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TRAPPED BEHIND THE WHEEL

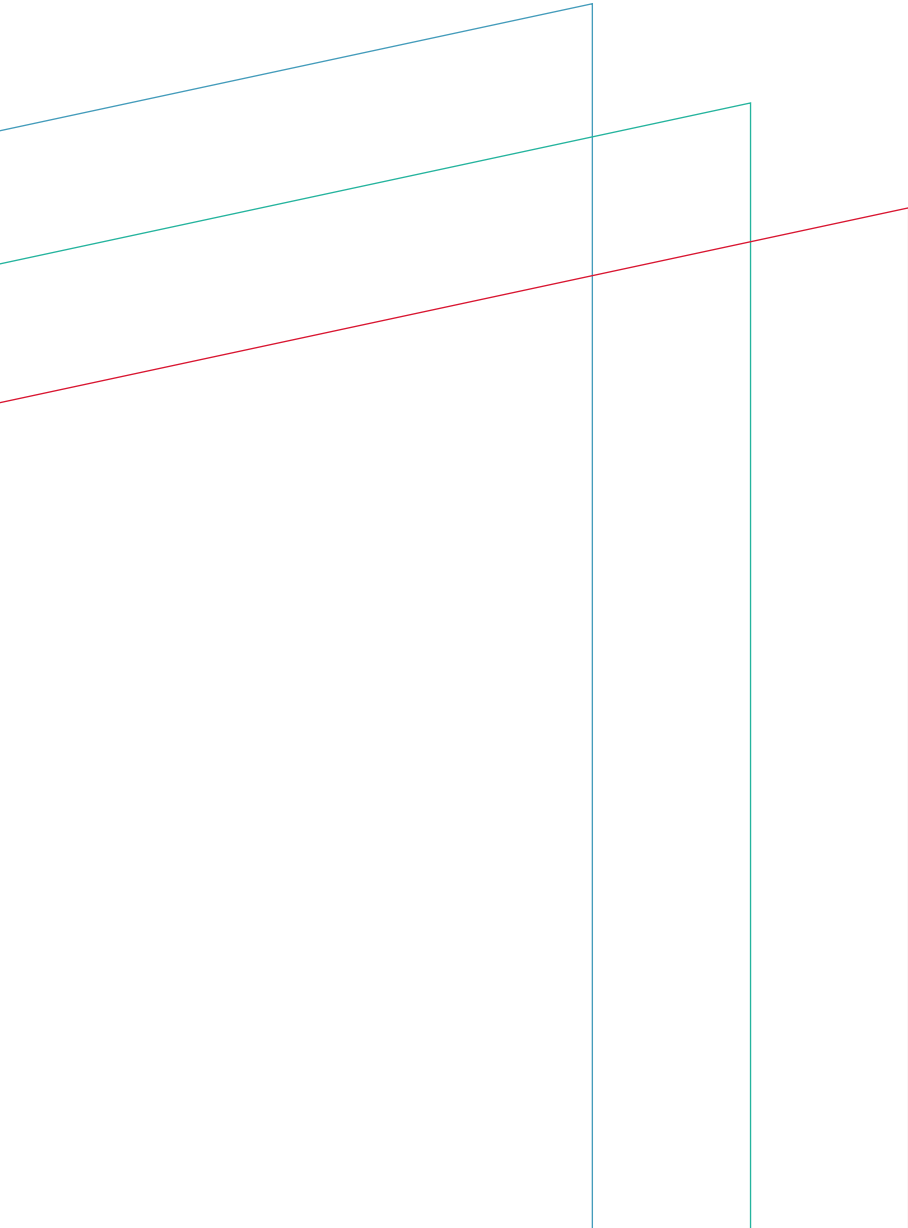
HOW ENGLAND'S NEW BUILDS
LOCK US INTO CAR DEPENDENCY



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GoAhead

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EXECUTIVE SUMMARY

The places we live in and how we get around are key ways in which the economy shapes our everyday lives. Each is dependent on the other. But far from moving our economy towards sustainability and improved wellbeing, England's new homes in recent years have increasingly encouraged car-dependent lifestyles. As the new government embarks on a period of increased housebuilding, it is vital to understand what is going wrong and how to change course in the coming five years. The experience of the past 15 years shows us that, without substantial changes, there is a major risk of locking in increased car dependency for decades to come. These changes are vital if the government is to deliver on other priorities, such as bringing the cost of living down to more manageable levels, reducing spatial inequality, and responding adequately to the climate emergency.

In this paper, we construct a Car Dependency Index (CDI) by combining data from every neighbourhood in England on car ownership, the share of residents commuting to work by car, the relative travel times to jobs, and key amenities by car and by public transport and population density. We find that the CDI of new homes has risen steadily since 2009 (Figure 1). New builds have become more and more car-dependent relative to existing homes, and this trend is present in all regions outside London. One factor in this change has been the outsized share of new homes being built in rural areas, which has risen continually across the country in recent years. There has also been an increase in the CDI of new builds located in small and medium-sized urban areas since 2009, reflecting that new homes have tended to be located in peripheral areas without good connections to nearby cities and towns.

We continue by digging deeper into what is driving the three different factors that create increasing car dependency.

THE LOCATION OF NEW HOMES is tending increasingly towards car-dependent places, driven by:

- Land value and condition, which favour cheaper greenfield land in a profit-driven housing development system.
- Relatively lower levels of local political opposition to new developments in more remote areas.
- A lack of early, integrated planning of transport, housing, and development sites, reinforced by substantial underfunding of public planning departments.
- Top-down local housing targets that act in combination with the factors above to produce development in the wrong places for sustainable transport.

THE PROVISION OF PUBLIC TRANSPORT AND ACTIVE TRAVEL for new homes is affected by:

