Wenhaston energy support group

Carbon emission estimates and survey results 2009

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Introduction

In September 2007 the Community Carbon Reduction (CRed) programme undertook a community carbon audit for the community of Wenhaston. CRed is now part of the Low Carbon Innovation Centre which was commissioned to undertake the analysis of a second community carbon audit in 2009 that generated responses from 138 households. This report presents the results of that survey.

As the survey design, the participants and some of the emissions factors have changed between the first and second audits any comparisons between the two reports should be made with care. At best comparisons will be indicative of possible trends.

The combustion of fossil fuels for power, heating and transport releases carbon dioxide and smaller quantities of other greenhouse gases into the atmosphere. Over a 250 year period from the start of the industrial revolution we are now witnessing the relatively sudden release of greenhouse gases from fossil fuels that were stored over a period of 80 million years about 470 million years ago. The carbon cycle attempts to absorb this additional load by increasing concentrations in the atmosphere, the oceans, in vegetation and soil. This is causing a higher concentration of these gases in the atmosphere leading to the retention of more heat energy in the earth's atmosphere and surface than is reflected back to space, which is linked to global warming and climate change.

There are many other reasons why reducing greenhouse gas emissions makes sense too. Fossil fuels are a finite resource so planning for the transition to a world powered by alternative sources of energy is a wise thing to do. As fossil fuels become scarcer the price becomes more volatile hence reducing our reliance on fossil fuels can help to avoid the economic impact of rapid price increases. Sustaining our supply of fossil fuels is also challenging, not least because our own national supply is dwindling. The UK relies more and more on imported energy from areas such as Russia and the Middle East. In recent times we have witnessed significant political unrest which, in some cases, has threatened supplies of gas to Europe.

Communities can help to engage with the challenge of reducing greenhouse gas emissions, firstly by understanding where they can be reduced. Wenhaston has provided information to enable the community to understand the causes of their emissions in order to meet this challenge.

Estimating Wenhaston Emissions

Survey data

The data was collected from a survey sent to 380 households[1]. The survey of both domestic *and* transport themes received 112 responses. This was augmented with data from a further 26 homes in Wenhaston taken from identical domestic energy efficiency questions collected using the Energy Saving Trust's 'home energy check' survey. In the 2007 survey a total of 166 people responded. Due to the different number of respondents between 2007 and 2009 total emissions, energy use of frequencies cannot be directly compared. Instead percentage comparisons are presented.

In presenting these data we must emphasise that the results are only as accurate as the respondents input to the surveys. The data collected in many cases are based on respondents' own estimates, or perhaps in some cases guesses. This must be taken into account if one is attempting to draw conclusions from these data on actual circumstances or behaviour of respondents. Comparisons between this survey and the 2007 survey are also difficult to make for some of the themes because the questions are not the same or the response categories are different. Some of the results presented are inherently complicated because the design of the response categories does not necessarily capture data in a way that provides clear answers or indeed clear questions to report on.

Household estimates

The greenhouse gas emissions for Wenhaston's households are estimated by applying an accepted model of energy use for specific housing types and fuels[2]. The model uses various assumptions on the energy use and heat losses from properties as informed by the survey data on the standard of insulation etc. The emission estimates presented do not represent actual energy use. More informative and accurate estimates would require actual fuel and electricity use data from each resident.

Transport estimates

The emissions estimated for transport are also based on government approved emission methods. These take into account research into pollutant emissions from combustion of fuels during drive cycles that aim to represent actual driving behaviour averaged over a set distance. Flight emissions also are estimated by fuel burn for various flight distances. There is ambiguity on the questions on the number of flights taken; it is not clear whether this asks respondents to provide flights taken by an individual respondent or for all members of each household.

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[1] Sixty of these dwellings are indicated as holiday homes. It is not certain from the data we received whether any of the holiday home owners responded to the survey.

[2] Modelling software using the 2001 standard assessment procedure (SAP) generated simplified emission profiles for a suite of generic housing types; terrace, detached, semi-detached, bungalow, flats etc with the different combinations of fuels and levels of insulation. These were matched to the survey results. These cannot reflect actual fuel use but are best available estimates using the detail available from the survey data. For information on the details of the SAP2001 methodology see http://projects.bre.co.uk/sap2001/

Overview

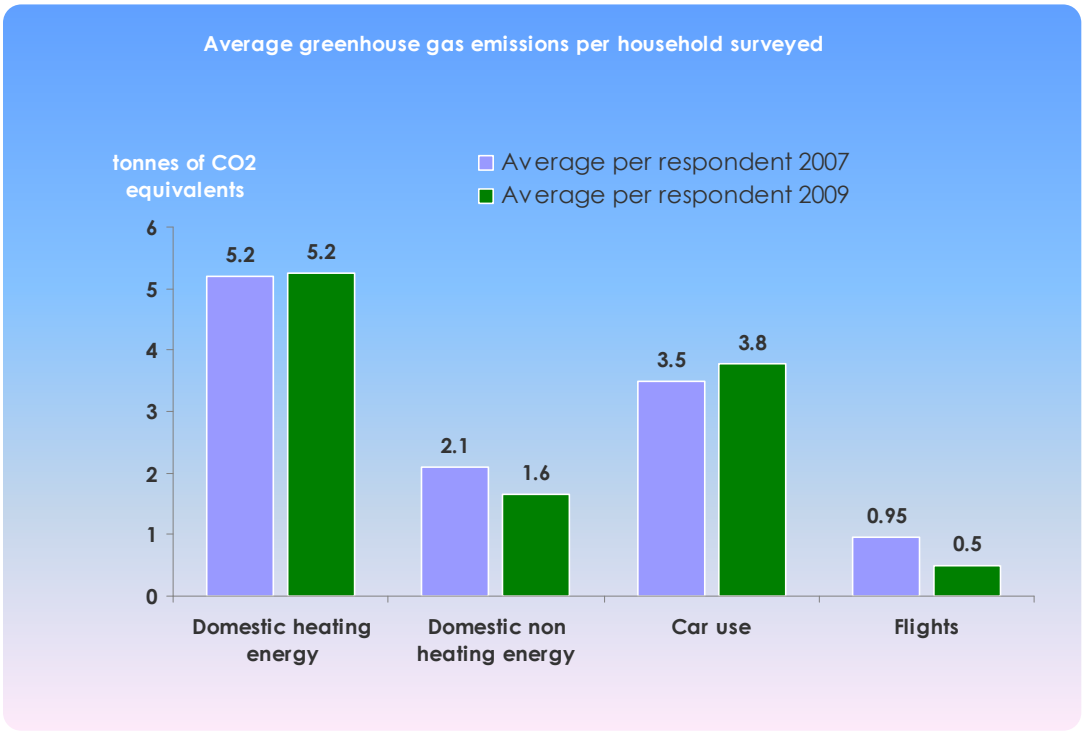
Per household emissions

The survey data provided by Wenhaston Energy Support Group was applied to UK government greenhouse gas emission factors and household emissions model. This gives an **average per household emission of 10.9 tonnes of carbon dioxide equivalents per year** for the surveyed residents. This includes emissions from residents' estimates of their driving behaviour, household condition and number of flights per year. The proportional contributions in per cent are shown in figure 2. The 2007 proportional contributions are shown in Figure 3. In both surveys the majority of emissions are dominated by the household heating energy, and as Figure 4 shows these are mainly from typically more carbon intensive oil fuelled heating systems.

