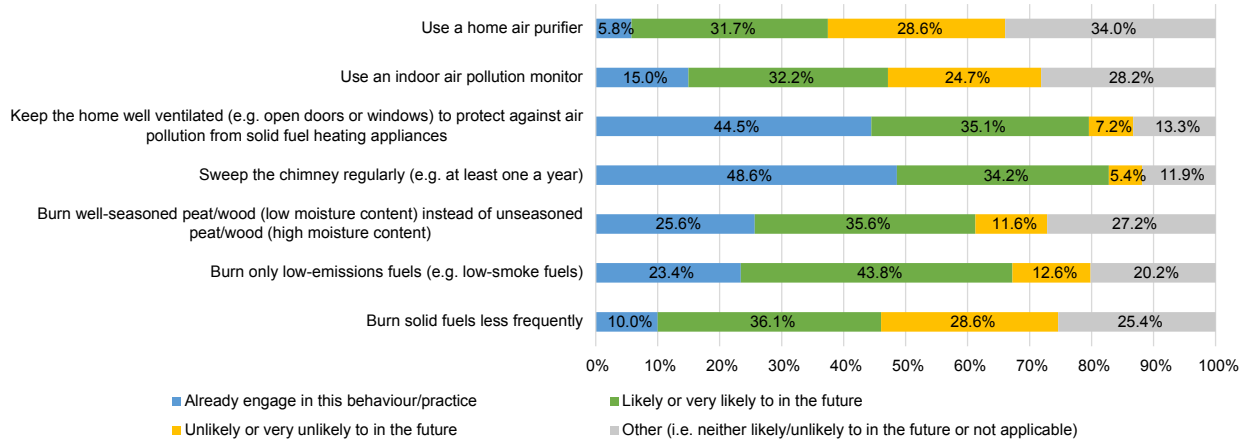


Figure 3.13. Solid fuel use behaviours and practices (Uwtd *n*=1043).

that they burn well-seasoned peat/wood rather than unseasoned peat/wood, although this weighted share increases among peat (sod turf) (30.3%) and wood logs/briquettes (29.0%) users. Low shares of solid fuel users use a home air purifier (5.8%) or an indoor air pollution monitor (15.0%) to protect against air pollution arising from solid fuel use.

Solid fuel users appear to exhibit a general willingness to engage in better burning practices and behaviours in the future. Over two in five solid fuel users (43.8%) report that they are likely or very likely to burn only low-emissions fuels in the future, while more than one in three indicate that they are likely or very likely to burn solid fuels less frequently (36.1%). Over one-third of solid fuel users (35.6%) report that they are likely or very likely to burn well-seasoned peat/wood instead of unseasoned peat wood, with the weighted share increasing among peat (sod turf) (38.4%) and wood logs/briquettes (38.5%) users. The Defra survey on burning in UK homes (Defra, 2020) found that most solid fuel users exhibited good burning practices, albeit perhaps not consciously. For example, over two-thirds of indoor burners said that they had their chimney swept at least once a year. However, evidence of poor practices still permeated; for example, over one-third of indoor burners did not have an open air vent and there appeared to be a lack of understanding of what dry wood means or the importance of seasoning bought or collected wood.

Respondents also answered a series of questions regarding instances of switching from a solid fuel to a non-solid fuel. Approximately a quarter of all households surveyed indicated that they had replaced or changed their central heating system in the last 20 years (28.2%, Uwtd *n*=1823). Of these households, the majority (67.9%) continued using a non-solid fuel or energy source for central heating, about one in five (19.8%) switched from solid to non-solid fuel, 6.7% of households continued using solid fuel and 5.8% switched from non-solid to solid fuel. Of the households that switched from solid to non-solid fuel for central heating, most report either home heating oil or natural gas as their new primary heating fuel. Increasing heat output within the home was also the most frequently reported reason for replacing/changing the heating system in these households. Interestingly, a small number of households that indicate they have switched to using non-solid fuel in the central heating system specify a solid fuel as their primary source of heating. Most of these are households that use peat (sod turf) for primary heating.

3.7 Support/Opposition to Policy Measures Related to Solid Fuel Use

The survey assessed the levels of support and opposition for nine policy measures that could help to mitigate the effects of solid fuel use in the residential sector. Figure 3.14 presents the results for the full sample of solid fuel users (Uwtd *n*=1043). Overall, there is high support for policy intervention, with most policy options being more favoured than opposed. The two most favoured policy measures were financial incentives, including grants for retrofitting homes and/or changing heating systems (85.3%) and grants for changing from conventional stoves/ranges to low-emission stoves/ranges (81.5%). Other

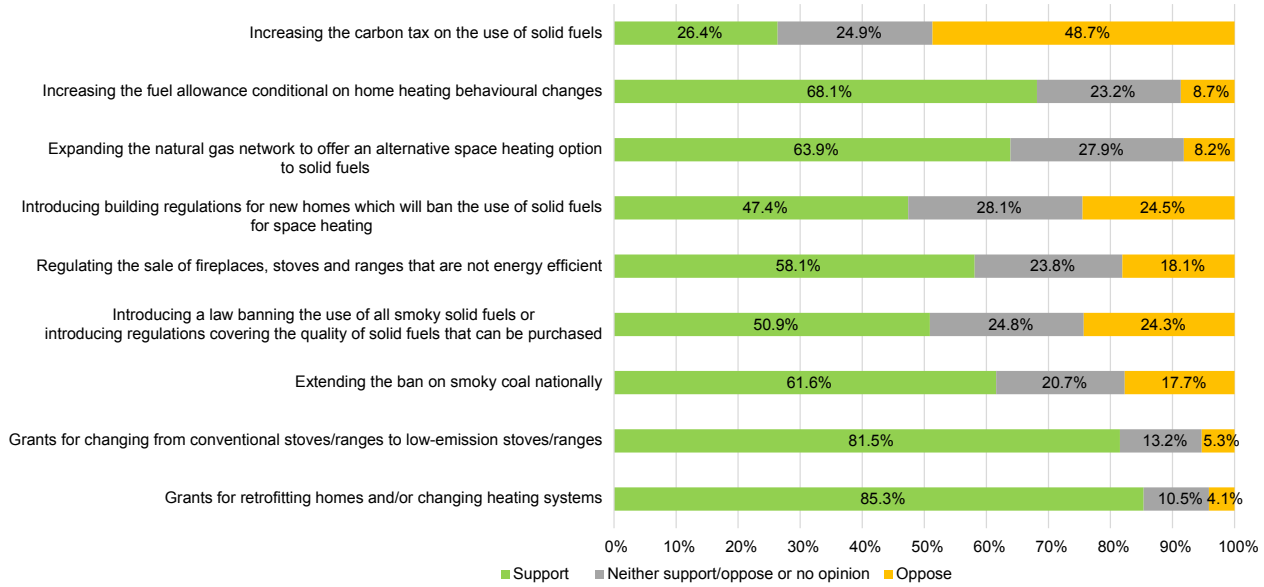


Figure 3.14. Support/opposition to policy measures (Uwtd *n* = 1043).

highly supported measures include increasing the fuel allowance conditional on home heating behavioural changes (68.1%) and expanding the gas network (63.9%). Notably, the results point to low opposition to restrictions on solid fuel use. Fewer than one in five (17.7%) solid fuel users would be opposed to a nationwide ban on smoky coal, while fewer than one in four (24.3%) would be opposed to a law banning the use of all smoky solid fuels. Of all the measures, carbon tax increases on solid fuels received the least support (26.4%).

Across primary and supplementary solid fuel users, similar policy preferences were reported, although the levels of support/opposition for certain policies varied, with supplementary users tending to be more supportive of the policies listed. Supplementary users had slightly higher levels of support for both grant policies than primary users (although both groups still registered support levels of close to 80% for these policies). Supplementary users were also more in favour of restrictions on solid fuel use than primary users. Almost two in three supplementary users (64.4%) indicated that they would support a nationwide smoky coal ban, while more than half (54.5%) would not be opposed to a law banning the use of all smoky solid fuels. In contrast, 54.2% of primary users support a nationwide smoky coal ban and 42.6% support a more restrictive ban on all smoky solid fuels.

Responses to possible policy levers were also examined by Defra (2020). In response to an increase in solid fuel costs, they found that one-third of indoor burners would continue buying the same amount of their existing fuel, even though it would cost them more. However, there was a strong willingness to pay more per kilogram for a solid fuel that has less environmental impact. There was also strong support for annual chimney sweeping requirements and annual appliance testing. In response to the question about what they would do if they could not burn solid fuels, almost two-thirds said they would switch to using central heating while 1 in every 20 of the respondents (5%) stated that they had no choice but to use solid fuels (Defra, 2020).

3.8 Conclusions

This chapter presented results from an online survey of 1823 Irish households, 1043 of which were solid fuel users. Over half of households in the sample recorded the use of at least one solid fuel for space heating, with 16.2% of households indicating that a solid fuel was their primary fuel and 37.5% indicating that they use a solid fuel (or fuels) for supplementary heating. In proportionate terms, low-smoke coal and peat (sod turf) were the most prevalent solid fuels used for primary heating and low-smoke coal and wood logs/briquettes for supplementary heating. However, a wide range of solid fuels are used, especially for supplementary heating, and it is quite common for households to use a mix of solid fuels for space heating purposes. In energy use terms, low-smoke

coal and other coal were estimated to be by far the most consumed solid fuels on a per day basis by households.

The survey and its findings can help to inform the SEAI's work in producing statistical estimates of energy use in the residential sector. It can also help to inform policy concerning the transition away from the use of solid fuels. In the case of the former, the survey has produced estimates for the shares of both use and consumption across a wide range of solid fuels. The estimates are useful as a base from which the SEAI can work, especially given the difficulties that the SEAI has itself acknowledged in obtaining accurate estimates when carrying out surveys of solid fuel suppliers (SEAI, 2018). The survey has also highlighted the sizeable level of supplementary solid fuel use. While current SEAI solid fuel statistics based on surveys of suppliers and industry experts should cover supplementary use, the distinction between primary solid fuel usage and supplementary solid fuel usage is not currently made in the annual energy balance statistics. Such a distinction could be useful, particularly to support policymakers in the area.

The survey's main contribution was to help inform the SEAI's work in providing estimates for the non-traded solid fuel sector. On an energy use basis, the non-traded sector was estimated to account for a little over a quarter of all solid fuel energy use. Non-traded sources were also broken down between grey sources and indigenous sources, with grey sources accounting for slightly more on an energy use basis. The figures varied considerably by solid fuel. Peat (sod turf), wood logs/briquettes and other wood are the largest non-traded solid fuels, although this is because they predominantly come from indigenous sources. Furthermore, this research has found that the non-traded sector is potentially larger than previous estimates suggest.