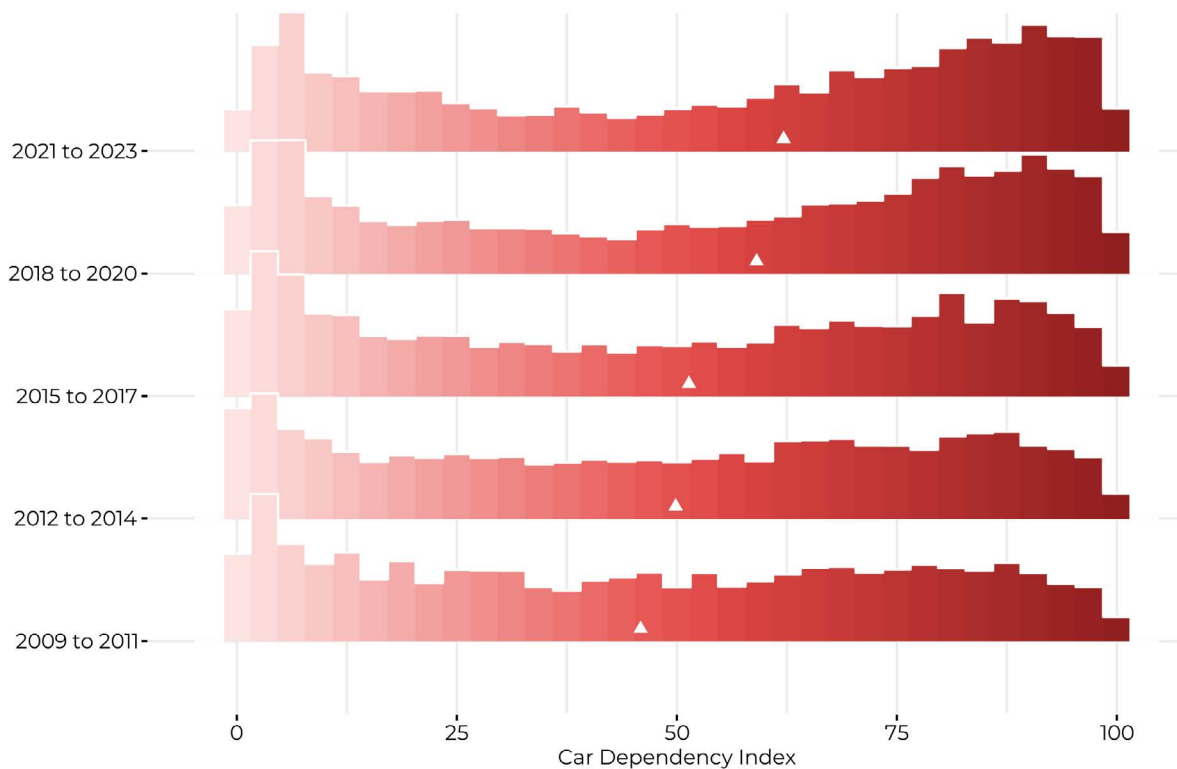
- The insufficiency of Section 106 funds to cover the public transport needed, together with the lack of negotiating power for councils tends to see transport provision lose out in a trade-off against social housing, community facilities, and other items.
- The use of large amounts of public funding on expensive road infrastructure alongside new developments, encouraged by a lack of advance transport planning and car-centred approaches.
- The provision of public transport and active travel for new homes, which is affected by poor public transport and active travel provision in adjacent neighbourhoods, due to congestion and a lack of safe walking and cycling routes.

THE DESIGN OF NEW PLACES tends to encourage car dependency through:

- The role of land value in encouraging estate layouts that are not well-suited to sustainable travel.
- The car-centric design of local retail and amenities that encourages driving to them.
- Parking policies that in some cases encourage excessive car travel and the inability of councils to set maximum parking space rules for new homes.

FIGURE 1: NEW HOUSING IN ENGLAND IS INCREASINGLY CAR-DEPENDENT.

CDI for all new dwellings in England since 2009 (inclusive), by period of completion (N = 2,672,239). The triangle indicates the CDI of the median new dwelling in that period.



Source: NEF analysis of EPC, AI23, PTAI22, Census 2021, ONS Postcode Directory.

An understanding of these parameters informs our proposals for what needs to change to reverse the rise in car dependency. There is a need for ambitious policies because the many second-best solutions that present themselves are unlikely to fully solve the problem. We outline some suggestions to replace a haphazard geography of new builds determined by crude public policies, an atrophied public planning function, and private profit and land value. Instead, we propose a move towards a system where the public sector delivers public benefit via a strong planning system that intervenes early on, creating plans democratically and using holistic evidence and integration of transport, housing and land plans at a regional scale. To achieve this we propose the following:

- Integrating regional strategic planning informed by a thorough data analysis considering

housing needs alongside ways of minimising car dependency. This should occur at the region or city-region level, involving a wide range of stakeholders including democratic input from residents. It would replace housing targets as a means of allocating new development sites within each region.

- Ensuring any release of green belt or grey belt land^a within the strategic spatial planning process is conditional on achieving a good minimum standard of sustainable transport in the resulting developments. Current green belt areas have higher car dependency and our analysis suggests that without careful consideration, grey belt developments will be car-dependent unless they deliver a significant improvement in the quality of public transport infrastructure and urban design.

^a This is defined as land in a green belt that was either previously developed, or makes a limited contribution to the five green belt purposes.

- Allocating powers for the sub-national government (combined authorities, their mayoral development corporations, and councils) for the compulsory purchase of land at, or close to, use value for development. Also, upfront public funding to these bodies for master planning and delivery of infrastructure, layout, active travel routes, public transport integration, mixed uses, and green space, applying a similar model to what was used in the first wave of new towns.
- Setting missions for mayoral development corporations or similar bodies for the sustainable transport mix and quality of homes and places that they aim to achieve in new developments. This could be shaped with residents' input, eg through local voting on master planning or design.
- Restoring funding and improving capacity and capability within local authority planning departments, providing the means to deliver the planning and strategic spatial planning proposals already outlined.
- Providing capital funding for city-regions to invest in new public transport capacity to unlock sustainable transport provision for new homes, eg additional light rail networks.

By approaching the next few years with fresh thinking, there is an opportunity to reshape the pattern of development to make a lasting impact on sustainable transport, fulfilling the potential of new homes and towns and developing great places in which to live well.

1. INTRODUCTION: WHY IT MATTERS

Few parts of the economy shape our lives as directly as housing and transport. The two are inseparable. Each determines the other to a large extent. We choose where to live based on where we can go, and where we live determines where we spend our time. Having the right mix of amenities nearby and being able to get around easily and sustainably, whether through public transport or active travel (walking, wheeling, or cycling) are key ingredients for living well. But equally, a badly designed place can make getting around difficult, dangerous, and expensive. The most car-dependent places leave people who live there to choose between spending a large amount of their income on driving, wasting their time waiting for unreliable buses, or walking or cycling in dangerous conditions. The construction of car-dependent places locks in these unenviable ways of travelling for generations, as it is very difficult to provide sustainable transport after the fact in neighbourhoods designed to frustrate it at every turn.

Improving transport, then, requires paying careful attention to how it is planned for new homes, especially in light of the increased volume of housebuilding that is expected in the coming years. The incoming Labour government was elected with a prominent policy on increasing the rate of housebuilding, aiming for 1.5 million new homes across its five-year term. This works out at an average of 300,000 new homes per year, though in practice delivery would be expected to ramp up in the latter years of the parliament¹. These targets mean that by 2029, approximately 5% of all homes in the UK will have been built during the term of the current government, exerting a substantial influence on housing and transport nationwide.^b The coming five-year parliament may also have a significant impact on where new homes are built in England.