The differences in both the flights and domestic non heating energy results presented here for 2007 and those of the original 2007 report are a result of the original report using incorrect emissions factors. This has been corrected for flights in the graph below but could not be corrected for non heating energy. The differences per respondent emissions estimates for each of the respective categories between the 2007 and 2009 survey show little significant change in all except the emissions from flying.

Again the reduction in domestic non heating energy in the 2009 survey is largely due to a methodological difference in survey calculations. Without actual energy use data non heating energy differences cannot be presented as anything more than a reflection of the model's crude characterisation of non heating energy for a specific house type. As such this is independent of any influence of inter-annual differences in outside temperatures.

Figure 1. Per household greenhouse gas emission estimates **per year.**



	2009			2007		
	Tonnes CO_2 equivalent	Number of Respondents	Average per respondent 2009	Tonnes CO_2 equivalent	Number of Respondents	Average per respondent 2007
Domestic heating energy	724	138	5.2	863	166	5.2
Domestic non heating energ	228	138	1.6	349	166	2.1
Car use	424	112	3.8	581	166	3.5
Flights	54	112	0.5	157	166	0.95
TOTAL	**1430**	**-**	**11**	**1950**	-	**11.7**

Table 1 Summary emission estimates from the 2009 and 2007 surveys. *(Please note: absolute figures should not be compared as a metric for performance since the number of households differs between surveys).*

Figure 2 Proportional contribution of the estimated greenhouse gas emission per household from the **2009 survey.**

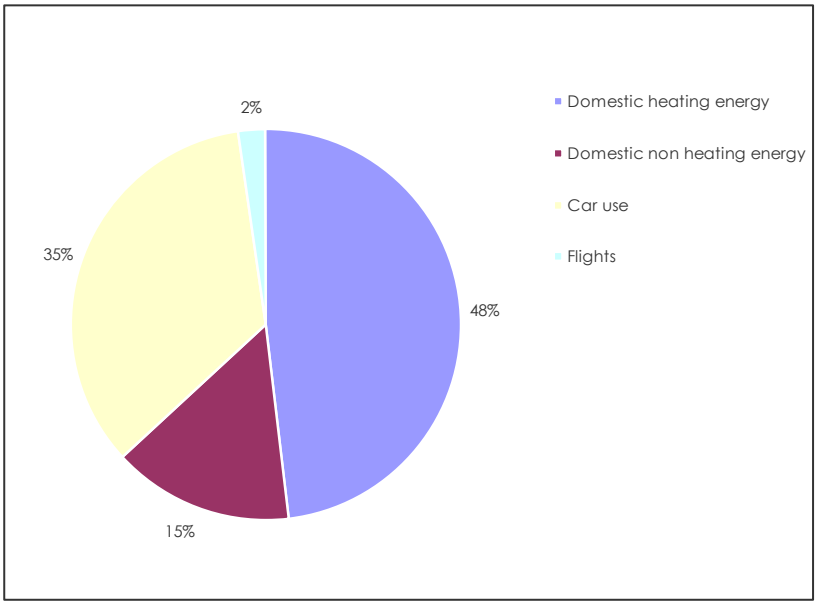
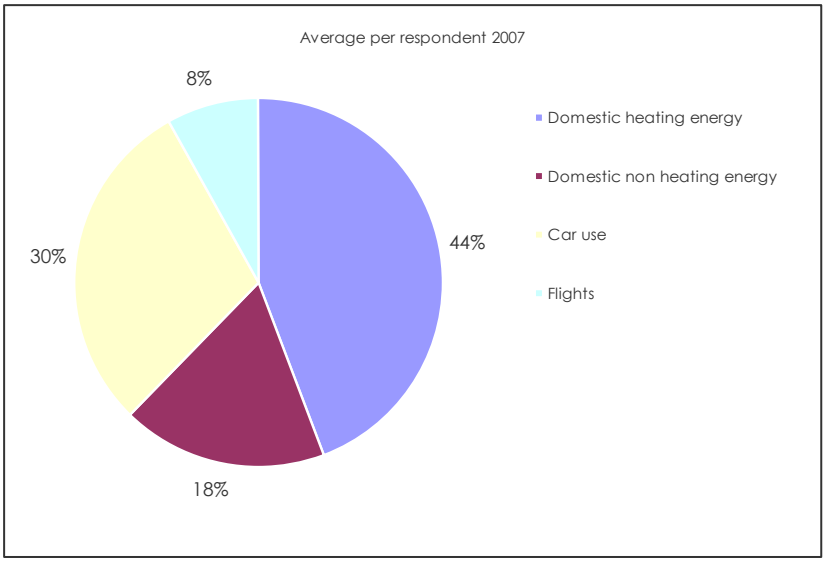


Figure 3 Proportional contribution of the estimated household greenhouse gas emissions from the **2007 survey.**



