

Making a sustainable community: life in Derwenthorpe, York, 2012–2018

by Deborah Quilgars, Alison Dyke, Alison Wallace and Sarah West

This report presents the results of a six-year evaluation of Derwenthorpe, an urban extension of about 500 homes in York, developed by the Joseph Rowntree Housing Trust (JRHT) and David Wilson Homes. The research documented the extent to which it met its aims to create a socially and environmentally sustainable community 'fit for the 21st century'.

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Actions

- Greater emphasis on the design, space standards and aesthetics of new developments should be incorporated into Government-level directives.
- Housing providers must work with resident groups to set up inclusive governance structures to promote the long-term social sustainability of communities.
- Architects and developers need to 'build in' environmental interventions into new homes, rather than choose technology that requires resident knowledge and operation. They also should consider how they can influence residents' overall carbon footprints.

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February 2019
www.jrf.org.uk

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Executive summary

Derwenthorpe is a new urban extension of approximately 500 homes on the outskirts of York, England, that is being developed and managed by the Joseph Rowntree Housing Trust (JRHT), and built by David Wilson Homes. It is a mixed community of social housing, shared ownership and owner occupation, and aims to create a socially and environmentally sustainable community 'fit for the 21st century' (JRHT, 2009). Derwenthorpe offers a wide range of 'interventions' intended to enable and encourage residents to live sustainably.

The Joseph Rowntree Foundation (JRF) commissioned the Centre for Housing Policy (CHP) at the University of York to examine resident experiences over Derwenthorpe's first six years, from 2012 to 2018. The research involved longitudinal interviews with 43 residents (69 interviews in total), and an environmental survey (REAP Petite) for Derwenthorpe residents and those living in three comparator communities in England (BedZED in London, Lancaster Cohousing, and Ashton Hayes in Cheshire). Interim findings were reported in Quilgars et al (2015). This report focuses on the community and homes in 2018, with change over time also considered.

Derwenthorpe homes

The vast majority of residents (89%) were satisfied with their homes, with residents more likely to be 'very satisfied' than the national average.

There was considerable praise for the overall design of the homes. Residents repeatedly commented positively on the space standards, the big windows/lightness, high ceilings, arrangement of rooms over the different floors, external appearance of the homes and, for some, the views from their home onto green areas.

As with all new developments, there is a period where some 'snagging' issues are expected. Residents' experiences in this area varied; however, many felt that the level of snagging had been quite high and, while urgent repairs were attended to quickly, less serious issues could have been dealt with more quickly.

A major achievement of Derwenthorpe was designing properties to the Lifetime Homes standard developed by JRF and the Habinteg Housing Association in 1991, and further adapting properties to meet the specific housing and support needs of people with disabilities or health conditions. The impact on families that had moved to Derwenthorpe in order to meet the needs of children or other household members with disabilities was life-changing.

Overall, most owners and tenants felt that the properties were affordable, although a few shared owners had concerns about ongoing affordability, with their rents going up more than their mortgages. Most people were reasonably happy with the estate charge level, however there was a consensus that more should be done for the money, particularly nearer to people's homes.

All homes include a number of environmental features, such as: high levels of airtightness/insulation; low-energy fittings; water restrictors; a mechanical ventilation system; and heating from a communal heat and hot water system (powered by a combination of biomass and natural gas).

The majority of residents were satisfied with the energy efficiency of their home, however there was some dissatisfaction; there were reports that the homes did not hold their heat as had been hoped. Others reported difficulties in heating the house to a suitable temperature in winter, particularly on the ground floor.

The REAP Petite survey showed that 48% of residents thought that living at Derwenthorpe would reduce their energy costs, while 25% disagreed and 28% were unsure. A number of residents were unhappy with the new dwelling charge on the heating costs, with energy bills increasing following this.

There was a clear need for greater explanation of heating and ventilation systems. There had been some disappointment at the low levels of biomass burnt, and the monopoly of one supplier for heating (also for internet connection) was felt to be less than ideal.

There remained a level of frustration with the MVHR (mechanical ventilation with heat recovery) system in phase one, with some having to have systems replaced; others were waiting for this to happen, and to hear how the systems would be serviced. There appeared to be varying levels of knowledge about the simpler MEV (mechanical extract ventilation) system installed in later phases.

All residents were recycling, and many more than previously were using the kitchen recycling bins, although it was felt that Derwenthorpe could go further with recycling. A community garden and pop-up shop for organic bread and vegetables/fruit had been established – these were well supported.

The main environmental feature that residents would have liked to see added to their homes was solar panels. Recently, JRHT had received monies to fit solar panels on the Super Sustainable Centre (SSC) and more widely, and this had been welcomed.

Some key conclusions from the residents' experience of their homes, which could be useful for other developers, include:

- The architectural design of homes that privileges space (including height) and light are highly regarded by residents, and impact positively on quality of life. Some of these design qualities also have environmental benefits. Design informed by cultural heritage, but also by aesthetics and wider international influences that push the boundaries of traditional design, can work.
- Time and funding pressures on developers, along with skill shortages, impact on build quality and performance. This is industry-wide and needs addressing at the national level.
- Lifetime Homes standards, along with the capacity to extend the home into the loft, can future-proof a home for a variety of household types.
- The transparency of energy and estate charges is crucial from the outset, to avoid considerable upset and possible misunderstandings among residents.
- Wherever possible, energy efficiency measures should be built into the fabric of the building. Where user knowledge is needed, clear (ongoing) information and instructions on energy efficiency measures are required.
- Any maintenance issues for energy efficiency measures (eg ventilation systems) need to be in place from occupation; individual householders should not be left to arrange these.
- Biomass boilers can reduce energy use, but their efficiency is compromised in low-density housing settings.
- Solar photovoltaics are well supported by residents, require little user operation, and should be considered at the outset rather than as later additions.

Derwenthorpe community

The majority of Derwenthorpe residents (88%) were satisfied with their homes, with residents more likely to be 'very satisfied' than the national average. Most interviewees were very happy with Derwenthorpe as a place to live, particularly enjoying the growing sense of community. Reasons for dissatisfaction with the area included that the development was not as sustainable as they had been led to believe, there was a lack of communication and consultation with JRHT, and the ongoing disruption of building work.

Derwenthorpe residents loved the green space around them and, six years on, were particularly pleased with how the green space integrated with the housing.

Participants appreciated having the SSC as a community hub and venue for activities, seeing it as very important for promoting community building. Many residents appreciated the provision of social opportunities, even if their work constrained them from attending. Some of those leading busy lives would have preferred more informal and ad hoc social opportunities; others requested further information on activities, in particular whether they were family friendly.

Derwenthorpe residents frequently talked about how friendly the development is, particularly in phase 1. Phase 1 residents had more social relationships than those in phases 2 and 3. More owners knew other people as friends, whereas shared ownership and renters identified more people as neighbours than as friends.

Residents appreciated the 'pepper-potting' or mixture of tenures, and that you couldn't identify tenure type from the outside of a home. In the main, residents were very supportive about the idea of a mixed community and felt it functioned well. However, some residents expressed concern that different tenure types weren't mixing at social events. There were also a couple of instances of social distance between owners and renters.

Interventions designed to promote sustainable lifestyles and support a reduction in car use included: siting the development by the Sustrans cycle way; the provision of cycle vouchers and bus vouchers; and an on-site car club. Residents appreciated the cycle network and buses, but the car club scheme was used much less. Parking remained a problem on the site, with differing views between residents as to the role of the car on the development, although there were many instances where neighbours had successfully negotiated their parking arrangements.

Generally, residents really appreciated the location of Derwenthorpe in York, and local services were generally considered good. Relations with the neighbouring areas of York appeared to have improved over time. Similarly, reports of anti-social behaviour had also reduced over time.

Some key conclusions from the community side of the development, which could be useful for other developers, include:

- Satisfaction with the development was generally high. Factors that may have helped this were the sense of community and the large amounts of communal open space, as well as the design of the houses and their appropriateness for family members with additional needs.
- The most common reason for people being dissatisfied with the area was that it was not as sustainable as they had been led to believe when they moved to the development. It is important not to 'over sell' such aspects during the house purchase stage.
- Provision of a central community space was very important for many residents, and has enabled a sense of community to develop across phases. Such spaces need to be planned in as an integral part of new developments.
- The Derwenthorpe Residents' Association was well established, but there was considerable concern that it had not succeeded in attracting members from across social renting and shared ownership tenures. It is recommended that equity across tenures be built into the constitution and terms of reference of community bodies.
- More generally, the integration of tenures in the design works well to generate a sense of equality and integration. Similarly, the distribution of different sizes of house helps to bring together residents at different life stages.
- Pedestrian and cycling routes, and leisure spaces accessible to all, enable residents to feel a sense of ownership over the whole development. Derwenthorpe demonstrated the value of green landscaping, including sustainable urban drainage systems, to new developments.
- Parking is a key issue for many people, with 1.1 allocated car spaces per property; this causes conflict between neighbours, despite initiatives such as a new bus route, bike vouchers and a car club scheme designed to encourage only one car per household. It was clear that more far-reaching policies are needed for a one-car-per-household policy to work, including earlier and better public transport, consideration of incorporating this policy into title deeds/rental agreements, and/or clearer options for visitor/overflow parking at the perimeter or off-site.

Derwenthorpe environmental footprint and comparators

Derwenthorpe respondents had a significantly lower carbon footprint than other UK respondents taking part in the REAP Petite environmental survey (13.66 tonnes of carbon dioxide equivalent, compared to

14.17 tonnes). Both of these were lower than the reported UK mean as a whole (16.24 tonnes). Derwenthorpe residents and the rest of the REAP Petite sample both had a mean positive attitude towards the environment.

Derwenthorpe residents had a significantly lower power component in their carbon footprint (1.39 tonnes per year) than both the UK sample (2.50 tonnes) and other respondents from York (2.76 tonnes). The design of the homes and the community heating system are the main drivers behind the significantly lower power footprints for Derwenthorpe compared to the rest of the UK sample.

At the moment, 41% of respondents reported using a green electricity provider, compared to 30% in the national REAP Petite sample.

Derwenthorpe residents had a significantly higher food component in their footprint compared to the rest of the UK sample (2.15 tonnes compared to 2.30 tonnes). They also had a significantly higher travel component in their footprint (3.96 tonnes) compared to other York residents (3.52 tonnes).

There was considerable variation in total footprints between individuals at Derwenthorpe – ranging from under 10 tonnes to around 30 tonnes of carbon dioxide equivalent per person; this difference was due to large variation in travel footprints. There was also variation by phase – the mean total footprint was 14.33 tonnes for phase 1 residents, 13.97 tonnes for phase 3, and 11.79 tonnes for phase 2.

Derwenthorpe residents had broadly positive attitudes towards the environment; however, there was no correlation between environmental attitudes and carbon footprint.

There was a significant difference in the total carbon footprint (and in the travel, food and power components) between the four comparator communities in the study. Unsurprisingly, Ashton Hayes had the highest power footprints, as the houses were not built as eco-homes; BedZED and Derwenthorpe came next, and Lancaster Cohousing had a significantly lower power footprint than both of these. This difference is mainly accounted for by the use of gas in BedZED's and Derwenthorpe's district heating systems until recently (compared to the wood-chip system used in Lancaster).

Several key conclusions arise from the environmental footprint analysis:

- Footprints can be lower than the UK average in new-build developments. Initial house design is critical for reducing energy bills and is a big driver of the power footprint, as is the energy that supplies it. Biomass boilers significantly reduce power footprints. Occupancy rates are also important – if under-occupation is occurring, then footprints per person are high.
- Other aspects of footprints, in particular travel, are harder to reduce, and require city- or national-level initiatives alongside community-level activities. The location of the community influences travel footprints. Community car club schemes and strict car ownership regulations (such as at Lancaster Cohousing) can lead to significantly lower travel footprints.
- Moving into a new home can lead to large amounts of new furniture, appliances, etc being purchased, leading to high shopping footprints. This could be reduced through promotion of community recycling or reuse schemes by housing providers.
- Community behaviour also has the potential to influence footprints, for example, communal shopping and eating can lower food footprints.
- We remain a long way from achieving low enough carbon footprints to keep us within the IPCC's 1.5–2°C limit on warming by 2050 (IPCC, 2018), which has been estimated at 1.05 tonnes of CO_2 per capita.

Conclusion

Increasing the sustainability of housing is critical, however in England (and Northern Ireland) the policy routes to achieving these measures across new and existing stock are uncertain. Sustainable housing development remains a niche enterprise, and mainstreaming learning points from exemplar sites is a challenge. Nonetheless, Derwenthorpe's experience can be instructive for new developments moving forward.

Overall, Derwenthorpe has succeeded in delivering a socially sustainable community, with its commitment to mixed communities and high-quality housing and neighbourhoods. A JRHT stewardship role and new, enthusiastic residents have together created a strong sense of community within a six-year period.

The Derwenthorpe experience on environmental sustainability has been more mixed. As with other similar developments, district heating systems and mechanical ventilation systems had proved difficult to operationalise, leading to some frustration among residents. However, despite this, residents had achieved lower than average power (and total) carbon footprints. The green features of the wider environment were also successful in terms of offering a good quality of life, as well as contributing to a small shift towards sustainable transport.

1 Introduction to Derwenthorpe

This chapter introduces Derwenthorpe, describing its aims, objectives and main features, as well as the research used to evaluate it.

Background to Derwenthorpe

Derwenthorpe is a new urban extension of about 500 homes on the outskirts of York, England. David Wilson Homes is developing the site on behalf of the Joseph Rowntree Foundation/Joseph Rowntree Housing Trust (JRF/JRHT), on land bought from the City of York Council. At the time of writing, the development was nearing completion, with approximately 400 homes occupied. It is a mixed community of social housing, shared ownership and owner-occupation.

Derwenthorpe was inspired by the renowned New Earswick community in York,[1] developed by Joseph Rowntree for workers within York 100 years earlier. JRF/JRHT wanted to create a new community, a century on, that was both socially and environmentally sustainable. There was an explicit aim to develop an urban extension that could be replicated by volume house builders to scale, rather than being a niche part of the housing market.

The Derwenthorpe Business Plan (JRHT, 2009) stated that the vision for Derwenthorpe was four-fold:

1. Derwenthorpe will be a vibrant and supportive community where residents are actively encouraged to be involved in decisions affecting their day to day life, the services received and management of the communal facilities.
2. Derwenthorpe will provide high-quality homes for the residents across York, and offer a number of innovative and special attributes including mixed income and tenure options covering all financial circumstances.
3. Derwenthorpe will be a community which is able to adapt to changes in the external environment over time and give both physical and financial accessibility to people of all ages and needs.
4. Derwenthorpe represents a demonstration and influencing opportunity at both a local and national level offering a potential blueprint for family living in a truly sustainable community 'fit for the 21st century'.

The plan for Derwenthorpe has a long and controversial history.[2] The development was delayed by a significant planning period, with local opposition, a public inquiry in 2006 and a European Commission investigation in 2008–2010. Finally, development started on-site in 2011, with Richard Partington Associates as architects, and David Wilson Homes as developer. The site was developed in four phases, each phase linked by footpaths and a Sustrans cycle way (with no through-traffic).

Phase 1, consisting of 64 homes, saw the first residents arrive in 2012 and was completed in 2013. Phases 2 and 3 (123 and 230 homes, respectively) saw the first residents in 2014, and remain under construction. The first residents of Phase 4 (66 homes in total) moved in recently. The 483 homes will be complete by 2019. In addition, an extension of phase 3 is also planned, with a further 40 homes being built on land formerly owned by the National Grid.

Table 1 shows the tenure split for the development. As can be seen, three in five (59%) homes are for sale across the development, while a quarter (26%) is for social rent; the smallest proportion (15%) is reserved for shared ownership. The different-tenured homes are scattered across the development, so neighbours are usually in homes of different tenure. At the time it was relatively rare to have this extent of tenure mix in a large housing development (Tunstall and Lupton, 2010).

Table 1: Derwenthorpe phases, by tenure split

	Total number of properties	Social rented	Shared ownership	Owner-occupied
Phase 1	64	15 (23%)	10 (16%)	39 (61%)
Phase 2	123	30 (24%)	19(15%)	74 (60%)
Phase 3	230	75 (33%)	41 (18%)	114 (50%)
Phase 4	66	4 (6%)	4 (6%)	58 (88%)
Total	**483**	**124 (26%)**	**74 (15%)**	**285 (59%)**

As shown in Figure 1, from the outset, Derwenthorpe offered a wide range of 'interventions' intended to enable and encourage residents to live sustainably (socially and environmentally).

Figure 1: Derwenthorpe social and environmental interventions



All homes included a number of environmental features, such as: high levels of airtightness/insulation; low energy fittings; water restrictors; a mechanical ventilation system; and heating from a communal heat and hot water system (powered by a combination of biomass and natural gas). Some changes were made for later phases: the mechanical ventilation and heat recovery (MVHR) system for ventilating homes in phase 1 was replaced by mechanical extract ventilation (MEV); winter gardens[3] became an option in later phases; and compost bins and water butts were not provided in later phases. These changes were made for capital cost reasons, and following resident feedback on the operational performance of the systems. Under the now-defunct Sustainable Homes Code,[4] phase 1 achieved level 4 (providing at least 25% improvement in dwelling CO_2 emission rate over target emission rate), with five homes being built to level 5. Future phases were developed to level 3 (although energy performance was at level 4).

Home-buyers purchase a freehold, though they are restricted through covenants from altering the environmental features of their homes or using an off-site energy supplier; tenancy agreements limit tenants in the same way.

Figure 1 also shows the wider environmental interventions within the development as a whole, including interventions designed to promote sustainable lifestyles and support a reduction in car use: siting the development by the Sustrans cycle way; provision of cycle vouchers to buy a bike; bus vouchers; and an on-site car club. The ponds and green space were designed to enhance quality of life, as well as provide a sustainable urban drainage (SUD) scheme[5] and wildlife habitat.

Finally, Figure 1 summarises the social interventions to date, including the Lifetime Homes standards,[6] the provision of community space via the Super Sustainable Centre (SSC; also Energy Centre) and outdoor space, a Facebook page for Derwenthorpe residents, and JRHT and JRF digital inclusion initiatives.

JRHT has a long-term stewardship role at Derwenthorpe, with a community manager in post at the scheme. Tenants, shared owners and owner-occupiers all pay an estate charge for the maintenance of the public spaces and up-keep of key facilities (average of £37 per household per month in 2017[7]). JRHT supported the development of a Derwenthorpe Residents' Association (DRA), with a core group and all resident meetings held regularly. A separate community activities group was also recently established. By 2017/18 there was a range of community activities that had been developed by the community (via both individual and group initiatives) and/or JRHT over the first six years (Table 2). Most of these used the SSC for meetings; others met at residents' houses or in the green areas.

Table 2: List of community activities, 2017/18

Social activities	Environmental activities
Choir	St Nicks wildlife monitoring
Art class	Community gardening and wildlife group
Parent and toddler group	Community litter-picking
Two book clubs	Open gardens
Film events	Special talks on Derwenthorpe
Wine club	
Two yoga classes	
Pilates	
Coffee mornings	
Xmas/Easter/Halloween parties	
Quiz nights	
Running club	
Outdoor table tennis	
IT classes (starting autumn 2018)	

The University of York research

The aim of the research was to determine the extent to which Derwenthorpe developed into an environmentally and socially sustainable community. The research involved a longitudinal study of residents' responses and experiences over a six-year period, from 2012 to 2018, situated within an examination of sustainable housing developments. An interim report (Quilgars et al, 2015) reported on the first three years of development. This report focuses mainly on the final phase of the research, but also looks back to the earlier findings.

The research methods involved four main elements, as follows.

A research review

The literature review was based on Google Scholar searches using various configurations of the terms and synonyms related to 'environmentally and socially sustainable housing development and house building' during the summer of 2017. Empirical studies published in the UK and during the last ten years were prioritised.

In-depth longitudinal interviews

A total of 43 separate resident households took part in 69 interviews, over three rounds (Table 3). This included 26 repeat interviews: in 2014/15, 13 of the 16 original phase 1 interviewees took part in a follow-up interview; and in 2018, eight of these same households took part in a third interview, and five phase 2 and 3 households also took part in a second interview (of the 10 interviewed in 2014–15).

This report mainly presents the findings from the last round of interviews: 10 households from phase 1 and 18 households across phases 2 and 3 (including 13 repeat interviews). However, where relevant, we also compare findings to those presented in the interim report (Quilgars et al, 2015).