To this end, the Labour Party has proposed to build “a series of large-scale new communities across England”, which would include several new towns, together with urban extensions and regeneration projects.² Labour has also promised to strategically release green belt sites that it considers having lower nature value (grey belt) subject to certain ‘golden rules’ governing subsequent development.³

The transport choices provided in these new homes, neighbourhoods, and towns will have important knock-on effects for a number of the issues that are most important to the public. The remaining part of this chapter makes the case for why getting transport for new homes right will be vital for the next government in delivering on three of its major priorities: tackling the cost of living, reducing spatial inequalities between different parts of England, and facing up to the climate emergency. A fuller review of the other benefits of reduced car dependence, for outcomes such as health and wellbeing, disability inclusion, congestion, air quality, safety, and nature recovery, is available in existing research.^{4,5}

1.1 TRANSPORT IN NEW HOMES AND THE COST OF LIVING

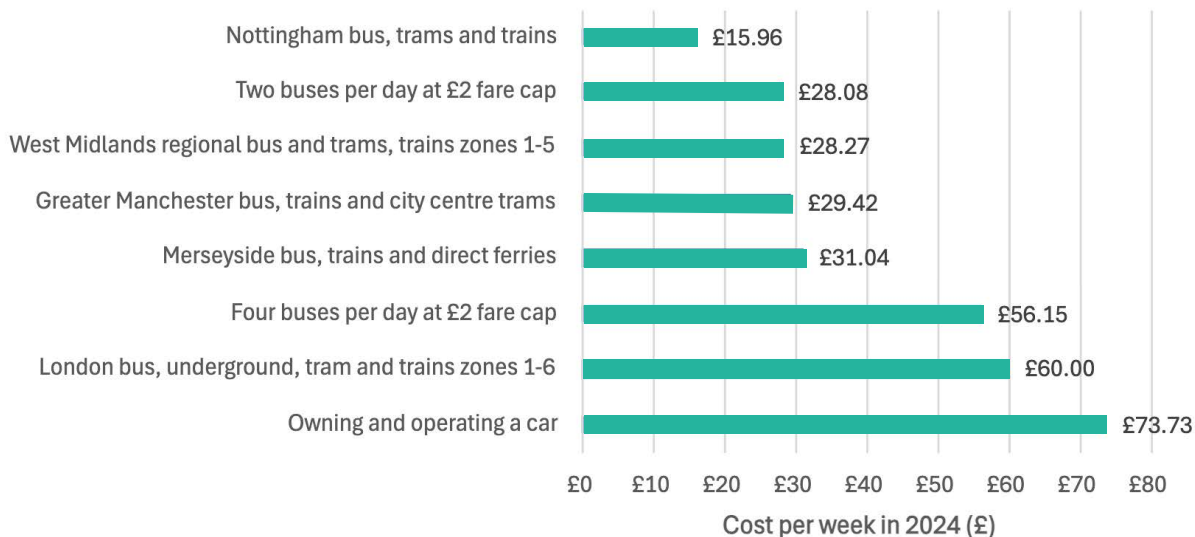
Public polling of the most important issues facing the UK today indicates that the cost of living is the top priority and is considered important by 87% of people.⁶ While it receives less discussion than topics such as energy prices and housing rents, the cost of driving is one of the biggest contributors to the rapid deterioration in people’s ability to make ends meet. Owning and operating a car cost £3,834 per year for the average person in 2024,⁷ an increase of 19% since 2020. This works out at £74 per week, significantly more expensive than the cost of a year’s unlimited travel on the public transport networks of major cities or the cost of taking four buses a day under the £2 fare cap elsewhere in England (Figure 2). Although full data on the equivalent annualised cost of an e-bike is not available, we estimate that this is likely to cost no more than half as much as owning and operating a car.^c

b Calculation using the 2022 total UK housing stock of 30.0 million as a baseline.

c Assumptions: purchasing a £2,500 e-bike plus helmet, lights and lock at a total of £150 using a 5-year consumer loan at 15% APR, meaning an annual repayment of £741. Additional costs: insurance at £15 per month, servicing at £100 per year, charging at £100 per year, replacement tyres at £60 per year. Total cost = £1,181. Even adding in depreciation, it is unlikely to exceed half of the annual cost of a car (£1,917).

FIGURE 2: OWNING AND OPERATING A CAR IS FAR MORE EXPENSIVE THAN USING PUBLIC TRANSPORT.

Weekly cost of car ownership compared with the weekly cost of unlimited travel on public transport using a yearly season ticket or the £2 fare cap available in many areas outside major cities.⁸ⁱ



Sources: NimbleFins (2024),⁹ Transport for London (2024),¹⁰ Mersey Travel (2024),¹¹ Transport for Greater Manchester (2024),¹² Transport for West Midlands (2024),¹³ and Robin Hood Network (2024).¹⁴

The cost of car ownership also tends to be more volatile than other modes of transport,^d exposing people in car-dependent places to unexpected cost increases they are ill-equipped to withstand. The average annual cost of repairs, servicing, and parts accounts for £472 of the total cost cited, with this component having become 31% more expensive since 2020. More than one in ten drivers, and one-quarter of drivers aged 17–24, were putting off necessary repairs due to the cost in late 2023,¹⁵ while at the beginning of that year, up to half of drivers were doing so.¹⁶ Were an unexpected major repair cost of £850 to arise, three in ten people would be unable to afford to cover it as of October 2023.¹⁷ This suggests that a significant proportion of people in car-dependent places are facing difficult choices between risking their safety while travelling or losing their ability to get around.

A car-dependent transport system is also relatively exposed to shocks in the global economy, which can feed through to the average household. An estimated 90% of petrol is imported, meaning

that the average household’s petrol consumption for driving makes up 44% of their energy imports.¹⁸ Allowing people to live well while using public transport or active travel could therefore significantly reduce their exposure to an increasingly turbulent global economy and reduce the risk of damaging supply-chain shocks. The fuel supply crisis of late 2021 illustrated the pace and severity of the effects that such shocks could have.¹⁹

In-depth research using national survey data from 2012 illustrates the dire effects that car dependency has on people near or below the poverty line. One estimate found that in 2012, 9% of UK households were spending at least 9.5% of their income (twice the average share) on owning and running a car and were pushed below the poverty line^e as a result.²⁰ People in this group spent an average of 24% of their income on car costs. Their fuel consumption changed little in response to price rises, meaning they were cutting back on other expenses instead. Among those with low incomes, people in rural areas were far more likely to have these very high

^d Public transport costs are typically fixed for at least one year. Bicycle costs may be volatile but repairs are cheaper, while walking has no cost volatility.

^e That is, with an income below 60% of the median income after housing costs.

car costs (49% of all rural, low-income households) than their counterparts in urban areas (30%–32%).²¹ A similar study estimated that in 2012, 6.7% of UK households experienced material deprivation (being unable to afford several essential living expenses) and owned a car.²² When compared with the 10.6% of households who couldn't afford a car at all, the aforementioned group had slightly lower deprivation levels, but also a much higher rate of fuel poverty, suggesting a knock-on impact from the cost of car ownership.²³

1.2 TRANSPORT IN NEW HOMES AND SPATIAL INEQUALITY

The large gaps in transport outcomes between England's regions and neighbourhoods, leaving many people with a poor standard of public transport and few safe choices for active travel in their area, is a stark and daily reminder of spatial inequality and the much-discussed challenges of levelling up. A 2021 study demonstrated that in left-behind neighbourhoods, which have high deprivation and poor social infrastructure provision, public transport is worse than average (74% have no railway station and bus journeys per capita have declined faster than the national average). Residents are less able to afford to compensate by owning a car (40% of households have no car, compared with 26% across England).²⁴ These areas of the country typically have worse connectivity than the English average but rely more than other parts of the country on their local bus service.²⁵ Compared with the south and the Midlands, a higher proportion of areas in the north of England are affected by transport-related social exclusion, with the transport system not adequately meeting people's daily social and economic needs, which in turn can cause "a vicious cycle of poverty, isolation, and poor access to basic services".²⁶