Although a survey provides valuable, highly detailed information at the household level, it is only a snapshot; therefore, a periodic survey of a nationally representative sample of households is recommended going forwards. Consideration for collecting a larger sample across a smaller range of solid fuels for ease of scaling up should also be made. The use of a standard receptacle to elicit quantity estimates has many advantages but some thought could be given to ways in which this method could be fine-tuned to improve the precision of the estimates. Further consideration could also be given to the distinction between primary and supplementary solid fuel users and how to account for households that use a mix of solid fuels. The methodology used in this survey for identifying sources of non-traded solid fuel use has generated interesting insights and is a key contribution. Such an approach could easily be adapted and used in future surveys.

The results from the survey can also help to inform policy in the transition away from the use of solid fuels. The most frequently reported reasons for using solid fuels included creating a pleasurable atmosphere in the home, heating only certain rooms/areas in the home and their perceived lower costs relative to other fuels or energy sources. These reasons differed by primary and supplementary users, which suggests that policies to encourage a transition away from solid fuels would also have to account for these differing preferences. Solid fuel users, and especially primary users, are found to have poor knowledge of the choice between appropriate solid fuels for air pollution and health and the risk associated with using solid fuels. Some evidence of practices to minimise the impact of using solid fuels was found, including chimney sweeping and use of ventilation. Reducing consumption of solid fuels is less of a desired option in this regard, however. Equally, only a small sample of households made the switch from a solid fuel to a non-solid fuel for central heating. Most of the policy options presented to the respondents that aim to reduce solid fuel use were more supported than opposed, with the most supported being grants to financially aid the change in heating system or appliance. Imposing restrictions on solid fuel use and even a strict nationwide ban on the use of all smoky solid fuels were still more supported than opposed. The least favoured policy option was to increase the carbon tax on solid fuels.

4 Solid Fuels – The Lived Experience

4.1 Background and Methodology

Much of the work on understanding (and changing) behaviour around energy has leveraged concepts and techniques that view behaviour through a rationalist, primarily individualistic worldview. There is a growing realisation that developing an appreciation of the so-called lived experience of energy use can complement such behaviouralist perspectives, combining to produce a better understanding of the human aspects of energy. The consumption of energy is so intimately interwoven with all aspects of daily life that people do not consider energy use abstracted from the goals to be achieved. Energy is, instead, viewed (if "viewed" at all) as a means to an end (e.g. cooking a meal, heating a home, commuting to work) and might be termed an energy service (Fell, 2017). This section aims to consider the very real social contexts through which people negotiate and understand their role with regard to solid fuel use. The underlying feelings, assumptions, associations and values held by the people who express them are very real influencing factors on their solid fuel energy-related practices.

The lived experience of solid fuel use is a social construction that needs to be interpreted. The reality of such experiences and relationships is inherently subjective, as each participant will have a different understanding, in keeping with Haraway's (1988) proposition that knowledge is partial and linked to the contexts in which it is created. Accordingly, a generic qualitative research methodology was adopted, using in-depth face-to-face interviews, a focus group and thematic analysis as the means of data collection and analysis. The study involved collecting qualitative data from a diverse group of householders to ascertain their attitudes towards solid fuels and develop an appreciation of their practices and behaviours associated with the use of such fuels. The engagements were recorded and transcribed, with the resultant transcripts qualitatively analysed using a thematic analysis approach. Participants were recruited through direct contact with communities and community groups. The engagements took place locally at locations convenient to the participants, who were recruited such that they constitute a diverse population profile, in terms of gender, socioeconomic privilege, and urban/rural residency. Participants were drawn from diverse areas, with selection depending on opportunity: the principal inclusion criterion was that participants must use (or have used) solid fuels in their homes. Engagements were designed in such a manner to promote gender, economic and physical inclusivity, including timing, location, format and supports.

The semi-structured interview was chosen as a key data gathering method for this study, as it was seen as offering the most effective means of capturing opinions and experiences and interpreting behaviours. During semi-structured interviews participants are provided with the time and scope to talk about their views on a particular subject. The objective was to understand the informant's point of view, not extrapolate findings to make generalisations. The interview is treated as a conversation, with interview schedules intended as a guide (Gill *et al.*, 2008). These interviews were supplemented with a focus group. Although a focus group may be thought of as a group interview, it is a facilitated group discussion rather than just collecting data from multiple participants at once. The discussions are observed, guided, facilitated by a researcher and recorded and transcribed. A key feature is the group interaction, from which much of the value from this method arises. Kitzinger (1995) contends that the "method is particularly useful for exploring people's knowledge and experiences and can be used to examine not only what people think but how they think and why they might think that way", while Gill *et al.* (2008) note its usefulness in exploring the meanings behind collective views. The analysis of qualitative data – what Schwandt (2007, p. 6) describes as making sense of, interpreting and theorising data, such as interview and focus group transcripts and notes – was conducted through thematic analysis to permit flexibility of the analysis to meet the research needs. Thematic analysis involves the identification, analysis and interpretation of themes (i.e. patterns of meaning) within qualitative data. This means the systematic ordering and categorising of data through a process known as coding. Developed

codes are used to segregate, classify and group data iteratively as patterns or themes are identified and as meaning and explanation emerge from analysis.

4.2 Engaging the Householders

A total of seven in-depth, semi-structured interviews were conducted with householders using solid fuels. These were conducted face to face, at a location of the interviewees' preference, where they felt comfortable and free to speak openly, and included participants' homes and their workplaces. Interviews were selected as a data collection method, as they have deeper reach than other approaches and, as Wellington and Szczerbinski (2007, p. 81) observe, they "… probe an interviewee's thoughts, values, prejudices, perceptions, views, feelings and perspectives". The interviewees were from locations in Cork City and Counties Cork, Laois, Kerry and Kilkenny, and represented a varied sociodemographic mix. This engagement was not intended to be representative; rather, purposive sampling was used to select information-rich respondents with the aim of gaining an appreciation of their lived experiences of using solid fuels. The semi-structured interviews were carried out using pre-formed, concise, easily understood, open-ended questions about the participants' use of solid fuels and their relationship with such fuel. All interviews were recorded (with the participants' consent) and notes taken as and when appropriate. A key consideration was to make sure such activities did not interfere with the natural flow of the conversation or the interviewees' train of thought. The recorded interviews were transcribed for analysis. In addition, and complementary to the semi-structured interviews, a focus group was conducted involving 15 participants from Achill Island, Co. Mayo. The participants were recruited through the local LEADER development partnership, Oirthuaisceart Mhaigh Eo. The participants represented a good sociodemographic mix of local residents. The focus group was held in a hotel local to and easily accessible from the target community on Achill Island. Discussions were recorded, transcribed and analysed.

The interviews and focus group discussion were recorded with the informed consent of the participants. These recordings were transcribed verbatim using standard spelling and were analysed following the approach used by Dunphy *et al.* (2017). The transcripts were prepared manually, rather than by using voice transcription software, acknowledging that the transcription process itself can form an important precursory part of qualitative data analysis. Following a full read-through several times, the text was analysed line by line to identify themes relating to the research objectives using standard thematic analysis procedures, with identifying codes applied to the relevant portions of text. As the coding process advanced, relationships between the codes became apparent and themes were grouped together in categories. These data were iteratively analysed in this manner: coding, categorising and refining themes. Emergent themes were interpreted and reinterpreted, allowing findings to be made and conclusions drawn.

4.3 Results and Findings

This study is concerned with the practices and behaviours surrounding the use of solid fuels. Dunphy *et al.* (2017, p. 48) observe that "some domestic practices are not only highly symbolic, but are, of necessity, deeply entrenched human behaviours which may explain their perceived resistance to substantial change". Identifying such practices and understanding the "meanings" behind them is key to engendering people to more sustainable practices and behaviours. Moreover, listening to the views of solid fuel users, such as the respondents in this study, allows perspectives born of the lived experience of those who burn such fuels to be fed back into prospective policies, and such reflection serves to enhance policy and improve outcomes. Our daily practices are embedded in our everyday lives; they are not something that we reflect on or think a great deal about. Practices are interwoven in the living of everyday life. Our energy-related practices are carried out to provide for our bodily needs, providing the basis for our personal and social lives. Many aspects of practice (e.g. those associated with a fire, including removing the ashes, setting the fire, bringing in the turf) become routine, almost automatic, procedures for most people. Although practices are often categorised in terms of the activity itself, i.e. heating our homes, in terms of what they provide (e.g. warmth) they also play another role. Through these practices people are creating "home", not simply in the sense of a physical space, but in the sense of identity and meaning, of relationships with people and place, of emotional values and securities

(Mallett, 2004). The findings detailed in this section represent the perceptions, views and attitudes of 22 people (11 of each gender) who use solid fuels of some sort in their homes as either a primary fuel or a supplementary fuel. The principal form of solid fuel used tends to be context and locale dependent, e.g. peat turf in areas adjacent to bogs, timber in rural locations, coal and peat briquettes in urban areas. In the respondents' homes the solid fuel is mainly used for heating purposes, with lower levels of use for heating water and cooking, both of which were mainly confined to rural areas.

4.3.1 Home is where the hearth is

A fire has traditionally been the focal point of the main living space in a home. Indeed, Rykwert (1991, p. 51) suggests that a fire is fundamental to home, arguing that a "home could just be a hearth" and that "the very notion of home seems to have grown round the hearth". Many respondents spoke of the meaning of having a fire for them. Sadie,[21] a professional middle-aged woman from the west of Ireland, spoke strongly of her attachment to having a real fire, saying:

> You couldn't live without a fire. Getting up on a rainy, grey day and no fire I mean it's not a life. It's not right.

Padraic, a retired man from rural County Laois, concurred, saying that a house without a flame was meaningless. He expanded on this thought, explaining the centrality of the fireplace throughout his life and recalling how many of his family memories were formed sitting around the fire, talking and listening to shows on the radio. For others, the flames themselves were the source of entertainment. Brian, a young man living on his own in County Mayo, explained how for him the fire was company; it was entertainment. Máire, a fellow county woman of his, put it quite eloquently when she observed:

> There's some stories you can get from the flames. From looking at the flames, you could nearly write a book.

For most respondents, having a real fire was just part and parcel of not only how they lived their lives, but also how they saw their lives. Seán, a farmer with a young family from north County Cork, talked about the decision process when building their house. Although they considered a number of heating options, they went with an oil burner with secondary heating from solid fuel not only for reliability, but also for a related attribute, its familiarity:

> I like the open fire, but comfort really is what it means. I suppose, tradition. It's nice to have the fire burning in the room, I do like it! I like the fact that we have an open fire, the same as I would have had in my own house when I was a child.