Table 3: Number of interviews with Derwenthorpe households

Year	Phase 1	Phase 2/3	Total
2012–2013	16	n/a	16
2014–2015	15 (13 repeat interviewees and 2 new interviewees)	10	25
2018	10 (8 repeat interviews and 2 new interviewees)	18 (5 repeat interviewees and 13 new interviewees)	28
Total	**41 (20 households)**	**28 (23 households)**	**69 (43 households)**

As this report focuses on the 2018 sample, Table 4 shows a more detailed breakdown of the interviewees by phase and tenure. Overall, this last round of interviews included 15 owner-occupiers, seven shared owners and six renters. This compared to 15 owners, six shared owners and eight renters in the interim report.

Table 4: Households interviewed, 2018

	Owner-occupiers	Shared owners	Rented	Total
1st phase	6	2	2	10
2nd phase	4	1	1	6
3rd phase	5	4	3	12
Total	**15**	**7**	**6**	**28**

The 28 interviewees included 13 couples, ten families with children and five single people. Each household received a £15 shopping voucher to thank them for taking part in the study.

The original sample was selected according to a three-level strategy. First, properties were selected at random by tenure; second, this sample was reviewed by household type to allow as many different households to take part; and third, the sample was checked for geographical distribution across the scheme. In the last phase of interviews, a similar strategy was followed, however household information was not available at this time. In addition, we also sent a letter to all renters and shared owners asking if they would be willing to be interviewed, due to the lower take-up rates among these groups.

In addition, nine interviews were conducted with key stakeholders over 2014–2018 from the private and public sector agencies involved in the design, commissioning, development and ongoing management of Derwenthorpe.

Tracking individual and household carbon footprints across Derwenthorpe

The research used the Stockholm Environment Institute's online environmental footprint calculator (REAP Petite) that converts data provided by residents into carbon footprints for the individual, household or community (see http://www.reap-petite.com). REAP Petite asks respondents for information on five key areas relating their household, to calculate their footprint: power (to heat homes), travel, food, shopping (clothes and other consumables), and activities (eg going to the theatre, watching sport). REAP Petite measures both the direct and the indirect supply chain impacts that are associated with the things that households consume. It provides suggestions for reductions and enables users to make pledges to take action and see their effects.

For this research, REAP Petite incorporated some important additions including: Derwenthorpe-specific categories (house type, biomass boiler); residents' knowledge of and involvement with Derwenthorpe environmental interventions; household characteristics (size, income, tenure); residents' views on energy efficiency; and a series of closed and open questions on residents' satisfaction with their new home and community. Additionally, the New Ecological Paradigm,[8] a measure of environmental attitude, was also incorporated into the survey.

Residents were asked to complete the survey on two occasions: in 2013/14 and 2017/18. Residents were recruited via letters from the research team (with copies of the questionnaire), presentations at community events, and requests via the Derwenthorpe Facebook site. In early 2018, all 325 occupied properties were invited by letter to take part. A total of 111 residents completed REAP Petite (a 34% response rate). Nineteen people completed the survey twice.

In addition, the team and JRF have widely publicised the REAP Petite tool locally and nationally. By 2018, 1,212 people had completed the survey.

A comparison with three other sustainable housing developments in England

Three other sustainable housing developments were asked to take part in a comparison exercise with Derwenthorpe. Lancaster Cohousing, BedZED and Ashton Hayes all kindly joined, and invited their residents to complete REAP Petite. Representatives from these three communities also attended two workshops to discuss findings across the projects. Responses from the three communities were as follows:

- Lancaster Cohousing scheme – an eco-housing development of 41 homes on the outskirts of Lancaster. Some 28 REAP Petite responses were received across two survey periods in 2013 and 2018 (68% of the community took part).[9]
- BedZED – a low-carbon development of 100 homes in London. There were 27 responses across two survey periods in 2015 and 2018 (33% of the community took part).[10]
- Ashton Hayes located in rural Cheshire, Ashton Hayes is an existing village of about 1000 people that is aiming to become England's first carbon neutral community. Nine people took part from one email request to a community group list in 2018.[11]

Report structure

Chapter 2 presents the research review on sustainable housing developments in the UK. Residents' overall satisfaction and views on their homes are presented in Chapter 3. Chapter 4 reviews people's views and experiences of Derwenthorpe as a new community. Residents' carbon footprints, collected via the REAP Petite survey, are analysed in Chapter 5 and compared to our comparator schemes. Chapter 6 presents the key conclusions from the research.

2 Achieving sustainable housing development

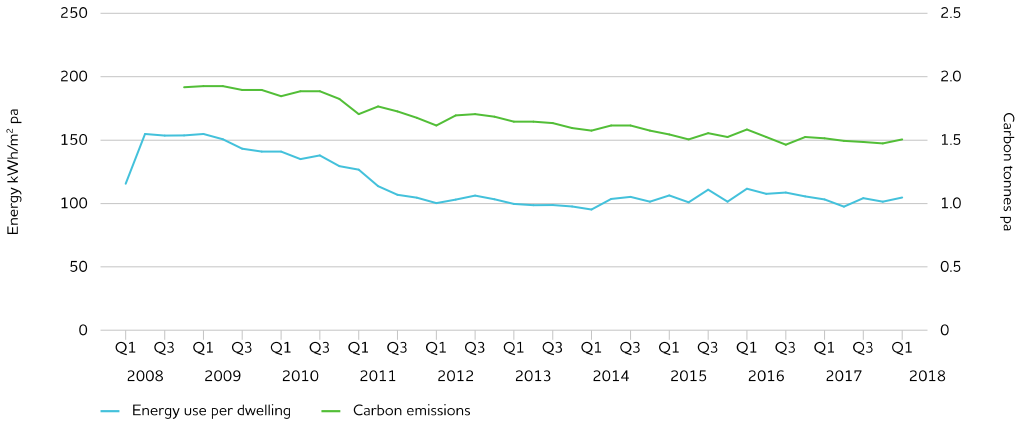
Introduction

This chapter provides an overview of what is known already about sustainable housing development, exploring: what it means for a residential development to be sustainable; the features that characterise sustainable housing developments; what exemplar new developments have achieved in terms of environmental and social concerns; and what factors facilitate or limit the production of sustainable housing schemes.

Increasing the sustainability of housing is critical – in 2017, residential buildings accounted for 19% of all carbon emissions in the UK and 30% of all energy demand (BEIS energy and emissions statistics[12]). Furthermore, any progress in reducing consumption and emissions has been slower in the residential sector than in other arenas. Between 2000 and 2017, total carbon emissions were reduced by 37%, but only by 22% for residential buildings; greenhouse gas emissions were reduced by 39% overall, but by only 22% in the residential sector; and total energy consumption was reduced by 15%, but only by 11% in the residential sector.

Energy performance certificate (EPC) data for England and Wales show that 87% of all new dwellings registered in Q1 of 2018 were rated in the top bands A and B for environmental impact, compared to only 17% across all dwellings (MHCLG, 2018a – Live tables D6 and NB6). The environmental impact of new homes is, therefore, a significant improvement on that of the existing dwelling stock. However, EPC data shows that the estimates of energy use for new homes have been essentially static over the last five years after showing earlier reductions, although estimates for carbon emissions continue to decline (Figure 2).

Figure 2: Estimates of energy use and carbon emissions for new homes from EPC data 2008–2018



Source: MHCLG (2018a); EPC Data Live Table NB7

Sustainable development is commonly conceptualised as 'meeting the needs of the present without compromising the ability of future generations to meet their own needs' (United Nations, 1987), and thus encompasses a built environment shaped in such a way as to remain successful or effective over the long-term with respect to the three pillars of economic, social and environmental concerns. Sustainable urban neighbourhoods are, therefore, about more than just energy and emissions, and need:

- social and economic choices that ensure long-term value and balanced communities
- sites well connected to jobs and services

- places of different character, to appeal to different markets over time
- neighbourhoods designed to conserve resources
- long-term management and stewardship (Falk and Carley, 2012).

Sustainable development holds multiple and malleable definitions and meanings that render it poorly understood and deployed for multiple purposes (Lombardi et al, 2010; Kates et al, 2016). In the context of delivering new homes, it has become fiercely contested (Morgan et al, 2015).

Interventions range from market-based responses to grassroots, self-sufficient communities. The first set of initiatives involves price incentives that concur with current economic structures and consumption patterns (Greenwood, 2012; Mayne et al, 2014; Reid and Houston, 2013). Reducing costs alone, however, can produce rebound effects where savings are translated into additional expenditure on energy-intensive expenditures such as travel; so policy should aim for policy sufficiency – limiting overall energy use – rather than energy efficiency (Herring, 2011). Alternatively, other responses see behavioural change as important, as otherwise sustainable goals are limited by what technical fixes can offer. In contrast to market models aimed at individuals, other approaches recognise the social nature of how carbon is produced (Mayne et al, 2014), and therefore promote a bottom-up approach of grassroots activities that mitigate climate change and privilege nature (Atkinson et al, 2017). Sustainable developments have adopted a variety of these divergent approaches (Holden et al, 2015).

The policy context for achieving sustainable housing development in the UK

The regulatory framework for sustainable development in the UK is governed by the European Union and the devolved governments of the UK. All jurisdictions capture broad ambitions for existing cities and neighbourhoods to transition towards sustainable environments, not least through their prescription of new built environments and urban forms.

The EU has 2020 targets enshrined in the Renewable Energy Directive, the Energy Efficiency Directive and the Energy Performance of Buildings Directive, and include: a target of 15% of all energy used for electricity, transport and heating to come from renewables; that UK energy consumption should fall by 129.2m tonnes of oil equivalent; and that all new buildings should be effectively zero energy by the end of 2020 (2018 for public buildings)(Sustainable NI, 2016). The EU also contributed to the wider UN Sustainable Development Goals for 2030, which include Goal 11 sustainable cities and communities.[13] The UK Government remains obligated to comply with these EU ambitions, at least until any Brexit transition is complete. The UK also has an obligation to reduce emissions by 80% below the 1990 baseline by 2050 under the Climate Change Act 2008, and has reaffirmed its commitment to the Paris Climate Deal 2015, whereby nation states agreed to mitigate climate change by ever more stringent targets to reduce emissions. Below these international and national policy headline commitments in respect of housing, much delivery is the responsibility of the devolved governments of the UK.

In England, previous commitments for all new homes to be zero carbon from 2016 (Goodchild and Walshaw, 2011) and a national retrofitting programme, the Green Deal, were dropped in 2015; arguably, policy in this area is now limited. The Renewable Heating Initiative incentivises – but now less generously – renewable and low-carbon heating and power technologies. There is also a target of insulating one million homes during this parliament, and the Government is reviewing the Standard Assessment Procedure (SAP) ratings system that measures the energy performance of buildings that feeds into the building regulations, and reviewing boiler performance standards (BEIS, 2018). The new National Planning Policy Framework (MHCLG, 2018b) still includes the presumption of sustainable development.

Scotland's housing strategy and policies on heat generation are perhaps bolder, and include efforts to decarbonise Scotland's heat system by 2050; eliminate fuel poverty by 2016; retrofit existing homes and upgrade building regulations by 2030; ensure all homes have loft and cavity wall insulation where appropriate and feasible, that gas-heated homes have energy efficiency boilers and suitable controls by 2020, and that 100,000 homes have community or renewable heat generation by 2030 (Scottish Government, 2013; University of Edinburgh, 2015). Moreover, Scotland has a community energy policy aiming for 500 megawatts of output by 2020 (Local Energy Scotland, 2015).

The Welsh Assembly is committed to sustainable development enshrined in the Well-being of Future Generations (Wales) Act 2015, and places sustainable development at the centre of public sector activities, encapsulating these in planning regulations (The Climate Group, 2015). National planning guidance suggests local authorities are sensitive to sustainability throughout the development process, and may request greater standards above building regulations in their Supplementary Planning Guidance for their area (Welsh Government, 2014).

In Northern Ireland, local authorities have recently assumed responsibility for the planning and guidelines for sustainable development. Across the area, there are presumptions in favour of sustainable development that include an ambition to reduce emissions by 35% of 1990 levels by 2025. Residential buildings have higher emissions as households are mostly reliant on oil as heating fuel; consequently there are moves to extend the gas network and push for networked heating in new developments (Committee on Climate Change, 2015).

The UK Green Building Council (2018) has produced guidance on how local authorities can have sustainability requirements and reduce spatial variation in planning requirements.

What has been achieved?

Housing developments built explicitly to meet sustainable goals have shown good reductions in energy demand and carbon emissions. One low-carbon development in the east of England found total energy consumption was 56% lower than the national average, carbon emissions were 63% lower and water consumption 39% was lower (Gill et al, 2011). Another development, BedZED[14] (see Chapter 5), achieved an 81% reduction in energy demand, a 45% reduction in electricity use (with 20% of site electricity generated by solar panels), and water consumption was 58% lower than the London average (Chance, 2009). Other exemplar sites exceed these results: Hockerton Housing Project[15] used 25% less energy than BedZED, and a porch over the front door that minimised heat loss was a key attribute that explained the difference in energy consumption between the two schemes (Goh and Sibley, 2008). BedZED also achieved a reduction of 23% in emissions resulting from personal transport with reduced parking, a car club and cycle-friendly streets, and residents driving 64% fewer kilometres a year (Chance, 2009). New homes built explicitly to meet sustainability goals have successfully reduced carbon emissions, from 1.6 tonnes to 0.86 tonnes per year (Davies and Osmani, 2011), which still compares favourably with 2018 Q1 carbon emissions of 1.05 tonnes per year from mainstream new builds (MHCLG, 2018a – Live Table NB7).

However, differential performance on resource consumption between individual homes, even between homes built to the same specification, was not explained by household size but by the occupants' behaviour: for example, their propensity to leave appliances on standby. A critical factor is that much energy use is therefore unregulated – ie not specified in building regulations, and possibly beyond direct policy control (Gill et al, 2011).

Moreover, studies rarely consider the variety of residents in exemplar schemes. Some schemes have comprised greater numbers of professional residents with greater carbon footprints compared to lower-income households (Chance, 2009). Lower-income residents travel and consume less, but can bear a greater burden of fuel poverty (Reid and Houston, 2013), and yet monopoly microgeneration suppliers with high standing charges can fail to reduce bills as anticipated (Changeworks, 2017). New energy-efficient technologies may reduce resource use, but are also less resilient to climate change as homes are subject to overheating in the summer; people do not understand the heating and ventilation controls; and some homes are incapable of adaptation depending on the capacity of community boilers in collective systems (Stevenson and Baborska-Narozny, 2014).

What factors limit sustainable housing development?

Acts of omission were the most common barrier to sustainable design features – developers did not include them because the clients and planners did not ask them to do so (Williams and Dair, 2007). Many of these issues relate to the structure of our house-building industry and the pressures on planners to limit regulatory burdens on developers. The house-building industry may be characterised as high risk, and therefore conservative and slow to innovate (Calcutt, 2007; Farmer, 2016). Sustainable housing development therefore remains a niche enterprise, protected from the market, which is why

mainstreaming learning points from these sites remains a challenge (Goodchild and Walshaw, 2011). House-builders cite problems with the definition of low- or zero-carbon homes, with conflicts between regulation and local authority discretion that produces an uneven playing field (ibid). Many industry players are sceptical about the deliverability and market demand for environmentally sustainable homes (Morgan et al, 2015; Heffernan et al, 2012; Heffernan et al, 2015; Osmani and O'Reilly, 2009). Reducing energy efficiency to zero carbon added between 2.9% and 12.9% to the costs of building a house, but is not currently reflected in house values or prices (Morgan et al, 2015), and new homebuyers have little appetite to pay this premium (Osmani and O'Reilly, 2009; Calcutt, 2007). Developers felt that the primary obstacles to sustainable development were high material costs and technologies, long-term savings not being reflected in their business models, and a lack of expressed interest from consumers (Morgan et al, 2015). Cultural barriers, untested technologies, and limited knowledge and skills shortages in the industry and supply chain, also inhibit progress towards sustainable housing (Osmani and O'Reilly, 2009; Stringer, 2010; Williams and Dair, 2007).

'As built' performance aligns poorly with design expectations (Kabele et al, 2016; Morgan et al, 2015), and in some instances low-carbon homes perform no better than traditional homes (Gill et al, 2011). For example, combined heat and power (CHP) biomass plants are most effective in high-density large schemes, and not in the suburban developments the UK frequently delivers (Goodchild and Walshaw, 2011). A precursor development to the Derwenthorpe development in York found heat losses were 54% higher in practice than the heating system was designed to achieve (Bell et al, 2010). This performance gap is attributed to limited skills in specification and installation of various technologies (Changeworks, 2017), with few financial incentives for developers to overcome these challenges (Osmani and O'Reilly, 2009). Consequently, stringent building regulations should be based on 'as built' performance standards rather than intent (Morgan et al, 2015).

Consequently, new developments are more likely to meet the social and economic goals of sustainability than the environmental goals, instead meeting only the minimum requirements specified in building regulations and planning (Williams and Dair, 2007). Best practice in energy efficient design and construction was foregone to secure other facets of the development site, as local stakeholders favoured issues such as accessibility, viability, cultural heritage, local service provision and mixed housing. However, achieving social sustainability is also not without its problems. This can be damaged if a social mix is not achieved (Bramley and Morgan, 2003), and recent challenges to viability after the Localism Act 2011 have meant that securing social housing through Section 106 planning has become harder (Brownhill et al, 2015). Nonetheless, the provision of community facilities and an emphasis on community development has paid off in a number of sites with food-growing spaces, and communal halls enabling social and leisure activities on-site (Chance, 2009). Community groups have also enabled social learning, as residents formed 'communities of practice' with intermediaries effectively facilitating low-carbon energy groups (Mayne et al, 2014).

Retrofitting existing homes demonstrates substantial savings in energy use (Hamilton et al, 2013), but action is limited by high capital costs for new technologies and energy efficient materials, and the VAT disparity between refurbishment works and new build (Davies and Osmani, 2011). The retrofit Green Deal scheme provided funds to install insulation and other technologies to homes, repaid by savings made in domestic fuel bills, but ultimately failed as homeowners did not want to take on the relevant debt, because the financial benefits and length and terms of the loan were uncertain (Gooding and Gul, 2017). Without retrofitting existing stock, a higher rate of demolition and replacement of older stock is required to meet emissions targets (Boardman, 2007). As the UK house-building rate already lags behind what is required, the prospects for a greater replacement rate are limited.

The physical design of new homes is not the sole determinant of building performance, as occupant behaviour can undermine the energy performance of buildings (Gill et al, 2011). Furthermore, people live and work off-site and, therefore, overall emissions are dependent on external infrastructure and services, as well as normative patterns of leisure consumption and travel (Chance, 2009). Closing the gap between what is technically possible and what could be achieved is also dependent on people, their culture and choices, which receives less attention than the technical, engineering or modelling of environmentally sustainable homes (Moezzi and Janda, 2014). Environmentally inflected homes have prompted some residents to change behaviours, but there is evidence that others unwittingly or purposely do not use their homes as intended (Jones, 2014).

Good design can overcome some of these issues, but studies of exemplar development sites reveal that residents:

- do not always understand the heating and ventilation controls, impairing the technical performance (Stevenson and Baborska-Narozny 2014)
- varied in their water use, differed in their use of electrical appliances on standby mode, and were unable to reflect accurately on their own consumption (Gill et al, 2011)
- used homes incorrectly, with curtains or blinds in conservatories minimising solar gain, leaving doors open to sun rooms and keeping windows closed, exacerbating problems of overheating (Goh and Sibley, 2008; Gill et al, 2011)
- replaced energy efficient lighting with fixtures that were more aesthetically pleasing (Jones, 2014)
- derestricted low water-flow measures in showers (Reid and Houston, 2013)
- switched off noisy mechanical ventilation systems (Stevenson and Baborska-Narozny, 2014)
- became reliant on mechanical ventilation and forgot about passive ventilation steps such as opening windows (ibid)
- stopped engaging in debates about lifestyle changes if only technological fixes were promoted (Reid and Houston, 2013).

What facilitates sustainable housing development?

Addressing household behaviour towards energy use is, therefore, as important as technological fixes. Communications should work with the reasons people use energy in the first place, in terms of securing cleanliness, comfort and convenience; we need to consume less, not consume more efficiently (Herring, 2011). The framing of messaging needs to identify the social potential to make environmental changes in ways that fit with people's concerns and contexts, and recognise the social processes involved in energy consumption inside and outside of homes (Moezzi and Janda, 2014). Such social learning through local communities of practice was found effective in changing energy behaviour, but needs time and resources to support groups (Gupta et al, 2013).

In addition, residents require guidance and practical know-how to maximise the benefits of their sustainable homes (Chance, 2009). This may involve better induction and guidance on the principles on which their homes were designed, and on minimising energy use while avoiding overheating (Stevenson and Baborska-Narozny, 2014). But energy efficiency and cost savings are greatest when residents are not required to understand how to use things properly, favouring building fabric solutions over the technological (Morgan et al, 2015).

