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# Enabling Sustainable Lifestyles in New Urban Areas: Evaluation of an Eco-Development Case Study in the UK

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**Abstract:** This study evaluated the actual environmental behaviours in an eco-development case study in the UK, which was designed to enable more sustainable lifestyles. Data analysis was based on the resident responses to a development-wide questionnaire survey ($n$ = 89), household interviews ($n$ = 12) and waste measurements. Reported energy- and water-saving behaviours were fairly common. The mean waste recycling rates (45% to 60%) were similar to local and national averages, and were below the target of 80%. The mean rates of purchasing organic food (37%), growing food (31%) and meat consumption (in 36% of all meals) indicated that the food behaviours were not more pro-environmental. Car-based modes of transportation were used for 71% of all the reported trips on average, which was higher than the national average, and the target of 55%. Despite these reported behaviours, most of the residents regarded their new lifestyles as more sustainable. This was related to the notion of energy efficiency and low-carbon technologies, rather than changes in behaviour. The findings of this study and similar studies indicated that enabling environmental behaviours in new developments is challenging. New policies need to be more holistic and support the delivery of not only well-performing buildings, but also developments that make sustainable urban living a reality.

**Keywords:** eco-development; sustainable neighbourhood; net zero carbon urban design; environmental behaviour; sustainable lifestyle



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## 1. Introduction

### 1.1. Policy Context

Preventing the worst impacts of climate change requires dramatic strengthening of national policies [1]. Given the climate emergency, the UK Government committed to a net-zero economy target for 2050 [2]. Household lifestyle/behavioural changes will play an essential role in meeting the national [3] and global climate goals [4]. The proposed national pathway to net zero requires reducing demand (between 10% and 40%) for the key carbon-intensive behaviours: driving, household waste and the intake of meat and dairy [3]. In this context, it is critical to identify and introduce effective strategies that can encourage such behavioural changes [5].

It is believed that human behaviour is shaped by external factors (such as physical settings) and personal factors (such as attitudes, norms and habits) [6]. The impact of personal factors seems to dominate over contextual factors in household consumption-based emissions [7]. Among a large number of models of consumer behaviour [8], for instance, the Theory of Planned Behaviour [9] fairly successfully explains travel mode choices, waste recycling, water use and meat consumption, where the balance between costs and benefits is a determining factor. Although shaping environmental behaviours with external factors seems to have been less systematically examined [10], this approach is still deemed more effective than altering personal values and attitudes [11]. Regarding human settlements, new urbanising areas are thought to offer the greatest carbon-reduction

potential, as their physical characteristics are not yet locked in [12]. Hence, spatial and urban planning are increasingly being regarded as important demand-side strategies for reducing carbon emissions [13,14].

Planning has been given a central role in the UK's sustainable development and in mitigating climate change [15,16]. The Government's vision for new sustainable neighbourhood-scale developments was demonstrated in the former eco-towns [17] and the current garden towns and villages [18] housing schemes. However, both schemes were criticised for allowing low-density developments on greenfield sites, which was associated with urban sprawl and other issues [19–23]. The National Planning Policy Frameworks [24–26] were deemed insufficient in ensuring that the dramatic action needed to support the net-zero economy goal was demonstrated in local and neighbourhood plans [27,28].

### *1.2. Eco-Developments*

Over the last two decades, an increasing number of urban eco-developments addressing sustainability and environmental challenges have been planned and delivered worldwide [29]. Despite their growth in numbers, due to the lack of policy drivers and market demand for more sustainable housing, the eco-developments have mostly been delivered as one-off demonstration projects [30–32]. The developments have varied in spatial scale, from small housing projects to eco-cities. The neighbourhood scale is deemed particularly suitable for combining urban design and new technologies [14], offering the potential to respond to and reinvent locality [33,34], benefitting from economies of scale [35] and generating new learning [36].

Eco-developments can utilise different sustainable planning principles, urban systems and technological measures in addressing their design objectives [37–42]. The recurrent design approach prioritises implementing energy efficiency and low-carbon technologies, which reduce emissions intrinsically, minimise resident involvement and do not require changes in lifestyle or personal values [43,44]. Achieving further carbon reductions by providing bicycle lanes, urban gardens and other on-site measures that could enable or limit household environmental behaviours is considered far less certain [45].

## 2. Literature Review

This section presents a literature review regarding the evaluation of environmental behaviours in eco-developments. The significance of eco-developments really depends on the extent to which the design aims have been achieved during the occupation (in-use) stage [42]. However, actual environmental behaviours are rarely evaluated against the design aspirations in new developments. The evaluation of the outcomes of neighbourhood-scale planning is not mandatory in current policy. In addition, the advantages of understanding the impacts of local planning can be overshadowed by concerns in regard to the time, costs, needed expertise, data availability and exposure of potentially poor results [46].

The in-use evaluations of eco-developments tend to focus on the energy and carbon performance of case study buildings [47–50]. However, it is argued that the scope of evaluations should expand from building performance to household lifestyles. Due to the Jevons paradox [51] and other behavioural factors, energy efficiency alone is insufficient for achieving reductions in overall energy demand and in household footprints [52].

Available studies that evaluated actual environmental behaviours, and the impact of the implemented design measures in eco-developments, are briefly presented in Table 1. The selection captured housing developments and neighbourhoods, excluding evaluations of city-scale eco-developments, such as Tianjin in China [53]. Evidence from the selected studies should be interpreted with caution, due to the possible biases associated with the self-selection of the participants, social desirability, stakeholder's involvement in the study and non-academic sources [54,55].

**Table 1.** An overview of key findings about actual environmental behaviours and the impact of the implemented measures in the evaluated eco-development case studies.

| Study | Development Name, Location and Size | Key Findings |
| --- | --- | --- |
| [56] | BedZED<br>UK<br>100 dwellings | About 10% lower ecological footprint due to more energy-efficient dwellings. Compared to those in conventional housing, residents seemed to drive and compost less, and grow less food. Proximity to the subway station and discouragement of on-site parking probably contributed to the reduced car use. |
| [45] | 13 case studies<br>UK<br>27–303 dwellings | Responses suggested that energy- and water-saving behaviours were more frequent. However, households owned more cars and composted less compared to national averages. |
| [57] | Derwenthorpe UK<br>500 dwellings | About 10% lower carbon footprint due to more energy-efficient dwellings. Higher car usage was associated with the end-of-town location of the site. Waste facilities appear insufficient. Provided measures had a marginal impact on food behaviours. |
| [58,59] | Adamstown<br>Ireland<br>1126 dwellings | Many design measures commonly found in eco-developments were lacking. Resident dissatisfaction with the lack of basic on-site facilities. Two-thirds of residents used a car for commuting, despite the good public transportation links in the vicinity. |
| [60,61] | Vauban<br>Germany<br>2000 dwellings | Parking being limited to only one communal zone and multiple public transportation options contributed to the significant increase in car-free households and bicycle use. Other on-site measures were welcomed, but residents continued with fairly common everyday practices. |
| [44,62–65] | Hammarby<br>Sweden<br>11000 dwellings | Multiple on-site amenities and public transportation options contributed to achieving the 20% car-use-rate target. Households opposed proposals for limited parking and did not behave more pro-environmentally in regard to waste, water and dwelling energy use compared to households in other areas of the city. |

Differences in the local contexts, design intents, assessment criteria and research methods made it difficult to effectively compare the findings of the presented studies. Although some eco-developments achieved the set targets for car-use reduction, most of the studies reported that the actual household behaviours were not more sustainable, as anticipated. The lack of lifestyle changes in Vauban and Hammarby developments was attributed to the top-down planning approach, which excluded residents from the planning process, assuming that the provided design measures would be accepted and used as envisioned. In the BedZED and Derwenthorpe studies, it was argued that a more significant reduction in household footprints would require broader sustainability measures, which would reduce the environmental impacts of household behaviours occurring beyond the small sites of the eco-developments.

Due to the small number of rigorous evaluations, the potential of eco-developments in encouraging pro-environmental behaviours is still not well understood. Considering the urbanisation trend and the vital role of behavioural change in meeting climate objectives, more empirical evidence about actual behaviours and achieved carbon emission reductions is urgently needed. In response to this context, this study evaluated environmental behaviours in an eco-development case study in the UK, which was designed to enable more sustainable lifestyles. Compared to other evaluations of eco-developments, which are often focused on particular behaviours or on estimating footprints, this study presents a more systematic analysis of a broad range of behaviours regarding energy, water, waste, food and transportation.

## 3. Methods

### *3.1. Case Study*

The case study development encompassed the initial two completed phases of a planned four-phase town extension. The two phases consisted of 157 dwellings, mainly terraced houses. The development was designed to become an exemplar of sustainable living. Consequently, it aspired to achieve a wide range of ambitious environmental design targets in regard to dwelling performance and household behaviours. Table 2 presents the design targets related to the environmental criteria of interest in this study.