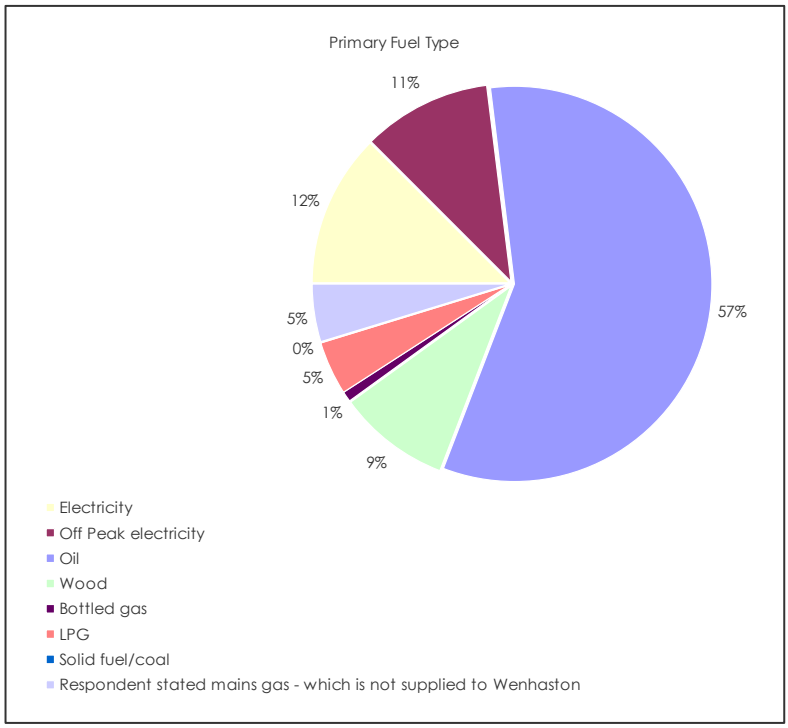


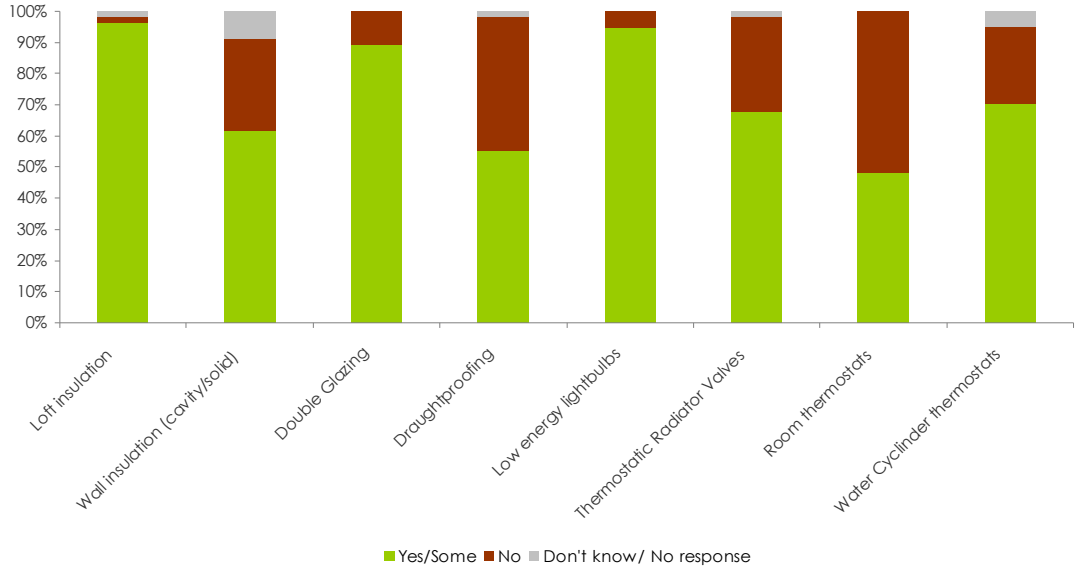
Figure 4 Reported fuel types used by the households surveyed

Housing Information

General energy efficiency measures

Figure 5 shows the degree of uptake of home energy efficiency measures. Relatively lower uptake of wall insulation compared to loft insulation reflects that over a third of households surveyed have solid walls where cavity insulation is not possible, (Figure 8).

Figure 5 The degree of uptake of a broad range of energy efficiency measures taken by the 138 surveyed households.



	Loft insulation	Wall insulation (cavity/solid)	Double Glazing	Draughtproofing	Low energy lightbulbs	Thermostatic Radiator Valves	Room thermostats	Water Cyclinder thermostats
Yes/Some	126	75	115	62	128	81	55	89
No	3	36	14	49	7	37	59	31
Don't know/ No response	2	11	0	2	0	2	0	6

Table 2 Frequency Data from the 138 respondents (2009) used in **Figure 5**.

Loft Insulation

The very high uptake of loft insulation is notable, but this could be improved substantially by topping up. The majority of households surveyed (

Figure 6) claim to have insulation below the recommended thicknesses; 270 mm for glass wool; 250 mm for rock wool; or 220 mm for cellulose. Nine million homes in the UK are insulated to 100 mm, a thickness which has not been considered adequate since the early 1980's[3]. The thickness categories reported differed between 2009 and 2007 surveys. The data was re-categorised into common formats for comparison.

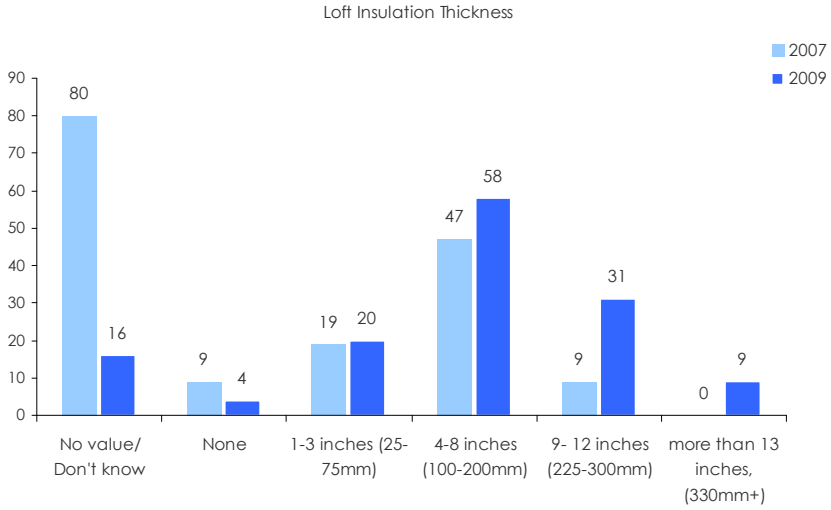


Figure 6
Number of respondents indicating their loft insulation thickness (138 households surveyed in 2009 and 166 surveyed in 2007(two respondents did not enter a value giving 164 data points).

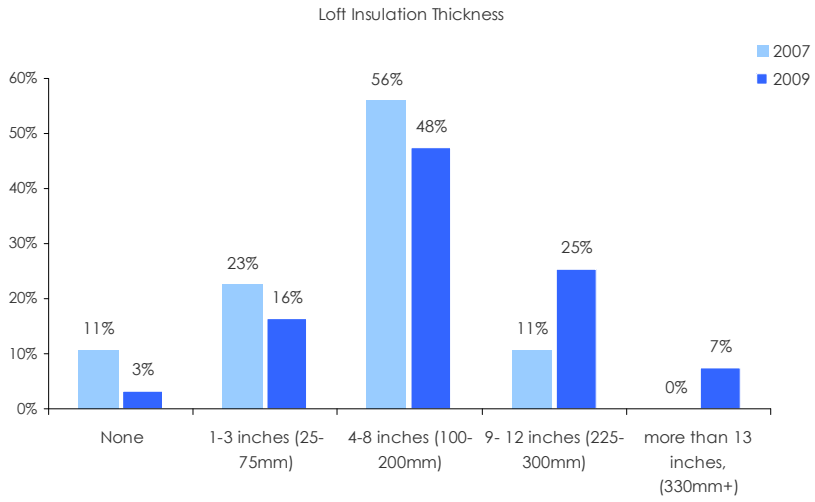


Figure 7
By removing the 'no value' or 'don't know' responses the per cent values for 2007 and 2009 surveys can be compared.

[3] National Insulation Association - http://www.nationalinsulationassociation.org.uk/householder/

Cavity Wall Insulation

A small proportion of households reported uninsulated cavity wall buildings in the 2009 survey. There may be potential to improve the energy efficiency of these properties.

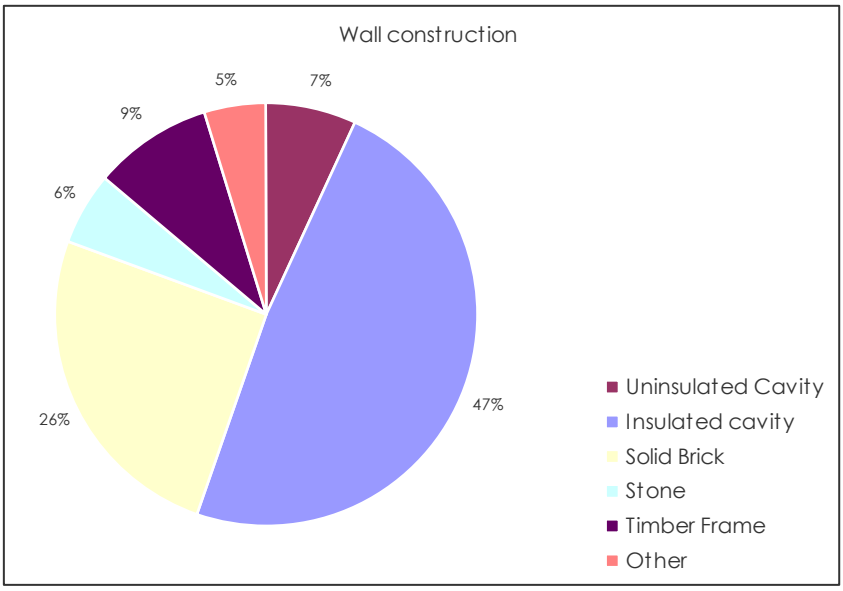


Figure 8
2009 Survey responses given for households' wall construction, **(138 households** 112 WESG survey and 26 EST HEC respondents**).**

	Uninsulated Cavity	Insulated cavity	Solid Brick	Stone	Timber Frame	Other
Frequency	10	70	37	8	13	7
Per cent	7%	48%	26%	6%	9%	5%

Table 3 respondents households wall type (nb the total is greater than the number of respondents 138, since some respondents indicated more than one type of wall in their property).