Developments cannot control off-site resource use, but can seek to influence behaviour. The provision of car clubs is effective in reducing car use in high-density areas with good public transport links where on- or off-site car parking spaces are at a premium (Melia, 2010). The now-abandoned 2016 building regulations provided 'allowable solutions', off-site initiatives to counter infrastructure and lifestyle generating emissions, which would have been a less expensive way for developers to achieve carbon reduction rather than relying on fabric and technology approaches alone (Morgan et al, 2015; Zero Carbon Hub, 2011).

Nonetheless, good design using passive design features and renewable technologies has a significant impact on reducing carbon emissions from new homes, and some key features are set out below. The use of these technologies at scale could also help the supply chain by standardising components and bringing down the price, enabling their wider application (Morgan et al, 2015).

- building at high density to minimise heat loss through the building envelope (Goh and Sibley, 2008)
- thermal massing to maximise thermal gains from the materials used in construction (Stevenson and Baborska-Narozny, 2014)
- maximising solar gain and increasing light levels through site orientation, sunspaces or winter gardens, and wide windows (Jones, 2014; Goh and Sibley, 2008)
- solar shading and window lights that open enable passive ventilation and not just mechanical ventilation systems to be used (Stevenson and Baborska-Narozny, 2014)

- CHP biomass boilers and other microgeneration measures (Changeworks, 2017)
- solar photovoltaics minimise the costs of meeting low- to zero-carbon home requirements, and the sector is mature and requires little input from residents (Changeworks, 2017)
- water recycling was apparent in the case study literature, but development professionals felt that consumers were not ready for this (Jones, 2014); there have also been problems in specification and installation (Shirley-Smith and Butler, 2008).

Regulation is a critical driver of sustainable development, as house-builders and stakeholders would otherwise sideline environmental issues to achieve other development goals (Williams and Dair, 2007; Morgan et al, 2015). However, developers require a level playing field with clarity about expectations to bring greater certainty, influence their bids for land and reduce risk (Morgan et al, 2015; Heffernan et al, 2012; Osmani and O'Reilly, 2009). Planning has an important role to play in meeting long-term demand, reducing this development risk, cutting construction waste and making housing affordable: all attributes important for new sustainable housing developments (Falk and Carley, 2012). The state therefore has great importance in enforcing standards and market-making.

Sustainable developments have been successful in fulfilling some social sustainability goals, creating strong communities with residents knowing more neighbours than in the wider population, and implementing growing boxes and veg box schemes to encourage food sustainability (Chance, 2009). For example, residents at the BedZED development in London knew 20 of their neighbours compared to the typical ten, which generally indicates a strong community. Long-term stewardship of sites by landowners or developers can support community development on new sites, where they alone or via joint community management companies can oversee community spaces; run handyman services; manage parking, rubbish or children's play issues; and look after the community and physical maintenance of the new neighbourhood (Falk and Carley, 2012).

Conclusions

The ambition of sustainable development is to meet environmental, economic and social goals that enable future generations to avoid paying for the mistakes of the past. Key points arising from this review included:

- There are different conceptualisations of sustainable development. While different approaches may see the ambitions being met via market mechanisms or grassroots activities (or both), the devolved UK governments are currently committed to meeting European carbon emissions targets, and thus require clear pathways to meeting the environmental goals of sustainable development.
- Wales and Scotland have pushed funds and have clear strategies to reduce energy use. In England and Northern Ireland, the policy routes to achieving these measures across new and existing stock is less certain. In this context, in England there are spatial variations in what is required of developers undertaking new residential development, and much activity remains niche.
- New housing plays an important role, as exemplar developments are shown to have reduced energy use by using a mixture of fabric solutions and renewable technology.
- More could be achieved if technological designs were more attuned to occupant behaviour, and if occupants could be approached as a community to reduce their energy demands overall and change their environmental behaviours. Measures that can achieve this involve messaging that cuts with the grain of why people adhere to current social practices of cleaning, leisure or travel, for example, and encompass the societal and whole system, rather than individual production of carbon.
- Ultimately, clear government regulation is the key driver to ensuring new mainstream homes are sustainable and contribute to carbon reduction, but retrofitting existing stock at scale remains critical, due to the slow rate of replacing stock in the UK housing system.

3 Derwenthorpe homes

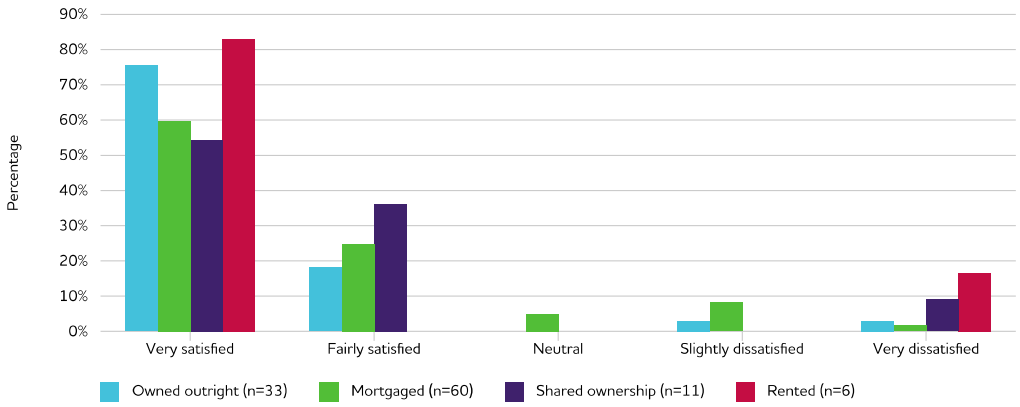
This chapter focuses on residents' experiences of their homes. The chapter starts with a consideration of residents' overall levels of satisfaction with their homes. Key aspects of the home are then reviewed, including house design, house quality, accessibility and affordability. The environmental features of the home are also discussed, including the heating system, ventilation systems, and water and other energy-saving features.

Overall satisfaction with homes

Residents' overall levels of satisfaction with their new homes were high. In the REAP Petite survey, the majority, 89%, stated they were satisfied (66% 'very satisfied', 23% 'fairly satisfied'; 3% were 'neutral', 6% 'slightly dissatisfied', and 4% 'very dissatisfied').[16] This approximates to national levels of satisfaction (90% satisfied), with slightly higher proportions in Derwenthorpe being 'very satisfied' (66% versus 59%; DCLG, 2017a).

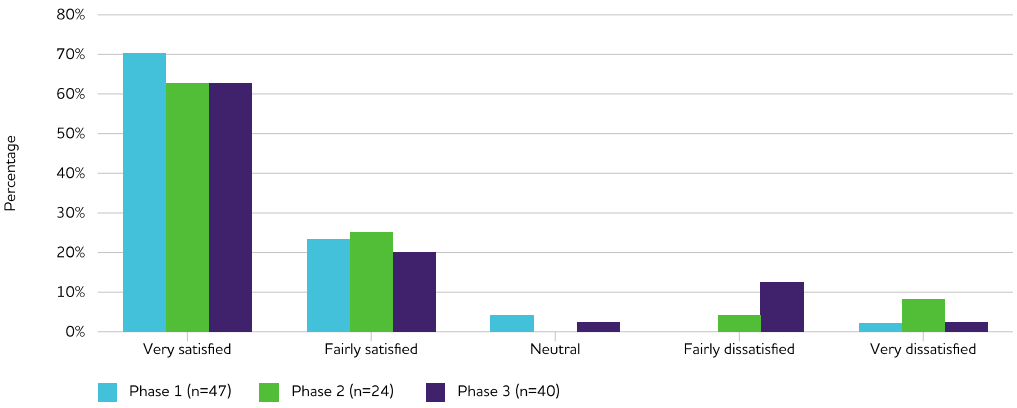
Outright-owners and renters were most likely to say they were 'very satisfied' with their homes (Figure 3). Nationally, those who own outright are most likely to be 'very satisfied' with their housing (74%), but less than half of all social renters (45%) are 'very satisfied' (DCLG, 2017a). However, tentative conclusions can only be drawn here due to the small number of social renters in our sample, and national figures referring to both new build and older homes.

Figure 3: Responses to the question, 'How satisfied are you with your accommodation?', presented as a percentage of respondents, by tenure



Across the development, satisfaction levels were slightly higher for phase 1 respondents (93%) compared to phases 2 and 3 (88% and 83%, respectively); phase 1 respondents were particularly likely to say they were 'very satisfied' (Figure 4). 'New' respondents (those who completed the survey within one year of moving) and 'settled' respondents (people who completed the survey at least one year after moving) had the same overall levels of satisfaction, but 'new' respondents were more likely to be 'very satisfied' (78% compared to 62%).[17]

Figure 4: Responses to the question, 'How satisfied are you with your accommodation?', presented as a percentage of respondents, by phase



Most people interviewed explained they were happy with their home, in particular its design, comfort and facilities. Almost without exception, people preferred this home to their previous accommodation. Nonetheless, interviewees often qualified their satisfaction by how much they liked their home, despite some issues that they felt needed addressing at the scheme level (as described in later sections).

> "It's very nice, very nice. To the point where I can't imagine myself really living somewhere else now."
> Single parent, shared owner, phase 2

> "Many things annoy us, but overall we feel we are lucky to live in this kind of house in York."
> Couple with children, owner, phase 1

House design and facilities

As reported in the interim report (Quilgars et al, 2015), there was considerable praise for the overall design of the homes. Residents repeatedly commented positively on the space standards, the big windows/lightness, thermal comfort, high ceilings,[18] arrangement of rooms over the different floors (having a third floor was much liked), external appearance of the homes (particularly height and white rendering, which reminded them of housing in other European countries) and, for some, the views from their home onto green areas.

> "It's lovely, as lovely as when we came … Bright, sunny, as you can see, large windows, tall ceiling … a bit of a garden, we love it."
> Couple, renter, phase 1

> "I quite like the house, the light, the windows and the doors, the large ones, the [light] coming through, I love it … it is a great place to live."
> Couple, owner, phase 3

> "Wow, it's really nice… Just the feel of the place, I feel like I'm not in England, [I'm] in Sweden or something!"
> Single parent, renter, phase 3

It was clear that all parties involved in the development of Derwenthorpe had been committed to pushing the design boundaries, and overall aesthetics, of the scheme.

> "There are obviously some decisions that have been made that are beyond the normal need for a house… The lifestyle, the aesthetics, in Phase 1 the pond is so close… It's aesthetically pleasing throughout…"

> "If I was to take anything from the designs at Derwenthorpe, it would be the ceiling heights and the huge windows, makes a huge difference."

> "Everyone should know that one of the major builders made a conscious decision to build with a higher floor to ceiling height."
> Stakeholders

The space provided appeared to be flexible enough to meet different residents' needs, with some altering the original intent of the room: for example, using an upstairs bedroom or living area as a study. People generally liked having space for all members of the family so that they did not feel on top of one another, although one family would have liked a second room downstairs for the children. The opportunity to build into the loft in the future was valued by one householder. There was some debate over the pros and cons of open plan living versus a separate kitchen; quite a few residents would have preferred a separate kitchen. It was commented that sound insulation between floors/rooms could be improved.

> "The house in terms of layout and design works very well for family homes. It's nice having the space... On the whole the house is very comfortable and it's a pleasure being here."
> Couple with adult child, owner, phase 3

Most households were satisfied with the kitchens and bathrooms, although a few would have liked utility rooms. Some home-owners would have chosen better quality fixtures (and some had replaced these). A back door would have been appreciated when allocated parking was at the rear of the property.

People were generally satisfied with the size of the garden:

> "The garden is very good, it's a little garden, but it's good for drying clothes. Because the communal areas are so nice you don't need a bigger garden."
> Single parent, shared owner, phase 2

However, many remained disappointed at the poor quality of the soil/lawns, especially problems with drainage. One recent buyer reported that the developer had replaced their lawn, which they described as 'very honourable'. A number of people had also moved the shed to a better location.

The fibre-optic internet connection seemed to work well overall, and connectivity appeared to have improved over time. There was still the occasional problem with poor signals across three floors. One renter, though, had struggled to find the £150 connection fee. A few people would also have preferred to be able to shop around for internet service, rather than having a monopoly provider.

The Derwenthorpe Facebook page, set up originally by JRHT, was well supported by many residents.

House conditions and repairs

As with all new developments in the UK, there is a period where some defects or 'snagging' issues are expected (Calcutt, 2007). Residents' experiences in this area differed, however many felt that the level of defects had been quite high, and that they could have been dealt with more quickly. One of the stakeholders described snagging as "a bit of a beast", and at one point the developer had hired more people to address these issues.

Some people reported a long list of repairs needed in the first couple of years (see Table 5 for examples). One shared owner in phase 3 had eight different issues, from minor cracks to three substantial leaks from the heating system. All of these had been resolved under the two-year guarantee, but the resident considered that many were "avoidable if greater care had been taken during the build phase". Others also felt that there had been examples of skill-gaps or the fitting of low-quality goods.

Table 5: Examples of repairs needed

Drain open under the kitchen units
Blocked toilets (on a regular basis)
Multiple leaks from the heating system into the void between the ground floor ceiling and the first floor
Front door porch sagging
Leaks – shower, radiator, under the sink
Tiling on roofs repaired
Light fittings not working
Balcony repaired
Windows repaired
New tap fitted
Damp on brickwork
MVHR problems

However, there was variation in experiences, with some homes having fewer defects. In addition, most people explained that any urgent issues were addressed promptly; more minor issues, however, often took a lot of time to be addressed, with respondents having to repeatedly contact the developer. This was frustrating for people, although overall has to be balanced with how residents spoke about living in Derwenthorpe:

> "Any problems that we have with remedial work are dwarfed by the fact that it's a lovely place to live."
> Couple, owner, phase 1

Accessibility

Derwenthorpe properties are built to Lifetime Homes standards, to enable residents to stay in their homes should they become less mobile or physically impaired. There is a shortage of adapted properties for people with disabilities in York, and a major achievement of Derwenthorpe was JRHT allocating and adapting properties for people with disabilities or health conditions. Stakeholders also stressed the importance of this feature:

> "We know that there are a lot of families that have children with disabilities, and we know what difference that makes not only to the child, but the whole family... The way that these houses can be adapted, and are adapted before people move in... They don't have all that upheaval, it's phenomenal!"
> Stakeholder

Residents with children or another household member with disabilities described a massive impact on their lives. For example, one family explained that no other housing provider had been able to help them in York until JRHT – and that JRHT had provided considerable assistance to them:

> "Joseph Rowntree bent over backwards to get what we wanted... They made the storage room into a bedroom, they did that as there might be a carer staying... Joseph Rowntree contributed £1000 towards the lift which cost us £14,000, they tried to accommodate our needs... Joseph Rowntree got us in as quickly as possible, fitted the lift as quickly as possible to give [the person] a better quality of life. I can't thank them enough for that, what more can you ask?"
> Single parent, renter, phase 2

Three interviewed households had moved to Derwenthorpe because the homes could be adapted to the needs of their children with disabilities. This included changes such as the installation of a lift, hoists, wet room, and varying height work surfaces. These householders were highly satisfied with their homes and

these facilities. They felt that these homes had been designed especially for their child, but also with thought of other family members, and intended to live there indefinitely.

> "I feel very fortunate to have been offered it. And it's a lot better for the family... With [our child's] disability, it's a lot easier... Everyone's got their own bit of space."
> Family with children, renter, phase 3

Few interviewees appeared to have bought the properties because they were built to Lifetime Homes standards, but there was an appreciation of the space standards that this provided, and the possibilities for staying put should a problem ever arise. One person had carried out some significant adaptations recently due to a health condition. This made an important difference to the family, although they reported that the process of arranging these with the developer was less than straightforward.

Housing costs

Overall, most owners felt that the properties were appropriately priced compared with other properties of the same size in York, given the design, size and sustainability features of the homes, and the location. Some owners also noted that the properties had appreciated in value quite significantly. Owners, particularly outright-owners, found their properties affordable, including the upkeep.

Renters found their rents just about affordable, but judged the home well worth the rent. In particular, it represented much better value for money than most private rented properties.

Some shared owners explained that the scheme had enabled them to buy better quality housing than what was available on the open market. One respondent had been able to reduce ownership from 60% to 25% when her partner left, explaining how JRHT had been "very understanding and very flexible", effectively buying her partner out. However, a few shared owners had concerns about ongoing affordability, with their rents going up more than mortgages.[19] One couple was looking to move due to affordability issues related to both rent and heating charges. There was also a feeling that they tended to miss out on assistance, with JRHT supporting renters, and David Wilson Homes supporting owners.

> "I would say the rent is pretty extortionate... Every year it seems to go up £12 a month... It has just gone up to £357... Our mortgage is £366... It's like a double whammy."
> Couple with children, shared owner, phase 3

> "We're happy as Larry, we're fine, it's just we're getting worried now because our wage doesn't go up. We're both low-wage earners and our wage doesn't go up the same way as they put the rent up, the heat up."
> Couple, shared owners, phase 1

Estate charge

Most people interviewed were reasonably happy with the estate charge, feeling it was worthwhile to have a green environment and community facilities. Most people also felt that the estate charge level was okay, although a few commented it was quite expensive (especially for smaller homes). However, there was a consensus that more should be done for the money. In particular, people wanted greater attention to areas near to their homes, believing they were given less attention, for example, by just putting down weed killer, something that was seen as inappropriate on an eco-development.

> "It is not too bad. They could do more. But it is not too bad. They look after the public areas, this little park, the lights, the roads, the bits of garden next to parking spaces (not the bits outside the house)... My main issue is the quality of the roads, for the money we pay for the service charge, they should look after them a lot better than they do."[20]
> Couple, owner, phase 3

Derwenthorpe Residents' Association had taken some of these concerns up with JRHT, and an itemised budget had recently been made available to residents. JRHT acknowledged that further work was needed to ensure that all residents were aware of what the estate charge covered.

"Its not that I think it's an onerous charge, my objection to it is the lack of clarity of when and what is happening."
Couple, owner, phase 1

Energy-efficiency measures

Heating and insulation: energy efficiency

At the interim phase, many residents reported that the heating system worked well, in terms of heating up and/or holding its heat. However, some were not so convinced and reported that homes took some time to heat up, and/or retained the heat poorly. Large windows were felt to maximise the sun, but poor positioning/size of radiators and poorly working thermostats could detract from this.

These resident experiences continued over time. Most residents appeared to enjoy reasonably good thermal comfort/insulation, however quite a few reported that the homes did not hold their heat as they had hoped. Others reported difficulties in heating the house in winter, particularly the ground floor, and one person had just had a larger radiator installed by the developer.

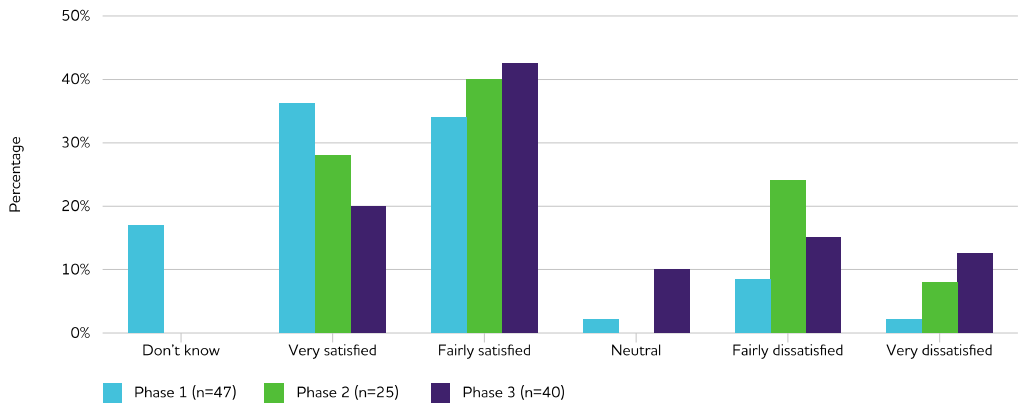
"We are very happy with the insulation, our house does get very nice and warm. "
Couple with children, owner, phase 1

"The house is very cold in winter, it gets very cold, and it takes a long time to heat up, obviously with a [large] space like this its going to take some time... For ages we thought that the thermostat was wrong because it kept telling us it was about 22 degrees but we'd all be in jumpers and have a blanket on! But once it heats up it holds its heat pretty well. Certainly on the upper floors where you have smaller spaces, we very rarely put the heating on in the upper floors as it keeps its heat... It's just down here that it's a bit chillier."
Couple with children, owner, phase 3

This pattern was confirmed in the REAP Petite survey, where the majority (67%) of residents were satisfied with the energy efficiency of their home; however, there was some dissatisfaction (20%, with the remainder 'not knowing' or 'neutral'), including six of our small sample of shared owners.