**Table 2.** Case study design targets per environmental criterion.

| Criterion | Design Targets |
| --- | --- |
| Energy | Mean energy use of 75.4 kWh/m$^2$/year per dwelling. |
| Waste | 80% household waste diverted from landfill by 2020. |
| Transportation | 45% of trips by non-car means by 2016. |
| Food | Increased consumption of low-impact foods. |

In order to achieve the targeted energy performance, dwellings were provided with highly energy-efficient fabric, appliances, in-built lights and heating systems. Households were provided with smart energy monitors providing real-time information about energy use and generation. Direct connections to roof-mounted photovoltaic (PV) panels allowed households the opportunity to yield benefits from the generated energy. Regarding transportation, waste and food behaviours, it was hoped that the provided on-site facilities and amenities would make it easy for households to behave more pro-environmentally.

Setting an 80% target rate for recycled and composted waste could be regarded as quite ambitious, considering the district's mean rate of 55% [66]. Apart from the conventional kerbside bins and communal recycling bins, households were provided with kitchen and garden compost bins. In addition, the local authorities provided support by holding informational stands during major community events.

The planned provision of low-impact foods in on-site shops, via large allotments, community orchards and other edible landscape was sidelined in the actual delivery. At the time of the survey, opening on-site shops was still not feasible due to the small development scale; the planned edibles were substituted by decorative plants, while the allotments were significantly downsized and still under construction.

Provided only with a primary school and a small office building, the development's households depended on the services in the surrounding urban area. The provided transportation measures included a bus line to the town centre (with further train and bus services), discounted bus tickets, an on-site folding-bike rental service, an electric car club, private electric car chargers and limited parking for the households in flats and all visitors. The existing road infrastructure offered detached bicycle lanes for only about half of the distance to the town centre.

### *3.2. Methods*

Similar to evaluations presented earlier in Table 1, this study was based on a case study. Although this limited the generalizability of the findings, the case study approach can allow studying contextualised and complex phenomena, such as eco-developments, from multiple aspects and in greater depth [67,68].

In order to capture household behaviours, a development-wide questionnaire survey was conducted. The results from the first part of the questionnaire, which used the Building Use Evaluation method [69], are not presented here. This text focuses on the responses to the second part of the bespoke questionnaire named Lifestyle Evaluation, developed by the authors of this paper. The questionnaire sample can be found in Appendix A.

The Lifestyle Evaluation questionnaire was divided into five main topics: household background, energy and water use, waste recycling, food choices and transportation. The questionnaire was designed to be concise, spanning only two A4 pages, with the aim of encouraging resident participation and maximising the response rate. The design combined categorical questions, six- and seven-point Likert scales and matrix questions, and provided some space for qualitative comments. Environmental behaviours were addressed with questions about the frequency of behaviours, the usage of the provided on-site measures and the perceived impact of the measures on behaviours. In order to contextualise the results, the majority of the questions were adopted from questionnaires used in national and local surveys or in studies of similar eco-developments.

The survey was conducted over a period of ~3.5 months, in 2018. Using a door-to-door approach, the authors of this paper approached all the households in the development, offering voluntary participation in the survey. Each interested household was offered to take up to two self-administered questionnaires for two adults, to be completed without the presence of the authors. Completed questionnaires were then physically collected in agreement with the residents, typically two or three weeks after the questionnaires were handed out.

The survey results showed that the questionnaires were completed by 63 households living in houses (49% of all houses), and by only one household living in a flat, from a total of 28 flats in the case study development. In order to make the study findings more robust, the response from the household living in a flat was removed from the final household sample. The sample was considered representative of the case study development in terms of the house typology and development phase. However, households from social housing were slightly underrepresented (12% less). As two adults completed the questionnaires in 26 households, the final sample consisted of 89 questionnaires. From now on, the resident sample ($n$ = 89) that completed the questionnaire will be referred to in this text as 'residents'.

All the households that completed the questionnaire were also offered the opportunity to participate in a semi-structured interview, as a part of a wider evaluation focused on dwelling performance. As a result, out of 63 households, 12 households agreed to be interviewed. This text reported the responses to questions about household behaviours in regard to smart energy monitors and solar PV panels.

## 4. Results

### *4.1. Household Background*

The majority of the residents reported holding a degree or higher qualification (63%), which was significantly higher than the average for England [70]. The higher levels of education found in this study, and higher levels of occupation [45] and income [57] reported in other eco-developments, indicated higher socio-economic backgrounds for the households in the eco-developments. Residents have chosen to move to the development primarily due to the characteristics of the dwellings (78%), followed by the development's eco-credentials (46%), potential energy and water savings (43%), and, lastly, the access to work (37%) and family or friends (23%). In other eco-developments, the architectural characteristics of the development were similarly regarded as most important by the households [45,60,62,71].

Studies have indicated that environmental attitudes were not associated with household consumption [72] or carbon footprints [57]. However, gathering insights about environmental attitudes in eco-developments could indicate if such locations attract more eco-minded households. When compared to national averages, the residents' responses to three questions about environmental attitudes demonstrated only an increase in the awareness about the personal impact on climate change (Table 3), which was weakly associated with higher education levels ($r_s$ = 0.30, $p$ = 0.009). In a similar notion, in two other eco-development studies, households appeared to be slightly more knowledgeable but not more concerned about the environment [45,73].

**Table 3.** Results from the Mann–Whitney test comparing scores from three environmental attitude questions between the case study and averages for England [74].

| Question | Mann–Whitney U | Wilcoxon W | Z | Asymp. Sig. (2-Tailed) |
|---|---|---|---|---|
| Which of these would you say best describes your current lifestyle? | 3917.50 | 8768.50 | −0.311 | 0.756 |
| I need more information on what I could do to be more environmentally (eco) friendly. | 3719.00 | 8669.00 | −1.298 | 0.194 |
| I do not believe my everyday behaviour and lifestyle contribute to climate change | 3162.00 | 6732.00 | −2.801 | 0.005 |

As seen in Table 3 and Figure 1, the residents' perceived occurrence of eco-friendly behaviours did not significantly differ from the national averages. Contrastingly, more than two-thirds (70%) of the residents saw their new lifestyles as more eco-friendly than before (Figure 2). The perception of having a more eco-friendly lifestyle was weakly associated with feeling more cautious in using energy ($\tau_c = 0.36$, $p < 0.001$) and in recycling waste ($\tau_c = 0.34$, $p = 0.002$), with noticing lower electricity bills ($r_s = -0.24$, $p = 0.038$) and with the use of major appliances in order to exploit the PV electricity ($r_s = -0.22$, $p = 0.045$).

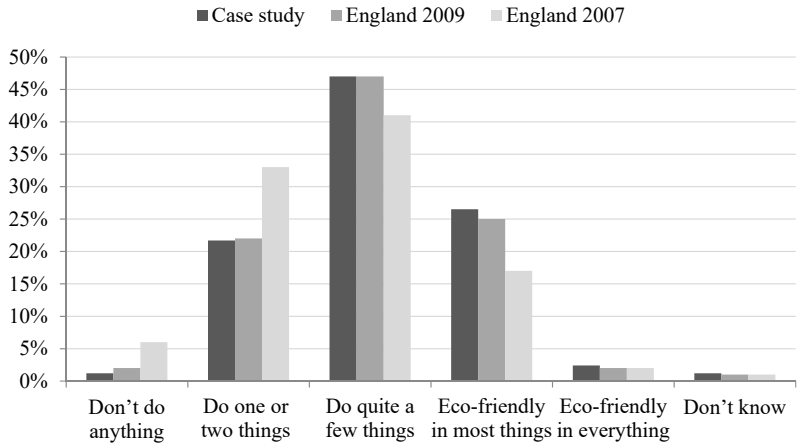


**Figure 1.** Histogram comparing responses to question, "Which of these would you say best describes your current lifestyle?", between the case study and averages for England [74].

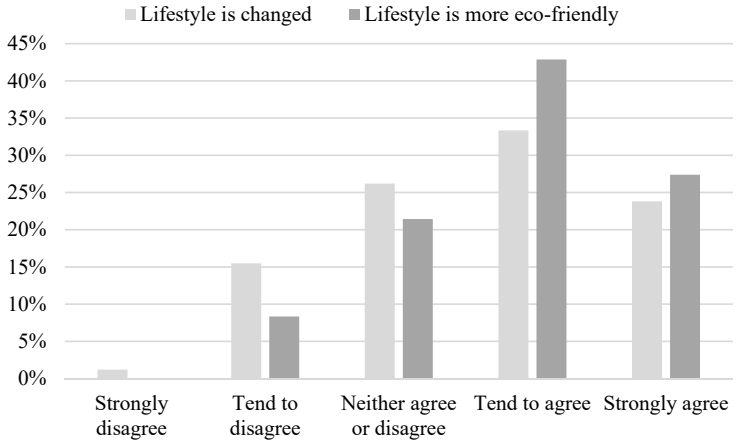


**Figure 2.** Histogram comparing responses to questions, "Living in the new development has changed my lifestyle" and "Since living in the new development my lifestyle has been more eco-friendly".