Heating Systems

The majority of surveyed households heating systems are oil fired wet heating systems. The emissions from oil fired heating systems are less carbon efficient than central gas supplied systems; however Wenhaston households are not connected to the gas grid. To reduce these emissions waste oil based biodiesel has been used in oil fired domestic furnaces[4]. This may not be cost competitive with current fossil fuels. Modern wood boilers are also available if a sustainable wood fuel source can be secured.

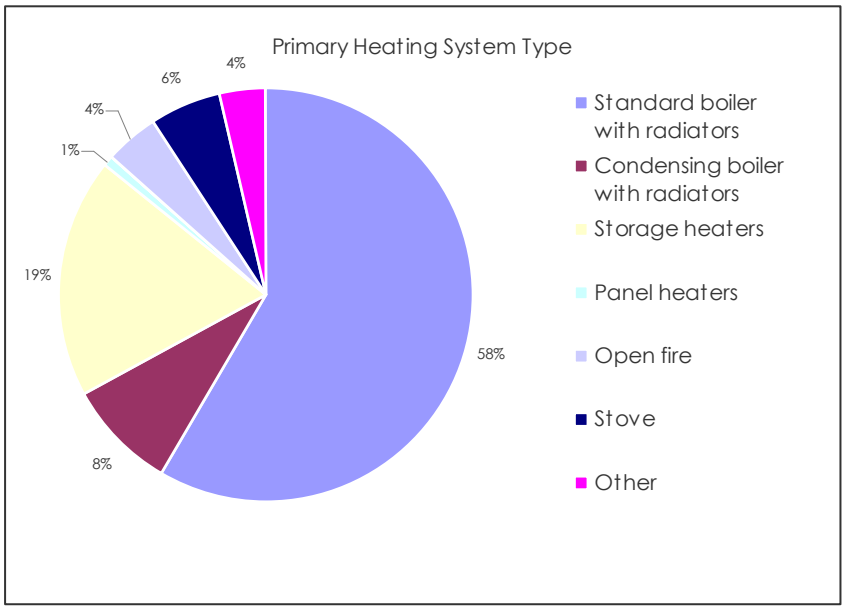


Figure 9
The chart shows the data from both the WEG survey and the EST check combined (138 households), as does Figure 10.

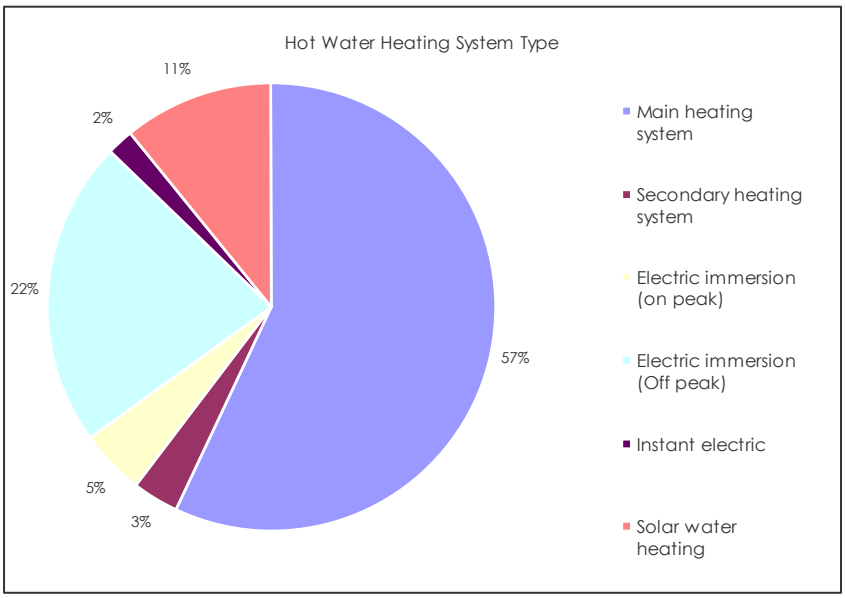


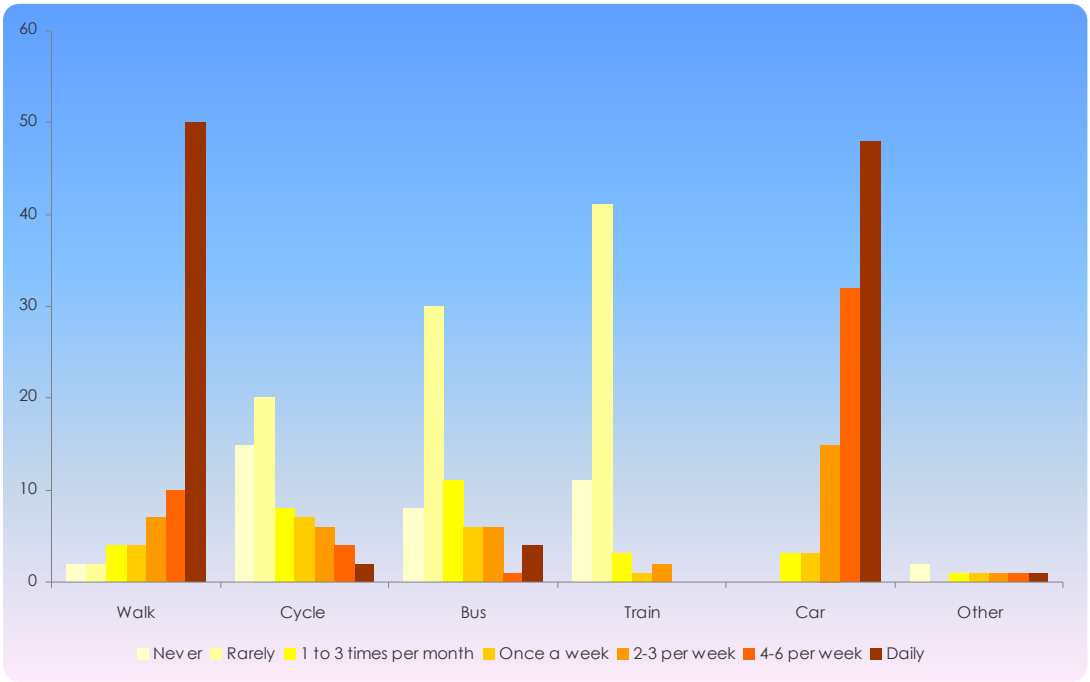
Figure 10
The rise in the proportion of solar water heating is encouraging to see. In the 2007 survey only one house reported having solar thermal panels.