A higher proportion of phase 1 residents were 'very satisfied' with the energy efficiency of their homes, with a larger minority of phase 2 and 3 residents being either 'very dissatisfied' or 'fairly dissatisfied' (32% of phase 2 residents; 28% of phase 3 residents; 11% of phase 1 residents – see Figure 5). This could be due to phase 1 being built to higher energy efficiency standards (see Chapter 1).

Figure 5: Responses to the question, 'How satisfied are you with the energy efficiency of your home?', presented as a percentage of respondents, by phase



Heating/energy costs

Residents also held varying views on the cost of heating homes, with some feeling it was quite reasonable and others that the costs were higher than expected. The REAP Petite survey showed that 48% of

residents thought that living at Derwenthorpe would reduce their energy costs, while 25% disagreed and 28% were unsure. Phase 1 respondents were more optimistic than later phases (61%, compared to 44% and 38% in phases 2 and 3, respectively).

Heating charges, and structures, have changed over time. From 2012–2014, JRHT owned and managed the heating system and there was a utility charge (7.02p/kW for most of this time). In late 2014, JRHT appointed Veolia (then Dalkia Utilities Services Plc) to operate the system. New charges consisted of a utility charge of 5.47p/kWh (2014) plus a dwelling charge (£350 per household per annum for owners). New pricing was effective from April 2018: a 5.98pp/kWh utility charge, plus a £390.22 dwelling charge for owners and £72.47 charge for renters.

A number of residents were unhappy with the dwelling charge component:

> "One of the things that I've tried not to get cross about has been the heating, they have just put the heating charge up 22% this month... They got all their calculations wrong... So it's costing me, probably another £400 a year because of that mistake and I do extremely well managing my heat costs, so that's a shame... I'm disappointed in [Joseph Rowntree], they are not who I thought they were."
> Single person, owner, phase 1

Electricity is supplied through a standard private supply to each home. In 2014, residents generally felt that electricity bills were about what they had expected or perhaps a little less. This view seemed to hold into the latter interviews.

Respondents were also asked how easy or not they found it to meet their household energy bills. While 12% did not know (they may have been waiting for bills), 65% found it easy to meet their energy bills, but 24% were either neutral or found it difficult to meet their energy bills. One renter said it was 'very difficult' and three shared owners said it was 'slightly difficult'.

Heating system: other issues

Most people found the heating controls easy to use, but some struggled with them. There was a clear need for greater explanation here, as initial instruction could be forgotten. This also applied to other technical aspects of energy-efficiency measures.

> "The heating unit, I can't understand it. I just know that when it goes it goes, and when it breaks it breaks."
> Couple, shared owner, phase 1

> "I don't think enough information has gone out to residents to tell them about the energy efficiency features of the home, whether that be the district heating system, whether that be MHVR... They don't understand, and if you don't understand, how do you know if something is working or not?"
> Stakeholder

A few residents were disappointed in the low levels of biomass and high levels of gas that had been used in the system over the last few years. In 2017/18, the system burnt 15% biomass, whereas there was an aim to burn 55% biomass in 2018/19.

> "I also strongly feel that the cost advantages and 'eco' credentials of the system have been massively oversold."
> Couple, shared owner, phase 3

The monopoly of one supplier for heating (and similarly for internet connection), and the long-term running costs of a district heating system, were also concerns raised by a few people:

> "I do like to switch, I switch quite a lot and I use 'Compare The Market' and things like that, because I'm a single parent I'm always looking to save money, so that is a bit annoying, but I don't feel like I'm getting ripped off. Apart from the £150 for the broadband [connection charge]!"

Single parent, renter, phase 3

Ventilation systems

Phase 1 properties had an MVHR system; however, following problems with this system and cost considerations, later phases were fitted with an MEV system. At the interim stage, a number of problems had occurred with the MVHR system (including incorrect units and installation, and associated issues such as noise), although some residents reported benefits from improved air quality. There was generally limited understanding by residents about what the systems were for and how they worked. A couple of people had turned the systems off. There were also concerns around maintenance issues.

By the last interviews, some MVHR systems had been replaced (sometimes on a number of occasions), and some households were waiting for them to be replaced. In at least one case the MHVR had stopped working. Most residents interviewed also knew they needed servicing, but were waiting (some felt a long time) for this and were uncertain as to who would pay for it. There was a clear split of experiences here – a couple of householders explained that earlier difficulties were now being resolved in a satisfactory manner. These residents had proactively been involved in addressing the issue with David Wilson Homes. Others, however, were quite exasperated by their experiences, and with the developer and JRHT.

> "We have had three MVHR systems put through the house... [The third] appears to actually function... They've put them in, they don't know what they are doing, its new technology, they might have put them in wrong in some places... They don't know how to properly assess them or manage them. They've jerked everyone around in the hope that the problem will go away."
>
> Couple, owner, phase 1

There appeared to be varying levels of knowledge about the simpler MEV system in phases 2/3 (whether people had one or not, and what it did), and how it was being used. Some stated there was some noise; one person had asked if they could turn it off, while another had actually turned it off. Others commented that it seemed to be working fine and was keeping damp away. One person was disappointed that they had not been given an MVHR system.

> Researcher: "Do you have a mechanical extract ventilation system?"
> Interviewee: "We do have switches everywhere so maybe! We have some in the kitchen, one at the bottom of the stairs, so maybe! We have them switched on. That does ring a bell. I think someone has probably said that before. I think [my partner has] been in the loft and said there are some fans."
>
> Couple with children, shared owner, phase 3

Low-energy fittings

Many people had utilised low-energy light fittings. A couple of people had replaced some of the lights, for example, to energy-efficient (or slightly less efficient) spotlights.

In addition, a few residents had problems with the induction hobs, having to spend money on new pans; in one case, they could not use the hob due to the person's health condition (having metal in their body).

Winter gardens

Some of the houses in phase 1 have a winter garden (see Chapter 1). Winter gardens were also an optional extra for some phase 2/3 houses (but no interviewees had one).

Two couples spoke very highly of the winter garden, with one continuing to use it very effectively to grow their plants. In contrast, another householder still failed to understand their value:

> "It feels like an annoying waste of otherwise usable space, and we don't understand what they are meant to do!"
>
> Couple with children, owners, phase 1

Water restrictors

Water-temperature restrictors and low water-usage taps were installed in all properties. It was reported at the interim stage that some householders had taken these off or altered the settings. Few people commented on water restrictors in this round of interviews, other than they were "fine". One householder was very pleased with lower water bills. Occasionally less helpful impacts were mentioned, for example having to run the tap longer to get warm water.

However, one problem mentioned by three householders was the difficulty in flushing toilets – the low-water toilets didn't always work, and you often had to flush twice. It also led to embarrassing conversations with guests to avoid the blocking of toilets that was also a frequent problem (see 'House conditions and repairs' above).

Food production/recycling/composting

Derwenthorpe kitchens incorporated recycling bin facilities. The vast majority of interviewees stated they were recycling, using these bins. A few households explained that they were now recycling more than previously. It was felt that Derwenthorpe could go further with recycling, and it was also suggested that there should be a food waste collection service.

Compost bins were only provided to phase 1 households; some were being used, others not, but the size of the gardens meant that any food growth was relatively small. Early in the development, there were a number of calls for the community production of food, and a community garden was established in 2015. More recently, a pop-up shop for organic bread and vegetables/fruit used the SSC. This had been well supported, and seen as a positive development.

Other desired energy-efficiency measures

As with earlier interviews, the main environmental feature that residents would have liked to see added to their homes was solar panels. A couple of interviewees had investigated this with JRHT and/or on their own. Recently, JRHT had received monies to fit solar panels on the SSC and on the estate.[21] Those who mentioned this were very pleased with this news, but worried that this may take a long time. There was also a consensus among stakeholders that modest additions of solar panels would have added to the scheme:

> "The other thing they missed was that they did put solar panels on a few of them... But I think it's a shame that more of them weren't built. Although now they are looking at it again."
> Stakeholder

Conclusions

Overall, there was a high level of satisfaction with Derwenthorpe homes, although this appeared to be driven more by the overall design of the houses rather experiences of the energy-efficiency measures. Some key conclusions from the residents' experiences of their homes, which could be useful for other developers, include:

- The architectural design of homes that privileges space (including height) and light are highly regarded by residents, and impact positively on quality of life. Some of these design qualities also have environmental benefits. Design informed by cultural heritage, but also by aesthetics and wider international influences that push the boundaries of traditional design, can work.
- Time and funding pressures on developers, along with skill shortages, impact on build quality and performance. This is industry-wide and needs addressing at the national level.
- Lifetime Homes standards, along with the capacity to extend the home into the loft, can future-proof a home for a variety of household types.
- The transparency of energy and estate charges is crucial from the outset, to avoid considerable upset and possible misunderstandings among residents.

- Wherever possible, energy-efficiency measures should be built into the fabric of the building. Where user knowledge is needed, clear (ongoing) information and instruction on energy-efficiency measures is required.
- Any maintenance issues for energy-efficiency measures (eg ventilation systems) need to be in place from occupation, and should not rely on individual householders to arrange them.
- Biomass boilers can reduce energy use, but their efficiency is compromised in low-density settings.
- Solar photovoltaics are well supported by residents and require little user operation, and should be considered at the outset of a development rather than as later additions.

4 Living in Derwenthorpe: the community

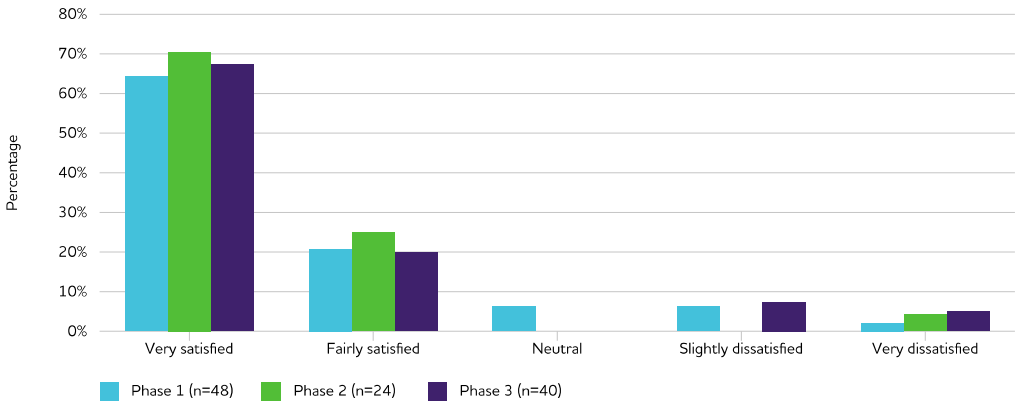
This chapter focuses on the community of Derwenthorpe. First, overall satisfaction with community life is considered, followed by a focus on community facilities and activities, and social networks. The chapter then moves on to consider the environmental features of the community and its wider location on the outskirts of York. Throughout the chapter, we consider how Derwenthorpe is developing as a community that can support all residents to live sustainable lives.

Overall satisfaction

Satisfaction with Derwenthorpe as a place to live

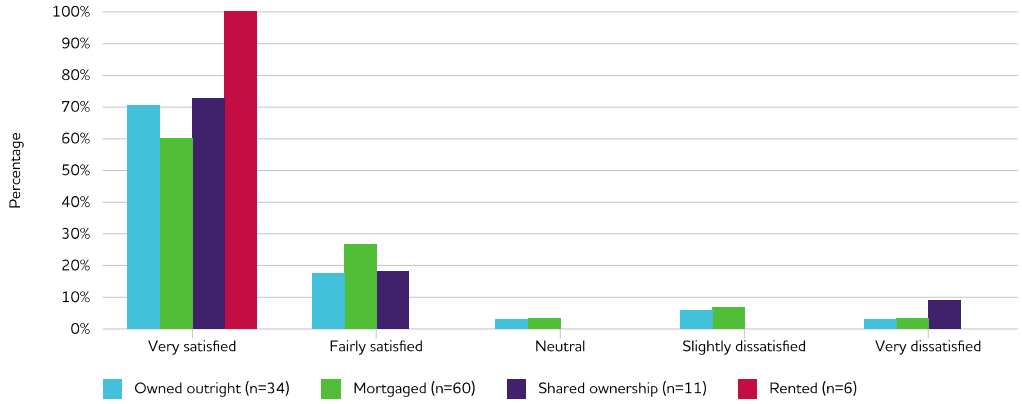
Overall, Derwenthorpe residents responding to the REAP Petite survey, were as likely to be satisfied with their local area as people nationally (88% for Derwenthorpe, and 88% nationally; DCLG 2017b). However, Derwenthorpe residents were more likely to state that they were 'very satisfied' with their local area (68% for Derwenthorpe, compared to 58% nationally; DCLG, 2017b). As Figure 6 shows, the pattern of satisfaction was similar for all phases.

Figure 6: Satisfaction with Derwenthorpe as a place to live, by phase



Renters showed higher levels of satisfaction with their local areas to live than other tenures (Figure 7), with all six people being 'very satisfied'. Nationally, social renters are the least satisfied with the local area (82% being 'satisfied', compared with 88% of those buying with a mortgage and 91% of outright-owners; DCLG, 2017b). Only 49% of social renters were 'very satisfied' with their area. There was little difference between satisfaction between 'new' REAP Petite respondents (who completed the survey within one year of moving) and 'settled' respondents (who completed it at least one year after moving).

Figure 7: Satisfaction with Derwenthorpe as a place to live, by tenure



Most interviewees were very happy with Derwenthorpe as a place to live, particularly enjoying the growing sense of community, commenting in the REAP Petite survey that, "People care about the place" and, "The neighbourliness and sense of community which is developing makes it a happy and quiet place to be".

> "[I] still feel like I'm on holiday... It is a good feeling. I think this estate is as close to the ideal of a communal life."
> Couple with adult child, owners, phase 3

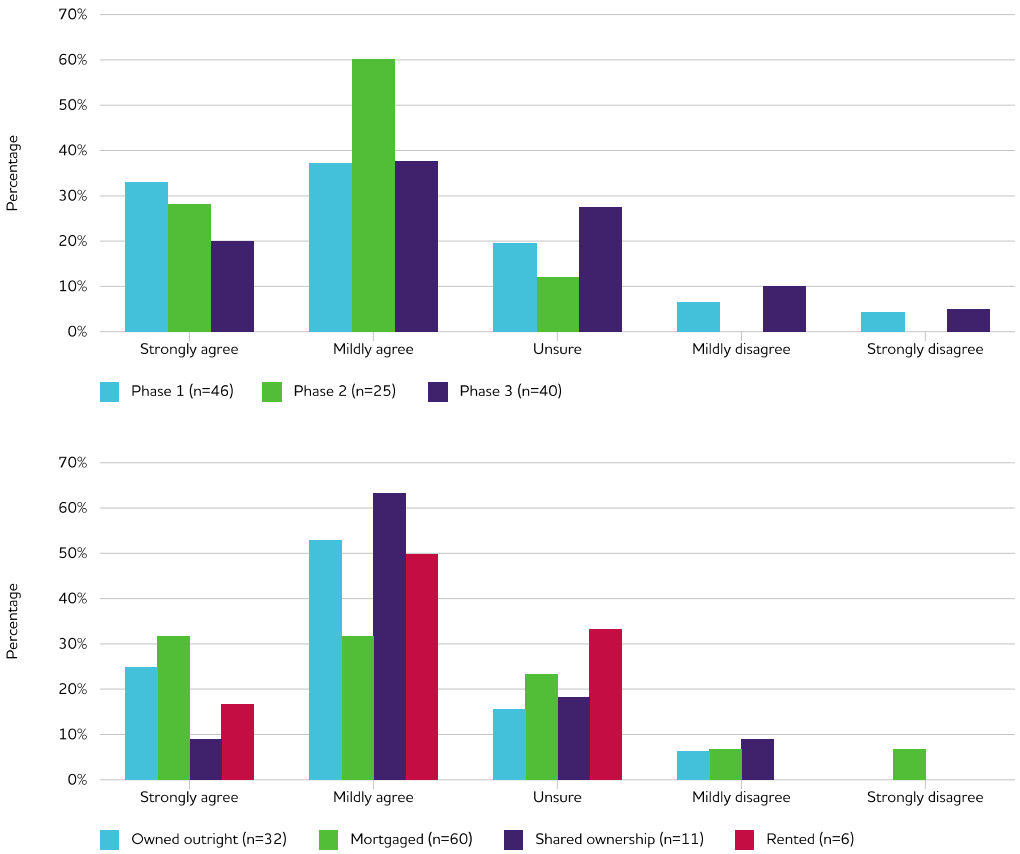
> "When you move you only have an artist's impression of what it would look like. But now the feeling of completeness is almost there."
> Single person, owner, phase 3

Of those who were dissatisfied with the area, the most common reason was that the development was not as sustainable as they had been led to believe (17 comments); the ongoing disruption of building work (six comments); anti-social behaviour (three comments); and lack of communication and consultation with JRHT (three comments).

REAP Petite respondents were asked about their perceptions of Derwenthorpe as a strong community. The majority of respondents of all tenure types agreed that it was. There was no clear difference in opinion between different phases, although phase 2 respondents were all neutral to positive about the strength of the community, whereas phase 1 and 3 responses were more mixed (see Figure 8). When divided by tenure, outright-owners were most likely to consider Derwenthorpe a strong community.

As might be expected, 'settled' residents were more likely to agree that Derwenthorpe was a strong community, compared to 'new' residents (71% compared to 64%).

Figure 8: Perceptions of the strength of the community at Derwenthorpe, by phase (top) and tenure (bottom)



Community facilities and activities

Green space and designed landscape

Derwenthorpe residents loved the green space around them and, six years on, were particularly pleased with how the green space integrated with the housing. One resident said fondly:

> "To me it looks a bit like Centre Parcs, you know how the houses look different to all the others and you have like a park and a pond."
> Couple with children, shared owners, phase 3

Most residents really valued the green space, using it to stroll around the development for recreation or crossing to other parts of the development. Families were generally complementary about the playground. Families of children with disabilities were, however, disappointed with the facilities for them.

> "They have a disabled chair [swing in the park], but there is no harness in it, you've got to buy your own harness and it's about £60."
> Single parent with children, renter, phase 1

Residents also appreciated the designated green space within the housing areas, and liked that some residents have made a community vegetable garden and planted edibles in some of the communal areas in the Rowntree Quarter:

> "[It's] very important, I love the trees, the green spaces and the hints of edibles around Derwenthorpe."
> Family with children, owners, phase 1

Residents did however comment that there had been several discussions about changes and improvements to the green space, and were frustrated about the length of time that changes took to be implemented:

> "And they promised an outside gym, but that never happened."[22]
> Family with children, renters, phase 3

While many of the residents valued the ponds and enjoyed watching the wildlife through the seasons, some were concerned about the safety of children near these areas, and didn't allow them to play unsupervised there.

The designed space of Derwenthorpe had had a very positive impact for one couple:

> "We are a better couple I think, and I think we started to live a healthier lifestyle, exercise more than we did before."
> Couple, owners, phase 3

Community space

Participants appreciated having the SSC as a community hub and venue for activities, seeing it as very important for promoting community building:

> "It feels like a community, there's always things on at the SSC."
> Couple, owners, phase 2

However, several felt that the community space at the SSC was not adequate for the full range of activities desired by the community.

> "The only thing is, it's not actually fit for purpose, the building, it's only got one loo, it's got a small kitchen."
> Couple, renters, phase 3

There were many ideas about how the community facilities could be improved. Several interviewees appreciated the pop-up shop, both to buy produce and to meet neighbours, but others would have liked a café or shop there all the time, rather than as an occasional pop up.[23] For some residents, the pop-up shop did not sound like an affordable option:

> "I haven't [used it], I just see 'organic' and that sounds expensive!"
> Single parent, renter, phase 3

One of the stakeholders pointed out that the community space had been built onto the Energy Centre, rather than the other way round. Earlier, integral development of community spaces would have been preferable.

Activities

Residents mentioned many different activities that they were involved in, including yoga, a running group, Zumba, an art class, coffee mornings, summer parties, film nights, a toddler group, book clubs, a litter-picking group and a wine club (see Chapter 1 for a full list of available activities).