### *4.2. Energy and Water Behaviours*

As observed in Table 4, statistical analysis suggested that the responses to three questions about common energy- and water-saving behaviours were not significantly different, compared to the national averages [74].

**Table 4.** Results from the Mann–Whitney U test comparing scores for three questions about energy- and water-saving behaviours between the case study and the averages for England [74].

| Question | Mann–Whitney U | Wilcoxon W | Z | Asymp. Sig. (2-Tailed) |
|---|---|---|---|---|
| How frequently do you wash clothes at 40 degrees or less? | 3868.50 | 7438.50 | −0.714 | 0.475 |
| How frequently do you personally leave the lights on when you are not in the room? | 4173.00 | 9223.00 | −0.079 | 0.937 |
| How frequently do you make an effort to cut down on water usage at home? | 3662.50 | 7232.50 | −0.537 | 0.591 |

More than two-thirds of the residents (72%) reported that living in their new home made them feel more cautious in using energy. This was slightly higher than the rate reported in 13 other eco-developments [45]. This difference was attributed to a more widespread provision of energy-efficient features in the case study dwellings. About a third (36%) of the residents felt more cautious in using energy due to the provided smart energy monitors. Interestingly, all of the 12 interviewed households regarded the monitor as not useful. For the majority of the interviewees, the devices frequently malfunctioned and often showed values that appeared illogical.

Most of the residents (83%) reported frequently using the washing machine, dishwasher and tumble dryer when PV electricity was generated. During the interviews, households reported being cautious in using major appliances only during the daytime. However, they would not postpone their routine of washing clothes if the sky appeared to be overcast and energy generation was probably marginal. Only half of the interviewees reported using the in-built timer, mainly for delaying the start of the dishwasher before going to work.

### *4.3. Waste Behaviours*

Most of the residents (88%) reported frequently using general recycling, glass recycling and food waste bins. The garden compost bin and kitchen bins were frequently used by significantly fewer residents (57%). As seen in Figure 3, more residents reported regularly recycling and composting compared to the national averages [74], and to households in 13 other eco-developments [45]. In DEFRA's report, "always", "very often" and "often" votes were aggregated to represent behaviour that could be considered as regular.

More than two-thirds of the residents (70%) felt that the on-site waste facilities encouraged them to recycle. It could be argued that households who regularly used more types of recycling bins showed higher attentiveness to recycling. Statistical analysis showed that the number of different recycling bin types used was weakly associated with all three environmental attitude variables ($r_s = 0.3$, $p < 0.05$).

To complement the results of the questionnaire, annual results for weight-based waste monitoring focused on the development site were sourced from the local authorities. As observed in Table 5, the annual results over a three-year period did not demonstrate a clear trend. However, in contrast to reported behaviours, the results indicated that the actual rates were relatively similar to the national (45%) and district averages (55%) [75], and significantly lower than the set target of 80%.

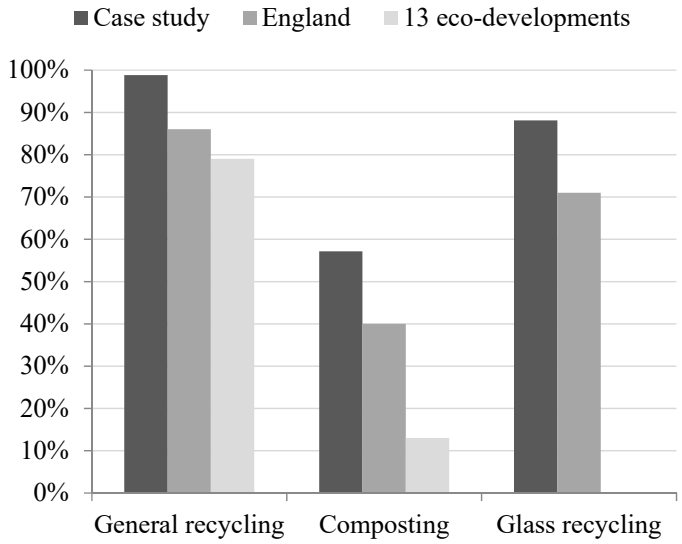


**Figure 3.** Comparing rates of regular recycling and composting between the case study, national averages [74] and the mean response for 13 other eco-developments [45].

**Table 5.** Annual waste arising for the eco-development from measurements taken over three consecutive years. Data provided by the local authorities.

| Period | Organic Waste (kg) | Dry Recycling (kg) | Residual Waste (kg) | Total Waste (kg) | Organic Waste | Dry Recycling | Total Organic/Dry |
|---|---|---|---|---|---|---|---|
| 2017/18 | 16,790 | 13,190 | 36,660 | 66,640 | 25% | 20% | 45% |
| 2018/19 | 19,190 | 22,020 | 50,280 | 91,490 | 21% | 24% | 45% |
| 2019/20 | 33,600 | 39,035 | 48,060 | 120,695 | 28% | 32% | 60% |

### *4.4. Food Behaviours*

The responses about the frequency of low-impact food behaviours are shown in Figure 4. About a third of the residents reported regularly buying organic food (37%) and growing food in their gardens (31%), which were similar rates compared to the national averages [74,76] and averages for Ireland [77]. Only 15% of the residents reported regularly visiting farmers' markets. The number of different low-impact food behaviours in which residents had engaged was weakly associated with higher education levels ($r_s$ = 0.23, $p$ = 0.48), and with eating less meat ($r_s$ = 0.22, $p$ = 0.47).

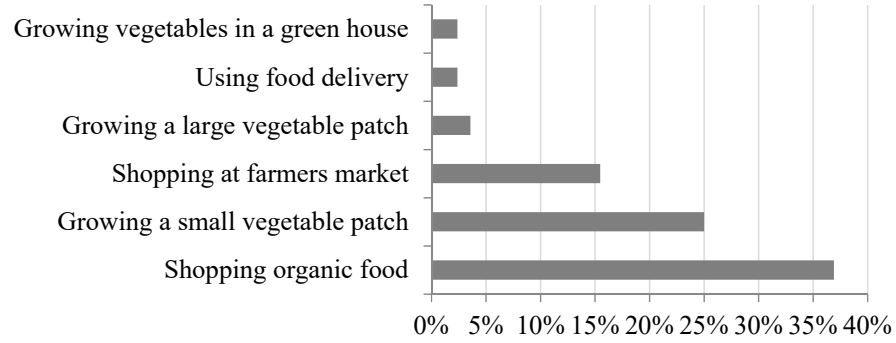


**Figure 4.** Rates of low-impact food behaviours.

The residents had included meat in 36% of all weekly meals, on average. This was similar to the rate reported by households living in conventional housing and in the Derwenthorpe eco-development, and it was higher than the rates in the BedZED and Lancaster Cohousing eco-developments [57].

### *4.5. Transportation Behaviours*

Based on residents' responses, the mean rate of using a car-based mode of transportation was 71% (Figure 5). This was higher than the national average (62%) [78] and the set target for 2016 (55%). Car-based modes included all car, van and motorcycle driver or passenger trips. Eco-modes of transportation included walking, cycling, public transportation trips and deliveries. Figure 5 also shows that business and non-education escort trips were the most car-dependent (around 90%), followed by grocery shopping and trips for visiting friends (around 80%). The residents were slightly more car-dependent than the wider population for every category of trip purpose apart for leisure trips. This particularly applied to grocery shopping and education-escort trips, where a 1.3 and 1.7 times higher car-use rate was reported, respectively.