Areas at the sharp end of England's spatial inequalities face a double disadvantage when trying to close the gap in average incomes with the rest of the country: people face the higher costs of car-dependent living while having lower incomes with which to meet these costs.²⁷ Their ability to enter paid employment or the training needed to secure a well-paid job is constrained by local transport. The public transport system in

wealthier parts of the country, such as London and the south-east, is much more effective and gives residents there far more access to jobs than the equivalents in the north-west, Yorkshire, and parts of the Midlands.²⁸ Despite this, public investment in transport has tended to overlook the parts of the country where it is most needed. The north of England would have received an additional £51bn in public investment in transport if it had matched the per capita level seen in London from 2014/15 to 2019/20.²⁹ Similarly, investment in active travel infrastructure between 2016 and 2021 was £24 per person in London but only £10 per person in the rest of England.³⁰ These investment gaps have created widespread anger in the regions losing out, with national policies, such as the cancellation of major components of the high-speed railway, HS2, seen as symbolic of a wider malaise.^{31,32} Some groups of people are likely to suffer worse effects from car dependency due to their relatively lower car use. Men still travel significantly farther by car than women on average,³³ while car ownership among white people is higher than for people of other ethnicities.³⁴

A BBC Radio 4 interview with Dan Wake, a resident of the Warwick Estate in Knottingley, West Yorkshire,^f powerfully illustrates the barriers that poor local transport poses to people's life chances in many parts of the country.^{35,36} There is no bus service in the early mornings or late evenings to the town of Normanton, seven miles away, making it difficult to secure a job there. When previously working at a large clothing warehouse that is visible from the estate where he lives, his transport choices were a long walk along the side of a motorway, or when finishing a shift at midnight, spending £4.50 from his shift earnings on a short taxi ride because the walk was too dangerous. He described his experience of getting to work:

One night, I was walking home beside the services. I nearly got run over by a car. I had to dodge out of the way. Taxis, from here to TK Maxx, it's £4.50 just for a taxi - it's only just there. I was doing it... five days a week. That's... a big chunk of money out of my weekly wage.

- Dan Wake, Knottingley resident interviewed on BBC Radio 4

^f While the Warwick Estate was built in the 1960s, the issues faced by its residents are likely to affect people with low incomes in more recent new developments, which tend to replicate some of the worst aspects of its car-dependent design.

1.3 TRANSPORT IN NEW HOMES AND THE CLIMATE EMERGENCY

Meeting the UK's commitment to net zero emissions by 2050 and creating an economy that allows people to live well within planetary limits, should be a top priority for the next government. Surface transport now accounts for more carbon emissions than any other sector of the UK economy, with cars and taxis making up 52% of the sector total.³⁷ Worryingly, there was hardly any progress in decarbonising the sector during the 2010s, with greenhouse gas emissions from domestic transport falling by just 1.5% between 2010 and 2019,³⁸ albeit emissions currently sit around 11% below pre-pandemic levels, some of which may represent a permanent reduction.³⁹ There is little evidence of a shift in travel from private cars towards public transport, walking, and cycling,⁴⁰ despite the need for a 17% reduction in car kilometres travelled by 2050 relative to the baseline to hit net zero, according to the Climate Change Committee.⁴¹ Other sectoral experts have estimated that a reduction in motor traffic of 20% or more will be needed for net zero.^{42,43}

Localised schemes to reduce unnecessary car travel, such as pedestrianisation, low-traffic neighbourhoods (LTNs),^{g,44} and school streets,^{h,45} are important tools for delivering the modal shift and emissions reduction needed. However, the experience of recent years has shown that limiting car traffic can be politically contentious, attracting pushback from vocal opponents even though polling suggests that far more residents support such measures than oppose them.^{46,47} Likewise, spatial restrictions such as LTNs need to be carefully planned to ensure they do not negatively affect bus routes and inadvertently reduce the convenience of buses relative to cars.^{48,49,50}

It is also clear that people need to have alternative ways of travelling if they are to cut their car use without a loss in wellbeing. Some of the longest-standing LTNs, such as De Beauvoir in Hackney, East London,⁵¹ are located in areas which also benefit from world-class public transport and one of the lowest levels of car ownership in the country.⁵² These areas can still easily accommodate those for whom car use is an essential part of their wellbeing, eg the portion of disabled people who need to drive regularly.

This context underlines how important the built environment produced in the coming years of housebuilding will be for wider policy goals such as decarbonisation. The easiest way to achieve the level of sustainable transport use needed for net zero is in neighbourhoods that are designed with that in mind, where public transport and active travel are the easiest options and car ownership is minimised.

1.4 STRUCTURE OF THIS REPORT

In Chapter 2, we present the findings of our new data analysis of car dependency in new homes across England since 2009, illustrating how the problem has become worse over this period and is moving the national average in the wrong direction. Chapter 3 discusses the findings from interviews and a review of evidence on the drivers of this increasing car dependency, unpicking the factors that favour car-dependent locations, cause problems with the provision of sustainable transport, and lead to car-dependent neighbourhood design. In Chapter 4, we propose some outline solutions to achieve better sustainable transport in new homes, while Chapter 5 concludes the report.

g These are spatial restrictions designed to reduce through-traffic from cars within a defined residential area. For more information on their measured impact in London-based studies to date, see Transport for London (2024).

h These are timed restrictions to motor traffic on streets near schools. For more details, see Transport for London (2022).

2. ENGLAND'S CAR DEPENDENCY PROBLEM

Car-centred development has been a dominant feature of much post-war planning and housebuilding in England. However, a suite of recent studies and reports are raising the alarm about the extent to which the car is central to new developments today^{53,54,55} and about the poor quality of urban design in new developments across England more broadly.⁵⁶ The built environment plays a key role in some of the main crises we are facing as a society – from climate and biodiversity breakdown to poor health driven by environmental pollution and travel patterns, to inequalities in access to services and economic, social, and cultural opportunities. Ingraining car use in new housing development goes directly against addressing these urgent challenges and is in stark contrast with the higher quality of planning and design in some of our continental European neighbours like the Netherlands.⁵⁷

In this chapter, we present the main trends in car dependency for new housing development in England. To understand car dependency, we developed a comprehensive Car Dependency Index (CDI) which draws on granular local data on car use and accessibility. In combination with information about the location of all new housing units completed over the past 15 years, the index provides an important insight into England's car dependency problem. The following four sections provide a brief note on the data and methodology, an overview of key national trends, and a handful of local and regional examples which illustrate important aspects of car-dependent development. We find that year after year, average new housing completions in England have been more and more car-dependent due to an increasing share of new homes being located in rural areas and a deteriorating standard of new developments in smaller cities and towns.