Some residents had yet to make the leap to get involved in social activities, as they weren't sure if the activities were 'for them' and appropriate for families:

> "I know they kind of did a quiz night... But I didn't go as it was on an evening and I didn't know if it was just for adults or families... I would like to do some of them."
> Single parent, renter, phase 2

> "The films tend to not be our cup of tea, maybe they'll have something for the kids on in the summer?"
> Single parent, renter, phase 2

Residents who didn't take part in activities were usually constrained by time and other responsibilities:

> "I think we expected it to be more open, like we don't meet each other very much, they organise these coffee mornings and stuff like that, but that is for people who are at home, like mums or elderly people, not people who are working, so we don't have the opportunity to join them on those events, because we are working full time [...] Sometimes with shift work you are too tired to go, or need to go to the shops or gym etc."
> Couple, owners, phase 3

> "It's very much how they said it would be, but when I get home from my job I'm too tired to be bothered with events and things like that."
> Couple, shared owners, phase 1

Some of those leading busy lives would have preferred more informal and ad hoc social opportunities like a café, rather than regular scheduled activities, while acknowledging that they were glad these options were available even if they couldn't make use of them:

> "It's the small stuff that makes this place nice, even if I'm not a participant in it, I'm very glad that it occurs. It's difficult for us, because of our work schedules to meet regular structured groups."
> Couple, owners, phase 1

Governance structures

Derwenthorpe Residents' Association (DRA) was established with the support of JRHT.[24] Initially interviewees had applauded the establishment of the DRA and the way that JRHT had supported it, but more recent interviews were varied in terms of how much they engaged with the DRA, and how well they think it is functioning. An interviewee flagged up that there needs to be clearer (and more direct) communication between JRHT and the residents, even with an active residents' association. One stakeholder suggested that a residents' charter should also have been developed.

Interviewees were divided about how effective they thought the DRA is, with some (exclusively owners) feeling that they were doing a good job:

> "I think the residents' group is very good, a lot of retired professional people who know how to get things done, that push things forward, which is nice."
> Couple with adult child, other tenure, phase 3

Many interviewees were concerned about how representative, inclusive and welcoming the DRA was, particularly for renters and shared owners.

> "There were a few people who were very loud. The leaders of the group. I think they were from phase 1, so they knew each other from before and had experience of how to argue with people."
> Couple, owners, phase 3

> "They say 'oh we don't think they are any different, just they might not get involved'. Well maybe that's right. Maybe they think this is a little group of middle class people who they wouldn't fit in with."
> Couple, renters, phase 1

The DRA is clearly a very important institution in the governance of Derwenthorpe, but it requires work to build inclusivity into its structure and operations in line with the tenure distribution on the development.

Social networks

Derwenthorpe residents frequently talked about how friendly the development is, and this appears to be particularly apparent in phase 1. Interviewees were asked to identify friends and neighbours on a

Derwenthorpe map. Many interviewees commented that as the development grew, they knew more people who they weren't able to place on a map.

> "There are a lot of people who I don't know where their houses are, I just know them from meetings and things."
> Single person, owner, phase 3

Feeling well connected in the community isn't universal however, with some interviewees not particularly wanting social contact and others feeling that they didn't have as much social contact as they would like. These differences appear to be in part geographic, with an obvious contrast between some areas of the development where geographically close neighbours were friendly with each other, and other areas where people don't come into contact with each other as much:

> "It's really nice, neighbours are really nice and friendly. We had a Christmas party with the neighbours."
> Couple with child, owners, phase 2

> "Our little street, it's one of the nicest parts of the development, but it can be very quiet, you don't see anyone."
> Couple, shared owners, phase 1

Differences between phases

Differences in the number and type of social relationships reported by interviewees are also apparent between phases. As might be expected, friend and neighbour relationships were concentrated in the phase where the interviewee lived; however, these differences were more marked in phase 1 residents than in phase 2 or 3 residents (see Table 6).

Phase 1 residents have more social relationships than those in phases 2 and 3 (Table 6). This has remained true through time. In early interviews, phase 1 interviewees talked of coming together as a relatively small new community. More recently, an interviewee mentioned that the development didn't feel quite as cosy now that it was almost complete.

> "It's definitely defused it more than if [the phases] were concentrated and separated. Things that did happen previously don't happen anymore – Christmas tree in the courtyard, ad-hoc ladies' night going out for a meal... The other phases, I feel that has taken away slightly from what we used to do here, so we used to get a Christmas tree in the courtyard, and people sung carols, that doesn't happen now... It has shifted away from phase 1."
> Couple, owners, phase 1

Comparing data collected in phase 1 in 2015 to data from 2018 (Table 6), the number of social relationships reported by interviewees had gone down. This is in part due to some residents in Derwenthorpe's oldest quarter having moved away, and also in part due to changes in the sample; and, as one resident put it, "friendships change" (older couple, owners, phase 1) and networks have consolidated.

Table 6: Average number of relationships per household, by phase and time of interviews; shading shows relationships within phases

	Phase 1		Phase 2		Phase 3	
	Neighbour	**Friend**	**Neighbour**	**Friend**	**Neighbour**	**Friend**
Phase 1, 2015	16.5	8	-	-	-	-
Phase 1, 2018	10.0	4.9	0.9	0.0	0.6	1.1
Phase 2, 2018	1.0	0.2	3.3	2.5	1.7	1.2
Phase 3, 2018	0.9	1.3	0.9	0.9	4.8	0.1

Differences between tenures

Residents reported very similar proportions of friend and neighbour relationships across phases (approximately 40:60), but this picture looks very different when residents are divided by tenure. While owners retain the 60:40 split between neighbours and friends, shared owners and renters have a much higher proportion of neighbours than friends, approximately 80:20 (see Table 7).

From 2015 data in phase 1, 75% of relationships reported by owners were with other owners, meaning that owners are disproportionately likely to know other owners. As one phase 1 resident put it, they are more likely to have the beginnings of a conversation around ownership issues:

> "I'd say from that map of friendship that we are connecting to other owners... And you know I think that's because, when you first meet, the thing that you have in common is Derwenthorpe and housing issues... So you start with the commonality so you are talking about this snagging issue, that snagging issue, but you are only really doing it if you own the house, there are probably similar socioeconomic levels as well, playing to your tribe, right."

> "A lot of interaction is from 'you're a home-owner, I'm a home-owner'..."
> Couple, owners, phase 1

For those with young children, activities such as a pre-school children's club have brought in a new social circle that extends beyond the activity itself:

> "It's really nice, so many times [my child] and I have been out and we've just bumped into people and you know fed the ducks together, or gone to the swing park, or gone to someone's house for a cup of tea, and that's really nice as it does feel like you're part of something, this is your neighbourhood and your wee area, so that's been fantastic."
> Family with child, owners, phase 3

Table 7 shows that the proportion of friend to neighbour relationships among owners in phase 1 has not changed significantly over time. This has not been consistent however, for social renters and shared owners, perhaps being due to less consistent social integration for these groups.

Table 7: Proportion of friend to neighbour relationships, by tenure and time (phase 1 only)

Tenure	Year	Neighbours	Friends
Owner	2015 (n=9)	64%	36%
	2018 (n=5)	60%	40%
Shared owner	2015 (n=2)	48%	52%
	2018 (n=1)	82%	18%
Renter	2015 (n=3)	90%	10%
	2018 (n=3)	76%	24%

Mixed community

The majority of interviewees (owners, shared owners and renters) appreciated the mixed tenure and thought it worked well. Renters and shared owners alike appreciated that tenures were 'pepper-potted' and that the houses didn't look any different.

> "Yes, I don't feel different to the next-door neighbour who owns it outright or to the one after who owns and rents it half in half, for me I don't see them as being any different, there is no stigma attached to it, you know that I'm a housing association and they are owning."
> Single parent, renter, phase 1

A couple of older interviewees were glad to live in a lively area with families around them:

> "This street is a mixture of social housing and ownership and I rather like that, and on this street we're the only retired people, and I like that. I like living among families and young people as that's what society is like. I didn't want to live in a retirement community because that's boring, it's not what I want from life. I like it [the neighbours] have got young children and they've got children. I like it, it's wonderful."
> Couple with adult child, owners, phase 3

Others were less sure how well integrated the community was: for example, one young family who were renting felt that others could be more relaxed about children playing outside, and felt judged by some of her neighbours and by JRHT. Others also commented:

> "We don't tend to ask when we meet somebody, whether you rent or own, I would expect that most of the people we know are owners."
> Couple, owners, phase 1

> "It's a bit like Stepford Wives, does that sound awful? [...] You try saying hello to some of the people in the bigger houses and they look down their noses at you, it's really weird."
> Couple, shared owners, phase 1

Some thought this might partially be down to engagement in activities and buy-in to the vision of Derwenthorpe:[25]

> "The social groups I go, there isn't a mixed tenure... I think it's disappointing that maybe people aren't mixing as much... I mean, I know society is on different levels, and I don't want to stereotype. But I certainly think that those of us that bought, bought into the bigger picture of Derwenthorpe and we were sold that by David Wilson, in all the blurb, whereas I'm not sure that the tenants are sold it in the same way, I don't know but I'm not sure that they are, and I don't know about the shared ownership."
> Single person, owner, phase 1

Cars and parking: getting along together

Derwenthorpe was designed to accommodate one car per household, with the expectation this should be feasible with the provision of alternatives such as the bus service, the car club and cycle vouchers. However, not all residents have abided by this, resulting in more cars than there are parking spaces on the site. Interviewees felt that the issue was unresolved, and that there was uncertainty about what provision for visitor parking there will be when the development is finished.

> "Parking always comes up at residents' meetings, it never gets resolved."
> Couple, owners, phase 2

One stakeholder felt that some owners may have been misled at the point of sales into thinking that there would be more parking than is actually the case:

> "Some people were misled by the sales people... One of my neighbours was told there'd be plenty of parking, you can just park on the road. But you can't just park on the road, as if you do, the road becomes too narrow and people can't get by. And there are no pavements anyway."
> Stakeholder

Several interviewees commented about continued car use on the development, perhaps with increased numbers of cars as teenagers grow up. Others were concerned about how the development might adapt to changing car use. There was demand from some residents for electric charging points. One interviewee was just about managing to charge an electric car, but for another resident with parallel parking on the other side of the footway outside their house, it was not really an option.

Some interviewees reported problems with neighbours. Sometimes these difficulties were non-specific, but the most frequent source of conflict was parking, and generally seated in misunderstandings of need. For one participant, it was specifically about being unable to park a larger car (adapted for the needs of a child with disabilities) in the garage, and having to park on the street instead. The interviewee felt that both her neighbours and JRHT had not understood or accounted for her difficulties.

> "As soon as there have been complaints about me, it seems like they are quick to jump on my case, without taking into consideration [my family circumstances]."
> Single parent, renter, phase 2

Parking was an issue that had caused conflict for other families with members who needed additional care. They found times when carers were changing over, or when they needed more than one carer at a time, particularly difficult to deal with when visitor parking is limited and not always close at hand. Other residents had been able to develop a more understanding approach:

> "We all talk in our little bit, if someone needs space for another car we move up and fit another one in. It's easier than arguing."
> Couple, shared owners, phase 1

Environmental features

Cycle and walking routes

The Sustrans route is used regularly by many Derwenthorpe residents to cycle or walk into town for shopping, to get to work, or to take children to school. For some residents this was a consideration when they bought their house, and for others it was something that had made their lives easier and more pleasant:

> "We knew it was there when we bought, and we knew it would be important but it has become unbelievably important."
> Couple, owners, phase 1

Some residents also use the route to go out of town by bike, or for running for exercise, or to access larger shops at Monk's Cross (an out-of-town shopping centre). Residents are appreciative that the cycle

path is kept in good condition by Sustrans (one resident, however, found that there was too much dog fouling to make it easy to use with small children). The paths and cycle routes within the development are also well used to get from place to place, and:

> "... for a nosy, to see what's changed."
> Single parent, renter, phase 2

One resident would have liked to cycle more, but found the way that the bike voucher scheme is administered, whereby JRHT would reimburse the cost of a bike, makes it impossible to manage in their financial situation:

> "It's a matter of getting the spare money together to get the bike."
> Single parent, renter, phase 3

Public transport provision

Derwenthorpe residents are fond of the bus service that was introduced in late 2016,[26] which comes onto the site and is well used; several commented on how nice the bus drivers are:

> "It's a nice service. The drivers seem to be nice, there are a lot of pensioners who use it. It feels like part of the community as well."
> Single person, owner, phase 3

For others, the service was not really frequent enough to make it practical; others would like the bus to run later, so you could use it for an evening out. For phase 1 residents, the bus through the neighbouring area is very convenient.[27] One stakeholder highlighted the need for putting public transport networks in much earlier in developments.

Car club

Very few interviewees had used the car club,[28] and for those that had, it was in special circumstances (needing to use a van, or when their own car had broken down), rather than as regular or habitual use. There were many reasons why this was the case, from the excess on the insurance being too high, to already owning a car and not wanting to forego that convenience.

Wider location

Facilities and services

Most Derwenthorpe residents were happy with the local services – they used local shops in Osbaldwick and on Tang Hall Lane. While most found these shops affordable, there were some who avoided the local shops in order to limit spending to less regular trips to a cheaper supermarket. Many of those who had moved within York had stayed with their previous doctors and dentists; some who had moved to services close to Derwenthorpe commented that they seemed busier and under more pressure than previously. Several residents talked about using local gyms and sports facilities, and mentioned that they sometimes met neighbours there, too.

Several Derwenthorpe residents have issues with school and nursery provision, either due to lack of places or being concerned about standards at a local school, which means a longer journey (by car) to a different school.

Relationships with neighbouring communities

Relations with Osbaldwick (the neighbouring village) appear to have eased over time, and Derwenthorpe interviewees were aware of residents of the local area engaging in activities at Derwenthorpe: attending coffee mornings, the book club and the running group. The DRA reflected this view, but felt that the Osbaldwick Parish Council was out of step with the community, and were continuing to be critical and obstructive.

Interviewees also spoke about the residents of Tang Hall (an adjacent neighbourhood) using and appreciating the bus service. Incidents of anti-social behaviour were also mentioned less in the most recent interviews, and the DRA is continuing to work with JRHT to address it. One interviewee attributed this to an easing of tension with the surrounding area:

> "On the negative side, whenever anti-social behaviour has come up, you know messing about, larking about with the ponds... Those kinds of issues have come and gone... [It] was quite a bad issue when [I] moved in, but think it was something to do with opposition to Derwenthorpe, think 'them over there' has died down, those teenagers have grown up. But always have teenagers hanging about even in villages."
> Couple, owners, phase 1

Conclusions

Derwenthorpe is developing as a community, with many residents commenting that it was a lovely place to live. Some key conclusions from the community side of the development, which could be useful for other developers, include:

- Satisfaction with the development was generally high. Factors that may have helped this were the sense of community and the large amounts of communal open space, as well as the design of the houses and their appropriateness for family members with additional needs.
- The most common reason for people being dissatisfied with the area was that it was not as sustainable as they had been led to believe when they moved to the development: it is important not to 'over sell' such aspects during the house-purchase stage.
- Provision of a central community space was very important for many residents, and has enabled a sense of community to develop across phases. Such spaces need to be planned as an integral part of new developments.
- The DRA was well established, but there was considerable concern that it had not succeeded in attracting members from across social renting and shared ownership. It is recommended that equity across tenures is built into the constitution and terms of reference of community bodies.
- More generally, the integration of tenures in the design works well to generate a sense of equality and integration. Similarly, the distribution of different sizes of house helps to mix up residents at different life stages.
- The provision of pedestrian and cycling routes, and leisure spaces, accessible to all enables residents to feel a sense of ownership over the whole development. Derwenthorpe demonstrated the value of green landscaping, including sustainable urban drainage, to new developments.
- Parking is a key issue for many people, causing conflict between neighbours, despite initiatives such as a new bus route, bike vouchers and car club scheme designed to encourage only one car per household. It was clear that more far-reaching policies are needed for a one-car-per-household policy to work, including earlier and better public transport options, consideration of incorporating this policy into title deeds/rental agreements, and/or clearer options for visitor/overflow parking at the edges of the development or off site.

5 Environmental footprints: Derwenthorpe and comparators

This chapter begins by investigating the environmental footprints of Derwenthorpe residents, in the context of York and the UK, using the REAP Petite survey. The chapter then moves on to consider a more detailed comparison of the footprints of Derwenthorpe residents to those of people living in three other sustainable communities (BedZED, Lancaster Cohousing and Ashton Hayes), examining reasons for observed differences.

Derwenthorpe residents' individual carbon footprints

The research examined the extent to which living at Derwenthorpe might be supporting a lower-carbon lifestyle, using the REAP Petite survey to calculate individual environmental footprints (see Chapter 1 for methods and the Appendix for the survey). The survey asks questions about households' power, travel, activities, shopping and food consumption. If households have bills available, then their power footprint is calculated directly from those, otherwise the power footprint is calculated by their responses to a series of questions about the size of the house, occupancy, and number and types of appliance used (see West et al, 2015, for more details). The household footprint is then divided by the number of people in the household, to give an individual footprint.

A total of 111 Derwenthorpe residents returned surveys over the period 2013–2018. Nineteen of these completed surveys more than once.[29] In addition, 1212 non-Derwenthorpe residents completed the survey over the same period nationally (reported as the 'rest of the REAP Petite sample' here). It is important to note that this data is likely to be biased towards people with lower carbon footprints than the UK mean, because they were self-selecting, and therefore more likely to complete it due to their interest in environmental action.[30] As we directly targeted Derwenthorpe residents, this self-selection bias may be smaller.

Table 8 shows the mean of the individual footprints, broken down by sector (power, food, travel, shopping and activities), for Derwenthorpe and the rest of the REAP Petite sample. It also shows the mean UK footprint, which has been calculated by dividing the total UK carbon footprint by the number of individuals in the UK.[31] It highlights that:

- Derwenthorpe overall carbon footprints (at 13.66 tonnes of carbon dioxide equivalent) were significantly lower than the rest of the REAP Petite sample (where the mean was 14.17 tonnes),[32] and both of these were lower than the UK average of 16.24 tonnes.
- Derwenthorpe residents have a statistically significantly lower power footprint per person (1.39 tonnes per year) than the rest of the REAP Petite sample (2.50 tonnes per year).[33]
- Derwenthorpe residents have a statistically significant higher food footprint per person than the rest of the REAP Petite sample (at 2.30 tonnes per year compared to 2.15 tonnes per year).[34]
- Derwenthorpe residents have a statistically significant lower activities footprint than the rest of the REAP Petite sample (at 0.94 tonnes per year compared to 1.01 tonnes per year).[35]
- Derwenthorpe residents appeared to have a higher travel footprint than the rest of the REAP Petite sample, but this was not statistically significant (as it had been at the interim stage; Quilgars et al, 2015).

Respondents were also asked to complete questions designed to assess their environmental attitude: 15 questions called the New Ecological Paradigm (NEP). This uses a scale to assess attitudes based on responses to 15 questions around the relationship between humans and the environment, to assess respondents' 'world view' (see Appendix for questions). Responses are indicated on a 5-point Likert scale ('strongly agree' to 'strongly disagree'). The maximum possible score on the NEP scale, indicating very pro-environmental attitudes, is 75, and the minimum score, indicating negative attitudes to protecting the environment, is 15. A neutral attitude would score 45. Derwenthorpe residents and the rest of the

REAP Petite sample both had a mean positive attitude towards the environment, scoring 58 and 57, respectively.

Table 8: Individual footprint (broken down by sector, and in tonnes of CO_2 equivalent) and environmental attitude score data for Derwenthorpe and the rest of the REAP Petite sample, compared to the UK average

		Power	Food	Travel	Shopping	Activities	Other*	Total	Attitude
Mean UK footprint		3.54	2.57	3.59	1.81	0.87	3.86	**16.24**	**n/a**
Rest of sample	**Mean**	2.50	2.15	3.52	1.12	1.01	3.86	**14.17**	**57**
	n	1393	1393	1393	1393	1393	1393	**1393**	**1212**
	Standard deviation**	1.97	0.74	3.46	0.52	0.33	0.00	**4.67**	**9**
	Minimum	0.18	0.55	0.34	0.18	0.37	3.86	**5.47**	**16**
	Maximum	28.23	4.87	54.88	7.80	3.20	3.86	**63.99**	**75**
Derwenthorpe	**Mean**	1.39	2.30	3.96	1.22	.94	3.86	**13.66**	**58**
	n	114	114	114	114	114	114	**114**	**111**
	Standard deviation**	0.66	0.71	3.32	0.65	0.27	0.00	**4.22**	**9**
	Minimum	0.08	0.83	0.34	0.36	0.50	3.86	**7.60**	**37**
	Maximum	3.54	4.18	19.91	3.68	1.92	3.86	**31.75**	**74**

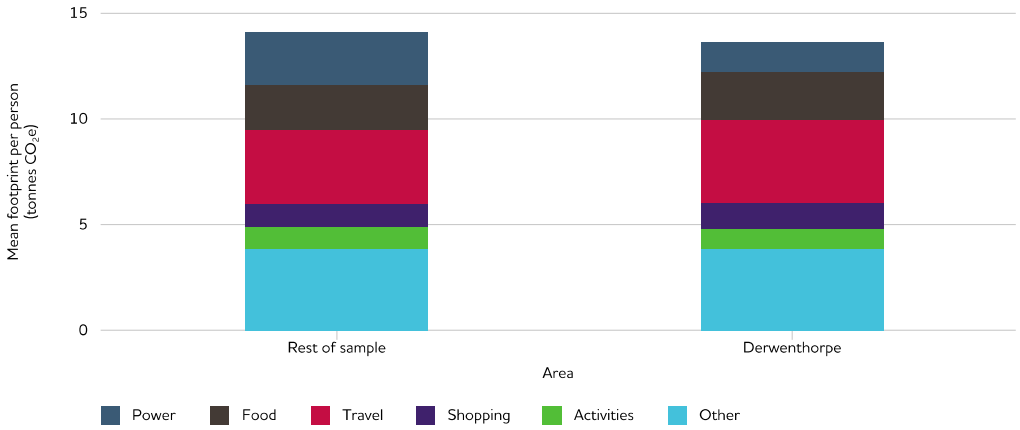
Notes: the footprint is measured in tonnes of carbon dioxide equivalent.