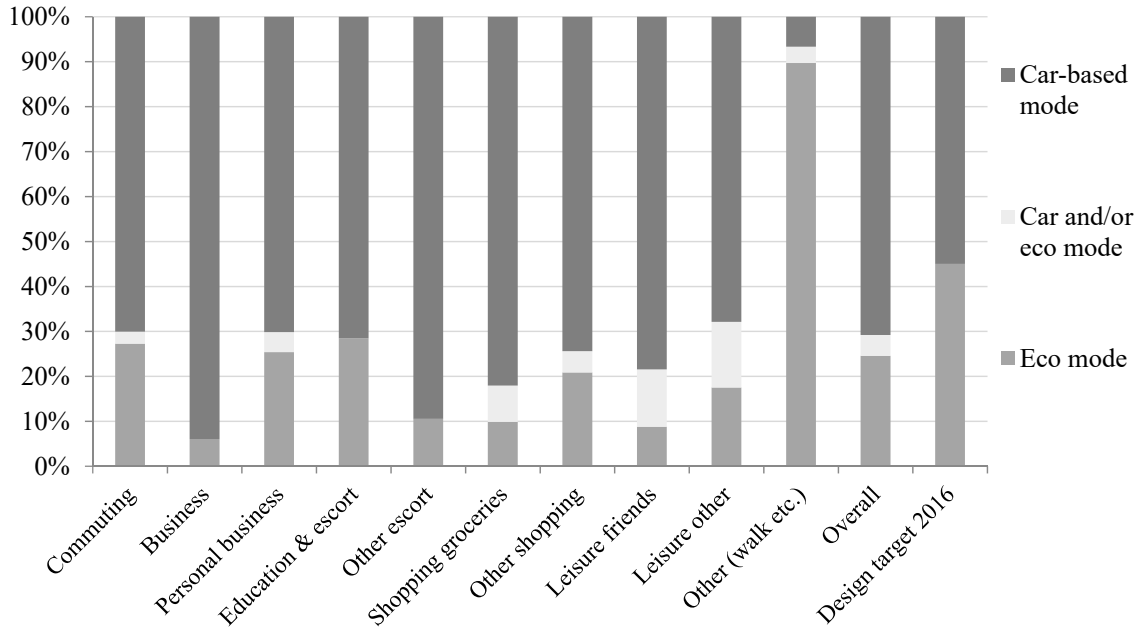


**Figure 5.** Transportation mode ratios, by trip purpose.

For commuting trips, the most popular types of eco-mode were public transportation (51%), followed by combining public transportation with cycling (20%), walking (21%) and just cycling (9%). For residents who regularly used eco-modes of transportation, the local bus to town was considered the most important measure (88%), followed by train and bus services located in the town centre (58%) and walking routes (46%). Bicycle routes, e-car clubs, electric car chargers and bike rental facilities were deemed the least important measures (<23%).

Data analysis suggested that the residents tended to walk less and use cars and public transportation more, compared to households living in the local town [79] and to the national averages [78]. This result was expected, due to the development's edge-of-town location. Compared to households in 13 other eco-developments [45], 9% more residents in the case study development preferred using cars for commuting over greener alternatives.

Analysis of the responses regarding the final trip destinations showed that the local town (<3-mile radius) was the final destination for about a bit more than a third of all the reported trips (37%). Close to half of the trips (45%) ended in the wider region (4- to 50-mile radius), while 12% of the trips were taken to destinations further than 50 miles away (Figure 6). The results also suggested that the town was the most attractive destination for grocery shopping (~90% of all trips), and the least attractive destination for work, business and other leisure activities (<25% of all trips). The local town was more than two times less attractive for work and leisure activities for the case study residents, compared to the households living in the town itself [79]. This significant difference was partly attributed to

the inclusion of minors in the town's survey, and the higher share of older adults living in the town [80]. As indicated in Figure 7, the Chi-square test suggested that, for commuting trips, residents favoured car-based modes for reaching destinations located in the wider region (4- to 50-mile radius) but not for longer or shorter trips ($X^2$ (2, $N$ = 68) = 10.61, $p$ = 0.005).

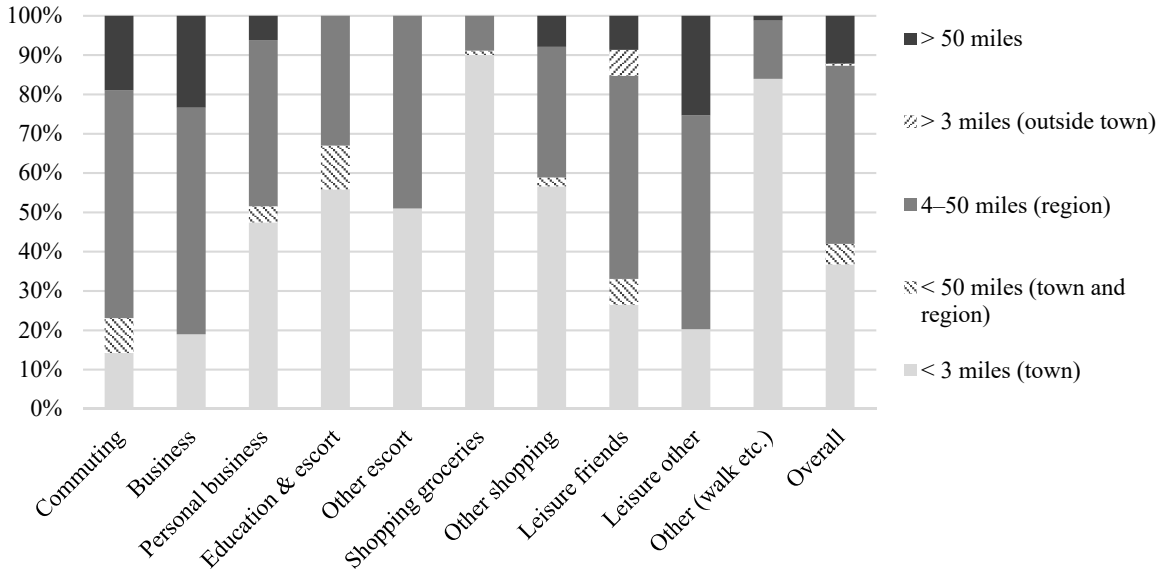


**Figure 6.** Destination ranges of trips, by trip purpose.

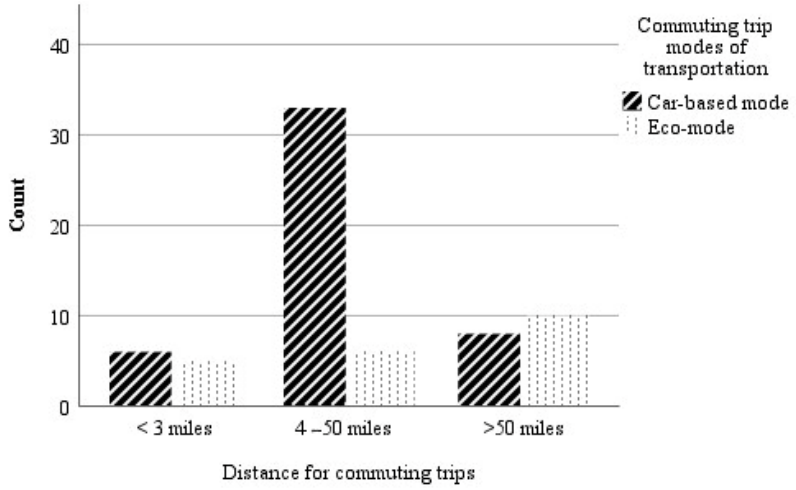


**Figure 7.** Ratios of transportation modes for commuting trips, according to the destination ranges.

The results also showed that the households owned 1.4 cars on average, which was similar to the average for the local town, and slightly more than the national average. Owning a car seemed to be necessary in the case study development, as only one surveyed household (2%) was car-free. The households seemed to own more cars and drive more miles per occupant (5550 miles/year) on average, compared to households in other new eco-developments [57]. The increased car dependency noted in the case study and in Derwenthorpe was probably related to their edge-of-town locations.

## 5. Discussion

The results of the data analysis suggested that the captured energy and water saving, waste recycling and low-impact food behaviours were similar, while the transportation

behaviours were less environmental compared to the national averages. Contrastingly, more than two-thirds of the residents perceived their new lifestyles as more eco-friendly, and felt more cautious in recycling waste and using energy in their homes. Similarly to in the study about Derwenthorpe [71], this perception was attributed to the intrinsic effect of dwelling energy efficiency and low-carbon technologies, rather than to significant changes in behaviour.

Although waste recycling appeared to be more widespread, the measured waste recycling rates were relatively similar to local and national averages. Reaching the targeted rate of 80% will probably require introducing additional measures proven effective in past waste-reduction initiatives [33,81,82]. The findings of this study demonstrated the importance of complementing household feedback with actual waste measurements, which offer a more robust view of the achieved waste performance [83]. Due to the challenges associated with monitoring waste at the development scale [81], waste behaviours in eco-developments will probably remain not well understood.

The reported food behaviours were rather conventional. This was expected, considering that the planned on-site measures were not really delivered. However, just providing opportunities to purchase and grow low-impact foods in on-site shops and gardens seems to have a limited effect on household food behaviours [56,57,60,84]. An increase in low-impact food behaviours probably requires the introduction of additional measures that might influence personal factors shaping food purchasing [85] and urban gardening [86], which is beyond the current scope of housing developers. In this context, it is not surprising that reducing household food footprints is often not prioritized in eco-developments. Nonetheless, defining aspirational targets for low-impact food behaviours would probably motivate housing developers to test different measures, evaluate the outcomes and generate new learning.

The increased car-dependency in the case study development was attributed to the selection of on-site infrastructure, the small development scale lacking basic amenities, the development's edge-of town location and household lifestyles. On one hand, providing a bus line to town and private electric car chargers is commendable. The former supported many residents in moving away from frequent driving. The latter is thought to increase willingness to buy an electric car [87]. On the other hand, the modal shift potential with car club and bike rental services is thought to be limited [88,89]. In addition, the limited parking space resulted in parking in undesignated areas in the case study, as well as in other eco-developments [56,57]. The reported transportation behaviours in the case study and Derwenthorpe developments indicated that the edge-of-town location hindered the frequent use of eco-modes of transportation for reaching basic amenities in the surrounding urban area. Lastly, the younger and more educated households attracted to the case study eco-development were expected to have higher numbers of car trips [90], which was further amplified by the scarcity of work and leisure options offered in the local town.