While Seán speaks about tradition associated with the open fire, he strongly implies that much of this tradition is to do with familiarity and trust in the system. Conversely, as will be mentioned in section 4.3.4, there is a lack of trust in the cost and reliability of alternative modes of heating.

For many people, the appearance of the fire is key: there is a reason that the vast majority of stoves have glass in their doors. Such is the innate desire to have a visible flame, many entertainment streaming services offer videos of wood fires for background ambience. As one woman quipped, "if you see a fire it just warms you up", implying a psychological value to a flame. Sadie from County Mayo agreed with this view and commented how having a fire would raise her spirits, saying:

> Sometimes yeah. If I'm in a bad mood I'd light the fire.

A common refrain from the respondents was a variation on the phrase "you can't beat a good fire". This attachment was neatly summed up by Jake from County Mayo, who said of having a fire:

> It's the hearth. It's the home.

4.3.2 Some like it hot

It goes without saying, of course, that the main value of a fire is the heat and warmth provided. A number of respondents relied on solid fuel as their primary

21 In reporting the engagements, pseudonyms have been used for the participants.

method of heating, while for others it was a secondary, but still important, source of warmth. One man commented on his family's heating arrangements, saying:

> It's all solid fuel, we have got oil – but we haven't used it this couple of years due to the price of it.

While his relatively recently renovated house had oil central heating installed, he explained that they simply found it too expensive to use and instead used a stove with a back boiler to heat their house and, indeed, supply hot water. They mainly used turf, supplemented by coal in very cold weather and, very occasionally, peat briquettes, although he noted that they were expensive. He further related how they would light the fire every day except for the summer, quipping:

> Well, the older you get, you seem to feel the cold more so, it's important for us to have the fire every day, on every day from October onwards at least.

This family's ability to heat their home adequately is down to, in no small part, the opportunity of saving turf and harvesting some wind-blown timber in their locality. Without access to these fuels, the householders believe that they would suffer energy poverty, with all the social and health implications of being energy poor, which includes exposure to air pollution from solid fuels. Although other respondents were not as open about their energy vulnerability, there was a good deal of discussion about how harvested non-traded fuels were very important to a lot of households. One woman in County Mayo observed of her community:

> … an awful lot of people are underemployed and this is contributing to the household without having to pay any money.

The cost of alternatives to solid fuels (in both capital and operational terms) was most definitely an issue. A woman on the west coast, for example, said:

> I would love to go photovoltaic, but as I said, at the moment I cannot afford it. And the grant system is rubbish.

Another woman commented that "I wouldn't have an open fire if I could afford it" [i.e. afford alternatives to solid fuels], while another informant was even more direct saying: "It's the money!".

4.3.3 Providing for the family

Although household chores still remain highly gendered, with women taking responsibility for and spending a lot more time engaged in tasks associated with cooking, cleaning, etc., than men (Dunphy *et al.*, 2017), most of the respondents reported a different gender profile for the work surrounding the fire. Given the centrality of solid fuel practices in the home, and indeed to the "making of the home", and the continued gender differences in other household duties, it is interesting that, while there are indications of some differences of opinion, a more distinct gendered pattern is not evident. For many households the work associated with lighting, maintaining and cleaning out a fire are highly routinised practices, often conducted by the same person. Anna, a young woman from County Kilkenny, spoke about how her father would get the fire started in the morning before going out to do farm work, replenish it at lunchtime and again in the evening. Leah, another young woman from County Kerry, spoke about how the fire has become somewhat of a habit for her father, saying:

> It's a routine like, even if we don't light the fire, my dad would stack it ready to be lighted.

For many retired men, the tasks associated with the fire appear almost to be a substitute for their daily work. There appears to be a sense of feeling useful, a way perhaps of still playing the traditional male role of provider, by taking over tasks they perhaps would see as fitting with their view of themselves. For example, Padraic, a retired man from County Laois, spoke joyfully of lighting a fire in wintertime, saying:

> Yeah, you can go out there on a very cold day, snow, frost or anything, and get your fuel and come in and light a good fire.

The pride taken by Padraic in saving his winter's fuel is obvious. Here is a man who has worked with his hands all his life and who visibly takes pleasure from the fact that he is still able to provide and contribute to the household. Seán from County Cork went further,

taking pleasure in the fact there was work involved in lighting a fire:

> I like the fact that there's a small bit of hassle, and you have to … you're lighting it because you want to, and there's a bit of routine to it, I suppose.

There might also be a link between those households that procure non-traded fuels and those that show increased interest in, and a greater contribution to, fire-related tasks by men. It is possible that harvesting of windblown timber and peat turf – itself chiefly a male-gendered activity – may engender a sense of ownership of the fire by men. The physical labour of saving turf or cutting timber, which once would have been considered part of daily life for many people, is now unknown. It is increasingly common to see men who find themselves working in office-based environments getting a release from the stress of such work through this almost primal activity. Padraic relates the story of his brother-in-law, on arriving to live in County Laois:

> … never saw a bog 'till he came up here and married … and he was amazed at it, he thought it was a holiday.

For many respondents the practice of saving their own fuels – whether timber or sod turf – is seen as an integral part of providing for their household. One elderly man noted the joy and security in having saved a year's fuel:

> Ah yeah, it's great relief when it comes to October to have your turf home and saved and dry, and a small amount of timber there.

A female contributor from the west of Ireland indicated how the saving of turf is seen as an integral part of the local calendar, commenting:

> It's part of the heritage, part of the seasonality of the place as well, and you know we work through the seasons.

4.3.4 Changing from solid fuels

All participants were very much aware of the climate crisis, and a common message was that they saw the need to reduce the amount of solid fuel used and many would welcome a reduced dependence on it. Interestingly, there was limited specific acknowledgement of air pollution and its health impacts. A lot of respondents who had open fires talked about their intention to install a stove, to both use less fuel and remove draughts from their house. For example, Seán from County Cork said:

> Yes, recently … you'd feel a bit of pressure alright to not burn it, because of environment issues, climate issues, and we are considering getting a stove, which would cut down the amount we're burning. It would also stop any draughts we have, which is partially the reason to be honest.

Those people who had installed a stove in fireplaces were uniformly in favour of the move, commenting on the reduced running costs, the increased comfort and general ease of use. The contrast between these positive experiences and some respondents' misgivings about previous investments in renewable energy technology was striking and perhaps offers some lessons to redefine the objective of renewable energy installation programmes. An older woman expressed a strong desire for more convenience saying:

> Anything that would be handy … with the switch of a button, that's what I'd love.

An emphasis on the convenience of newer technologies would probably find a receptive audience among the householders. However, there is a lack of trust in the novel heating technologies (and in suppliers) that will be difficult to overcome. Some informants felt they (or people they knew) had been oversold on the performance and longevity of newer systems. A woman in the west of Ireland commented that installing a geothermal heating system was one of her biggest mistakes because of the excessive running costs. Another informant also referenced this lack of trust saying:

> It's the money. It's the money. There are lots of people who want to change, who have huge oil bills etc., but they don't have the faith in the new system to dosh out a lot of money.

One man with substantial knowledge of construction expressed frustration at the difficulty of getting any information from suppliers on performance, running costs or even on installation costs. He complained:

> I couldn't find anybody to give me a straight answer what their bill was [for the newer technologies].

This lack of trustworthy information from suppliers, public authorities and the government on the issues was striking. A man from the west of Ireland captured this view, commenting:

> There's a nervousness to it at present. People are prepared to wait another little while, because it's like the car industry. We were all advised to go diesel a few years ago and now they're telling us we're dead. It's the same with the heating, we're at the cusp of a major change. We know this. There's new technology coming out every week, it's just impossible to keep up with it.

A strong argument was raised by rural informants who do not see their use of timber to be an issue. The problem of particulates, they suggest, is primarily an urban issue and not something affected by their household practices. They argue that such fuel is more sustainable than any other alternatives available to them. When queried what he would do if, hypothetically, solid fuels were prohibited, one farmer incredulously asked: "they'd stop me from chopping up a tree that I have on my own land and putting it into the fire?", while observing that doing so would only result in them using greater quantities of the less sustainable kerosene. Another concurred, arguing:

> I certainly cannot see how they could stop having a fire with … by cutting up blown down trees. It would only make sense to use them, to save other types of energy.

4.3.5 Desire for a fire

The attachment to having a fire is also evident in the participants' views that, even with renewable energy heating sources, they would like to retain a fire, usually in the form of a stove. One woman, for instance, who has had a geothermal heating system in her house for a number of years, said she retained her fire and could not imagine not having it:

> Yeah, I still have a fire, even with the geothermal. Even with that, yeah.

Another householder said that, although having alternative heating sources might reduce the amount of solid fuel used, it would not replace it, stating:

> But I would still have a fire even if I had [renewables]. But I mightn't light it until six in the evening maybe instead of at the moment, ten in the morning.

A woman in the Midlands spoke of her desire to have a cleaner, more convenient heating system. However, after some thought, she went on to say:

> I'd still have a fire, I would yeah.

A comment from another female informant sums it up:

> I think everyone's ideal world would be to have a nice fire in your sitting room to look at, but to have something clean then [for a main heating source].

4.4 Conclusions

There remains a strong attachment to burning solid fuels among many groups, but particularly in rural areas. Although air quality and health implications are increasingly discussed in connection with the use of solid fuels, much of the discourse around the need to move away from such fuels remains focused on their climate impact. Rural dwellers argue that their use (carbon-neutral in their minds) of timber is more sustainable than other possible alternatives and that this is especially the case when it is windblown. In discussions on any future arrangements, any suggestion of a hypothetical outright restriction or prohibition on all solid fuels would be an issue of contention. Furthermore, there is a cohort of people (mostly in rural areas and small towns) for whom their access to non-traded fuels (whether turf or wind-blown timber) is a significant part of the way in which they provide for themselves, and this could result in serious deprivation for many of these households if this was not available to them. Measures to

prevent householders falling into energy poverty would be key to acceptance of change. Urban dwellers, and particularly those with less socioeconomic privilege, would appear to be open to changing their heating source if the cost issue was resolved. However, the information deficit on these systems and lack of assurance on performance would have to be rectified. To this end, there is a need for reliable information about the technologies, assurances on performance and support measures (e.g. grant or green finance schemes) to persuade such people of the need, convince them of the technology and enable them to invest in appropriate systems.