2.1 MEASURING CAR DEPENDENCY

Our understanding of car dependency draws on the well-established link between car use and the built environment. Where and how we live, the quality of local public transport and active travel infrastructure, and the accessibility of employment or key services including social and cultural opportunities are a key influence on how and where we travel. The sparsity of development – measured here through low residential density – is an important underlying factor in terms of generating travel need, increasing travel distance, and raising the cost of public transport provision. However, understanding car dependency through land use alone has its limitations, as habits, attitudes, and ownership play an important role in locking in cycles of car-oriented behaviour.⁵⁸

In our index, we combine five different measures across three distinct domains of car dependency – the extent of the car's advantage over public transport in accessing services and employment; residents' car-oriented behaviour; and the sparsity of development (Table 1). The index draws on a range of datasets from 2021 to 2023, providing a snapshot of car dependency across the country at one point in time, rather than, for example, at the time of completion of individual developments.

The data on journey to work, car ownership, and residential sparsity come from the 2021 Census. This part of the CDI builds on the Travel Sustainability Index developed by Duncan Smith⁵⁹ at the Centre for Advanced Spatial Analysis, UCL and excludes people who predominantly work from home in the journey to work variable. The employment car advantage and services car advantage variables are our calculations drawing on the 2022 public transport accessibility indicators for Great Britain (PTAI22)⁶⁰ and the 2023 Great Britain accessibility indicators (AI23)⁶¹ developed by the Urban Big Data Centre at the University of Glasgow. All data used in the index is at Lower layer Super Output Area (LSOA) level and the measures are, as expected, moderately to strongly correlated with one another. We standardised all five variables before combining, and the final index as well as the three domain scores provide a ranking of all small areas in England from 0 (areas of lowest car dependency) to 100 (areas of highest car dependency).ⁱ For more detailed methodology notes see Appendix A.

i See Appendix A for a more detailed discussion of the data sources and methodology used to construct our CDI.

TABLE 1: THE DOMAINS AND MEASURES OF OUR CDI.

Domain	Measure	Data	Weight
Car advantage	Employment car advantage The ratio of the number of jobs within reach in 45 minutes by car and by public transport.	Urban Big Data Centre accessibility indicators (PTAI22, AI23)	20%
	Services car advantage The difference in average travel time to the nearest secondary school, supermarket, hospital, and local urban centre, by car and public transport.	Urban Big Data Centre accessibility indicators (PTAI22, AI23)	20%
Behaviour	Journey to work The proportion of commuters who travel to work by car or van (either as drivers or passengers) or by taxi.	Census 2021 (TS061)	20%
	Car ownership The proportion of households with one or more cars and vans.	Census 2021 (TS045)	20%
Sparsity	Residential sparsity The number of usual residents per square kilometre (reversed so that lower values indicate higher sparsity)	Census 2021 (TS006)	20%

Note: See Appendix A for more details on data and methodology.

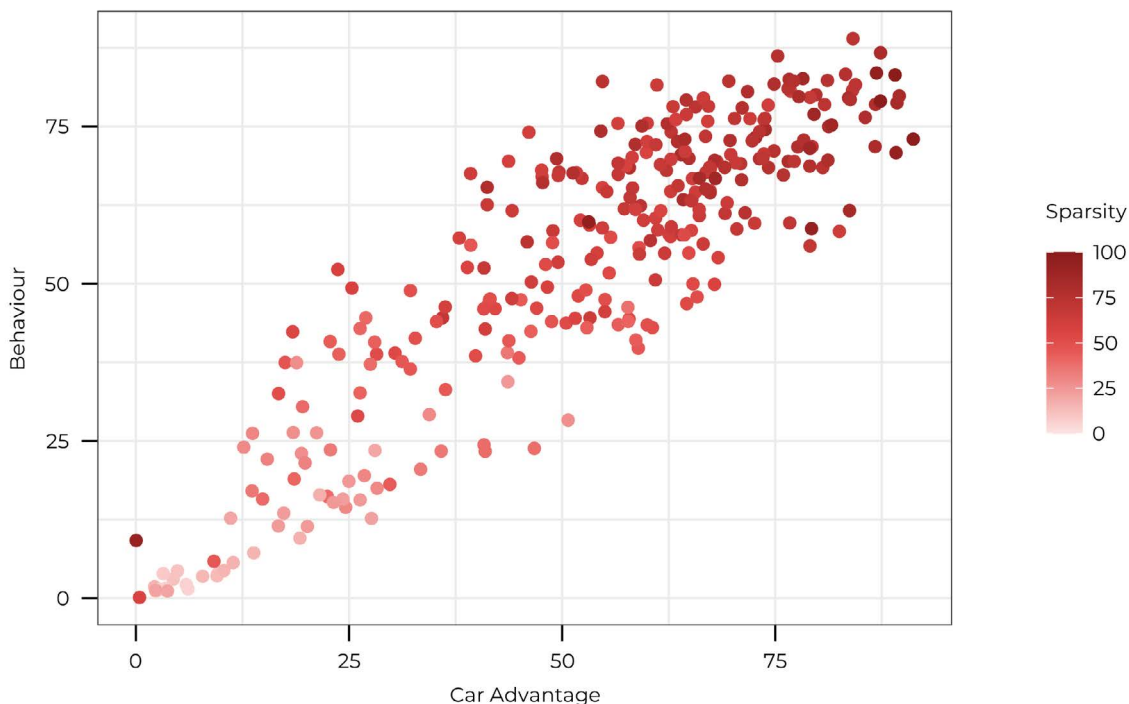
To analyse the pattern of car dependency in new developments in England, we link our LSOA-level CDI to a comprehensive dataset of all new dwellings from the domestic Energy Performance Certificate (EPC) data.⁶² Thanks to the legal requirement to produce an EPC before sale or renting, the EPC dataset contains a near-complete publicly accessible dwelling-level record of all new development in England (N = 2.7 million) and Wales since 2009, which can be geolocated using each dwelling’s unique property reference number (UPRN)⁶³ and/or postcode.⁶⁴

To understand patterns of car dependency in older housing stock, we also disaggregated^j LSOA-level data⁶⁵ derived by Owen Boswarva/Datadaptive from statistics published by the Valuation Office Agency, resulting in a dataset with a build period and approximate location of all 25.4 million properties with a Council Tax band in England. While the results of analysis for post-2008 developments are nearly identical using either dataset we generally use the more precise EPC dataset.

j To disaggregate LSOA-level data, we used dplyr’s uncount() function to create an expanded dataset with one row (inheriting corresponding LSOA’s values) for each dwelling.

FIGURE 3: CAR ADVANTAGE, RESIDENTIAL SPARSITY, AND CAR-ORIENTED BEHAVIOUR IN NEW DWELLINGS ARE CORRELATED.

Average sub-domain scores for all new dwellings (post-2008) by LPA.



Source: NEF analysis of EPC, AI23, PTAI22, Census 2021, ONS Postcode Directory.

Figure 3 shows the average score for all new builds since 2009 in each local planning authority (LPA) on each of the three domains of the CDI. As expected, car advantage, residential sparsity, car-oriented behaviour scores for new developments are distinct but related. The figure shows that new dwellings are being built across the full range of areas, including both the most and the least car-dependent parts of England.