Evaluations of low-carbon and eco-developments demonstrated significant reductions in dwelling energy use and resulting carbon emissions. Achieving additional reductions from changes in transportation, waste and food behaviours appears to be far more challenging. The significantly lower household footprints reported in intentional housing communities [91] support the argument that the transition to more sustainable lifestyles might demand a shift from a top-down to a more community-based model of housing delivery [92], and a change in personal values [93].

Given the urgency of climate change, growing interest in delivering sustainable urban areas will drive the need to evaluate the emissions associated with household lifestyles, not only with dwelling use [52]. Therefore, more holistic evaluations are needed to provide more empirical evidence about the effectiveness of different design measures in reducing emissions, and to build the knowledge base. Narrowing the reoccurring gap between the aspired-to and actual lifestyles in new developments would result in stronger carbon reductions associated with multiple sectors of the economy, not just the building sector.

This would be in line with the whole-system thinking that the UK Government has been adopting for meeting the net-zero economy target [94].

## 6. Conclusions

This study evaluated the actual household environmental behaviours of households living in a case study eco-development in the UK, designed to enable more sustainable lifestyles. The data analysis was based on resident responses to a development-wide questionnaire survey ($n$ = 89), household interviews ($n$ = 12) and provided waste measurements. Increased cautiousness in using energy was reflected in the use of major appliances, while other energy- and water-saving behaviours were fairly conventional. The actual waste recycling rates measured over three years (45% to 60%) were similar to local and national averages, and well below the 80% target. The rates of purchasing organic food (37%), growing food (31%) and meat consumption (in 36% of all meals) indicated that the food behaviours were not more pro-environmental. Car-based modes of transportation were used for 71% of all the reported trips on average, which was higher than the national average and the set target of 55%. In contrast to the reported behaviours, most of the residents considered their new lifestyles as more eco-friendly, which was related to the notion of energy efficiency and low-carbon technologies, rather than to changes in behaviour.

Overall, the case study development should be commended for integrating a wide range of sustainability measures and for the ambitious aim to enable more sustainable lifestyles. However, the findings of this study suggested that the provided measures (which are recurrently used across eco-developments) were not effective in achieving this aim in the given urban context. More systematic evaluations of environmental behaviours in urban areas are urgently needed, to improve understanding about the effectiveness of different housing delivery models and design measures.

Expanding urban zones offers an opportunity to integrate high levels of energy efficiency and the latest technologies, but also to shape environmental behaviours and achieve further reductions in carbon emissions. Evidence from this study and other scarce studies of eco-developments suggests that enabling environmental behaviours is challenging. New government policies need to be more holistic and support the delivery of not only well-performing dwellings, but also new developments that make sustainable urban living a reality. The forthcoming local plans and housing programmes could be more ambitious, integrating performance requirements that capture carbon-intensive household behaviours, rather than just the building performance. Setting quantifiable performance targets and requiring ongoing performance monitoring seem to be essential for motivating developers to actually deliver the promised design measures.

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**Institutional Review Board Statement:** The study was conducted in accordance with the Declaration of Helsinki, and approved by the Oxford Brookes University Research Ethics Committee (UREC) (protocol code: 181178, date of approval: 6 April 2018).

**Informed Consent Statement:** Informed consent was obtained from all subjects involved in the study.

**Data Availability Statement:** The data presented in this study are available on request from the corresponding author.

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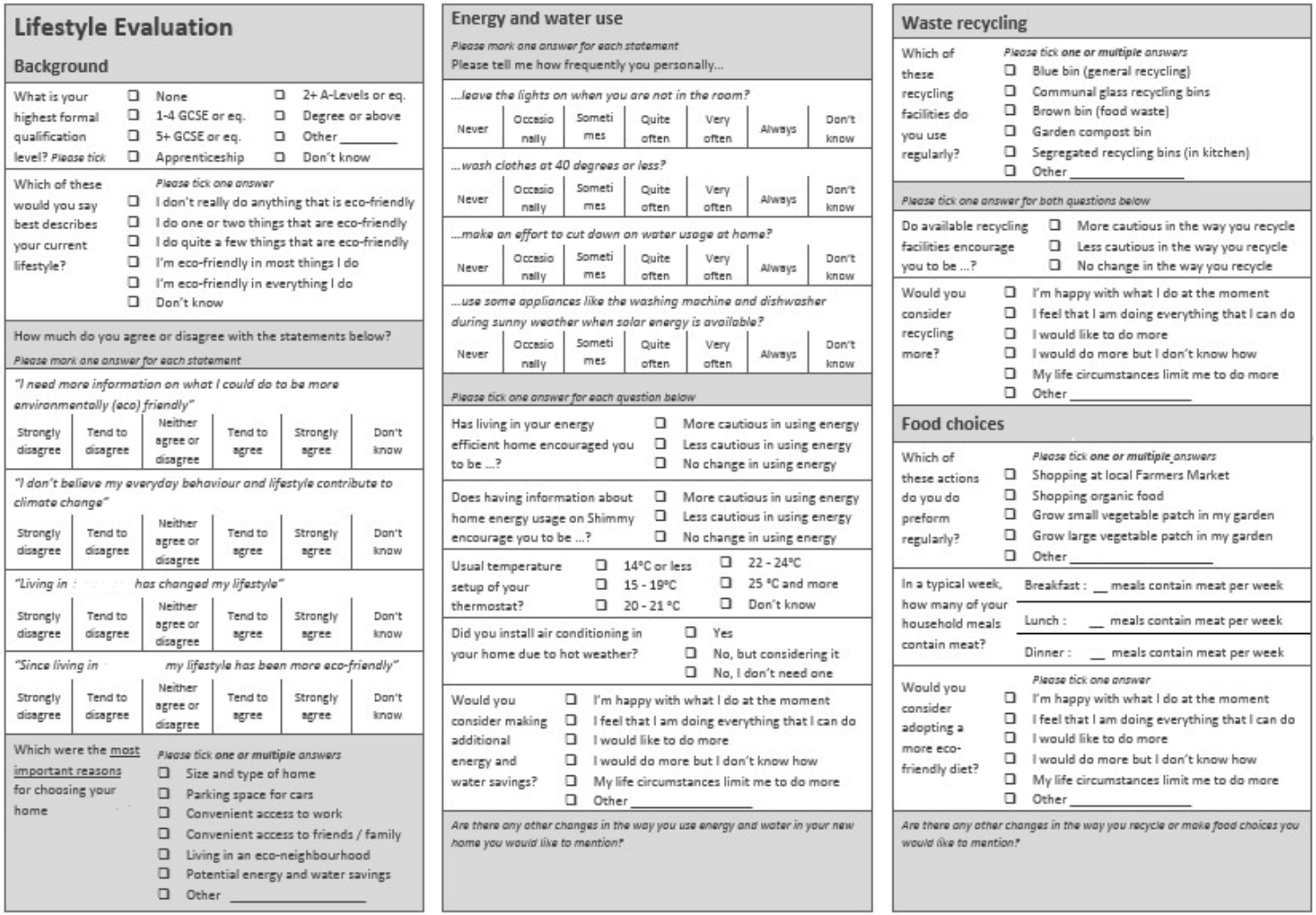
**Conflicts of Interest:** The authors declare no conflict of interest.

## Appendix A



**Lifestyle Evaluation**

**Background**

What is your highest formal qualification level? *Please tick*
- ❑ None
- ❑ 1-4 GCSE or eq.
- ❑ 5+ GCSE or eq.
- ❑ Apprenticeship
- ❑ 2+ A-Levels or eq.
- ❑ Degree or above
- ❑ Other _____
- ❑ Don't know

Which of these would you say best describes your current lifestyle? *Please tick one answer*
- ❑ I don't really do anything that is eco-friendly
- ❑ I do one or two things that are eco-friendly
- ❑ I do quite a few things that are eco-friendly
- ❑ I'm eco-friendly in most things I do
- ❑ I'm eco-friendly in everything I do
- ❑ Don't know

How much do you agree or disagree with the statements below?
*Please mark one answer for each statement*

*"I need more information on what I could do to be more environmentally (eco) friendly"*

| Strongly disagree | Tend to disagree | Neither agree or disagree | Tend to agree | Strongly agree | Don't know |
|---|---|---|---|---|---|

*"I don't believe my everyday behaviour and lifestyle contribute to climate change"*

| Strongly disagree | Tend to disagree | Neither agree or disagree | Tend to agree | Strongly agree | Don't know |
|---|---|---|---|---|---|

*"Living in : has changed my lifestyle"*

| Strongly disagree | Tend to disagree | Neither agree or disagree | Tend to agree | Strongly agree | Don't know |
|---|---|---|---|---|---|

*"Since living in my lifestyle has been more eco-friendly"*

| Strongly disagree | Tend to disagree | Neither agree or disagree | Tend to agree | Strongly agree | Don't know |
|---|---|---|---|---|---|

Which were the most important reasons for choosing your home *Please tick one or multiple answers*
- ❑ Size and type of home
- ❑ Parking space for cars
- ❑ Convenient access to work
- ❑ Convenient access to friends / family
- ❑ Living in an eco-neighbourhood
- ❑ Potential energy and water savings
- ❑ Other _____

**Energy and water use**

*Please mark one answer for each statement*
Please tell me how frequently you personally...