5 Policy Instruments to Support the Transition Away from Solid Fuels

5.1 A Survey of National and International Policy Measures on Household Solid Fuel Use

In line with national and international climate change obligations, many countries have introduced policy measures aimed at promoting a transition to cleaner and more efficient sources of home heating. Policymakers have also implemented measures directly aiming to reduce residential solid fuel use and the associated adverse health effects resulting from poor air quality. In many cases, the policy measures have had the positive knock-on effect of promoting a transition away from the use of solid fuels, although perversely the recent increases in residential wood use have had negative consequences for air quality (EEA, 2019). This section provides a summary of such measures from a selection of countries, which either directly or indirectly support the transition away from solid fuels. Four categories of measures are examined:

1. restrictions on the sale and use of solid fuels;
2. home retrofitting and heating system replacement programmes;
3. regulations for solid fuel appliances and education and awareness campaigns;
4. fiscal incentives such as tax measures.

Table 5.1 provides an overview of the measures and evidence of their effectiveness where applicable.

5.2 Applicability of Policy Measures to Promote the Transition Away from Solid Fuels in Ireland

This section draws on the key findings presented in Chapters 2, 3 and 4 and the survey of existing policy measures used nationally and internationally, outlined in Table 5.1, to identify the potential for further insights in the development of policy measures that could be used to promote the transition away from solid fuels in the residential sector in Ireland.

5.2.1 Restrictions on the sale and use of solid fuels

The evidence presented in Table 5.1 has shown that restrictions on the sale and use of solid fuels have been an effective policy tool in many countries, including Ireland. Expanding the restrictions in Ireland by extending the smoky coal ban or setting minimum environmental product standards on the sale of all solid fuels is therefore likely to have clear and immediate positive effects. A recent scenario and policy analysis assessment of the introduction of a nationwide low-smoke zone in Ireland estimated the anticipated reduction in $PM_{2.5}$ emissions to be approximately 1.75 kilotonnes per annum and the associated health benefits in the region of €4.5–7.2 million per annum (EnvEcon, 2017). There is also public support for such policies, as indicated by the survey results presented in Chapter 3. Some elements would have to be considered, however. One is the relative effectiveness of solid fuel restrictions for the different cohorts of primary and supplementary solid fuel users. The survey results presented in Chapter 3 showed that public support for policies relating to restrictions on the use of solid fuels is stronger among supplementary users of solid fuels than among primary users. Moreover, supplementary users of solid fuels are more likely to cite non-economic reasons for using solid fuels, such as creating a pleasurable home atmosphere. Supplementary users of solid fuels are also more likely than primary solid fuel users to be located in or proximate to urban areas and would therefore experience the effects of further regulations on the sale of solid fuels to a greater extent.

The response of primary solid fuel users to the imposition of restrictions on the use of solid fuels is likely to be different. As highlighted in Chapter 3, primary users of solid fuels are less supportive of a range of policy options than supplementary users, and place a higher importance on the perceived lower cost as a reason for using solid fuels. Chapter 4 has also demonstrated the strong attachment to burning solid fuels that households have in rural areas and in specific regions. It is also the case that a sizeable

Table 5.1. Summary of national and international policy measures on household solid fuel use

Location	Schemes or measures introduced	Evidence of effectiveness (where applicable)
Restrictions on the sale and use of solid fuels		
Ireland	Ban on the marketing, sale and distribution of bituminous coal (smoky coal ban). First introduced in Dublin in 1990 and extended to other cities and large towns since. As of September 2020, the ban covers all towns with populations exceeding 10,000 people	Clancy *et al*. (2002) found that the ban resulted in lower air pollution emissions and about 359 fewer respiratory and cardiovascular deaths per year in the 6-year period following the ban's introduction in Dublin. Rich *et al*. (2009) reported falls of 13% and 8% in cardiovascular and respiratory mortality, respectively, following the ban's introduction in Cork
Krakow, Poland	Ban on the burning of all types of solid fuels for residential heating purposes, in effect since 2019 Subsidies offered, covering up to 100% of the cost of heating system replacement Additional financial supports to low-income households to compensate for increased heating costs	PM_{10} emissions fell by 45% in the winter heating period 2019–2020, compared with the same period in 2014–2015 (Kowalczyk, 2020). Some have argued, however, that the ban may not work to change the behaviour of the lowest income households and that additional measures, such as thermal retrofits, are necessary (Baborska-Narozny *et al*., 2020)
Italy and Germany	A ban on coal was introduced in certain regions of Italy in 2002. Since 2007, localised bans on the use of solid mineral fuels were progressively introduced in Germany	The restrictions have been more successful in reducing coal use in Italy than in Germany. In both countries, the bans have had the unintended consequence of increasing the use of biomass fuels, leading to higher $PM_{2.5}$ emissions and poorer air quality (Abbott *et al*., 2016)
England	Regulations to phase out the supply of smoky coal and wet wood as solid fuels for use in domestic premises were introduced in May 2021. Sales of traditional house coal will be illegal in England from May 2023. Similar controls are under consideration in the other devolved administrations	
Montreal, Canada	Law enacted in 2015 banning the burning of solid fuel during smog warnings	According to the United Nations Economic Commission for Europe (UNECE) Executive Body for the Convention on Long-range Transboundary Air Pollution, the measure has proved effective for improving air quality (UNESC, 2018, p. 12)
Home retrofitting and heating system replacement programmes		
Ireland	Better Energy Homes (BEH) and the Better Energy Communities (BEC) schemes administered by the SEAI. Exchequer funding of €284.9 million and €120.2 million has been invested in the BEH and BEC schemes, respectively (Reddy, 2020)	Reddy (2020) reported investment in the schemes to generate a net benefit to society with estimated future CO_2 savings outweighing the exchequer investment cost. Most of the retrofits delivered were relatively shallow, however, with few households taking measures to achieve a B2 BER rating (Reddy, 2020). Collins and Curtis (2017) found that households in older and rural homes were more likely to abandon energy efficiency retrofit grants than households in newer and urban homes, and deeper retrofit applications were also more likely to be abandoned Coyne *et al*. (2018) reported a reduction in solid fuel use in retrofitted social houses under the BEC scheme. However, some households continued using solid fuels, suggesting additional measures would be required to discourage persistence in solid fuel use
Various schemes in European countries, including Italy, Germany, France, the UK and Sweden[a]	Italy – under the Ecobonus tax relief system, which offers tax credits for the installation of energy efficient appliances	In Italy, over 3.3 million projects have been carried out, with total energy savings equating to 1.31 Mtoe per annum
	Germany – with the aid of low-interest loans and direct grants to homeowners	In Germany, a modest decline in primary energy consumption of 0.25 Mtoe per annum has been experienced

Table 5.1. Continued

Location	Schemes or measures introduced	Evidence of effectiveness (where applicable)
	France – under the Sustainable Development Tax Credit and Energy Transition for Green Growth Act tax credit schemes	The implementation of these schemes over the period of 2009 to 2012 led to a reduction in French annual final energy consumption by 0.78 million tonnes of oil equivalent (Mtoe) in 2013, 0.93 Mtoe in 2016 and was projected to amount to 1.08 Mtoe in 2020 (Schneller and Hennig, 2018)
	UK – a loan-based funding mechanism in which the repayments are made through households' electricity bills	The retrofitting scheme in the UK is perceived to be a failure. An audit of the scheme concluded that the £240 million spent resulted in less energy efficiency than would have been achieved had the government not intervened at all (National Audit Office, 2016)
	Sweden – through the use of tax deductions for the labour costs of repairing, maintaining, rebuilding and enlargement of a dwelling	
Poland	A nationwide "Clean Air" programme to improve air quality and combat energy poverty, with €24 billion allocated for 10 years, was introduced in 2018. The main goal was to improve the energy efficiency of the existing housing stock thorough thermal modernisation and replacement of solid fuel-based systems	Progress of the "Clean Air" programme was slow and a "Clean Air 2.0" programme was launched in 2020 to eliminate red tape, including a simplification of regulations concerning awarding of the subsidies.[b] A study of households in northern Poland following the "Clean Air" programme reported uncertainties about future energy prices and security of supply to be key factors deterring the switch from solid fuels to cleaner heating technologies (Frankowski and Tirrado Herrero, 2021)
Wroclaw, Poland	A campaign to "Change the stove" ("Zmień Piec") provided financial subsidies up to PLN 15,000	The Wroclaw "Zmień Piec" campaign has resulted in 8000 stoves being replaced with ecological heat sources with a target to replace a further 18,000 by 2024[c]
New Zealand	"Warm Up New Zealand: Heat Smart" and "Warm Up New Zealand: Healthy Homes" programmes provide subsidies towards the retrofitting costs of ceiling and floor insulation in older houses and subsidies targeting low-income households	Grimes *et al*. (2011) reported sizeable net benefits attributed to the Heat Smart programme with estimated benefits almost five times estimated resource costs. The two programmes had assisted with the retrofitting of about 20% of the country's housing stock (OECD, 2017)
Christchurch, New Zealand	Residential heater replacement programme to encourage householders to change to cleaner forms of heating	Approximately 76% of the open fireplaces and old solid fuel burners were replaced with cleaner heating technologies, while the stock of open fires and solid fuel burners fell by 45%. Air quality improved, with PM_{10} emissions falling by 71% (Scott and Scarrott, 2011)
Libby, MT, USA	Wood stove replacement programme in a small rural community where the stock of older wood stoves was replaced with either certified appliances or alternative heating technologies over a 4-year period between 2005 and 2008	The community-wide intervention resulted in a 27% reduction in winter ambient $PM_{2.5}$ concentrations, although findings across homes and across years were highly variable (Noonan *et al*., 2012)
Launceston, Australia	A wood heater replacement programme launched in 2001, with rebates offered for the exchange of wood heaters for cleaner heating technologies	On the programme's completion in 2004, only 30% of households in the region were users of wood heaters, down from 66% prior to the programme. Air quality improvements were observed, with average wintertime PM_{10} emissions 39% lower in the period 2001–2007 than the period 1994–2000 (Johnston *et al*., 2013)
British Columbia, Canada	The "Provincial Wood Stove Exchange Program"[d] started in 2008, to change old, smoky wood stoves to cleaner heating options, including heat pumps, gas or pellet stoves and cleaner-burning wood stoves. The programme has provided funding of $2.2 million to communities across the province	Since the programme started in 2008, 6067 uncertified stoves have been decommissioned and replaced with cleaner alternatives, resulting in an estimated reduction of 1590 tonnes of $PM_{2.5}$ emissions. However, the replacement figure was less than 20% of the initial target of 50,000 (Pinna Sustainability Inc., 2015)
Temuco and Padre Las Casas, Chile	Programme to remove the use of wood-burning stoves and introduce new heating technologies. The government subsidises 100% of the cost of replacing the old wood-burning stoves, including the cost of the new stove, the installation and set-up operations and the removal of the old appliance	Take-up of the programme has been low. Figures from 2018 show that only 18% of the 39,000 wood-burning stoves (the target for 2020) have been replaced. According to Boso *et al*. (2019), households having low risk perceptions about the health impacts of indoor air pollution was a key reason for non-participation