*'Other' is standard across the UK, and is based on the individual share of emissions associated with government spending on hospitals, roads etc.

**Standard deviation shows how spread out the data are around the mean, with a larger number showing greater variation in the data, and a smaller number showing that responses are more similar.

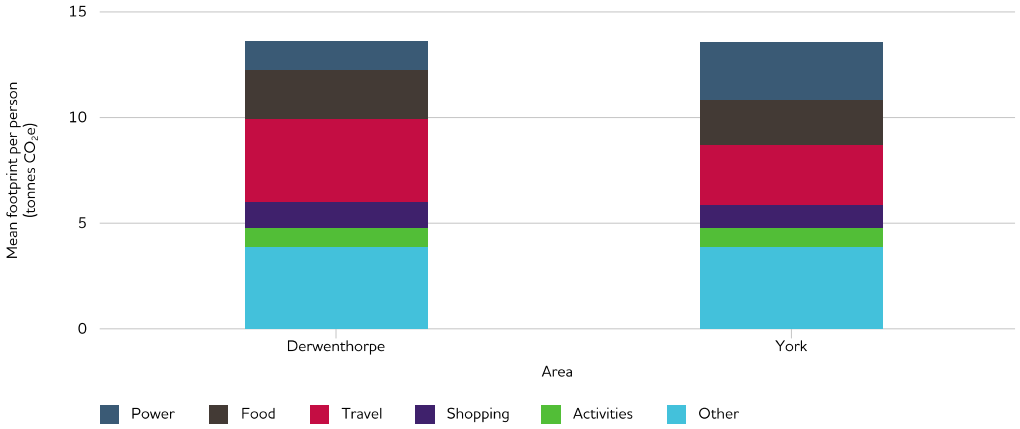
The differences between footprints in these two samples can be seen in Figure 9. The design of the homes and the community heating system are the main drivers behind the significantly lower power footprints for Derwenthorpe compared to the rest of the UK sample.

Figure 9: Mean footprints of the REAP Petite sample and Derwenthorpe sample, broken down by sector



There was considerable variation in total footprints between individuals at Derwenthorpe – ranging from under 10 tonnes to around 30 tonnes of carbon dioxide equivalent per person; further investigation revealed that this difference was due to large variation in travel footprints. The range may reflect the mixed community at Derwenthorpe, and that the average income of respondents was higher for the Derwenthorpe sample (mean £54,890) compared to the national REAP Petite sample (mean £43,990). Derwenthorpe respondents were also compared to other York residents who completed the REAP Petite survey (Figure 10). Derwenthorpe residents had a significantly lower power footprint than other York residents, but a significantly higher travel footprint. This may be related to Derwenthorpe's position in the city: it is towards the outskirts of York, so travel connections are not as good as those for residents who live in the city centre. There was no difference in the other components of the footprint. Although power footprints are lower than those in York and the national REAP Petite sample, some of the Derwenthorpe respondents did have a large power footprint, as seen by the relatively high maximum power footprint in Table 8. This is likely to be for several reasons: the houses are relatively large in terms of numbers of bedrooms; 17% of respondents were in single person households; and there is generally under-occupation, with many couples in four-bedroom houses (see Quilgars et al, 2015), meaning the electricity usage and biomass/gas for heating is not divided up between household members. Having a green electricity provider reduces emissions considerably, so if residents wanted to reduce their footprints further, this could be an option. At the moment, 41% of respondents reported using a green electricity provider, compared to 30% in the national REAP Petite sample.

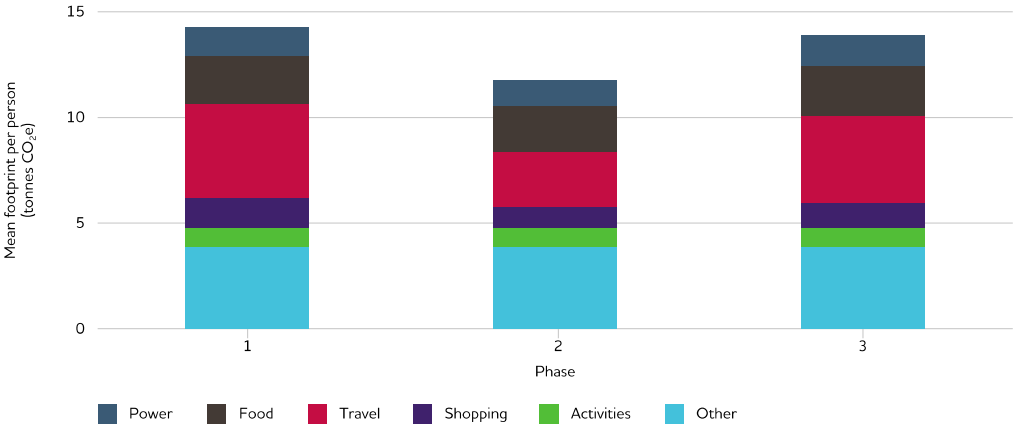
Figure 10: Mean footprint per person for power, food, travel, shopping, activities and other, for Derwenthorpe and York REAP Petite respondents



Comparisons between Derwenthorpe residents

Derwenthorpe is a mixed community, and our analysis also looked for similarities and differences between residents, by phases and tenures. Comparing footprints within Derwenthorpe (see Figure 11), the mean total footprint was 14.33 tonnes for phase 1 residents (n=47), 13.97 tonnes for phase 3 (n=43) and, significantly lower than the other two phases at 11.79 tonnes, was phase 2 (n=24).[36] Phase 2 had a significantly lower shopping footprint and travel footprint than phase 1, [37] and also a significantly lower travel footprint than phase 3.[38]

Figure 11: Mean footprint per person for power, food, travel, shopping, activities and other, for the different phases of Derwenthorpe



It might be expected that the wealthier the household, the higher the carbon footprint (Minx et al, 2009; Preston et al, 2013). Using tenure as a proxy of income, data from Derwenthorpe suggests that residents who own their homes outright, or have a mortgage or loan, had the greatest spread in their total footprints; residents who rented their houses and, to some extent, shared owners, had a smaller spread in their footprints, but this difference was not statistically significant.[39] There was, however, a difference in the power and food footprints by tenure,[40] with renter households having the lowest power footprint but highest food footprint, although it should be noted that the sample size for rented properties is relatively small.

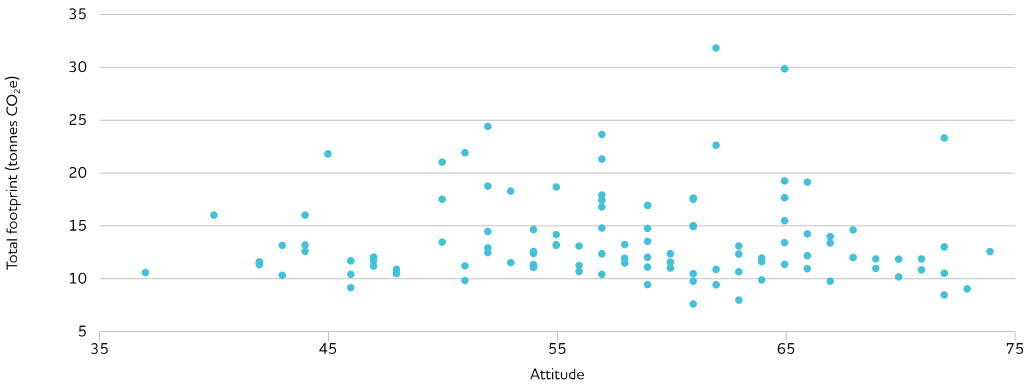
Individuals over time

Residents were periodically asked to complete their footprints while living at Derwenthorpe. This showed that there was a small, but not significant, increase in the mean total footprints over time (15.04 to 17.07; n=18). Seven residents saw a drop in their total footprint over this time, while 11 saw an increase in their total footprint over this time.

Carbon footprints and environmental attitudes

There did not appear to be a link between Derwenthorpe residents' environmental attitudes and their footprints (see Figure 12, which shows a wide spread in attitude score, and no relationship between this and respondents' footprints). A statistical test showed no correlation between these variables.[41] At the national level there was a significant relationship in that as attitude increased, ie people became more pro-environmental, their total footprint decreased. This may be because much of the difference in footprint is driven by travel, which people perceive as being an essential part of their lives and are therefore unwilling to change practices; or it may be because of the relatively small sample size of Derwenthorpe respondents compared to the national REAP Petite sample.

Figure 12: Environmental attitude of Derwenthorpe residents plotted against total footprint



Derwenthorpe compared to other eco-communities in England

Since 2015, three comparator communities kindly agreed to complete their carbon footprints. These were: Ashton Hayes (Cheshire), which describes itself as a 'well knit community of about 1000 people that is aiming to become England's first carbon neutral community' (http://www.goingcarbonneutral.co.uk/); BedZED (London), which is 'the UK's first large-scale mixed-use eco-village' with 100 homes (https://www.bioregional.com/bedzed/), and Lancaster Cohousing scheme, a 'multi award winning eco cohousing community' of around 80 people (https://lancastercohousing.org.uk/). Nine people from Ashton Hayes completed the REAP Petite tool,[42] 27 completed it from BedZED, and 28 completed it from Lancaster Cohousing. Some of these respondents completed it more than once: in these cases, an average of their responses has been used in analysis.

Box 1: Comparator communities

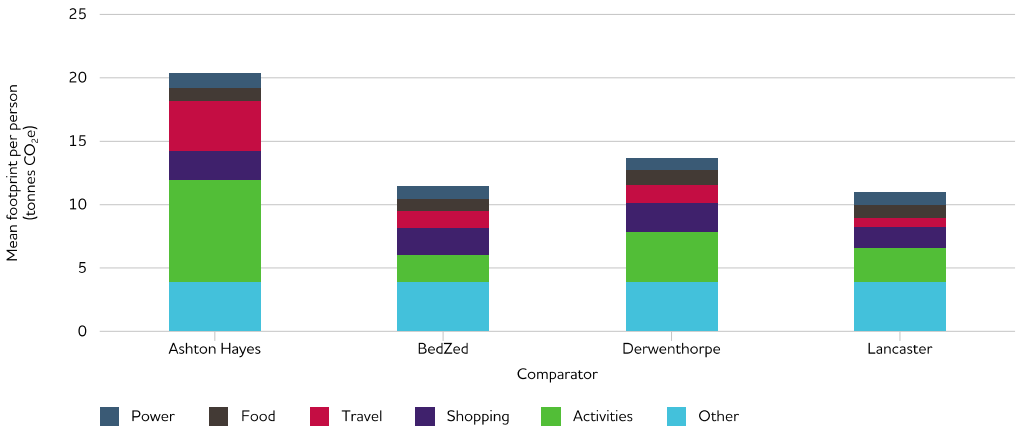
Lancaster Cohousing (https://lancastercohousing.org.uk/)
The idea for the initiative dates from 2006, when a small group wanted to establish a community and eco-home development. The group (constituted as a limited company) eventually purchased a site 3 miles from Lancaster city centre (formerly an engineering works). Planning permission was granted in 2010 for a total of 41 properties (flats, and one-, two- and three-bedroom houses), shared facilities and a common house. The homes are built to Level 6 of the Code for Sustainable Homes and Passiv Haus standards, and heated via a district heating system fuelled by wood chips. Potential members formally apply to join the cohousing community, and are expected to take part in community life through regular volunteering. Some meals are cooked and eaten together in the common house. There is a well-stocked food store that is run as a co-operative (where some food is bought in bulk), from which members can purchase for personal use or communal meals. As there are only 11 parking spaces, there are a small number of privately owned cars and a well-used car-club scheme.

BedZED (https://www.bioregional.com/bedzed/)
BedZED (Beddington Zero Energy Development) was initiated by housing association Peabody, architects Zedfactory and sustainability charity Bioregional, and was completed in 2002. It is in suburban London and consists of 100 homes. The majority are heated through passive solar: the houses have large windows that face south and a large thermal mass, which means that they retain heat well. All homes have solar ohotovoltaic panels. There is a district heating system that is fuelled by wood pellets. There is a car-share scheme and alternatives to car ownership are encouraged, with less than one car space per home, ample secure bicycle parking and good public transport links.

Ashton Hayes (http://www.goingcarbonneutral.co.uk/)
Ashton Hayes in Cheshire is aiming to become England's first carbon neutral village. Like most villages in England, houses are a mixture of ages – the village is mentioned in the Doomsday book, and there are also some new-build properties. Initiatives under 'Going Carbon Neutral' have included changing household behaviour by improving insulation, switching off appliances, etc. They conduct regular surveys of households to monitor carbon footprints and give feedback about how to reduce these. There is a community energy company that has installed solar photovoltaic panels on the primary school and sports pavilion. There is a community-run village shop.

Statistical tests showed there is a significant difference between the total footprint and travel, food and power footprints of the four comparator communities[43] (see Figure 13). There was no difference in activities or shopping footprints. There was also no significant difference in environmental attitude score between the four communities (Derwenthorpe mean = 57.6, Ashton Hayes mean = 59.3, Lancaster mean = 60.5 and BedZED mean = 61.4).

Figure 13: Mean total footprint of the four communities, divided into the constituent parts



Ashton Hayes had significantly higher power footprints than the other three communities,[44] not surprising as the houses were not built as eco-homes and vary in age from new builds to 600 years old. Lancaster had a significantly lower power footprint than both BedZED and Derwenthorpe.[45] There was no significant difference in the power footprint between BedZED and Derwenthorpe. Lancaster homes are built to Passive Haus standards and were completed in 2012. They are heated through a district heating system powered by wood chips, with a gas backup. BedZED was completed ten years earlier, in 2002, also has a combined heat and power plant and district heating system, but from 2005 until 2017 this used natural gas rather than wood chips. In 2017, a wood pellet boiler was installed, and the electricity imported from the grid is 100% renewable. Like Derwenthorpe, BedZED homes have high levels of insulation. The passive solar heating design at BedZED and the structure of the houses means they have a large thermal mass, so comfortable temperatures are maintained throughout the year. The use of gas rather than wood chips at BedZED before 2017 (100% gas) and Derwenthorpe (where the mix has varied between years, but currently stands at 60% biomass/40% gas) accounts for these communities having a higher power footprint than Lancaster, but lower than the UK average.

For travel, the lowest footprint was at BedZED, followed by Lancaster and Derwenthorpe, with the highest at Ashton Hayes.[46] BedZED had a significantly lower travel footprint than Derwenthorpe,[47] but the lower footprint at Lancaster was not significantly different from Derwenthorpe's. BedZED, like Derwenthorpe, was designed to encourage low levels of car ownership (including only one parking space per home (Derwenthorpe) or less than one space per home (BedZED), and good links to buses (BedZED and Derwenthorpe) and trains (BedZED). BedZED, Derwenthorpe and Lancaster all have a car-club scheme. Location is likely to play an important role here: BedZED is in suburban London with excellent public transport links; Derwenthorpe is on the outskirts of York, and so buses are less frequent and stop earlier in the day; Lancaster Cohousing is located a few miles out of the city centre; and Ashton Hayes is a village, 8 miles from Chester, with no railway station, so there is high reliance on personal cars. Table 9 shows that BedZED and Lancaster have fewer car-miles per person, less access to cars and fewer flights per person than Ashton Hayes, Derwenthorpe or the UK sample.

Table 9: Travel data for the four comparator communities and the UK REAP Petite sample, showing the mean number of flights per person; the mean number of car-miles per person, per year; and the mean number of cars to which the households have access

Sample	Mean annual flights per person	Mean car-miles per person	Mean number of cars household has access to
UK REAP Petite	1.7	4536	1.4
Ashton Hayes	3.2	6777	2.0
BedZED	0.8	2084	0.7
Lancaster	0.5	2399	0.9
Derwenthorpe	1.7	4873	1.2

Lancaster had a significantly lower food footprint than Derwenthorpe or BedZED, and a non-significant lower food footprint than Ashton Hayes.[48] This is most likely due to two factors – the lower than average number of meat meals per household per week (2.7 in Lancaster, compared to the UK average of 7.7, Ashton Hayes at 8.9, BedZED at 5.9 and Derwenthorpe at 7.1), and the cohousing nature of the community. The community orders food in bulk, and cooks communal meals four times a week, so respondents' expenditure on food is lower than average (which is how REAP Petite calculates this element of the food footprint).

Conclusions

Several key conclusions arise from the environmental footprint analysis:

- Footprints can be lower than the UK average in new-build developments. Initial house design is critical for reducing energy bills, and is a big driver of the power footprint, as is the energy that supplies it. Biomass boilers significantly reduce power footprints. Occupancy rates are also important – if under-occupation is occurring, then footprints per person are high.

- Other aspects of footprints, in particular, travel, are harder to reduce, and require city- or national-level initiatives alongside community-level activities. The location of the community influences travel footprints. Community car-club schemes and strict car ownership regulations (such as at Lancaster Cohousing) can lead to significantly lower travel footprints.
- New homes can lead to large amounts of purchases of new items of furniture, appliances etc, leading to high shopping footprints. This could be reduced through promotion of community recycling or reuse schemes by housing providers.
- Community behaviour also has the potential to influence footprints; for example, communal shopping and eating can lower food footprints.
- Despite all the measures that are being put in place in our four comparator communities, we are a long way from achieving low-enough carbon footprints to keep us within the 1.5–2°C limit on warming by 2050 (IPCC, 2018),[49] which has been estimated to be 1.05 tonnes of CO_2 per capita (OPEN:EU 2011).[50]

6 Conclusion

This report has examined Derwenthorpe's residents' experiences of their homes and community over time, with a particular focus on community life in 2018. JRHT/JRF's vision was to build a socially and environmentally sustainable community 'fit for the 21st century' (JRHT, 2009). The Derwenthorpe business plan envisaged a vibrant and supportive community, accessible to all, and able to adapt to environmental changes over time. It also hoped to deliver high-quality homes and provide learning experiences for others to develop similar schemes in the future. It can usefully inform the development of new garden communities (MHCLG, 2018c) and chimes with key lessons from the Town and Country Planning Association (TCPA) New Communities Group (TCPA, 2018). It should also inform the future expansion of social housing (MHCLG, 2018d), and local planning more generally (MHCLG, 2018b).

This final chapter considers the extent to which Derwenthorpe has succeeded in its aims in its first six years, looking first at social sustainability and then at environmental sustainability.

Social sustainability

The social sustainability of Derwenthorpe requires housing that provides people with suitable, affordable and accessible homes, within a wider safe and supportive community. The REAP Petite survey showed that the vast majority of residents were satisfied with their homes and community. Moreover, residents were more likely to be 'very satisfied' with both home and community than the national average, and this was particularly the case for social renters.

Much of the satisfaction with Derwenthorpe homes appeared to be influenced by good design, demonstrating the value of aesthetics in new developments (Airey et al, 2018). Architecturally, Derwenthorpe was inspired both by former JRHT homes in New Earswick and by European models. The striking houses, with their white render, high ceilings, three floors (or potential for extending into the loft), excellent space standards (partly driven by Lifetime Homes standards), and large windows/greater lightness (driven by eco-design standards), delivered homes that most people were delighted to live in. Although some commented the houses themselves were overlooked by other properties, the landscaped, green areas were much appreciated by most residents.