*...leave the lights on when you are not in the room?*

| Never | Occasionally | Sometimes | Quite often | Very often | Always | Don't know |
|---|---|---|---|---|---|---|

*...wash clothes at 40 degrees or less?*

| Never | Occasionally | Sometimes | Quite often | Very often | Always | Don't know |
|---|---|---|---|---|---|---|

*...make an effort to cut down on water usage at home?*

| Never | Occasionally | Sometimes | Quite often | Very often | Always | Don't know |
|---|---|---|---|---|---|---|

*...use some appliances like the washing machine and dishwasher during sunny weather when solar energy is available?*

| Never | Occasionally | Sometimes | Quite often | Very often | Always | Don't know |
|---|---|---|---|---|---|---|

*Please tick one answer for each question below*

Has living in your energy efficient home encouraged you to be ...?
- ❑ More cautious in using energy
- ❑ Less cautious in using energy
- ❑ No change in using energy

Does having information about home energy usage on Shimmy encourage you to be ...?
- ❑ More cautious in using energy
- ❑ Less cautious in using energy
- ❑ No change in using energy

Usual temperature setup of your thermostat?
- ❑ 14°C or less
- ❑ 15 - 19°C
- ❑ 20 - 21 °C
- ❑ 22 - 24°C
- ❑ 25 °C and more
- ❑ Don't know

Did you install air conditioning in your home due to hot weather?
- ❑ Yes
- ❑ No, but considering it
- ❑ No, I don't need one

Would you consider making additional energy and water savings?
- ❑ I'm happy with what I do at the moment
- ❑ I feel that I am doing everything that I can do
- ❑ I would like to do more
- ❑ I would do more but I don't know how
- ❑ My life circumstances limit me to do more
- ❑ Other _____

*Are there any other changes in the way you use energy and water in your new home you would like to mention?*

**Waste recycling**

Which of these recycling facilities do you use regularly? *Please tick one or multiple answers*
- ❑ Blue bin (general recycling)
- ❑ Communal glass recycling bins
- ❑ Brown bin (food waste)
- ❑ Garden compost bin
- ❑ Segregated recycling bins (in kitchen)
- ❑ Other _____

*Please tick one answer for both questions below*

Do available recycling facilities encourage you to be ...?
- ❑ More cautious in the way you recycle
- ❑ Less cautious in the way you recycle
- ❑ No change in the way you recycle

Would you consider recycling more?
- ❑ I'm happy with what I do at the moment
- ❑ I feel that I am doing everything that I can do
- ❑ I would like to do more
- ❑ I would do more but I don't know how
- ❑ My life circumstances limit me to do more
- ❑ Other _____

**Food choices**

Which of these actions do you do preform regularly? *Please tick one or multiple answers*
- ❑ Shopping at local Farmers Market
- ❑ Shopping organic food
- ❑ Grow small vegetable patch in my garden
- ❑ Grow large vegetable patch in my garden
- ❑ Other _____

In a typical week, how many of your household meals contain meat?
- Breakfast : __ meals contain meat per week
- Lunch : __ meals contain meat per week
- Dinner : __ meals contain meat per week

Would you consider adopting a more eco-friendly diet? *Please tick one answer*
- ❑ I'm happy with what I do at the moment
- ❑ I feel that I am doing everything that I can do
- ❑ I would like to do more
- ❑ I would do more but I don't know how
- ❑ My life circumstances limit me to do more
- ❑ Other _____

*Are there any other changes in the way you recycle or make food choices you would like to mention?*

| **Transport** | Per each purpose of transport please mark your transport mode choice with the destination and trip frequency in a typical week. | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | **YOUR MODE OF TRANSPORT** *mark one mode per each purpose* | | | | | | | **YOUR DESTINATION** *mark one destination per each purpose* | | | **4.FREQ-UENCY** *(number)* |
| **PURPOSE OF TRANSPORT** | Walk | Bicycle | Car/ van driver | Car/ van passenger | Motor -cycle | Other private transport (school bus etc...) | Public transport | < 3 miles | 4-50 miles | > 50 miles | Number of trips per typical week |
| Commuting | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ___ |
| Business | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ___ |
| Personal business | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ___ |
| Education / escort for education | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ___ |
| Other escort (to activities etc.) | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ___ |
| Groceries shopping | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ___ |
| Shopping (other) | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ___ |
| Leisure (visiting friends/ relatives) | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ___ |
| Leisure (other)* | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ___ |
| Other purpose including just walk | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ___ |

**Leisure (other) category includes entertainment, sport, holiday and day trip*

**Transport**

Would you consider choosing a more eco-friendly travel (walk, cycle, public transport)?

*Please tick one answer*

- ❑ Already using eco-friendly travel
- ❑ Alternative exists, I am using car out of choice
- ❑ No adequate alternative to car is offered
- ❑ My life constraints make car the only option
- ❑ Other _____

If you do not own or regularly use a standard car/van, were any of these facilities important to you in taking this decision?

*Please tick one or multiple answers*

- ❑ Brompton bike hire
- ❑ E1 bus
- ❑ Train and buses
- ❑ E-car club
- ❑ Electric car chargers
- ❑ Convenient cycle routes
- ❑ Convenient walking routes
- ❑ Other _____
- ❑ Not applicable

Please mark car type and annual mileage for each vehicle kept at your residence

| Type of vehicle | Vehicle 1 | Vehicle 2 | Vehicle 3 | Vehicle 4 |
|---|---|---|---|---|
| Petrol | ○ | ○ | ○ | ○ |
| Diesel | ○ | ○ | ○ | ○ |
| Hybrid | ○ | ○ | ○ | ○ |
| Full electric | ○ | ○ | ○ | ○ |
| Motorcycle | ○ | ○ | ○ | ○ |
| Miles/year | ___ | ___ | ___ | ___ |