Table 5.1. Continued

Location	Schemes or measures introduced	Evidence of effectiveness (where applicable)
Regulations for solid fuel appliances, public education and awareness campaigns		
Germany	Since 2019, stricter emissions standards on wood stoves have been imposed through the Blue Angel eco-label. The criteria for award of the Blue Angel include emission reduction measures to promote improved firing, and significant reductions in particulate and other exhaust emissions compared with conventional wood stoves[e]	
UK, USA and Australia	"Burn Right" campaign in the UK to provide advice to households on how to save money and reduce air pollution by burning less-polluting fuels and operating appliances in an environmentally friendly manner. The UK also operates a quality assurance scheme for wood fuel (Woodsure "Ready to Burn") to build awareness about the health and environmental impacts of wet wood use and promoting a switch to drier and less polluting wood fuels[f] The "Burnwise" campaign operates in the USA and aims to promote the importance of using "the right wood, the right way, in the right appliance"[g] In Australia, educational campaigns operate in New South Wales ("Wood Smoke Pollution Resource Kit") and Canberra ("Burn Right Tonight"), to reduce pollution from wood heaters and encourage households to use cleaner forms of heating on nights when dispersion conditions are poor[h]	There is research to suggest that education can play an important role in reducing emissions from solid fuel burning. In a study of a stove replacement programme in the USA, it was found that educating homeowners on better burning practices led to improved indoor air. In 10 out of 16 homes studied, $PM_{2.5}$ levels were lower following a training programme on proper stove use (Ward *et al*., 2011). In Australia, a study by Hine *et al*. (2011) reported a substantial reduction in wood smoke emissions as a result of educational interventions using health risks as a motivational trigger
Tax measures		
Ireland	Since May 2013, solid fuels including coal, peat briquettes, milled peat and other peat are also subject to the carbon tax. Wood and wood products that have no solid fuel component are not liable. The current rate of Solid Fuel Carbon Tax (SFCT) is €33.50 per tonne of CO_2	It is still unclear as to the actual effect that the SFCT has had on solid fuel use. Carbon tax receipts on solid fuels have remained relatively stable since its introduction.[i] The regressivity of carbon taxes has been examined by researchers. An uncompensated rise of €7.50 in the carbon tax reduces disposable incomes of the lowest-income decile by 0.3% and of the highest-income decile by 0.1% (O'Malley *et al*., 2020). The same researchers also showed, however, that the regressive impact of an uncompensated carbon tax rise can be reversed through welfare increases, particularly those which target low-income households with children

[a]See Reddy (2020), section 3, for more information on these schemes.

[b]https://www.gov.pl/web/climate/clean-air-20-programme-launched (accessed 10 December 2021).

[c]https://zmienpiec.pl/ (accessed 10 December 2021).

[d]https://www2.gov.bc.ca/gov/content/environment/air-land-water/air/air-pollution/smoke-burning/exchange (accessed 10 December 2021).

[e]https://www.umweltbundesamt.de/en/press/pressinformation/blue-angel-for-wood-stoves (accessed 10 December 2021).

[f]https://www.burnright.co.uk/ and https://woodsure.co.uk/ (accessed 10 December 2021).

[g]https://www.epa.gov/burnwise (accessed 10 December 2021).

[h]https://www.epa.nsw.gov.au/your-environment/air/reducing-wood-smoke-emissions/council-resource-kit and https://www.environment.act.gov.au/environment/residential/burn-right-tonight (accessed 10 December 2021).

[i]https://www.revenue.ie/en/corporate/documents/statistics/excise/net-receipts-by-commodity.pdf (accessed 10 December 2021).

Mtoe, megatonnes of oil equivalent; PM_{10}, PM with a diameter of less than 10 µm.

proportion of households rely solely on solid fuels as their only source of space heating (close to 6% in the survey results in Chapter 4). Providing a sustainable alternative for these households would be key to acceptance of change. Supports, including financial, would need to be put in place to prevent fuel poverty and support a fair transition. It is therefore no surprise that primary users of solid fuels are more supportive of grants for retrofitting homes and/or changing heating systems and are less supportive of imposing restrictions on the use of solid fuels.

Another aspect to further regulations on the use of smoky solid fuels is the potential for substitution to the non-traded solid fuel market. The survey results presented in Chapter 3 have shown the extent of the non-traded solid fuel market to be significant, especially for rural households and households in the Border, Midlands and Western regions. Households in these areas already have well-established non-traded sources of solid fuels and the potential for further substitution is conceivable. There may also be an incentive for those who have not engaged in the grey market before to do so in response to an introduction of further regulations. Therefore, just like any regulatory measure, its success would be dependent on the extent to which effective enforcement is implemented in the area.

5.2.2 Home retrofitting and heating system replacement programmes

The findings from Chapters 2 and 3 have reinforced the view that users of solid fuels for primary heating purposes predominantly live in older, energy-inefficient dwellings and would therefore be some of the principal beneficiaries of a retrofitting scheme. This report has also shown that there are specific locations with a high prevalence of solid fuel use and targeting support schemes to these locations would bring further positive impacts. Good examples of such practice include a dedicated retrofit programme for local authority homes in the Midlands region, which includes grant support of up to 80% of the total eligible costs associated with upgrading an energy-poor home (SEAI, 2017). Although stated support for home retrofitting policies may be high in Ireland (as seen in Chapter 3), abandonment of applications, particularly for deep retrofits, is an issue (Collins and Curtis, 2017). The analysis in Chapter 2 also showed that switching from a solid fuel to a non-solid fuel central heating system was most likely to occur with a change in occupancy, indicating a strong habitual component to the use of solid fuels. Reddy (2020) suggests that a range of policy measures will be essential to sufficiently stimulate demand in the private household market. The tax relief and low-interest loan schemes in Italy, France and Germany referred to in Table 5.1 serve as possible models, but are also likely to incur a significant cost to the Exchequer (Reddy, 2020).

The *Climate Action Plan* (DECC, 2019) also commits to a target of installing approximately 400,000 heat pumps in existing residential buildings by 2030. Heat pumps require a dwelling to have low heat loss, and measures, such as installing attic/roof insulation, wall insulation and/or double/triple glazing of windows, may have to be undertaken beforehand. This can significantly increase the financial burden to the householder, creating a barrier to transition for those on lower incomes. High financial barriers are not the only issue affecting the take-up of renewable residential heating systems. Michelsen and Madlener (2016) emphasise the importance of perceptions in how a residential heating system works and operates for their adoption. Research by Gaur *et al*. (2021) identifies other factors including low public awareness, a lack of understanding of costs and environmental benefits arising from heat pumps and the lack of adequately trained professionals in the area.

5.2.3 Regulations for solid fuel appliances, public education and awareness campaigns

The EU's Ecodesign Directive (EU, 2015) came into force on 1 January 2022 for all solid fuel local space heaters. The ecodesign requirements cover three categories: energy efficiency, emissions [including nitrogen oxides (NO_x) and PM] and product information. There is also a requirement for an energy labelling scale, starting at A++. Since 1 January 2022, it has become illegal to manufacture and sell new stoves that do not comply with the ecodesign requirements, although stoves that are already in the supply chain can be sold after this date and the requirements do not apply to existing stoves (EU, 2015). The Directive will have its greatest impact when old stoves or open fires are replaced and the research in Table 5.1 shows the benefits of having

improved heating appliance standards. The survey data analysed in Chapter 3 highlighted the prevalence of open fires and stoves in households in Ireland and Chapter 4 demonstrated the strong affinity that users of solid fuels have to open fires. The survey results in Chapter 3 did show a trend towards the replacement of open fires with stoves in recent years, indicating that there is some willingness to change, even if the reasons for the change were not necessarily related to environmental or health concerns. However, it will be difficult to incentivise households that have already made an upgrade to a new stove to do so again.

Education and awareness campaigns can also play an important role in changing behaviours related to solid fuel use. The survey of Irish households undertaken in this report found that most users of solid fuels lacked knowledge about the right type of solid fuels to use and the impact of solid fuels on air quality and health and had low risk perceptions about the adverse health effects associated with solid fuel use. This is especially the case among primary solid fuel users. Education and awareness campaigns on better burning practices, similar to the "BurnRight" and "BurnWise" examples outlined in Table 5.1, could make similarly positive impacts if applied to households in Ireland. Developing air quality information materials, such as brochures, educational packs and information boards for schools, colleges and social/sports clubs, and designating a citywide Clean Air Day are more general awareness initiatives that have been advocated by Cork City Council in its recently published Air Quality Strategy 2021–2026.[22] Continuing to provide both information related to the benefits of adopting new heating technologies and assurances on their operation, in line with the financial grants that are offered by the SEAI, would also be important, given that these have been identified as barriers in previous research and in this research report.

5.2.4 Tax measures and fuel allowances

Carbon taxes are increasingly being used by governments as a key policy instrument to tackle national carbon emissions (World Bank, 2021). Ireland is one of several countries to have recently increased their carbon tax rates and adopt more ambitious trajectories. The current Programme for Government (Department of the Taoiseach, 2020) sets out a clear commitment to increase the carbon tax to €100 per tonne by 2030. The commitment to increase the carbon tax has been advocated by bodies such as the Climate Change Advisory Council (CCAC), providing a price signal to reduce fuel consumption and lower carbon emissions. The CCAC recognises that the acceptability of carbon taxes will depend on how the revenues are recycled. The Programme for Government (Department of the Taoiseach, 2020) sets out three areas in which carbon tax revenues will be ringfenced. These include targeting social welfare and other initiatives to prevent fuel poverty and ensure a just transition, providing money for a national retrofitting programme with an emphasis on the houses in the Midlands region and social and low-income tenancies, and incentivising the role that farmers can play in the management of carbon stocks through increased rates of afforestation and improved management of soils with a high-carbon content, including peatlands.