Generally, residents considered that the houses offered high-quality accommodation. This was tempered by some dissatisfaction with snagging and repairs in the early years, and frustration with the process of getting these dealt with; however, most people felt such snagging was annoying, but did not detract from the enjoyment of living in their homes. Some dissatisfaction was also related to some of the eco-features (see 'Environmental sustainability' section). There were similar reasons for dissatisfaction with the area, including lack of communication and consultation with JRHT, ongoing disruption of building work, and the eco-features.

There was an aim that Derwenthorpe should be accessible to all; this was met, to a large extent. As a mixed-tenure development, three in five homes (59%) were for sale across the development, with a quarter reserved for social renters and 15% for shared ownership. While the buoyant housing market in York meant that owned properties were priced higher than the national average, the owners who moved in felt the properties represented good value and found them affordable. Shared owners were very pleased with the opportunity the scheme had given them to live in a much higher-standard property than they could otherwise have afforded; however, a few were concerned with ongoing affordability issues, an issue worthy of further investigation. The interim report (Quilgars et al, 2015) showed that renters felt fortunate to be allocated a property at Derwenthorpe, and the rent was considered just about affordable (but very good for the house, and compared to the private rented sector). An estate charge was also considered reasonable, although there was a consensus that more should be done for the money, particularly in the smaller spaces in the lanes outside of people's homes (rather than the larger, open, green spaces that were seen as well tended).

A major achievement of Derwenthorpe was adapting properties for people with disabilities or health conditions. The impact on the families that had moved to Derwenthorpe to meet the needs of their children or another household member with disabilities was life changing. JRHT, with the assistance of

the developer, was able to adapt houses before people moved in, and was seen as very supportive within this process. The Lifetime Homes standards also gave people opportunities to adapt properties further down the line, although one case study indicated that this process could be improved. There were some examples of Derwenthorpe homes also supporting life events and transitions more generally. Recent JRF research (Croucher et al, 2018) highlighted that housing is often poor at supporting changes over the life-course. As well as Lifetime Homes standards, shared ownership had enabled people to respond to changes in their experiences, for example in reducing the proportion of the property owned following a relationship breakdown, to enable them to stay in their home. A number of people had also experienced bereavements, but the homes remained affordable and the residents had been supported by neighbours.

The research indicates that, six years on, Derwenthorpe was functioning to a large extent as the intended vibrant and supportive community. JRHT has a long-term stewardship role at Derwenthorpe, helping residents to establish governance and social groups, and managing the SSC that provides community space (as well as housing the biomass boilers: see below). Participants appreciated having this community hub and venue for activities, seeing it as very important for promoting community-building. A wide range of social activities had been established in the first six years, and most groups were flourishing and well supported. Many residents appreciated the provision of social opportunities, even if their work constrained them from attending.

Derwenthorpe residents frequently talked about how friendly the development was. This was particularly the case in phase 1, which was the first to be established and the smallest, and had attracted a group of people who were passionate about community-building. Friendships were most likely, however, to have been established between owners. Across the phases, residents commented on the value of being part of a new community, where everyone was new and often looking to make new connections. There were also examples of people getting together on an informal basis, whether at the play-park or going out/staying in.

In the main, Derwenthorpe was working very well as a mixed community; virtually everyone supported this as an aim, and applauded the scheme for pepper-potting and the fact that you could not tell tenure type from the house exterior. However, some residents expressed concern that different tenure types were not mixing at social events, and there were also a couple of instances of social distance between owners and renters. The research data would support some additional proactive work in ensuring that tenants and shared owners feel ownership of the development to the same extent as owners.

Derwenthorpe residents loved the green space around them and, five years on, were particularly pleased with how the green space integrated with the housing. This appeared to further support social cohesion on the development, offering opportunities for people to meet each other in pleasant surroundings and functional spaces such as the playground. Residents also appreciated the location of Derwenthorpe in York: local services were good, and relations with the neighbouring areas of York appeared to have improved over time.

Although the community was still developing, and some improvements could be identified, the day-to-day reality of living in Derwenthorpe was overwhelming a positive one.

Key learning points regarding social sustainability that could usefully be considered in similar sustainable developments nationwide include:

- The architectural design of homes that privileges space (including height) and light is highly regarded by residents and impacts positively on their quality of life. Some of these design qualities also have environmental benefits. Design informed by cultural heritage, but also by aesthetics and wider international influences that push the boundaries of traditional design, can work.
- Time and funding pressures on developers, along with skill shortages, impact on build quality and performance. This is industry-wide, and needs addressing at the national level.
- Lifetime Homes standards, along with the capacity to extend the home into the loft, can future-proof a home for a variety of household types.
- The transparency of energy and estate charges is crucial from the outset, to avoid considerable upset and possible misunderstandings among residents.

- Satisfaction with the development was generally high. Factors that may have helped this were the sense of community, the large amounts of communal open space, and the design of the houses and appropriateness for family members with additional needs.
- Provision of a central community space was very important for many residents, and has enabled a sense of community to develop across phases. Such spaces need to be planned as an integral part of new developments.
- The DRA was well established, but there was considerable concern that it had not succeeded in attracting members from across social renting and shared ownership. It is recommended that equity across tenures be built into the constitution and terms of reference of community bodies.
- More generally, the integration of tenures in the design works well to generate a sense of equality and integration. Similarly, the distribution of different sizes of house helps to mix up residents at different life stages.

Environmental sustainability

Derwenthorpe also aimed to be environmentally sustainable, at both home and community level, and remain adaptable to environmental changes over time. From the perspective of residents, this aim had been met less well than social sustainability. It is important, however, to note some quite substantial achievements in this area. Dissatisfaction often seemed to be related to feelings of disappointment that the development had not achieved more, problems with technology, and frustration with the process of addressing ongoing issues by JRHT and David Wilson Homes. This cautions the over-selling of exemplar housing, as expectations can be very high and disappointment can follow when problems are experienced.

At Derwenthorpe, all homes featured a number of environmental features, including: high levels of airtightness/insulation; low-energy fittings; water restrictors; a mechanical ventilation system (MVHR in phase 1); and heating from a communal heat and hot water system (powered by a combination of biomass and natural gas).

The majority of residents were satisfied with the energy efficiency of their home, however some reported that the homes did not hold their heat as well as they had hoped. Others reported difficulties in heating the house to a suitable temperature in winter, particularly on the ground floor. The REAP Petite survey showed that 48% of residents thought that living at Derwenthorpe would reduce their energy costs, while 25% disagreed and 28% were unsure. A number of residents were unhappy with heating costs and how these had increased recently.

There remained a level of frustration with the MHVR systems, with some having systems replaced, and others waiting for this and to hear how the systems would be serviced. There appeared to be varying levels of knowledge about the simpler MEV system. There was a clear need for greater explanation of heating and ventilation systems. There had been some disappointment at the low levels of biomass burnt, and the monopoly of one supplier (also for internet connection) was felt to be less than ideal. The main environmental feature that residents would have liked to see added to their homes was solar panels. Recently, JRHT had received monies to fit solar panels on the SSC and more widely, and this had been welcomed. At the moment, 41% of respondents reported using a green electricity provider, compared to 30% in the national REAP Petite sample, indicating better progress than nationally, but scope for further improvement.

Despite the problems above, Derwenthorpe residents had achieved a significantly lower power component of their carbon footprint (1.39 tonnes per year); this was lower than both the UK sample (2.50 tonnes) and other respondents from York (2.76 tonnes), indicating that the design of the homes and the community heating system were lowering footprints (albeit not as effectively as had been hoped). A comparison with Lancaster Cohousing, which used 100% wood chips in its biomass boiler and had been built to Passiv Haus standards, showed that a significantly lower power footprint was achievable in niche developments (but may be challenging to mainstream into larger developments such as Derwenthorpe).

Mainly as a function of the power component, Derwenthorpe respondents had a significantly lower carbon footprint than other UK respondents taking part in the REAP Petite environmental survey (13.66 tonnes of carbon dioxide equivalent, compared to 14.17 tonnes), and lower than the reported UK mean as a whole (16.24 tonnes). However, Derwenthorpe residents had a significantly higher food component

of their footprint, compared to the rest of the UK sample (2.15 tonnes compared to 2.30 tonnes). They also had a significantly higher travel component of their footprint (3.96 tonnes) compared to other York residents (3.52 tonnes), although not compared to the rest of the UK sample, as at the interim stage (Quilgars et al, 2015).

Interventions already incorporated into Derwenthorpe to promote sustainable lifestyles and support a reduction in car use included siting the development by the Sustrans cycle way, the provision of cycle vouchers and bus vouchers, and an on-site car club. Residents appreciated the cycle network and bus, and these were well utilised, but the car-club scheme was used much less. Parking remained a problem on the site.

In terms of food generation, a community garden and pop-up shop for organic bread and vegetables/fruit had been established; these were well supported, however they have a marginal impact on people's overall food shopping habits at present. All residents were recycling, many more than previously, using the kitchen recycling bins, although it was felt that Derwenthorpe could go further with recycling.

The Derwenthorpe experience suggested that there was considerable scope for extending environmental interventions to reduce residents' overall footprint. The survey results indicated that interventions had to be at the level of behavioural change, not at attitudinal change, as residents with more pro-environmental attitudes did not have a lower carbon footprint. It was also clear that this would require city- and national-level interventions alongside community-level change. As with the development of new garden communities (MHCLG, 2018c), there was also a need to address economic considerations as part of the development, in terms of availability of local jobs and the creation of new local enterprises, along with better public transport networks. Derwenthorpe, however, was on a smaller urban extension scale, which made influencing these wider economic issues more difficult.

Key learning points regarding environmental sustainability that could usefully be considered in similar sustainable developments nationwide include:

- Wherever possible, energy-efficiency measures should be built into the fabric of the building. Where user knowledge is needed, clear (ongoing) information and instruction on energy-efficiency measures is required.
- Any maintenance issues for energy-efficiency measures (eg ventilation systems) need to be in place from occupation, and not rely on individual householders to arrange.
- Biomass boilers can reduce energy use, but their efficiency is compromised in low-density settings.
- Solar photovoltaic panels are well supported by residents; they require little user operation and should be considered at the outset, rather than as later additions.
- The most common reason for people being dissatisfied with the area was that it was not as sustainable as they had been led to believe when they moved to the development; it is important not to 'over sell' such aspects during the house-purchase stage.
- Pedestrian and cycling routes, and leisure spaces, accessible to all enables residents to feel a sense of ownership over the whole development. Derwenthorpe demonstrated the value of green landscaping, including sustainable urban drainage, to new developments.
- Parking can remain a key issue in sustainable developments. Far-reaching policies are needed for a one-car-per-household policy to work, including early and better public transport, consideration of incorporating this policy into title deeds/rental agreements, and/or clearer options for visitor/overflow parking at the edges of the development or off-site.
- Overall carbon footprints can be lower than the UK average in new-build developments. Initial house design is critical, as is the energy that supplies it. Occupancy rates are also important – if under-occupation is occurring, then footprints per person are high.
- Other aspects of footprints, in particular travel, are harder to reduce, and require city- or national-level initiatives alongside community-level activities.

- New homes can lead to large amounts of purchases of new items of furniture, appliances, etc, leading to high shopping footprints. This could be reduced through promotion of community recycling or reuse schemes by housing providers..
- Community behaviour also has the potential to influence footprints, for example, communal shopping and eating can lower food footprints.

Conclusion

Increasing the sustainability of housing is critical – in 2017, residential buildings accounted for 19% of all carbon emissions in the UK and 30% of all energy demand. However, while Wales and Scotland have clear strategies to reduce energy use, the policy routes to achieving these measures across new and existing stock is uncertain in England and Northern Ireland. Exemplar developments of new housing to date have reduced energy use by using a mixture of fabric solutions and renewable technology. However, sustainable housing development remains a niche enterprise, and mainstreaming learning points from exemplar sites is a challenge. We also remain a long way from achieving low enough carbon footprints to keep us below the 1.5–2°C limit on warming by 2050 (IPCC, 2018), estimated to be 1.05 tonnes CO2 per capita (OPEN: EU 2011), and new initiatives have to push further boundaries. Nonetheless, Derwenthorpe's experience can be instructive for new developments.

Overall, Derwenthorpe has succeeded in delivering a socially sustainable community with its commitment to mixed communities and high-quality, aesthetically pleasing housing and neighbourhoods. A stewardship role, and a new enthusiastic community, had together created a strong sense of community within a six-year period.

The Derwenthorpe experience on environmental sustainability had been more mixed, with the design of the homes out-performing its environmental features. As with other similar developments, district heating systems and MHVR had proved difficult to operationalise, leading to some frustration among residents. However, despite this, residents had achieved lower than average power (and total) carbon footprints. The green features of the wider environment were also successful in terms of offering a good quality of life, and promoting sustainable transport. As well as generating considerable learning for future sustainable developments, Derwenthorpe delivered what many residents described as a "great place to live".

Notes

1. https://www.jrht.org.uk/community/new-earswick-york

2. A more detailed history of the development can be found in the interim report for this project (Quilgars et al, 2015).

3. A winter garden helps to heat the house in winter; both the inner and outer doors are kept closed to act as a buffer zone to the cold outside. Any heat from sun is trapped and transferred inside to help warm the rest of the house. The doors can be opened at other times of year, to create more internal or outdoor space.

4. The Code for Sustainable Homes was an environmental assessment method for rating and certifying the performance of new homes, with mandatory performance measures for energy and CO_2 emissions, water usage, materials, surface water run-off, waste, and health and wellbeing elements. This code was withdrawn by the Government in March 2015 (with exception of legacy cases), with some of its standards being incorporated into Part L of the Building Regulations from 2016.

5. The SUD system is designed for both water conservation and flood risk management. The site has underlying clay formations, and previously the local area had experienced standing water in particular areas. There was also flooding from the Osbaldwick beck – the SUD scheme will help counter water collection and flooding in the future.

6. The Lifetime Homes standards are a series of 16 design criteria intended to make homes more easily adaptable for lifetime use at minimal cost. The concept was initially developed in 1991 by JRF and the Habinteg Housing Association. For further details, see http://www.lifetimehomes.org.uk/

7. The charge payable for each household is linked to the size of the property.

8. The NEP scale was chosen, as it is widely used for measuring the degree of pro-environmental attitude. It was created in the 1970s and revised in the 1990s (Dunlap et al, 2000). It has been used in hundreds of studies around the world (Hawcroft and Milfont, 2010), and therefore allows us to compare the environmental attitudes of those completing the REAP Petite survey with the attitudes of people from other studies.

9. https://www.lancastercohousing.org.uk/

10. https://www.bioregional.com/BedZED/

11. http://www.goingcarbonneutral.co.uk/

12. https://www.gov.uk/government/organisations/department-for-business-energy-and-industrial-strategy/about/statistics

13. http://ec.europa.eu/eurostat/web/sdi/indicators; SDG 11 aims to renew and plan cities and other human settlements in such a way that they offer opportunities for all, with access to basic services, energy, housing, transportation and green public spaces, while improving resource use and reducing environmental impacts.

14. A larger low-carbon development in London that comprises 100 homes and community facilities.

15. An earth-sheltered development of five homes that has a high thermal massing, a wind turbine, low-impact construction techniques, water harvesting and reed bed filters, in Nottinghamshire.

16. This was slightly lower than findings at the interim stage, where 91% were satisfied overall (Quilgars et al, 2015).

17. There were 38 'new' respondents and 83 'settled' respondents. Note that if someone completed the survey within one year of moving, and again after that period, both responses are used. If someone completed it more than once as a 'new' or 'settled' person, the average of their responses for that period is used.

18. The high ceilings also increased the overall footprint of the house, as more space was needed to accommodate stairs in the properties.

19. Shared ownership rent increased by the Retail Price Index + 1.005%. For fully rented properties, the 1% Government rent reduction was applied, meaning that rents were reduced.

20. It should be noted that the top layer of the road had yet to be laid.

21. Solar panels installed on the SSC will be used to reduce the energy costs associated with running the facility. These costs are paid for indirectly by residents through the estate charge/energy supplier charges. By installing the panels, JRHT intends to pass the benefits of reduced energy use through to those charges.

22. This had been installed at the time of writing.

23. JRHT provided data that showed the SSC was running at 18% capacity presently, meaning that it was unlikely that extra funds would be available to build an extension for a café in the near future. A new community centre has recently opened less than a mile away that has a café on-site in the Explore library, alongside a wide range of other health, social and enterprise facilities, and rooms to hire (http://www.yor-ok.org.uk/service-detail.htm?serviceid=7699)

24. More recently a Community Activities Group has also formed, and is supported by JRHT to organise social activities.

25. Other interviewees commented that the vision of Derwenthorpe as a sustainable community was also being lost from the institutional memory of JRHT through staff turnover.

26. The City of York Council worked with JRHT to develop the bus service, with a contribution made by JRHT as part of the S106 planning agreement for Derwenthorpe. The service runs to the city centre (although not to York railway station, as desired by some residents), and also to another suburb of York.

27. Existing bus service to city centre, hospital and university.

28. The operation of the car club was looked at in detail in Quilgars et al (2015).

29. For these 19 residents, the mean score of these entries was used in analysis.

30. Tool promoted via SEI website, twitter, blogs during Climate Week, and via student research projects.

31. Calculated from average UK consumption figures from the Stockholm Environment Institute's REAP model, which uses national accounts to estimate footprints for different economic sectors. Here, we have taken the UK carbon footprint from these accounts and divided it by the number of individuals in the UK. Note that a direct comparison between a cohort of users from REAP Petite and average data from REAP should be avoided, due to the different baselines and methodologies used in the preparation of the data, as the REAP Petite results are derived from the responses made by individual households, unlike the REAP data, which uses national-level economic sector data.

32. Mann-Whitney U test Derwenthorpe to rest of REAP Petite sample: $Z=-2.067$, $p=0.039$.

33. Mann-Whitney U test Derwenthorpe to rest of REAP Petite sample power: Z=-8.755, p<0.0001.

34. Mann-Whitney U test Derwenthorpe to rest of REAP Petite sample food: Z=-2.124, p=0.034.

35. Mann-Whitney U test Derwenthorpe to rest of REAP Petite sample activities: Z=-2.234, p=0.025.

36. Mann-Whitney U test for total footprint between phase 1 and 2: Z=-2.006, p=0.045, 2 and 3: Z=-1.988, p=0.047.

37. Mann-Whitney U test for travel footprint between phase 1 and 2: Z=-2.097, p=0.036, shopping: Z=-2.468, p=0.014.

38. Mann-Whitney U test for travel footprint between phase 2 and 3: Z=-2.177, p=0.029.

39. The Kruskal Wallis test showed no significant difference in footprint by tenure (X^2=0.820, df=3, p=0.845).

40. The Kruskal Wallis test for power: X^2=18.766, df=3, p<0.0001, food: X^2=16.376, df=3, p=0.001.

41. Non-parametric Spearman's Rank Correlation test for correlation between Derwenthorpe attitude and total footprint: rho=-0.056, n=111, p=0.557; Non-parametric Spearman's Rank Correlation test for correlation between total REAP Petite sample attitude and total footprint: rho=-0.138, n=1323, p<0.0001.

42. The small sample size means that results from Ashton Hayes should be treated with caution, as high footprints from one or two individuals can skew the means upwards.

43. The Kruskal Wallis test results showed significant results: Total: X_2=29.931, df=3, p<0.0001; Travel: X_2=16.857, df=3, p=0.001; Food: X_2 = 20.554 df=3, p<0.0001; Power X_2=48.911, df=3, p<0.0001.

44. Mann-Whitney U test for power – Ashton Hayes to BedZED: Z=-4.002, p<0.0001; Ashton Hayes to Lancaster: Z=-4.207, p<0.0001; Ashton Hayes to Derwenthorpe: Z=-4.380, p<0.0001.

45. Mann-Whitney U test for power – Lancaster to BedZED: Z=-3.223, p=0.001; Lancaster to Derwenthorpe: Z=-5.815, p<0.0001.

46. Although the Ashton Hayes travel footprint was high, this was not significantly different from the UK average, possibly due to the small sample size at Ashton Hayes. One respondent's travel footprint was particularly high, and several people in the community who take large numbers of long-haul flights are known to buy carbon offsets.

47. Mann Whitney U test for travel – BedZED to Derwenthorpe: Z=-3.427, p=0.001.

48. The small sample size at Ashton Hayes may again account for this lack of significance.

49. The recent IPCC report highlights a number of climate change impacts that could be avoided by limiting global warming to 1.5˚C degrees rather than 2˚C.

50. It should be noted that this is a global figure, and some countries have a much lower per capita footprint than we have in the UK.

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Appendix: Reap Petite questionnaire

Calculate your footprint

This questionnaire allows us to calculate the impact your household has on the environment. It is divided up into a number of different sections: some basic details, power, food, travel, shopping and other activities. This information will be put into a spreadsheet, which allows us to calculate the greenhouse gas emissions associated with your household. The more information you provide, the more accurate your result will be. You can either complete this paper copy, or complete it online at www.reap-petite.com

Please complete this now, even if you have completed it before – we can then let you know how your carbon footprint has changed over time.