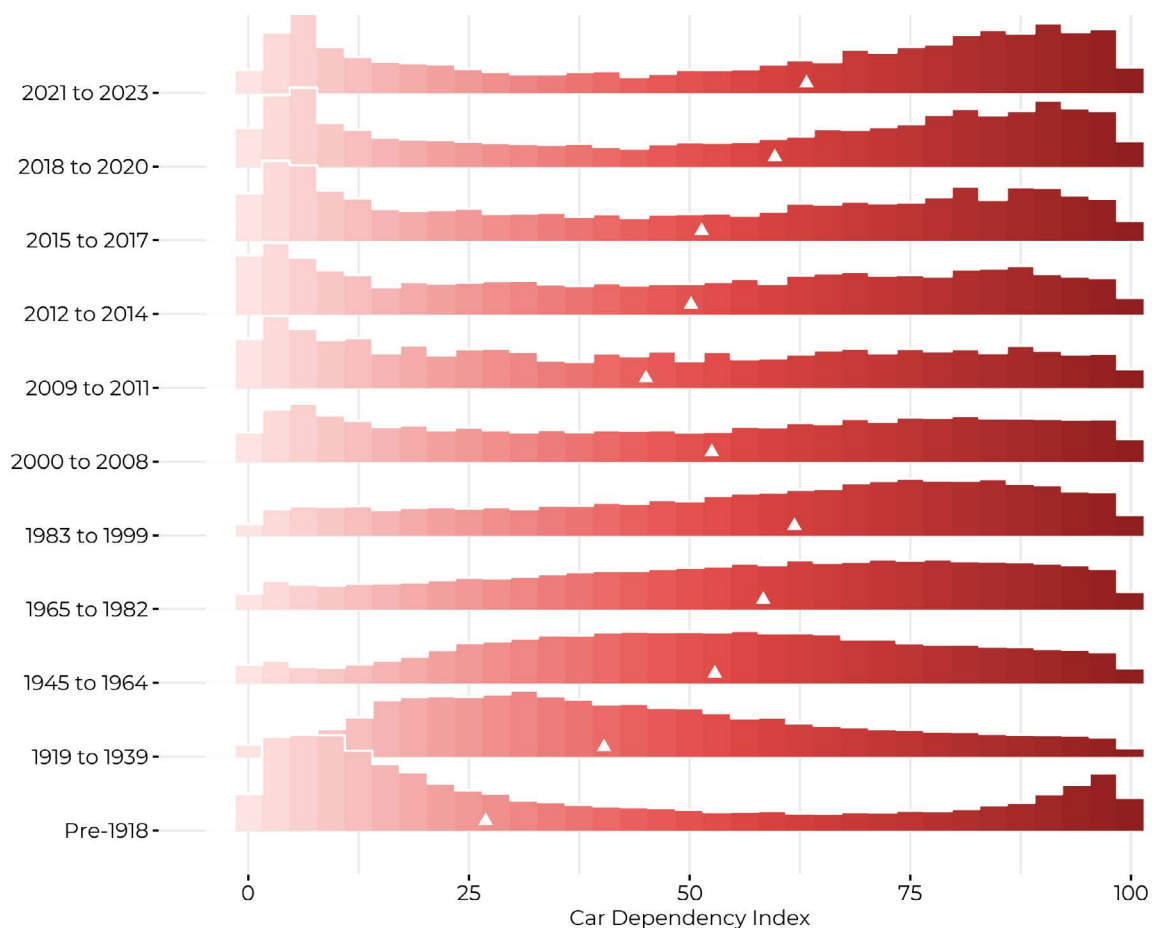
2.2 CAR DEPENDENCY ON THE RISE

Our analysis shows a clear trend. Over the past 15 years, new development in England has been increasingly car-dependent, with a median car dependency score rising from 45.9 for dwellings completed in the 2009–2011 period to 62.1 for the 2021–2023 period, the highest of all periods yet (Figure 4). This has coincided with an overall increase in the volume of new completions over the past 15 years,^k and followed a brief period of less car-centric development in the early 2000s, after steady rises in car dependency throughout the 20th century.

^k The number of new dwelling completions recorded in the EPC dataset was 117,000 in 2010. This steadily increased in the years after to 246,000 in 2018, and decreased since to 192,400 in 2023.

FIGURE 4: NEW DEVELOPMENTS IN ENGLAND ARE INCREASINGLY CAR-DEPENDENT

CDI for all housing stock in England by period of completion (N = 25,362,422). The triangle indicates the CDI of the median new dwelling in that period.



Source: NEF analysis of Datadaptive, AI23, PTAI22, Census 2021, ONS Postcode Directory.

Alarming, the jump in the median car dependency score in new developments from 2009–11 to 2021–23 is of a similar scale, as the difference between inter-war developments and the 1965–82 period, with its highly car-dependent second- and third-wave new towns.

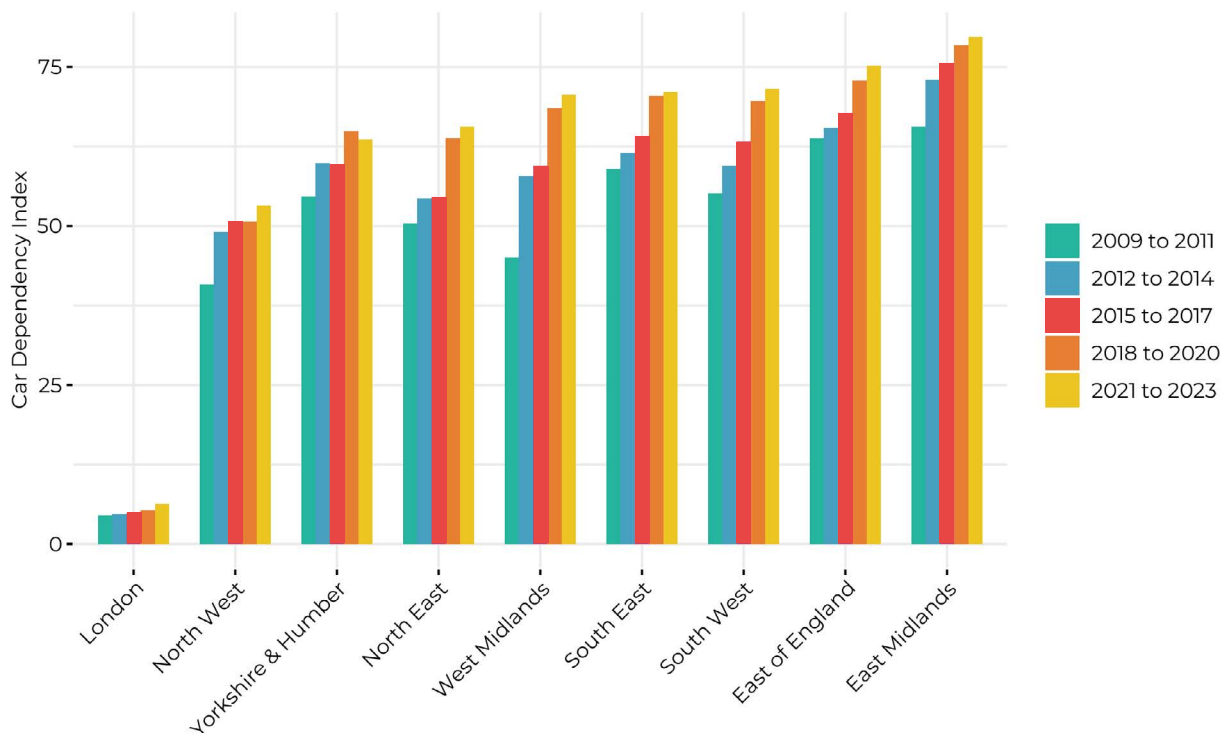
Except for London, all regions have seen a progressive increase in car dependency in new housing in the past 15 years (Figure 5). However, there are considerable differences in the scale of the change: the West Midlands has had the greatest increase in median car dependency, from 45.1 in 2009–11 to 70.6 in 2021–23, while the East Midlands has had the most car-dependent new housing year

after year. New developments in London are a clear outlier, with only marginal increases and very low car dependency scores throughout.