The success of the carbon tax in reducing the use of solid fuels will also depend on ensuring that substitution occurs to the desired low-carbon and environmentally friendly, cleaner heating fuels. As with introducing restrictions on the sale of smoky solid fuels, increased carbon taxes may incentivise greater substitution to the non-traded solid fuel market. The fact that wood is currently not liable to the Solid Fuel Carbon Tax (SFCT) is also likely to create an incentive for people to use it as a substitute solid fuel. In both instances there could be negative consequences for air quality with increases in PM emissions. A related issue is the possibility that households will source solid fuels from outside Ireland. Such an issue has been mentioned by the Tax Division of the Department of Finance, which suggested that higher tax differentials and different environmental standards on solid fuels between Ireland and Northern Ireland can drive illegal sales (Tax Strategy Group, 2020).

A negative consequence of increasing carbon taxes is its regressive effect on lower-income households and implications for fuel poverty. This could be partly

22 The Cork City Council Air Quality Strategy 2021–2026 can be downloaded from https://www.corkcity.ie/en/council-services/news-room/latest-news/cork-city-council-launches-innovative-air-quality-strategy.html (accessed 10 December 2021).

offset by increasing the money paid through the fuel allowance under the National Fuel Scheme. However, analysis by O'Malley *et al*. (2020) suggests that a reform that focuses on increasing welfare payments to low-income households with children and smaller increases to the national fuel allowance would be unambiguously progressive, with gains for lower-income deciles and losses for higher-income deciles. A potential aligned strategy would be to administer the national fuel allowance through a voucher scheme, in which the allowance can be used only to purchase cleaner heating fuels or low-smoke solid fuels from registered retailers and merchant fuel outlets. Such a scheme may incentivise purchases in the traded rather than non-traded solid fuel market, with potential benefits to the Exchequer. Other potential fiscal measures could also be considered in line with increases in carbon taxes to incentivise a switch to cleaner solid fuels. The SEAI's domestic fuel cost comparison figures show low-smoke coal to be 9% more expensive than standard coal on a mass basis but cheaper on an energy or heat basis (SEAI, 2021). Introducing a lower value added tax (VAT) rate on low-smoke coal could shift use towards this cleaner alternative. It may also help to partly mitigate against the issue of cross-border trading from Northern Ireland (EnvEcon, 2017). In addition, labelling products on an energy basis could assist this shift. Such measures should be seen as short-term goals, however, when viewed in the context of the longer term goal of transitioning away from the use of all solid fuels.

5.3 Conclusions

This chapter examined a range of policy instruments that have been employed either directly or indirectly to promote the transition away from the use of solid fuels in the residential sector. The effectiveness of these policy instruments in the context of solid fuel use in the residential sector in Ireland was also examined. In the context of measures that directly target the use of solid fuels, the implementation of nationwide restrictions on the use of smoky solid fuels and planned future increases in carbon taxes are likely to have the greatest desired effect. However, the potential for switching to the non-traded solid fuel market and wood, in particular, in response to these measures is a possible unintended consequence which needs to be monitored. The acceptability of increases in carbon taxes is also another potential obstacle, but which may be helped if revenues are filtered back into communities that are most adversely affected by the increases. Although the Programme for Government (Department of the Taoiseach, 2020) has committed to a range of carbon tax recycling schemes, consideration could also be given to examining financial incentives to support a transition from open fires and stoves and address wider issues of energy poverty. The introduction of new EU ecodesign regulations from 1 January 2022 will set minimum emissions standards on new stoves placed on the market for the first time. However, they do not apply to existing stoves, which will constitute the vast majority of installations and emissions for many years to come. Education and awareness campaigns, particularly on the impact of solid fuels on air quality and health and on better solid fuel burning practices, can also play a very important supporting role in tandem with the measures mentioned above.

The implementation of a national deep retrofitting scheme allied with the installation of heat pumps are broad measures to enable a transition to a clean, low-carbon residential sector, but they should also have positive side effects to the transition away from solid fuels. The successful implementation of a deep retrofitting scheme is dependent on uptake, and the evidence so far suggests that primary users of solid fuels, who require retrofitting the most, may face greater barriers than supplementary users owing to financial considerations or a lack of awareness of the benefits of such schemes. Targeted projects, such as the current Midlands Retrofit Programme for Local Authority Homes, could serve as a prototype to encourage householders in older, energy-inefficient dwellings to upgrade. Encouraging a transition to more sustainable heating systems also faces a strong barrier of habits or solid fuel "lock-in", as referred to by Curtis *et al*. (2018). Even if a household upgrades its heating systems or switches central heating fuels, there is still evidence of persistence in using solid fuels, as shown by Coyne *et al*. (2018).

It is clear that all of the policy measures discussed in this chapter can play a role, either directly or indirectly, in the transition away from solid fuel use. In examining the effectiveness of the measures, it is perhaps best not to consider these measures in isolation. The experience from examining the implementation of

these policies in other countries, such as Poland and New Zealand, would suggest that they are at their most effective when implemented as a suite of polices, each one supporting the other. Policies that support the transition away from solid fuel heating options could also be made in a stepwise fashion, making improvements to the current situation across the range of different solid fuels.

6 Conclusions and Recommendations

There are clear motivations for encouraging the transition away from the use of solid fuels to more sustainable space heating alternatives. A difficulty in facilitating this transition is the relative lack of understanding surrounding the factors that determine the choice to use solid fuels and the levels of usage. Developing new data sources to inform national energy statistics is crucial to facilitate a better understanding of the sector. The extent of unaccounted or non-traded solid fuel use is one such data gap, as is the extent of usage of solid fuels as a supplementary source of heating. To examine these issues, this research project used a variety of methods and sources, including a literature review to identify knowledge gaps, an examination of existing and bespoke data sets to detail the current state of knowledge on residential solid fuel use, the creation of new data through a large survey of residential solid fuel users and interviews with selected solid fuel users, and a review of the experience of other countries in applying policy measures within this subject area.

Several key conclusions arise from the analysis contained in this report. The proportion of households that rely on solid fuels for primary heating purposes based on existing data sets is approximately 12–16% and therefore any transition is going to affect a sizeable cohort. Data from the census show evidence of switching away from and also towards solid fuels for central heating purposes. Where evidence of switching away from using solid fuels does exist, it is primarily because of a change in occupancy, an indication of the strong habitual effect that comes with using solid fuels. There also appears to be a considerable cohort of households that are supplementary users of solid fuels, with existing data sets indicating that up to half of households in Ireland are in this category. This has implications for monitoring air quality, as even infrequent use of smoky solid fuels can result in high episodic emissions of PM and other air pollutants, both indoors and outdoors.

The distinction between the characteristics of primary and supplementary users of solid fuels is important. A number of findings in this report suggest that there are two submarkets. The primary solid fuel market, and particularly peat use, is strongly influenced by location, with higher prevalence in rural areas and certain regions. Other factors which are associated with primary solid fuel use include lower levels of educational attainment, lower socio-economic groups and living in older dwellings. In contrast, users of solid fuels for supplementary purposes are more diverse. The findings from the survey also suggest that primary and supplementary solid fuel users have different reasons for using solid fuels, knowledge surrounding adverse effects of using solid fuels and responses to proposed policy changes to reduce solid fuel use. These features could be influential in the design of policy in this area. More specifically, primary users placed a higher importance on cost than supplementary users as a reason to use solid fuels, had poorer knowledge of the adverse effects of solid fuels and were more opposed to proposed policy options to reduce solid fuel use.

There is also evidence of heterogeneity among solid fuel users depending on the type of solid fuel used. Locational effects, including the urban–rural divide and regional divides, are strong across all the solid fuels and particularly when they are used as a primary fuel. Proximity to a peat bog, for example, is an important explanatory factor for peat use. Other differences are also present, including the finding that coal and peat users are more likely to have lower levels of educational attainment and be in lower socio-economic groups than wood users. Policies accounting for differences between primary and supplementary users must also therefore account for differences between users of different primary solid fuels.

The report presents results from a survey of households in Ireland that examined many aspects of the residential solid fuel market not previously explored, including a quantification of solid fuel use. The survey advanced previous household surveys by examining a wider range of different types of solid fuels. In proportionate terms, low-smoke coal and peat (sod turf) were the most prevalent solid fuels used for primary heating and low-smoke coal and wood logs/briquettes for supplementary heating. In energy consumption terms (MJ), low-smoke coal and

other coal were the most consumed solid fuels on a per day basis by households. The importance of supplementary use of solid fuels was also highlighted by the survey results, with the average usage of a supplementary user almost three-quarters that of a primary user. The fact that households were more likely to use a combination of solid fuels for space heating purposes rather than just one in isolation is a probable contributory factor to this.

A key element of the survey was the quantification of the non-traded solid fuel sector. Respondents to the survey were asked to identify their sources of solid fuels from a list provided, ranging from traded (e.g. local shops, fuel merchants) to non-traded (e.g. paid money to a local household/individual). On an energy use basis, the non-traded sector was estimated to account for a little over one-quarter of all solid fuel energy use, with peat (sod turf), wood logs/ briquettes and other wood (or foraged wood) being the largest non-traded solid fuels. A further breakdown of non-traded sources between the grey market and indigenous sources was also provided, with the grey market contributing slightly more to non-traded energy use than indigenous sources. The estimates were also compared with previous SEAI estimates of non-traded wood and, on this basis, the non-traded wood sector may be larger than previously thought. Solid fuel users who source most of their solid fuels from non-trade sources are predominantly those with low incomes, with lower levels of educational attainment and located in rural areas and the Border, Midlands, West and Mid-West regions. The importance of non-traded sources of solid fuels was also highlighted in interviews with rural dwellers who stated that it was a significant part of the way in which they provided fuel for themselves.

An examination of potential policy options to transition from solid fuel use adopted in other countries provided examples of success in the area. The survey data showed that, although differences existed between primary and supplementary solid fuel users, high levels of support for most of the policy options put forward were still recorded. Interviews with solid fuel users did suggest some acceptance of the necessity to change heating systems and engage in a transition away from solid fuels, while also highlighting the obstacles that are still in place for this to happen. This points toward a receptiveness for policymakers to begin putting the measures in place that will further promote this transition.