At the end of the questionnaire is an optional section called 'Views' – this asks some demographic information about the person completing the questionnaire and their attitudes towards the environment. At the end of the questionnaire, you can leave contact details, which we will use to provide you with your results.

Details

Your postcode _____

How many people live in your home? _____

How many of these are under 18? _____

Power

1. What kind of home do you live in?

Detached house	☐ 2 bedrooms	☐ 3 bedrooms	☐ 4+ bedrooms
Semi-detached house	☐ 2 bedrooms	☐ 3 bedrooms	☐ 4+ bedrooms
Mid-terrace	☐ 2 bedrooms	☐ 3+ bedrooms	
End-terrace	☐ 2 bedrooms	☐ 3+ bedrooms	
Detached bungalow	☐ 2 bedrooms	☐ 3 bedrooms	☐ 4+ bedrooms
Semi-detached bungalow	☐ 2 bedrooms	☐ 3+ bedrooms	
Flat with 3 external walls -	☐ 1 bedroom	☐ 2 bedrooms	☐ 3+ bedrooms
Flat with 2 external walls	☐ 1 bedroom	☐ 2 bedrooms	☐ 3+ bedrooms

2. What is the main fuel used to heat your home?

☐ Gas	☐ Liquefied petroleum gas
☐ Electricity	☐ Coal
☐ Oil	☐ Wood

3. If you have your household's energy bills available, please enter the amount of energy used per year. You should receive an 'Annual Energy Statement' once a year that contains this information. If you do not have this information, we can estimate it from your answers to the rest of the questionnaire.

Fuel	Amount
Gas	kWh per year
Electricity	kWh per year
Oil	Litres per year
Liquefied petroleum gas	Litres per year
Coal	Tonnes per year
Wood	Tonnes per year

4. Do you own any of the following appliances?

Appliance	Yes – energy efficient	Yes – not energy efficient	No – did not have
Fridge			
Freezer			
Washing machine			
Dishwasher			

5. What proportion of your household's light bulbs are energy efficient?

   ☐ All of them ☐ Some of them ☐ Most of them ☐ None of them

6. Which of these home energy-efficiency improvements does your household have installed?

   ☐ Thick loft insulation (150–270mm)

   ☐ Thin loft insulation (less than 150mm)

   ☐ Filled cavity walls ☐ Condensing boiler

   ☐ External wall insulation ☐ Combined heat and power system

   ☐ Hot water tank insulation ☐ Double or triple glazing

7. Which of these renewable technologies does your household have?

   ☐ Photovoltaics ☐ Ground source heat pump

   ☐ Solar water heating ☐ Biomass boiler

8. Does your electricity come from 'green' sources?

   ☐ Yes ☐ No

9. Do you turn lights and electrical items off when not in use?

   ☐ All the time ☐ Some of the time

   ☐ Most of the time ☐ Never

Food

1. In an average **week**, how many meals eaten by your household contain meat? (Please circle.) Note, if some members of your household eat less meat than others, choose a smaller number.

Breakfast	0	1	2	3	4	5	6	7
Lunch	0	1	2	3	4	5	6	7
Dinner	0	1	2	3	4	5	6	7

2. Per **week**, the average household in York spends the following amounts on food and non-alcoholic drinks:

One person	Two people	Three people	Four people	Five people
£20	£52	£61	£82	£102

Do you think **your household** spends:

☐ Nothing

☐ Less than this

☐ About this amount

☐ More than this

3. Per **week**, the average household in York spends the following amounts on alcoholic drinks:

One person	Two people	Three people	Four people	Five people
£3	£6	£9	£12	£15

Do you think **your household** spends:

☐ Nothing

☐ Less than this

☐ About this amount

☐ More than this

4. Per **week**, the average household in York spends the following amounts on catered food and drink from canteens, restaurants and pubs:

One person	Two people	Three people	Four people	Five people
£14	£28	£43	£57	£71

Do you think **your household** spends:

☐ Nothing

☐ Less than this

☐ About this amount

☐ More than this

5. Does your household try to buy local and seasonal produce?

☐ All the time

☐ Most of the time

☐ I don't tend to think about it

6. Does your household grow its own fruit and vegetables?

☐ No

☐ Yes, we had a small vegetable patch

☐ Yes, we had a large vegetable patch/allotment

Travel

1. How many different cars are used by your household in the average week? Include hired cars, car shares and cars where someone gets a regular lift:

_____

For **car one:**

What type of car is it? Note: LPG = liquefied petroleum gas, CNG = compressed natural gas

☐ Small petrol car up to 1.4l ☐ Small diesel car up to 1.7l

☐ Medium petrol car 1.4l to 2.0l ☐ Medium diesel car 1.7l to 2.0l

☐ Large petrol car over 2.0l ☐ Large diesel car over 2.0l

☐ Medium petrol hybrid car ☐ Medium LPG or CNG car

☐ Large petrol hybrid car ☐ Large LPG or CNG car

How many people usually travel in it? _____

What is your household's yearly mileage in this car? _____

For **car two**:

What type of car is it?

☐ Small petrol car up to 1.4l ☐ Small diesel car up to 1.7l

☐ Medium petrol car 1.4l to 2.0l ☐ Medium diesel car 1.7l to 2.0l

☐ Large petrol car over 2.0l ☐ Large diesel car over 2.0l

☐ Medium petrol hybrid car ☐ Medium LPG or CNG car

☐ Large petrol hybrid car ☐ Large LPG or CNG car

How many people usually travel in it? _____

What is your household's yearly mileage in this car? _____

For **car three:**

What type of car was it?

☐ Small petrol car up to 1.4l ☐ Small diesel car up to 1.7l

☐ Medium petrol car 1.4l to 2.0l ☐ Medium diesel car 1.7l to 2.0l

☐ Large petrol car over 2.0l ☐ Large diesel car over 2.0l

☐ Medium petrol hybrid car ☐ Medium LPG or CNG car

☐ Large petrol hybrid car ☐ Large LPG or CNG car

How many people usually travel in it? _____

What is your household's yearly mileage in this car? _____

For **car four:**

What type of car was it?

☐ Small petrol car up to 1.4l ☐ Small diesel car up to 1.7l

☐ Medium petrol car 1.4l to 2.0l ☐ Medium diesel car 1.7l to 2.0l

☐ Large petrol car over 2.0l ☐ Large diesel car over 2.0l

☐ Medium petrol hybrid car ☐ Medium LPG or CNG car

☐ Large petrol hybrid car ☐ Large LPG or CNG car

How many people usually travel in it? _____

What is your household's yearly mileage in this car? _____

2. Estimate how many miles your household travels by each mode of transport in the average week. Include commuting travel (ie getting to work), but **not** travel done as part of your job:

Mode of transport	Total miles travelled
On foot	
Bicycle	
Bus	
Train	
Light rail	
Tram	
Underground	
Ferry – foot passenger	
Ferry – car passenger	

3. Using the map, how many return flights have been made in total by your household to the following locations in the past year? For example, if four people travelled to the Western USA, include this as four return flights to Zone 4.

___ Zone 1 (UK)

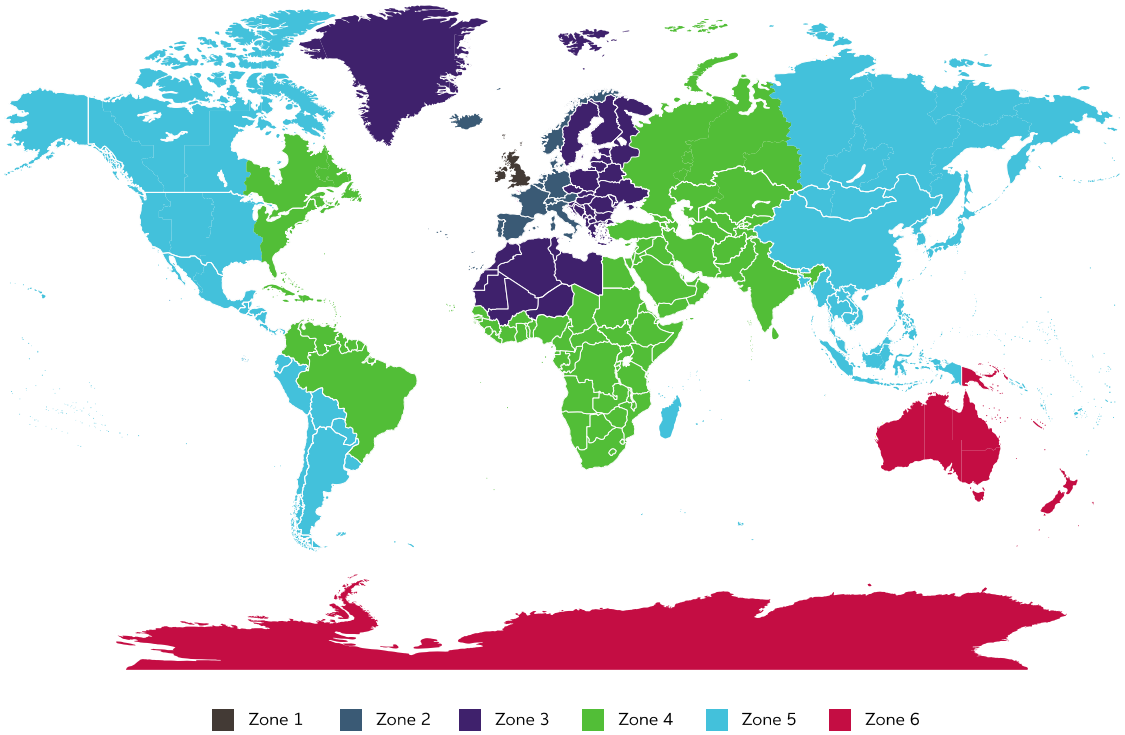
___ Zone 2 (Western Europe)

___ Zone 3 (Eastern Europe and North Africa)

___ Zone 4 (Western USA, Brazil, rest of Africa, Middle East, West Asia)

___ Zone 5 (Rest of USA, East Asia)

___ Zone 6 (Australia and New Zealand)



Shopping

1. Per **month**, the average household in York spends the following amount on clothing:

One person	Two people	Three people	Four people	Five people
£33	£66	£99	£132	£165

Do you think **your household** spends:

☐ Nothing ☐ Up to double this amount

☐ Less than this ☐ More than double this amount

☐ About this amount

2. Per **month**, the average household in York spends the following amount on footwear:

One person	Two people	Three people	Four people	Five people
£8	£15	£23	£30	£38

Do you think **your household** spends:

☐ Nothing ☐ Up to double this amount

☐ Less than this ☐ More than double this amount

☐ About this amount

3. Per **month**, the average household in York spends the following amount on newspapers and books:

One person	Two people	Three people	Four people	Five people
£11	£23	£31	£45	£56

Do you think **your household** spends:

☐ Nothing ☐ Up to double this amount

☐ Less than this ☐ More than double this amount

☐ About this amount

4. Per **month**, the average household in York spends the following amount on toiletries and make-up:

One person	Two people	Three people	Four people	Five people
£17	£34	£51	£68	£86

Do you think **your household** spends:

☐ Nothing ☐ Up to double this amount

☐ Less than this ☐ More than double this amount

☐ About this amount

5. How many of these items have you bought in the last **year**?

☐ Large item of furniture (eg sofa/bed/wardrobe)

☐ Small item of furniture (eg bookcase/coffee table)

☐ Small kitchen appliance (kettle/juicer/food processor)

☐ Small household appliance (iron, electric fan)

☐ Fridge ☐ Washing machine

☐ Freezer ☐ Dishwasher

6. How many of these items has your household bought in the last **year**?

☐ Mobile phone ☐ Laptop

☐ Camera ☐ Desktop computer

☐ MP3 player ☐ Hi-fi

☐ Flat-screen television ☐ DVD player

☐ Regular television ☐ Camcorder

☐ Digital box ☐ CDs

7. In one **year**, the average household in York spends the following amount on jewellery and watches:

One person	Two people	Three people	Four people	Five people
£64	£128	£192	£256	£320

Do you think **your household** spends:

☐ Nothing ☐ Up to double this amount

☐ Less than this ☐ More than double this amount

☐ About this amount

8. In one **year**, the average household in York spends the following amount on power tools:

One person	Two people	Three people	Four people	Five people
£38	£76	£113	£151	£189

Do you think **your household** spends:

☐ Nothing ☐ Up to double this amount

☐ Less than this ☐ More than double this amount

☐ About this amount

Activities

1. Per **month**, the average household in York spends the following amount on games, computer games, sports equipment and hobbies:

One person	Two people	Three people	Four people	Five people
£8	£16	£23	£31	£39

Do you think **your household** spends:

☐ Nothing ☐ Up to double this amount

☐ Less than this ☐ More than double this amount

☐ About this amount

2. Per **month**, the average household in York spends the following amount on watching and participating in sports, including gym membership:

One person	Two people	Three people	Four people	Five people
£9	£18	£26	£35	£44

Do you think **your household** spends:

☐ Nothing ☐ Up to double this amount

☐ Less than this ☐ More than double this amount

☐ About this amount

3. Per **month**, the average household in York spends the following amount on making phone calls, including mobile calls:

One person	Two people	Three people	Four people	Five people
£20	£40	£60	£80	£99

Do you think **your household** spends:

☐ Nothing ☐ Up to double this amount

☐ Less than this ☐ More than double this amount

☐ About this amount

4. Per **month**, the average household in York spends the following amount on betting and the lottery:

One person	Two people	Three people	Four people	Five people
£6	£12	£18	£25	£31

Do you think **your household** spends:

☐ Nothing ☐ Up to double this amount

☐ Less than this ☐ More than double this amount

☐ About this amount

5. Per **month**, the average household in York spends the following amount on cinema, theatre, television licences and subscriptions:

One person	Two people	Three people	Four people	Five people
£18	£36	£53	£71	£89

Do you think **your household** spends:

☐ Nothing ☐ Up to double this amount

☐ Less than this ☐ More than double this amount

☐ About this amount

6. Per **month**, the average household in York spends the following amount on pets and pet food:

One person	Two people	Three people	Four people	Five people
£6	£11	£17	£22	£28

Do you think **your household** spends:

☐ Nothing ☐ Up to double this amount

☐ Less than this ☐ More than double this amount

☐ About this amount

7. If your household contains smokers, how much is spent on cigarettes and tobacco per **week**?

☐ Nothing ☐ £20 to £40

☐ Less than £20 ☐ More than £40

8. How frequently do you redecorate your home?

☐ Rarely – one room every three or more years

☐ Occasionally – one room every one or two years

☐ Often – always working on something

Views

This section will help us put your responses into context, but is entirely voluntary.

1. Name: _____
2. Sex: ☐ Male ☐ Female ☐ Prefer not to say
3. Age: _____
4. Contact details (email, phone, address). This will allow us to let you know your footprint calculation:

   _____

   _____
5. Yearly household income:

   ☐ £0 ☐ £20,000–29,999

   ☐ £1–4999 ☐ £30,000–49,999

   ☐ £5000–9999 ☐ £50,000–74,999

   ☐ £10,000–19,999 ☐ £75,000 plus

Now we would like to get your opinion on a wide range of environmental issues. For each of the following statements, please indicate the extent to which you agree or disagree. This will give us a measure of your environmental attitude.

	Strongly disagree	Mildly disagree	Unsure	Mildly agree	Strongly agree
We are approaching the limit of the number of people the earth can support.					
Humans have the right to modify the natural environment to suit their needs.					
When humans interfere with nature it often produces disastrous consequences.					
Human ingenuity will insure that we do NOT make the earth unliveable.					
Humans are severely abusing the environment.					
The earth has plenty of natural resources if we just learn how to develop them.					
Plants and animals have as much right as humans to exist.					
The balance of nature is strong enough to cope with the impacts of modern industrial nations.					
Despite our special abilities, humans are still subject to the laws of nature.					
The so-called 'ecological crisis' facing humankind has been greatly exaggerated.					
The earth is like a spaceship with very limited room and resources.					
Humans were meant to rule over the rest of nature.					
The balance of nature is very delicate and easily upset.					
Humans will eventually learn enough about how nature works to be able to control it.					
If things continue on their present course, we will soon experience a major ecological catastrophe.					

Living at Derwenthorpe

1. Which year did you move to Derwenthorpe? _____
2. Which month did you move to Derwenthorpe? _____
3. Why did you move to Derwenthorpe? _____
4. What is it like living at Derwenthorpe? _____
5. In which of these ways do you occupy your home? (Please tick.)

☐ Own it outright

☐ Buying it with the help of a mortgage or loan

☐ Pay part rent and part mortgage (shared ownership)

☐ Rent it from Joseph Rowntree Housing Trust

☐ Rent it from an individual private owner

☐ Live here rent-free (eg living in relative's/friend's property)

☐ Don't know

6. How satisfied are you with your local area as a place to live? (Please tick one option.)

☐ Don't know

☐ Very satisfied

☐ Fairly satisfied

☐ Neither satisfied nor dissatisfied

☐ Slightly dissatisfied

☐ Very dissatisfied

7. How satisfied are you with your accommodation? (Please tick one option.)

☐ Don't know

☐ Very satisfied

☐ Fairly satisfied

☐ Neither satisfied nor dissatisfied

☐ Slightly dissatisfied

☐ Very dissatisfied

8. How satisfied are you with the energy efficiency of your home? (Please tick one option.)

☐ Don't know

☐ Very satisfied

☐ Fairly satisfied

☐ Neither satisfied nor dissatisfied

☐ Slightly dissatisfied

☐ Very dissatisfied

9. How easy or not do you find it to meet your household energy bills at the moment?

☐ Don't know

☐ Very easy

☐ Fairly easy

☐ Neither easy nor difficult

☐ Slightly difficult

☐ Very difficult

10. How regularly do you use your household recycling bins provided by the council?

☐ Don't know

☐ Always

☐ Usually

☐ Sometimes

☐ Rarely

☐ Never

11. How regularly do you use your compost bin?

☐ Don't know

☐ Always

☐ Usually

☐ Sometimes

☐ Rarely

☐ Never

☐ Not applicable/don't have one

12. How regularly do you use your water butt?

☐ Don't know

☐ Always

☐ Usually

☐ Sometimes

☐ Rarely

☐ Never

☐ Not applicable/don't have one

13. Please indicate the extent to which you agree or disagree with the following statements about Derwenthorpe.

	Strongly disagree	**Mildly disagree**	**Unsure**	**Mildly agree**	**Strongly agree**
Derwenthorpe is a strong community.					
Living at Derwenthorpe will reduce my energy costs.					
Living at Derwenthorpe will reduce my transport costs.					
Derwenthorpe will make me live a greener lifestyle.					

14. Has anyone in your household used or participated in any of the following over the last six months at Derwenthorpe? (Please tick all that apply.)

☐ Car club

☐ Bicycle purchase discount scheme

☐ Discounted bus pass

☐ Community environmental event, eg organised walk, community presentation

☐ No, but hope to use one or more of above in the future

☐ No, and do not plan to use any of above

15. Please add any other comments on Derwenthorpe here:

_____

_____

_____

Thank you for your time!

Acknowledgements

This research would not have been possible without the assistance of Derwenthorpe residents who gave up their time to share their experiences of moving in and living in Derwenthorpe, and those who took part in our environmental footprint survey. We are very grateful to people for welcoming us into their homes and conveying so eloquently how they felt about their new homes and community.

We would also like to thank representatives of three other sustainable housing developments in the UK for taking part in a very valuable comparison with Derwenthorpe. Thank you to Jan Maskell, Lancaster Cohousing; Nicholas Schoon, Bioregional, and; Roy Alexander, Ashton Hayes/Chester University. We are also grateful to key stakeholders involved in the development of Derwenthorpe for sharing their perspectives on the scheme.

Finally, thank you to the research managers at the Joseph Rowntree Foundation, Katherine Knox and Brian Robson, for their support and patience. We are also grateful to the Derwenthorpe JRHT representatives, Owen Daggett and Joanne Lofthouse, for their assistance with the research process.

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To speak to us about this research, contact our subject experts.
See https://www.jrf.org.uk/about-us/our-experts

The Joseph Rowntree Foundation has supported this project as part of its programme of research and innovative development projects, which it hopes will be of value to policy-makers, practitioners and service users. The facts presented and views expressed in this report are, however, those of the authors and not necessarily those of JRF.

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© University of York 2018
First published February 2019 by the Joseph Rowntree Foundation
PDF ISBN 978 1 911581 60 4
Cover image: Derwenthorpe / Jonathan Pow

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