[4] The Carbon Connections Programme (www.carbon-connections.org) is completing a trial of biofuel use for domestic heating that has demonstrated the successful use of waste oil based biofuel. The conversion of the boiler and the blending of the fuel are both important elements that have been investigated and demonstrated as part of the project.

Mobility and transport

Despite reliance on the car as a main mode of transport encouragingly as many people it seems walk daily as use cars.

Figure 11 *The sum total of all respondents estimated frequency of use of each respective transport mode.*



Frequency	Walk	Cycle	Bus	Train	Car	Other
Never	2	15	8	11	0	2
Rarely	2	20	30	41	0	0
1 to 3 times per month	4	8	11	3	3	1
Once a week	4	7	6	1	3	1
2-3 times per week	7	6	6	2	15	1
4-6 times per week	10	4	1	0	32	1
Daily	50	2	4	0	48	1

Table 4 The frequency of travel mode chosen by 2009 respondents. This is summarised from the actual responses shown in Table 11.

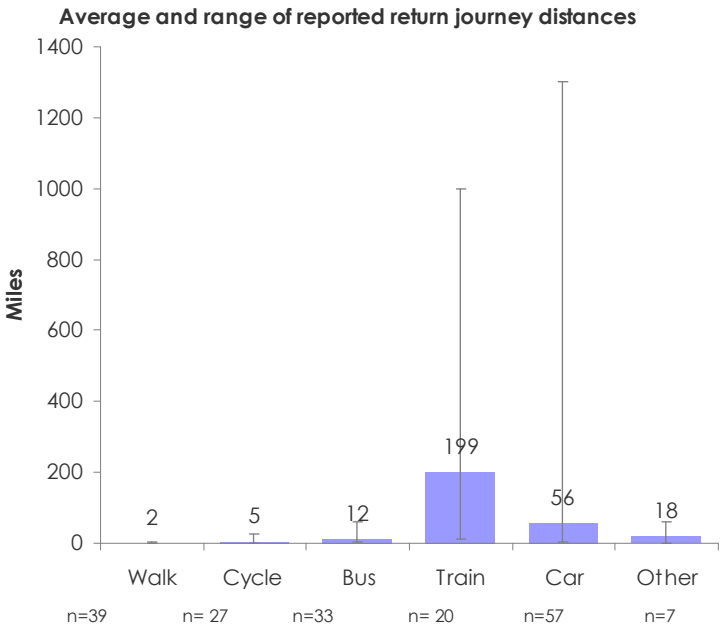


Figure 12 *Average respondents estimated return journey distances by their chosen transport mode. The vertical lines show the **range** of reported distances. Respondents train journeys are estimated to be the furthest journeys on average but both reported train and car journey distances vary considerably.*

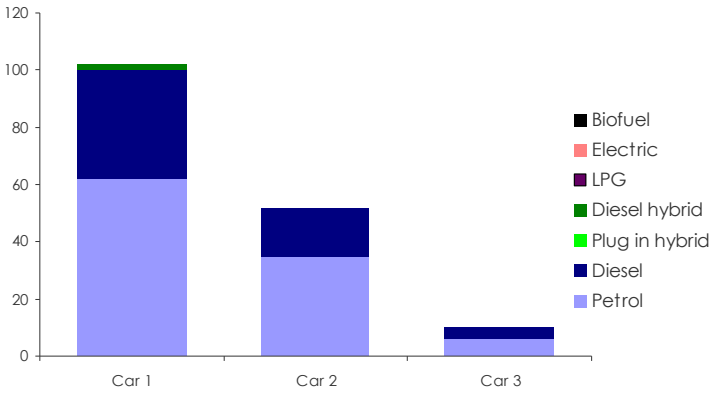


Figure 13 *Reported vehicle fuels used by surveyed householders.*

Figure 14 *Surveyed householders' stated number of cars owned. This is similar to the situation that the survey in 2007 shows.*

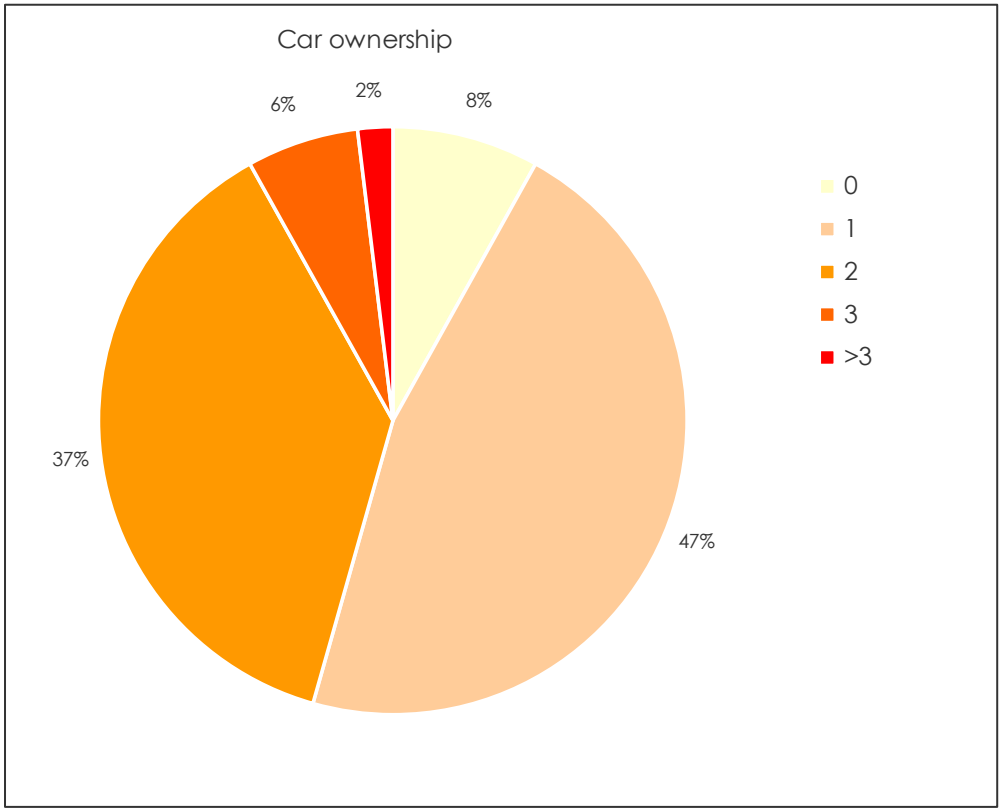
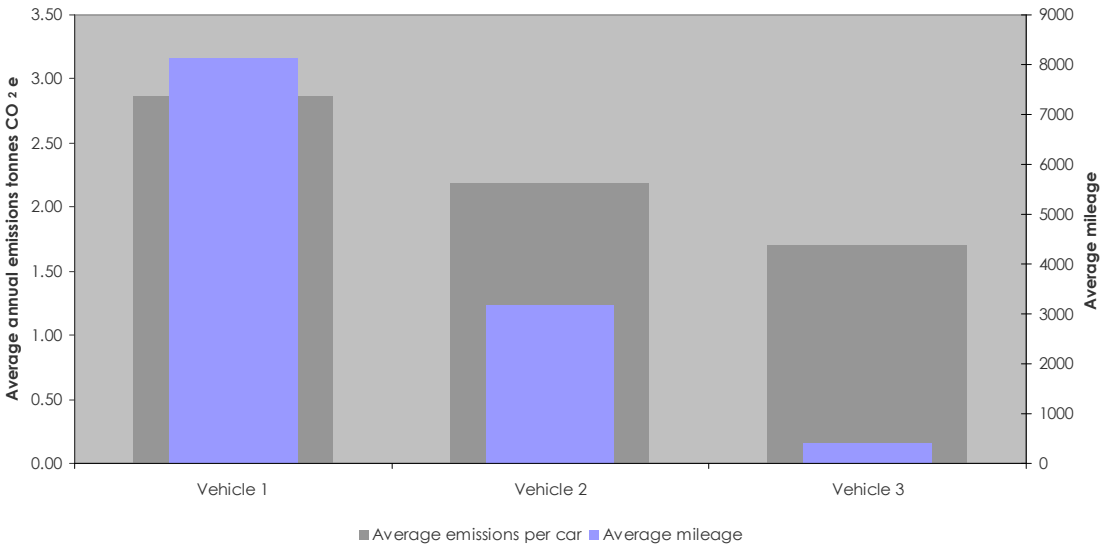