Despite the rising median, the share of new dwellings with very good scores also increased over the past 15 years, predominantly in large urban areas. There has been a clear polarisation since the beginning of the millennium, with new developments increasingly scoring either very low or very high on car dependency (Figure 4). As a result, the median values are in fact fairly atypical – rather, they are driven up by the extremely car-dependent, often rural and suburban development.

FIGURE 5: THE EAST MIDLANDS HAS THE MOST CAR-DEPENDENT NEW HOUSING, WHILE THE WEST MIDLANDS HAS SEEN THE GREATEST DETERIORATION SINCE 2009.

Median CDI for all new dwellings in England since 2009 (inclusive), by region and period of completion (N = 2,672,239).



Source: NEF analysis of EPC, AI23, PTAI22, Census 2021, ONS Postcode Directory.

2.2.1 HOUSING IN RURAL AREAS

A rising share of new developments in rural areas is one of the two main drivers of increasing car dependency revealed by our analysis. Over the past 15 years, the percentage of new developments in rural areas increased every period, from 17.5% in 2009–11 to 26.0% in 2021–23. As we are using the 2011 Census rural-urban classification, some of these areas might be more accurately described as formerly rural (eg greenfield urban extensions), or rural towns and fringes rather than dispersed developments. Plausibly, the increase in the share of rural developments might appear less dramatic if a more recent rural-urban classification was available.

Notwithstanding this, new developments in rural and formerly rural areas contain the most car-dependent housing (Figure 6), with median dwellings completed in the last 15 years in (formerly) rural villages and dispersed settings scoring 94.1 on the CDI. The scores for (formerly) rural developments have been consistently high since 2009, but the increased volume of such developments has contributed to driving up the overall median. The regional trends in the share of rural developments closely correspond with the increases in car dependency – the east of England, the south-west and the East Midlands have consistently had the highest shares of rural developments, and the West Midlands has experienced the biggest increase (Table 2).

TABLE 2: THE LEVELS AND INCREASES IN CAR DEPENDENCY BROADLY CORRESPOND TO THE SHARE OF NEW BUILDS THAT ARE IN RURAL AREAS, WITH THE WEST MIDLANDS SEEING THE GREATEST INCREASE IN BOTH MEASURES.

The proportion of new dwellings since 2009 delivered in areas classified as rural, by region and period.

Region	2009 to 2011	2012 to 2014	2015 to 2017	2018 to 2020	2021 to 2023
London	0.0%	0.1%	0.1%	0.0%	0.1%
North-West	7.4%	10.7%	14.4%	13.2%	16.5%
Yorkshire & Humber	17.3%	16.4%	18.1%	23.4%	25.8%
West Midlands	12.6%	16.9%	24.2%	28.3%	27.0%
South-East	19.7%	19.8%	23.2%	27.1%	27.8%
North-East	23.7%	20.8%	22.4%	29.1%	30.3%
East Midlands	25.4%	29.1%	30.5%	34.9%	37.9%
South-West	28.1%	32.9%	34.4%	38.6%	41.4%
East of England	31.5%	31.2%	33.4%	40.0%	41.4%
England	17.5%	18.5%	20.7%	24.2%	26.0%

Source: NEF analysis of EPC, Census 2011.

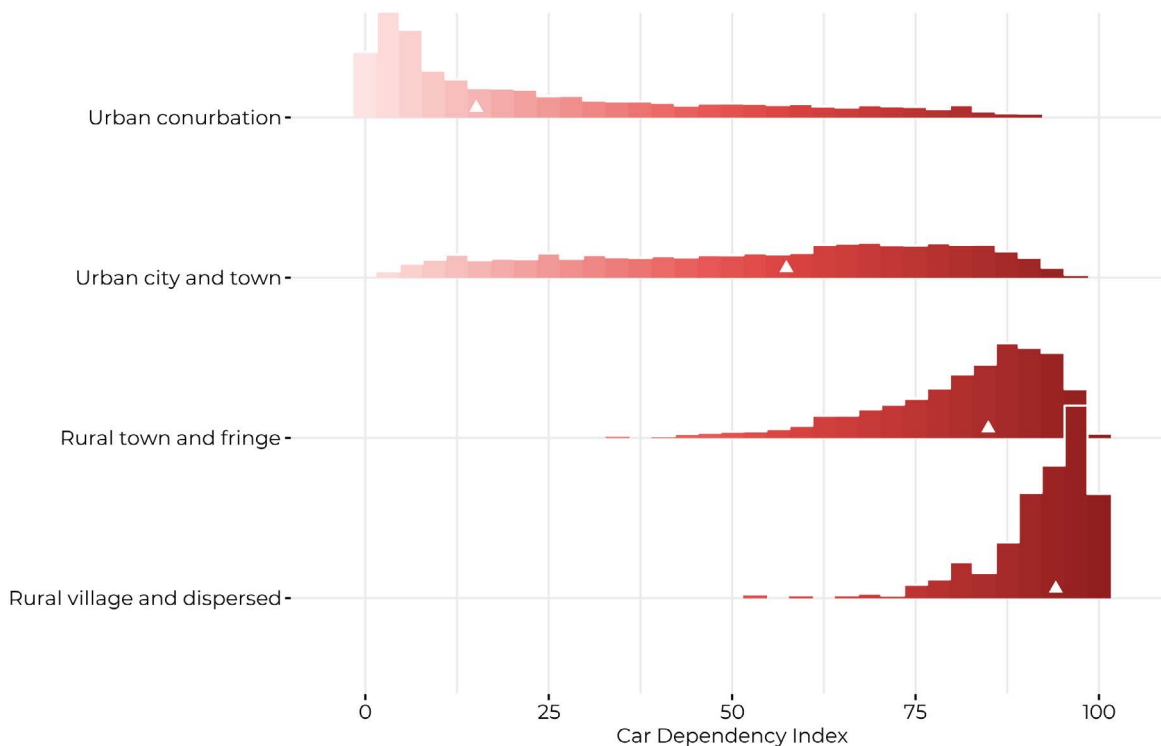
Rural areas make up approximately one sixth of England's population but accounted for one in four new homes built since 2018¹, meaning they are overrepresented in new builds. This has significant implications for the viability of public transport as a regular mode of travel for the residents of one quarter of the recently added housing stock. Looking at some of the data within our CDI, we see that in 2023, the

average public transport travel time from new builds in rural areas was 62 minutes to the nearest hospital, compared with 28 minutes from new builds in urban areas. For the same rural new builds, public transport trips took 37 minutes to the nearest supermarket (compared with 12 minutes from new builds in urban areas) and 43 minutes to the nearest secondary school (compared with 17 minutes from urban new builds).