**Thank you for your help** Please return the filled-in questionnaire to the researcher.

## References


1. UNEP (United Nations Environment Programme). *Emissions Gap Report 2020—Exclusive Summary*; United Nations Environment Programme: Nairobi, Kenya, 2020.
2. DBEIS (Department for Business Energy and Industrial Strategy). UK Becomes First Major Economy to Pass Net Zero Emissions Law-GOV.UK. Available online: https://www.gov.uk/government/news/uk-becomes-first-major-economy-to-pass-net-zero-emissions-law (accessed on 14 February 2022).
3. CCC (Committee on Climate Change). *The Sixth Carbon Budget: The UK's Path to Net Zero*. Committee on Climate Change Copyright. 2020. Available online: https://www.biee.org/meeting/the-sixth-carbon-budget-the-uks-path-to-net-zero/ (accessed on 14 February 2022).
4. IEA (International Energy Agency). *Net Zero by 2050: A Roadmap for the Global Energy Sector*; IEA Publications: Paris, France, 2021.
5. Carmichael, R.; Dobson, R.; Greaves, J.; Whitmarsh, L. *How Behaviour Change Will Unlock Net-Zero*; Energy Research Partnership: Birmingham, UK, 2021.
6. Stern, P.C. Toward a Coherent Theory of Environmentally Significant Behavior. *J. Soc. Issues* **2000**, *56*, 407–424. [CrossRef]
7. Minx, J.; Baiocchi, G.; Wiedmann, T.; Barrett, J.; Creutzig, F.; Feng, K.; Förster, M.; Pichler, P.P.; Weisz, H.; Hubacek, K. Carbon footprints of cities and other human settlements in the UK. *Environ. Res. Lett.* **2013**, *8*, 035039. [CrossRef]
8. Jackson, T. *Motivating Sustainable Consumption: A Review of Evidence on Consumer Behaviour and Behavioural Change*; A Report to the Sustainable Development Research Network; Centre for Environmental Strategy, University of Surrey: Surrey, BC, Canada, 2005; ISBN 0958-305X.
9. Ajzen, I. The theory of planned behavior. *Organ. Behav. Hum. Decis. Process.* **1991**, *50*, 179–211. [CrossRef]
10. Steg, L.; Vlek, C. Encouraging pro-environmental behaviour: An integrative review and research agenda. *J. Environ. Psychol.* **2009**, *29*, 309–317. [CrossRef]
11. Geller, E.S. The Challenge of Increasing Proenvironment Behavior. In *Handbook of Environmental Psychology*; John Wiley & Sons, Inc.: New York, NY, USA, 2002; pp. 525–540. ISBN 0-471-40594-9.
12. IPCC (Intergovernmental Panel on Climate Change). *Climate Change 2014 Mitigation of Climate Change; Working Group III Contribution to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change; Summary for Policymakers*; Cambridge University Press: Cambridge, UK, 2016; p. 656. [CrossRef]
13. Creutzig, F.; Fernandez, B.; Haberl, H.; Khosla, R.; Mulugetta, Y.; Seto, K.C. Beyond Technology: Demand-Side Solutions for Climate Change Mitigation. *Annu. Rev. Environ. Resour.* **2016**, *41*, 173–198. [CrossRef]
14. Newton, P. Low-carbon precincts for low-carbon living. *Carbon Manag.* **2014**, *5*, 5–8. [CrossRef]
15. HMG (Her Majesty Government). *Securing the Future. Delivering UK Sustainable Development Strategy*; The Stationery Office: Norwich, UK, 2005.
16. DCLG (Department for Communities and Local Government). *Planning Policy Statement: Planning and Climate Change*; Her Majesty's Stationery Office: Norwich, UK, 2007.
17. DCLG (Department for Communities and Local Government). *Planning Policy Statement: Eco-Towns*; Communities and Local Government Publications: London, UK, 2009.
18. DCLG (Department for Communities and Local Government). *Locally-Led Garden Villages, Towns and Cities*; Department for Communities and Local Government: London, UK, 2016.
19. Morris, E.S. Down with ECO-towns! Up with ECO-communities. Or Is There a Need for Model Eco-towns? A Review of the 2009–2010 Eco-town Proposals in Britain. In *Eco-City Planning: Policies, Practice and Design*; Springer: Berlin/Heidelberg, Germany, 2011; ISBN 978-94-007-0383-4.
20. Manns, J. Eco-towns, New Labour and Sustainable Residential Development. *People Place Policy Online* **2008**, *2*, 132–139. [CrossRef]
21. Rose, S. A Town Called Eco: What Notions of Sustainable Development do the Government's Proposed Eco-Towns Embody? CSERGE Working Paper EDM No. 09-05. 2009. Available online: https://www.econstor.eu/obitstream/10419/48807/1/601514467.pdf (accessed on 14 February 2022).
22. TNH (Transport for New Homes). Garden Villages and Garden Towns: Visions and Reality. 2020. Available online: https://www.transportfornewhomes.org.uk/the-project/garden-villages-and-garden-towns/ (accessed on 14 February 2022).
23. Smart Growth, UK. Garden Towns & Villages: Unwanted, Unnecessary and Unsustainable. 2017. Available online: https://smartgrowthuk.org/wp-content/uploads/2021/03/Garden_Communities_Report_2020.pdf (accessed on 14 February 2022).
24. DCLG (Department for Communities and Local Government). *National Planning Policy Framework*; Department for Communities and Local Government: London, UK, 2012.
25. MHCLG (Ministry of Housing Communities & Local Government). *National Planning Policy Framework*; Ministry of Housing, Communities and Local Government: London, UK, 2019; ISBN 978-1-5286-1033-9.
26. MHCLG (Ministry of Housing Communities & Local Government). *National Planning Policy Framework*; Ministry of Housing, Communities and Local Government: London, UK, 2021.
27. CSE (Centre for Sustainable Energy). TCPA (Town and Country Planning Association); Response to National Planning Policy Framework (NPPF) and National Model Design Code (NMDC) Consultation. 2021. Available online: https://www.cse.org.uk/downloads/file/nppf-consultation-submission-march-2021.pdf (accessed on 14 February 2022).
28. CSE (Centre for Sustainable Energy). *Neighbourhood Planning in a Climate Emergency*; Centre for Sustainable Energy: Bristol, UK, 2020.

29. Joss, S.; Tomozeiu, D.; Cowley, R. *Eco-Cities: A Global Survey 2011*; University of Westminster International Eco-Cities Initiative Copyright© University of Westminster All: Westminster, UK, 2011; ISBN 9780957052703.
30. Bayulken, B.; Huisingh, D. Are lessons from eco-towns helping planners make more effective progress in transforming cities into sustainable urban systems: A literature review (part 2 of 2). *J. Clean. Prod.* **2015**, *109*, 152–165. [CrossRef]
31. Townshend, T. Why Aren't We Building More Sustainable Residential Neighbourhoods in the UK. *Int. J. Sustain. Dev. Plan.* **2007**, *2*, 222–238. [CrossRef]
32. Williams, K.; Dair, C. What Is Stopping Sustainable Building in England? Barriers Experienced by Stakeholders in Delivering Sustainable Developments. *Sustain. Dev.* **2007**, *15*, 135–147. [CrossRef]
33. Barton, H. *Sustainable Communities: The Potential for Eco-Neighbourhoods.*; Earthscan: London, UK, 2000; ISBN 1853835129.
34. Gibberd, J.T. Neighbourhood facilities for sustainability. *WIT Trans. Ecol. Environ.* **2013**, *179*, 225–234. [CrossRef]
35. Codoban, N.; Kennedy, C.A. Metabolism of Neighborhoods. *J. Urban Plan. Dev.* **2008**, *134*, 21–31. [CrossRef]
36. Fitzgerald, J.; Lenhart, J. Eco-districts: Can they accelerate urban climate planning? *Environ. Plan. C Gov. Policy* **2015**, *34*, 364–380. [CrossRef]
37. Falk, N.; Carley, M. *Sustainable Urban Neighbourhoods: Building Communities that Last*; Joseph Rowntree Foundation: York, UK, 2012.
38. Thomson, G.; Matan, A.; Newman, P. A Review of International Low Carbon Precincts to Identify Pathways for Mainstreaming Sustainable Urbanism in Australia. In Proceedings of the SOAC Conference 2013 Proceedings, 26–29 November 2013; State of Australian Cities Research Network: Sydney, Australia, 2013.
39. Codispoti, O. Sustainable urban forms: Eco-neighbourhoods in Europe. *J. Urban.* **2021**, 1–26. [CrossRef]
40. Pullen, S.; Zillante, G.; Arman, M.; Lou, W.; Zuo, J.; Chileshe, N. A Case Study Analysis of Sustainable and Affordable Housing. Ph.D. Thesis, University of Melbourne, Melbourne, Australia, 2015.
41. Fraker, H. *The Hidden Potential of Sustainable Neighborhoods: Lessons from Low-Carbon Communities*; Island Press: Washington, DC, USA, 2013; ISBN 9781610914093.
42. Joss, S. Eco-cities: The mainstreaming of urban sustainability—Key characteristics and driving factors. *Int. J. Sustain. Dev. Plan.* **2011**, *6*, 268–285. [CrossRef]
43. Lovell, H. Framing sustainable housing as a solution to climate change. *J. Environ. Policy Plan.* **2004**, *6*, 35–55. [CrossRef]
44. Rutherford, J. Infrastructure Integration and Eco-City Futures: Permeability and Politics of the Closed Loop of Hammarby Sjöstad. In *Redeploying Urban Infrastructure*; Palgrave Macmillan: Cham, Italy, 2020; Volume 2010, ISBN 9783030178871.
45. Williams, K.; Dair, C.; Lindsay, M. Neighbourhood Design and Sustainable Lifestyles. In *Dimensions of the Sustainable City 2*; Springer: Dordrecht, The Netherlands, 2008; pp. 183–214.
46. Seasons, M. Indicators and core area planning: Applications in Canada's mid-sized cities. *Plan. Pract. Res.* **2003**, *18*, 63–80. [CrossRef]
47. Wingfield, J.; Bell, M.; Miles-Shenton, D.; South, T.; Lowe, B. *Evaluating the Impact of an Enhanced Energy Performance Standard on Load-Bearing Masonry Domestic Construction Understanding the Gap between Designed and Real Performance: Lessons from Stamford Brook. Project Report*; Department for Communities and Local Government: London, UK, 2011; ISBN 978-1-4098-2891-4.
48. BSRIA (Building Services Research and Information Association). *Hanham Hall Monitoring and Evaluation*; Summary Report October 2015; BSRIA Limited: Bracknell, UK, 2015.
49. Lowe, R.; Altamirano, H. *Innovate UK Building Performance Evaluation. One Brighton—Ongoing Monitoring. Phase 2: In-Use Performance & Post Occupancy Evaluation*; University College London: London, UK, 2014.
50. EST (Energy Saving Trust). *Energy Efficiency Best Practice in Housing. The Hockerton Housing Project*; Energy Saving Trust: London, UK, 2004.
51. Sorrell, S. Jevons' Paradox revisited: The evidence for backfire from improved energy efficiency. *Energy Policy* **2009**, *37*, 1456–1469. [CrossRef]
52. Vale, B.; Vale, R. Domestic energy use, lifestyles and POE: Past lessons for current problems. *Build. Res. Inf.* **2010**, *38*, 578–588. [CrossRef]
53. Flynn, A.; Yu, L.; Feindt, P.; Chen, C. Eco-cities, governance and sustainable lifestyles: The case of the Sino-Singapore Tianjin Eco-City. *Habitat Int.* **2016**, *53*, 78–86. [CrossRef]
54. Gatersleben, B.; Steg, L.; Vlek, C. Measurement and determinants of environmentally significant consumer behavior. *Environ. Behav.* **2002**, *34*, 335–362. [CrossRef]
55. Femenias, P.; Kadefors, A.; Eden, M. The Demonstration Project as 'Tool' for Client Driven Innovation: Exploring the Potential From a Swedish Perspective. In Proceedings of the Proceedings from the CIB Conference Changing Roles, Rotterdam, The Netherlands, 3–4 October 2009.
56. Bioregional. *Seven Years On. The Impact of the UK ' s Best Known Eco-Village and Its Residents*; BioRegional Development Group: Surrey, UK, 2009.
57. Quilgars, D.; Dyke, A.; Wallace, A.; West, S. *Making a Sustainable Community: Life in Derwenthorpe, York, 2012–2018*; Joseph Rowntree Foundation: York, UK, 2019.
58. Amarach Research. *Adamstown Residents Survey. A Presentation Prepared For South Dublin County Council*; Amarach Research: Dublin, Ireland, 2009.
59. Hunt, D.V.L.; Lombardi, D.R.; Jefferson, I.; Rogers, C.D.F.; Butler, D.; Memon, F.A. Appraising infrastructure for new towns in Ireland. *Proc. Inst. Civ. Eng. Urban Des. Plan.* **2012**, *165*, 103–121. [CrossRef]