Figure 15 *Average emissions per vehicle and average mileage per year from householder vehicles; the respondents first vehicles on average have the larger and least fuel efficient engines compared to the other vehicles owned, and these vehicles are the most used – i.e. they have the highest average mileage.*



2009 survey

	<2500	2500-4999	5000-7499	7500-9999	10000-12499	12500-14999	15000-17999	18000-20999	<30,000	Totals
car 1	10	15	21	13	20	10	4	4	3	100
car 2	13	7	13	7	6	2	1	0	2	51
car 3	5	2	1	0	1	1	0	0	0	10
Total cars	28	24	35	20	27	13	5	4	5	161
Per cent	17%	15%	22%	12%	17%	8%	3%	2%	3%	100%

2007 survey

	< 2500	2500 - 4999	5000 - 7499	7500 - 9999	10,000 – 12,499	> 12500	15000-17999	18000-20999	<30,000	Total
Frequency	35	43	58	41	29	30	no data	no data	no data	236
Percent	15%	18%	25%	17%	12%	13%	no data	no data	no data	100%

Table 5 and Table 6 *Respondents estimated annual mileage driven. Headings are the annual mileage rang categories. Respondents were asked to indicate which category of annual distance each of their vehicles had been driven in 2008/9.*

2009 Car size

Frequency	Small	Medium	large	Total
Car 1	27	63	11	101
Car 2	17	23	10	50
Car 3	4	3	3	10
Total	48	89	24	161
Per cent	30%	55%	15%	100%

2007 Car size

	Small <1.4 litre	Medium 1.4 - 2 litre	Large >2litre	SUV	Total
Frequency	75	120	43	2	240
Percent	31	50	18	1	100

Table 7 and Table 8 *Respondents car sizes. Not much change between the two survey years. Different samples may account for the <5% differences between the two surveys.*

Figure 16 *Most drivers would not switch from driving. However there may be some opportunities for better marketing of informal or formal car sharing (15% of respondents indicate some form of car sharing may help). Improved marketing of bus time tables would seem to be the next single solvable issue to aid switching from car use.*

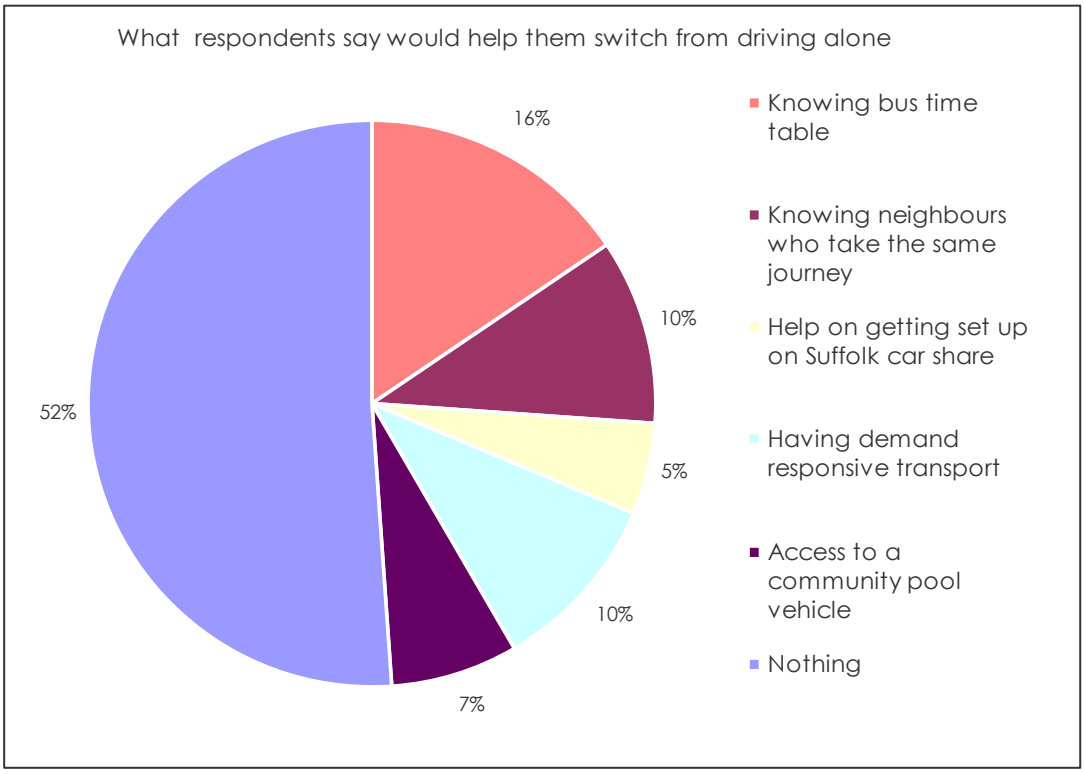
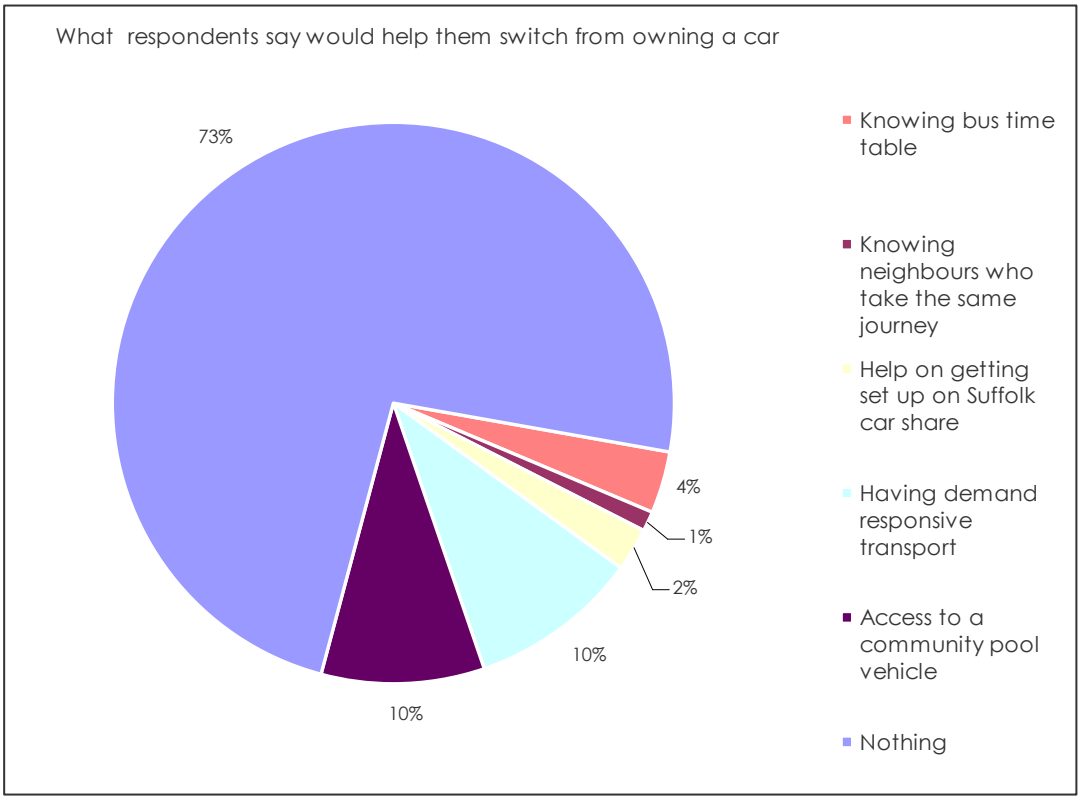