The key recommendations of the report can be listed as follows:

- The survey results presented in this report represent an attempt to quantify solid fuel consumption using a bottom-up approach based on a representative sample of households. The survey is not without its limitations, but it represents a significant first step in examining this complex area. A periodic survey of a nationally representative sample of households is a recommendation going forwards. Many of the aspects developed in this survey, including the approach to estimate non-traded solid fuel use, could be adapted and used in these surveys. Such a repeated bottom-up approach would be useful in capturing trends in household solid fuel use and would complement the top-down approach used by the SEAI in its energy balance statistics. In addition, such a periodic survey would provide a baseline against which progress in relation to policies implemented could be measured and tracked.
- This report supports the implementation of nationwide minimum standards for certain solid fuels, which would regulate the smokiest solid fuels and would be likely to have the greatest direct desired effect in transitioning to cleaner fuels. It is important to understand, given the lessons learned in Chapter 5, that this transition should be made in a stepwise fashion, making improvements to the current situation across the range of different solid fuels. In advocating this approach, consideration should be given to the potential for solid fuel users to switch to more polluting and carbon-intensive alternatives in the non-traded solid fuel market. This report has highlighted its extent, particularly for certain solid fuels and in certain areas.
- This report suggests that the recognition of differences between primary and supplementary users is important for the development of policy in the area. For primary users, the transition will be difficult given their reliance on solid fuels and a strong emotional attachment to using these fuels. Targeted support schemes, for example, with financial incentives to retrofit homes that align with fuel poverty strategies, are likely to be required to provide enough encouragement to switch away from solid fuels or, to a lesser extent, reduce

consumption. For supplementary users, alternative policy measures may be required, especially if deep retrofit is not an option for homes that are already energy efficient but which still use solid fuels for comfort or aesthetic effect. Restrictions on the use of smoky solid fuels would encourage the take-up of more sustainable fuels for this cohort. As with the experiences in other countries, a range of policy measures is likely to be required.

- Education and awareness campaigns, which work in tandem with government intervention, will also be vitally important. This report has shown that there is a willingness among households to make behavioural changes with regard to solid fuel use, but it has also shown that there are many examples of informational deficits and uncertainties that can prove to be strong barriers to a successful transition. These include providing a better understanding of the benefits associated with transition, including financial, health and environmental. Reducing the uncertainties associated with the adoption of new heating technologies would also be important, as would cultivating the guiding principle of a just transition.
- It is true to say that some policy measures, such as restrictions on the use of solid fuels, are likely to have the greatest desired effect. However, the experience from other countries shows that a range of policies will be required. The success of any policy discouraging the use of non-sustainable solid fuels will have to be accompanied by policies encouraging the use of sustainable alternatives. Previous research and this research report have shown that there is a strong habitual effect to using solid fuels, which is based as much on a lived experience element as it is on economic considerations. Breaking this barrier perhaps represents the greatest obstacle and requires a strong coherent approach from policymakers.

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Abbreviations

BER	Building Energy Rating
CPI	Consumer Price Index
CSO	Central Statistics Office
EPA	Environmental Protection Agency
HRP	Household reference person
PM	Particulate matter
$PM_{2.5}$	Particulate matter with a diameter of 2.5 µm or less
SEAI	Sustainable Energy Authority of Ireland
Uwtd	Unweighted sample

Appendix 1 Survey Description

The survey was administered online by market research company Dynata (www.dynata.com), which is a global leading company in first-party data collection. Dynata maintains a large online panel of approximately 107,000 demographically diverse Irish householders who are registered to participate in online surveys. Market research companies have been used for data collection purposes in academic research before (see Curtis *et al.*, 2018) and are especially useful for obtaining large samples of hard-to-reach groups, such as primary users and non-traded users of specific solid fuel types. The online questionnaire used in the survey was developed by the project team and was based on a review of previous national and international literature and surveys on solid fuel use. Between November 2019 and January 2020, the questionnaire was piloted and refinements were made to the layout and structure of the questionnaire, as well as to question phrasing and response options. In total, 196 respondents participated in the pilot testing.

Respondents to the final survey were recruited using a quota sampling technique, i.e. households were selected for the final sample based on a specific characteristic. This was chosen (instead of random sampling, for example) to ensure that sufficient samples of solid fuel users, and particularly non-traded solid fuel users, were obtained to carry out a meaningful analysis. Hence, households that use solid fuels for primary space heating and households in regions where non-traded solid fuels were more likely to be used were oversampled. Quotas were also applied to households that used other fuels for primary heating purposes (e.g. natural gas, home heating oil) and solid fuels for supplementary heating. Consideration was also given to ensuring a representative spread of households across regions (other than those targeted) and the age of the respondent.

The final version of the survey was administered between February and March 2020 and 1823 responses were collected in total. Of this final sample, 1043 households indicated that they used at least one solid fuel for space heating purposes, of which 441 households indicated that they used a solid fuel for primary space heating purposes and 602 households indicated that they used a solid fuel for supplementary space heating purposes. To account for the oversampling of primary users and certain regions, a weighting procedure was applied based on three factors:

1. The first adjusted the sample to reflect the proportion of primary solid fuel users in the CSO *Survey on Household Environmental Behaviours* (CSO, 2016).
2. The second used Census 2016 data (CSO, 2017) to weight the sample in line with the proportion of Irish households by Nomenclature of Territorial Units for Statistics (NUTS) 3 Region.
3. The third adjusted the sample to reflect Census 2016 data (CSO, 2017) on the proportion of the Irish population aged 18 or over by age category (18–34 years, 35–54 years, 55–74 years and 75 years or over).

With any survey methodology, there are potential drawbacks. The fact that it was carried out online reduces the ability of the interviewer or respondent to clarify questions and answers or ask (and answer) more detailed and technical questions, but piloting the survey would have helped to mitigate these issues to some extent. A plan to carry out face-to-face interviews with a small number of solid fuel users as a follow-up to the survey was considered, should further survey detail be desired, but could not be acted on owing to the coronavirus disease (COVID-19) outbreak in March 2020. Using a quota sampling technique, while desirable to produce samples of adequate size, also does not produce a representative sample. The reweighting approach described above is the project team's effort to make the sample more representative, but other reweightings could have been applied.[23] The sample's representativeness can be examined

23 The project team examined other possible reweighting options with a similar logic to the three-factor adjustment described above, but none produced sizeably different results to the final weighting option chosen.

by comparing some of its characteristics with similar data from the CSO (2016) *Survey on Household Environmental Behaviours*. Table A1.1 displays the proportion of households for selected characteristics across these two surveys. As can be seen, the proportions compare reasonably well, with only slight over and underrepresentations of certain cohorts.

To provide further support for the robustness of the survey results, Table A1.2 shows the weighted proportions for the full sample of households and for the subsamples consisting of solid fuel users, primary solid fuel users and supplementary solid fuel users across a variety of socioeconomic, dwelling and location characteristics. The statistics for the full sample of households show a reasonably good spread of numbers with each characteristic; the sample therefore includes most cohorts. The results are also broadly in line with what is expected, based on previous research, i.e. primary solid fuel users tend to have lower incomes, lower levels of educational attainment and live in older dwellings, and they are less likely to have a BER audit conducted than supplementary solid fuel users. Furthermore, primary solid fuel users tend to live in specific regions and rural areas whereas supplementary users tend to live in urban areas. The values in the table also support the analysis conducted in Chapter 2, which suggested that primary and supplementary users tend to have different characteristics, particularly in terms of income and education and the urban–rural divide.

Table A1.1. Proportions of households with selected characteristics in the CSO *Survey on Household Environmental Behaviours*[a] and the weighted Solid Fuel Survey sample

Characteristic	CSO survey[a] (*n* = 13,032; %)	Solid Fuel Survey, weighted sample (Uwtd *n* = 1823; %)
Primary space heating fuel		
Natural gas	34.24	27.78
Home heating oil	41.00	43.00
Solid fuels	16.18	16.23
Other	8.58	12.99
Region		
Border	10.81	8.65
Dublin	26.78	30.42
Mid-East	10.07	13.90
Midlands	6.60	5.43
Mid-West	7.56	9.95
South-East	12.39	8.80
South-West	15.62	13.74
West	10.17	9.11
Rural/urban		
Rural	35.66	30.49
Urban	64.34	69.51
Dwelling age		
1980 or earlier	42.21	43.17
1981–2000	25.15	29.50
2001 or later	25.42	27.33
Not known	7.22	-

[a]**CSO (2016).**

Table A1.2. Proportions of households in the Solid Fuel Survey for the full sample and for the sub-samples of solid fuel users, primary solid fuel users and supplementary solid fuel users

Characteristic	Full sample (Uwtd *n*=1823; %)	Solid fuel users (Uwtd *n*=1043; %)	Primary solid fuel users (Uwtd *n*=441; %)	Supplementary solid fuel users (Uwtd *n*=602; %)
Annual net household income				
Under €20,000	16.95	17.93	28.79	13.24
€20,000–30,999	17.88	17.75	21.43	16.16
€31,000–49,999	26.38	28.70	27.14	29.38
€50,000–78,999	25.26	22.33	15.68	25.21
€79,000 or over	13.53	13.28	6.95	16.02
Adults with third-level education				
0	20.37	22.42	30.34	19.00
1	33.81	32.05	35.91	30.39
2 or more	45.82	45.52	33.76	50.61
Age of oldest adult				
18–34 years	13.95	10.17	9.20	10.58
35–54 years	41.56	40.03	39.00	40.48
55–74 years	34.84	39.16	41.50	38.15
75 years or over	9.65	10.64	10.30	10.79
Dwelling age				
1980 or earlier	43.17	43.54	46.67	42.18
1981–1990	13.06	15.98	18.00	15.10
1991–2000	16.44	15.61	14.84	15.94
2001–2010	22.73	21.93	18.20	23.55
2011 or later	4.60	2.94	2.28	3.23
BER				
A	10.02	7.61	5.01	8.74
B, C	32.96	32.64	28.57	34.4
D or lower	7.96	7.84	7.62	7.93
No audit conducted	49.06	51.91	58.79	48.94
Region				
Border	8.65	13.37	13.80	13.18
Dublin	30.42	15.27	7.19	18.77
Mid-East	13.90	14.52	12.75	15.28
Midlands	5.43	7.50	12.66	5.26
Mid-West	9.95	11.36	12.13	11.03
South-East	8.80	11.49	11.02	11.69
South-West	13.74	14.57	14.62	14.55
West	9.11	11.93	15.83	10.24
Rural/urban				
Rural (pop <1500)	30.49	43.97	50.60	41.10
Small town (pop 1500–5000)	18.31	20.39	23.56	19.01
Large town (pop 5000–50,000)	24.09	20.68	17.67	21.98
City (pop >50,000)	27.11	14.97	8.17	17.91

Pop, population.

AN GHNÍOMHAIREACHT UM CHAOMHNÚ COMHSHAOIL
Tá an Ghníomhaireacht um Chaomhnú Comhshaoil (GCC) freagrach as an gcomhshaol a chaomhnú agus a fheabhsú mar shócmhainn luachmhar do mhuintir na hÉireann. Táimid tiomanta do dhaoine agus don chomhshaol a chosaint ó éifeachtaí díobhálacha na radaíochta agus an truaillithe.