60. Freytag, T.; Gössling, S.; Mössner, S. Living the green city: Freiburg's Solarsiedlung between narratives and practices of sustainable urban development. *Local Environ.* **2014**, *19*, 644–659. [CrossRef]
61. Nobis, C. The impact of car-free housing districts on mobility behaviour—Case study. *WIT Trans. Ecol. Environ.* **2003**, *67*, 701–710. [CrossRef]
62. Vestbro, D.U. Conflicting perspectives in the development of Hammarby Sjöstad, Stockholm. In *Rebuilding the City Managing the Built Environment and Remediation of Brownfields*; Vestbro, D.U., Ed.; The Baltic University Press: Upsala, Sweden, 2007; pp. 1277–1279.
63. Mahzouni, A. The "Policy Mix" for Sustainable Urban Transition: The city district of Hammarby Sjöstad in Stockholm. *Environ. Policy Gov.* **2015**, *25*, 288–302. [CrossRef]
64. Green, A. Hållbar Energianvändning i Svensk Stadsplanering: Från Visioner till Uppföljning av Hammarby Sjöstad och Västra Hamnen. Ph.D. Thesie, Linköping University, Linköping, Sweden, 2006.
65. Pandis Iverot, S.; Brandt, N. The development of a sustainable urban district in Hammarby Sjöstad, Stockholm, Sweden? *Environ. Dev. Sustain.* **2011**, *13*, 1043–1064. [CrossRef]
66. DEFRA (Department for Environment Food & Rural Affairs). *Statistics on Waste Managed by Local Authorities in England in 2019/20*; A National Statistics Publication: London, UK, 2021.
67. Flyvbjerg, B. Five Misunderstandings About Case-Study Research. *Qual. Inq.* **2006**, *12*, 219–245. [CrossRef]
68. Yin, R.K. *Applications of Case Study Research*, 3rd ed.; SAGE Publications Inc.: Thousand Oaks, CA, USA, 2012; ISBN 9781412989169.
69. Leaman, A. BUS Occupant Survey Method: Details for Licensees. 2011. Available online: https://www.usablebuildings.co.uk/BUSMethodology.pdf (accessed on 14 February 2022).
70. ONS (Office for National Statistics). *Census: Qualifications and Students, Local Authorities in England and Wales*; Office for National Statistics: Newport, UK; Titchfield, UK; London, UK, 2011.
71. Quilgars, D.; Dyke, A.; Tunstall, R.; West, S. *A Sustainable Community? Life at Derwenthorpe 2012–2015*; Joseph Rowntree Foundation: York, UK, 2015.
72. Newton, P.; Meyer, D. Exploring the attitudes-action gap in household resource consumption: Does "Environmental Lifestyle" segmentation align with consumer behaviour? *Sustainability* **2013**, *5*, 1211–1233. [CrossRef]
73. Hostetler, M.; Noiseux, K. Are green residential developments attracting environmentally savvy homeowners? *Landsc. Urban Plan.* **2010**, *94*, 234–243. [CrossRef]
74. DEFRA (Department for Environment Food & Rural Affairs). *Public Attitudes and Behaviours towards the Environment-Tracker Survey. Final Report to the Department for Environment Food and Rural Affairs*; Department for Environment Food & Rural Affairs: London, UK, 2009.
75. DEFRA (Department for Environment Food & Rural Affairs). *Local Authority Collected Waste Statistics—Local Authority Data 2019–2020*; A National Statistics Publication: London, UK, 2021.
76. OTB (Organic Trade Board). *A Fresh Look at the Organic Consumer*; Organic Trade Board: Andover, MA, USA, 2015.
77. DAFM (Department of Agriculture Food and the Marine). *Bord Bia Organic Consumer Research Study*; Ipsos MRBI: Dublin, Ireland, 2014.
78. DT (Department for Transport). *National Travel Survey; Table NT0409; Average Number of Trips (Trip Rates) by Purpose and Main Mode*; Department for Transport: London, UK, 2017.
79. OCC (Oxfordshire County Council). *Travel Behaviour Demonstration Project. Travel Behaviour Survey Summery of Results. Autumn/Winter 2010/2011*; Oxfordshire County Council: Oxford, UK, 2011.
80. OCC (Oxfordshire County Council). 2011 Census Summary. 2014. Available online: www.oxford.gov.uk/districtdatapublications (accessed on 14 February 2022).
81. WRAP. *Increasing Recycling in Urban Areas*; WRAP: Banbury, UK, 2018.
82. Phillips, P.S.; Tudor, T.; Bird, H.; Bates, M. A critical review of a key Waste Strategy Initiative in England: Zero Waste Places Projects 2008-2009. *Resour. Conserv. Recycl.* **2011**, *55*, 335–343. [CrossRef]
83. Read, M.; Gregory, M.K.; Phillips, P.S. An evaluation of four key methods for monitoring household waste prevention campaigns in the UK. *Resour. Conserv. Recycl.* **2009**, *54*, 9–20. [CrossRef]
84. Wang, M.C.; MacLeod, K.E.; Steadman, C.; Williams, L.; Bowie, S.L.; Herd, D.; Luluquisen, M.; Woo, M. Is the Opening of a Neighborhood Full-Service Grocery Store Followed by a Change in the Food Behavior of Residents? *J. Hunger Environ. Nutr.* **2007**, *2*, 3–18. [CrossRef]
85. Guido, G. *Behind Ethical Consumption: Purchasing Motives and Marketing Strategies for Organic Food Products, Non-GMOs, Bio-Fuels*; Peter Lang: Bern, Switzerland, 2009; ISBN 978-3-0343-0095-7.
86. Evers, A.; Hodgson, N.L. Food choices and local food access among Perth's community gardeners. *Local Environ.* **2011**, *16*, 585–602. [CrossRef]
87. Patt, A.; Aplyn, D.; Weyrich, P.; van Vliet, O. Availability of private charging infrastructure influences readiness to buy electric cars. *Transp. Res. Part A Policy Pract.* **2019**, *125*, 1–7. [CrossRef]
88. Fishman, E.; Washington, S.; Haworth, N. Bike Share: A Synthesis of the Literature. *Transp. Rev.* **2013**, *33*, 148–165. [CrossRef]
89. Bonsall, P. *Car Share and Car Clubs: Potential Impacts. Final Report for DTLR and the Motorists Forum*; Institute for Transport Studies, University of Leeds: Leeds, UK, 2002.
90. Hanson, S.; Hanson, P. The Travel-Activity Patterns of Urban Residents: Dimensions and Relationships to Sociodemographic Characteristics. *Econ. Geogr.* **1981**, *57*, 332–347. [CrossRef]

91. Daly, M. Quantifying the environmental impact of ecovillages and co-housing communities: A systematic literature review. *Local Environ.* **2017**, *22*, 1358–1377. [CrossRef]
92. Willett, J. Eco Towns, Complexity and Understanding. In Proceedings of the Regional Studies Annual International Conference, Newcastle-upon-Tyne, UK, 17 April 2011; pp. 1–14.
93. Smith, A. Translating sustainabilities between green niches and socio-technical regimes. *Technol. Anal. Strateg. Manag.* **2007**, *19*, 427–450. [CrossRef]
94. CST (Council for Science and Technology). *Achieving Net Zero Carbon Emissions through a Whole Systems Approach: CST Report*; Council for Science and Technology: London, UK, 2020.