Figure 17 *Almost three quarters of drivers would not switch from owning a car*



Flights

Figure 18 *Short haul flights dominate frequency the kind of flights taken by residents*

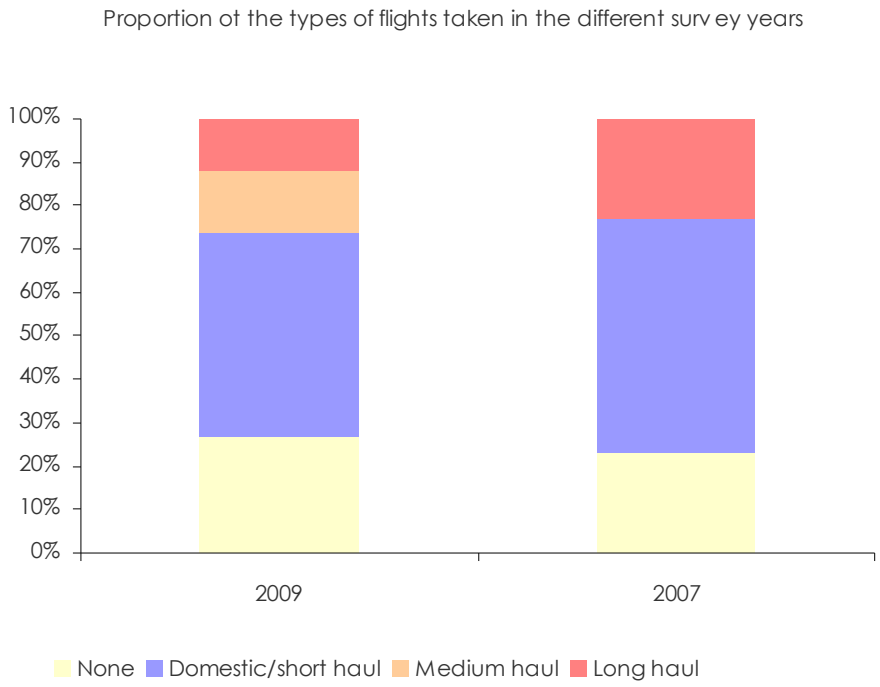
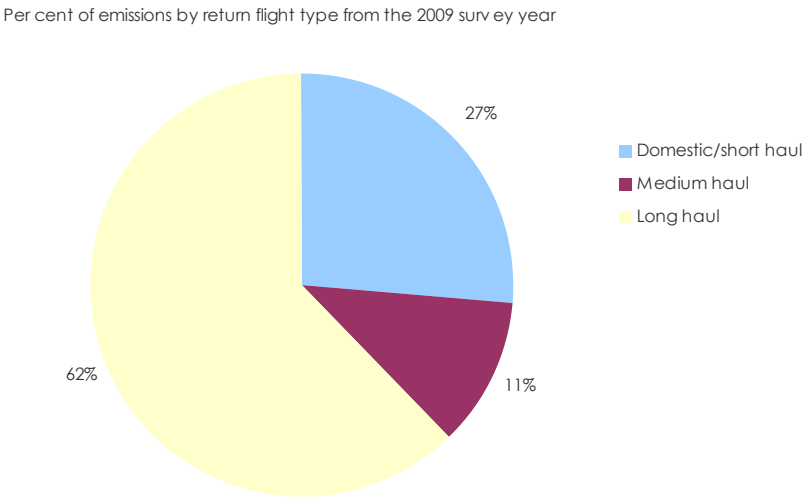


Figure 19 *Though Figure 18 shows that short haul is the most common reported flight categories chosen by respondents, the largest potential impact on greenhouse gas emissions are the relatively fewer flights taken that are long haul*[5].



[5] The official government emissions factors per person estimated for long haul per km distance flown are not so different from short haul (or medium haul as we define here); the emissions are only 12% less per passenger travelling a km than a long haul flight. It is the large differences in average distance flown that makes the long haul return flight release more carbon dioxide. We use average return distances for domestic, medium and long haul of approximately around 1,000km, 2,000km and 13,000km respectively. These distances, halved (because we are calculating returns flight distances)) are referenced as average distance to destinations for these flight types in the DEFRA greenhouse gas reporting guidelines 2009.

Table 9 and Table 10
Show the frequency flights and estimated emissions. 2007 emissions have been corrected as these were seen to significantly overestimate the emissions from long haul flights.

2009	Domestic/short haul	Medium haul	Long haul	None
Frequency	90	28	23	52
Emissions	14	6	34	0

2007	Domestic/short haul	Medium haul	Long haul	None
Frequency	201	not collected	85	85
Emissions	32	n/a	125	0

Conclusions

Perhaps unsurprisingly the carbon footprint of a typical Wenhaston household remains dominated by emissions from space heating and car transport. This is a similar position to the community carbon audit undertaken in 2007 and reflects the challenges of:

1. Switching away from oil-based heating systems; and
2. Switching away from car use.

Reducing emissions from space heating may now be more possible with the advent of the biofuel for domestic heating trials undertaken by the Carbon Connections Programme at UEA. Alternatively modern wood fuelled heating systems could be investigated to supplement or replace older oil fuelled boilers. This will however depend on the availability of a sustainable and economic supply of quality wood fuel in the region.

Reducing the emissions from car use is possibly even more challenging, not least as over half of the respondents (52%) reported that nothing would switch them away from car use and nearly three-quarters (73%) report that nothing would help them switch away from owning a car. It seems that the future here lies in improving the technical efficiency of vehicles rather than in generating significant levels of modal shift.