Is féidir obair na Gníomhaireachta a roinnt ina trí phríomhréimse:

Rialú: *Déanaimid córais éifeachtacha rialaithe agus comhlíonta comhshaoil a chur i bhfeidhm chun torthaí maithe comhshaoil a sholáthar agus chun díriú orthu siúd nach gcloíonn leis na córais sin.*

Eolas: *Soláthraímid sonraí, faisnéis agus measúnú comhshaoil atá ar ardchaighdeán, spriocdhírithe agus tráthúil chun bonn eolais a chur faoin gcinnteoireacht ar gach leibhéal.*

Tacaíocht: *Bímid ag saothrú i gcomhar le grúpaí eile chun tacú le comhshaol atá glan, táirgiúil agus cosanta go maith, agus le hiompar a chuirfidh le comhshaol inbhuanaithe.*

Ár bhFreagrachtaí

Ceadúnú
Déanaimid na gníomhaíochtaí seo a leanas a rialú ionas nach ndéanann siad dochar do shláinte an phobail ná don chomhshaol:
- saoráidí dramhaíola *(m.sh. láithreáin líonta talún, loisceoirí, stáisiúin aistrithe dramhaíola)*;
- gníomhaíochtaí tionsclaíocha ar scála mór *(m.sh. déantúsaíocht cógaisíochta, déantúsaíocht stroighne, stáisiúin chumhachta)*;
- an diantalmhaíocht *(m.sh. muca, éanlaith)*;
- úsáid shrianta agus scaoileadh rialaithe Orgánach Géinmhodhnaithe *(OGM)*;
- foinsí radaíochta ianúcháin *(m.sh. trealamh x-gha agus radaiteiripe, foinsí tionsclaíocha)*;
- áiseanna móra stórála peitril;
- scardadh dramhuisce;
- gníomhaíochtaí dumpála ar farraige.

Forfheidhmiú Náisiúnta i leith Cúrsaí Comhshaoil
- Clár náisiúnta iniúchtaí agus cigireachtaí a dhéanamh gach bliain ar shaoráidí a bhfuil ceadúnas ón nGníomhaireacht acu.
- Maoirseacht a dhéanamh ar fhreagrachtaí cosanta comhshaoil na n-údarás áitiúil.
- Caighdeán an uisce óil, arna sholáthar ag soláthraithe uisce phoiblí, a mhaoirsiú.
- Obair le húdaráis áitiúla agus le gníomhaireachtaí eile chun dul i ngleic le coireanna comhshaoil trí chomhordú a dhéanamh ar líonra forfheidhmiúcháin náisiúnta, trí dhíriú ar chiontóirí, agus trí mhaoirsiú a dhéanamh ar leasúchán.
- Cur i bhfeidhm rialachán ar nós na Rialachán um Dhramhthrealamh Leictreach agus Leictreonach (DTLL), um Shrian ar Shubstaintí Guaiseacha agus na Rialachán um rialú ar shubstaintí a ídíonn an ciseal ózóin.
- An dlí a chur orthu siúd a bhriseann dlí an chomhshaoil agus a dhéanann dochar don chomhshaol.

Bainistíocht Uisce
- Monatóireacht agus tuairisciú a dhéanamh ar cháilíocht aibhneacha, lochanna, uiscí idirchriosacha agus cósta na hÉireann, agus screamhuiscí; leibhéil uisce agus sruthanna aibhneacha a thomhas.
- Comhordú náisiúnta agus maoirsiú a dhéanamh ar an gCreat-Treoir Uisce.
- Monatóireacht agus tuairisciú a dhéanamh ar Cháilíocht an Uisce Snámha.

Monatóireacht, Anailís agus Tuairisciú ar an gComhshaol
- Monatóireacht a dhéanamh ar cháilíocht an aeir agus Treoir an AE maidir le hAer Glan don Eoraip (CAFÉ) a chur chun feidhme.
- Tuairisciú neamhspleách le cabhrú le cinnteoireacht an rialtais náisiúnta agus na n-údarás áitiúil *(m.sh. tuairisciú tréimhsiúil ar staid Chomhshaol na hÉireann agus Tuarascálacha ar Tháscairí)*.

Rialú Astaíochtaí na nGás Ceaptha Teasa in Éirinn
- Fardail agus réamh-mheastacháin na hÉireann maidir le gáis cheaptha teasa a ullmhú.
- An Treoir maidir le Trádáil Astaíochtaí a chur chun feidhme i gcomhair breis agus 100 de na táirgeoirí dé-ocsaíde carbóin is mó in Éirinn.

Taighde agus Forbairt Comhshaoil
- Taighde comhshaoil a chistiú chun brúnna a shainaithint, bonn eolais a chur faoi bheartais, agus réitigh a sholáthar i réimsí na haeráide, an uisce agus na hinbhuanaitheachta.

Measúnacht Straitéiseach Timpeallachta
- Measúnacht a dhéanamh ar thionchar pleananna agus clár beartaithe ar an gcomhshaol in Éirinn *(m.sh. mórphleananna forbartha)*.

Cosaint Raideolaíoch
- Monatóireacht a dhéanamh ar leibhéil radaíochta, measúnacht a dhéanamh ar nochtadh mhuintir na hÉireann don radaíocht ianúcháin.
- Cabhrú le pleananna náisiúnta a fhorbairt le haghaidh éigeandálaí ag eascairt as taismí núicléacha.
- Monatóireacht a dhéanamh ar fhorbairtí thar lear a bhaineann le saoráidí núicléacha agus leis an tsábháilteacht raideolaíochta.
- Sainseirbhísí cosanta ar an radaíocht a sholáthar, nó maoirsiú a dhéanamh ar sholáthar na seirbhísí sin.

Treoir, Faisnéis Inrochtana agus Oideachas
- Comhairle agus treoir a chur ar fáil d'earnáil na tionsclaíochta agus don phobal maidir le hábhair a bhaineann le caomhnú an chomhshaoil agus leis an gcosaint raideolaíoch.
- Faisnéis thráthúil ar an gcomhshaol ar a bhfuil fáil éasca a chur ar fáil chun rannpháirtíocht an phobail a spreagadh sa chinnteoireacht i ndáil leis an gcomhshaol *(m.sh. Timpeall an Tí, léarscáileanna radóin)*.
- Comhairle a chur ar fáil don Rialtas maidir le hábhair a bhaineann leis an tsábháilteacht raideolaíoch agus le cúrsaí práinnfhreagartha.
- Plean Náisiúnta Bainistíochta Dramhaíola Guaisí a fhorbairt chun dramhaíl ghuaiseach a chosc agus a bhainistiú.

Múscailt Feasachta agus Athrú Iompraíochta
- Feasacht chomhshaoil níos fearr a ghiniúint agus dul i bhfeidhm ar athrú iompraíochta dearfach trí thacú le gnóthais, le pobail agus le teaghlaigh a bheith níos éifeachtúla ar acmhainní.
- Tástáil le haghaidh radóin a chur chun cinn i dtithe agus in ionaid oibre, agus gníomhartha leasúcháin a spreagadh nuair is gá.

Bainistíocht agus struchtúr na Gníomhaireachta um Chaomhnú Comhshaoil
Tá an ghníomhaíocht á bainistiú ag Bord lánaimseartha, ar a bhfuil Ard-Stiúrthóir agus cúigear Stiúrthóirí. Déantar an obair ar fud cúig cinn d'Oifigí:
- An Oifig um Inmharthanacht Comhshaoil
- An Oifig Forfheidhmithe i leith cúrsaí Comhshaoil
- An Oifig um Fianaise is Measúnú
- Oifig um Chosaint Radaíochta agus Monatóireachta Comhshaoil
- An Oifig Cumarsáide agus Seirbhísí Corparáideacha

Tá Coiste Comhairleach ag an nGníomhaireacht le cabhrú léi. Tá dáréag comhaltaí air agus tagann siad le chéile go rialta le plé a dhéanamh ar ábhair imní agus le comhairle a chur ar an mBord.

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Residential Solid Fuel Use in Ireland and the Transition Away from Solid Fuels

Authors: John Eakins, Bernadette Power, Niall Dunphy and Gordon Sirr

Identifying Pressures

The Environmental Protection Agency has highlighted air quality issues in urban centres in Ireland in recent years. Emissions of fine particulate matter (PM2.5), attributable to the burning of solid fuels, such as coal, peat and wood, are a particular cause of concern. The complexity of the residential solid fuel sector, due to the heterogeneity of fuels being used and the lack of reliable and periodic data sources, hampers the task of developing effective policy solutions to support the continued transition away from the use of solid fuels for residential home heating. This research project aims to provide a deeper understanding of the sector using existing and new sources of data on solid fuel use. Some of the aims of the project include a more detailed examination of individual solid fuels; identification of the factors that determine the use of solid fuels, including the use of solid fuels as a "supplementary" fuel; and a quantification of the use of non-traded solid fuels, i.e. purchases made through informal markets or the own production and use of harvested peat, wind-blown trees or foraged wood.

Informing Policy

Recent government policy responses in this area include the announcement of new nationwide minimum environmental standards on residential solid fuels and a public awareness campaign to reduce air pollution from residential fires. Evidence from other countries suggests that a range of different policy measures, including retrofitting, tax measures and further awareness of the negative effects of using solid fuels, will be required to support an effective transition away from the use of solid fuels. The implementation of these measures should be made in a stepwise fashion, making improvements to the current situation. Accounting for the heterogeneity of the different solid fuel users, and especially the differences between primary and supplemental solid fuel users identified in this report, is an important aspect of the design of policy. Consideration should also be given to the potential for substitution to the non-traded solid fuel market. This report has highlighted the significance of the non-traded market, particularly for certain solid fuels, such as peat and wood, and for households in rural areas.

Developing Solutions

The analysis of existing data sets, a survey of residential solid fuel users and interviews with selected solid fuel users have provided valuable insights. The heterogeneity of solid fuel users in relation to household characteristics and levels of use is one aspect that has not been presented in research before. New data on supplementary solid fuel use can help to strengthen the understanding and management of air quality in Ireland. Another contribution of the survey of solid fuel users has been to highlight the significance and scale of the non-traded solid fuel sector and increase our understanding of who engages in its use. A periodic survey of a nationally representative sample of households going forward would be beneficial in capturing trends in this sector and household solid fuel use in general. Such a bottom-up approach would complement the top-down methods used by the Sustainable Energy Authority of Ireland in its energy balance statistics. A periodic survey would also provide a baseline against which progress in relation to policies implemented could be measured and tracked.

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