Electric vehicles may provide a solution to shorter journeys and reduce localised airborne pollution burdens in urban areas, but the reduced operational global warming impact depends heavily on the delivered carbon intensity of the electricity generation used to charge the vehicle and the weight of the vehicles with batteries. Currently energy sources for national grid electricity may provide only limited benefit for lowering the carbon intensity of extra urban electric vehicle travel compared to modern efficient diesel engines.

The modal distance travelled and similar destinations could suggest that shorter journeys may be catered for by improving public transport services and ridership or by improving car sharing, perhaps by setting up a parish car sharing scheme.

Appendix

2009 survey responses

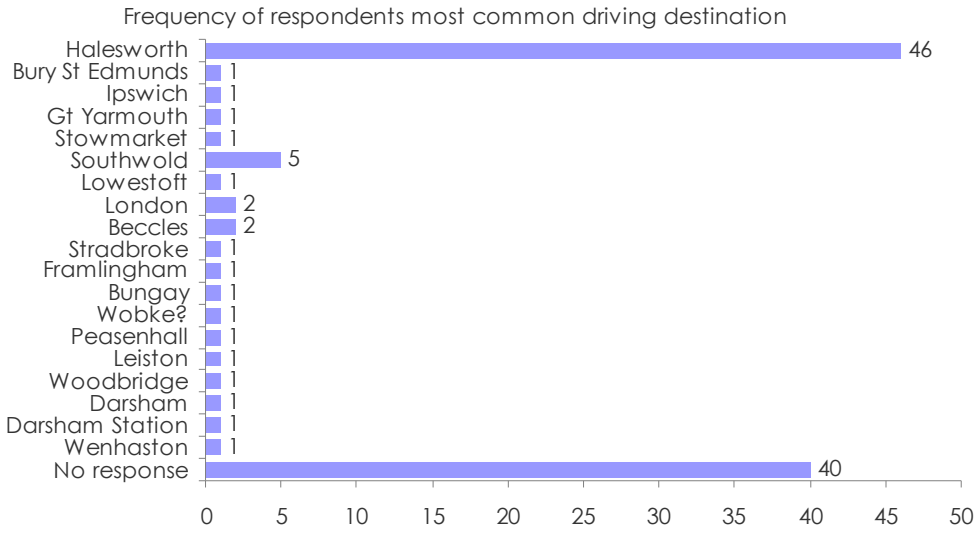
Response	Walk	Cycle	Bus	Train	Car	Other
Not asked	26	26	26	26	26	26
Never	2	15	8	11	0	2
Rarely	2	20	30	41	0	0
1per month	1	2	5	3	1	0
2 per month	3	4	2	0	1	1
3 per month	0	2	4	0	1	0
4 per month	0	3	1	0	1	0
5 per month	0	0	1	0	0	0
6 per month	0	0	1	0	0	0
1 per week	2	1	5	0	3	2
2 per week	4	4	4	1	2	1
3 per week	3	2	2	1	13	0
4 per week	8	1	0	0	17	0
5 per week	2	3	1	0	13	1
6 per week	0	0	0	0	2	0
Daily	50	2	3	0	47	1
8 per week	0	0	0	0	0	0
9 per week	0	0	0	0	0	0
10 per week	0	0	1	0	1	0

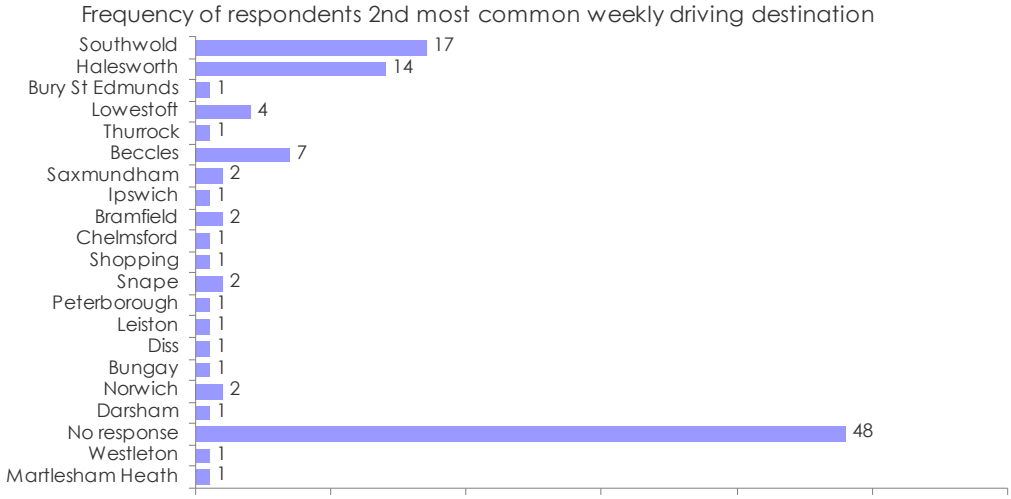
2007 survey responses

Response	Walk	Cycle	Bus	Train	Car	Other
Once a year	0	2	0	0	0	n/a
A few times a year	5	20	41	53	0	n/a
Monthly	5	15	6	16	2	n/a
Weekly	26	18	22	4	26	n/a
Daily	76	8	4	2	112	n/a
Never	2	33	29	28	0	n/a

Table 11 and Table 12, show the travel mode frequencies given by respondents collected in each year. These should be placed in an appendix, but is necessary here to show the non compatible response categories in the 2009 and 2007 surveys. The duplications in 2009 responses were grouped into more sensible frequency ranges to allow presentation of the results in **Figure 11**.

Figure 20 *Frequency of first, second and third most travelled to destinations as specified by householders surveyed*





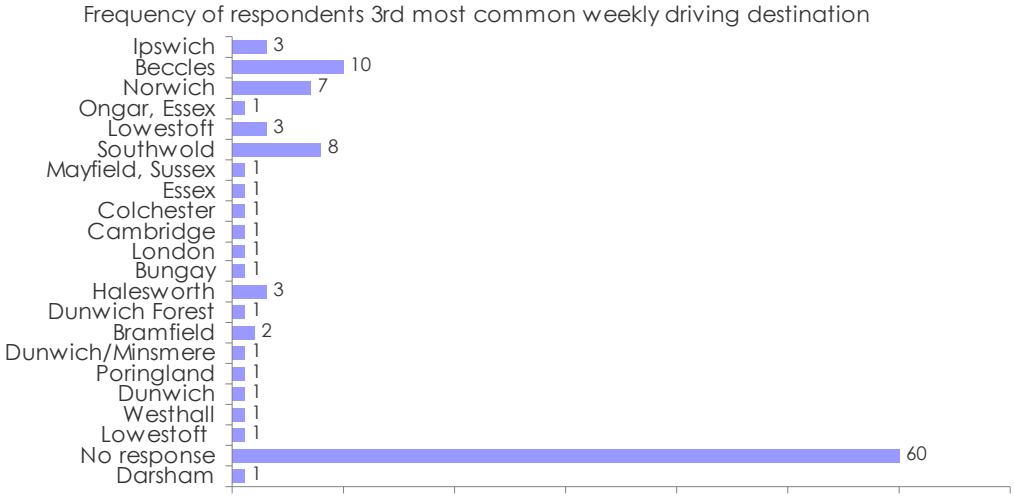


Figure 21 *total weekly mileage of first, second and third most travelled to destinations as estimated by householders surveyed (based on householders distance estimates and their reported frequency of trips). Please note the distance scales differ.*