¹ Department for Environment, Food & Rural Affairs (2023). Statistical Digest of Rural England: 1 – Population. <https://www.gov.uk/government/statistics/population-statistics-for-rural-england>

FIGURE 6: NEW CONSTRUCTION IN RURAL AREAS TENDS TO BE CAR-DEPENDENT, BUT THERE IS MUCH GREATER VARIATION IN CAR DEPENDENCY FOR NEW CONSTRUCTION IN URBAN SETTINGS.

CDI for all new dwellings since 2009 (inclusive) in England, by rural-urban classification (N = 2,672,239). The triangle indicates the CDI of the median dwelling in that type of area.



Source: NEF analysis of EPC, AI23, PTAI22, Census 2021, Census 2011, ONS Postcode Directory.

2.2.2 URBAN CAR DEPENDENCY

The second driver of the overall trend revealed by our analysis is a steadily rising CDI for developments in areas classified as *urban cities and towns*, ie new housing within and at the edges of cities and larger towns outside of Greater London, West Midlands, Greater Manchester and Merseyside, West Yorkshire, Tyne & Wear, South Yorkshire, and Greater Nottingham (*conurbations*). Developments in urban cities and towns account for the largest share of new housing delivered in England in each period over the past 15 years. Their median CDI scores have increased from 50.5 in 2009–11 to 62.9 in 2021–23 (Figure 7). The increase in median CDI scores for urban cities and towns can be observed in all regions outside of London (which is classified as a conurbation). This is a contrast with rural developments which score consistently high on car dependency throughout

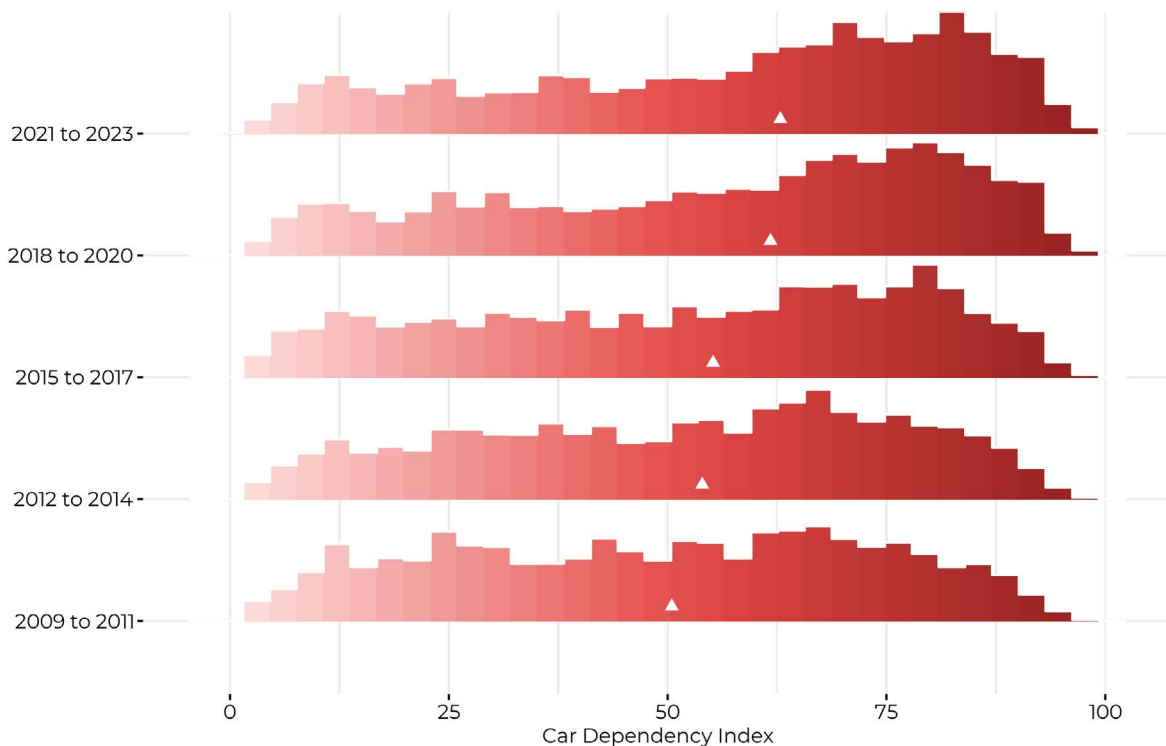
the period, and developments in conurbations which score consistently low on car dependency throughout the period

2.3 LOCAL PATTERNS IN CAR DEPENDENCY

In this section, we zoom in to present a few examples that reveal some of the key aspects of car-dependent development that underpin the trends we have described. The selection is informed by our analysis and draws on insights from existing work on car-dependent development including by Transport for New Homes.⁶⁶ Our investigation provides less local detail compared to case studies based on site visits, which can draw on local knowledge and enable more meaningful engagement with urban design or local specifics. However, what stands out in sharp relief in our mapping of car dependency is the sheer quantity

FIGURE 7: NEW HOUSING IN URBAN AREAS OUTSIDE THE BIGGEST CITIES IS INCREASINGLY CAR-DEPENDENT.

CDI for all new dwellings in England since 2009 (inclusive) in areas classified as “urban city and town”, by period of completion (N = 1,139,471). The triangle indicates the CDI of the median new dwelling in that period.



Source: NEF analysis of EPC, AI23, PTAI22, Census 2021, Census 2011, ONS Postcode Directory.

of extremely car-dependent new developments across England. The most common patterns of development that emerge include *cowpats* (isolated greenfield developments not connected to existing urban areas, with limited or no local infrastructure), swollen villages and large rural extensions (effective *cowpats*), and urban extensions that are poorly connected to main urban areas.

While the vignettes that follow focus on specific developments, Table 3 also shows some of the best- and worst-performing LPAs with median CDI scores for new developments in different rural and urban contexts. Often, the median values are a reflection of how local boundaries are drawn – eg Leicester, Norwich, or Reading (excluded from Table 3) all score very well only because the planning authority boundaries exclude car-dependent edge-of-town developments.

Across cities, towns, and villages, two clear patterns emerge. First, nearly all settlements with well-performing new developments are those that have natural or imposed constraints that development that does not leapfrog – this is the case of Brighton and Hove (sea and the South Downs National Park), York (sufficiently large green belt), Plymouth (sea) – as well as well-performing coastal towns and villages in North Devon, Cumberland, South Hams, or Chichester. This pattern suggests that spatial development constraints prevent car-dependent development. However, the second clear pattern is that many of the worst performers are just beyond or within green belt areas. This is the case for Wigan and Ebbsfleet, as well as highly car-dependent town and rural developments in Derbyshire and Stafford. We discuss the patterns emerging in green belts in more detail later on in this chapter.

TABLE 3: RURAL-URBAN CONTEXT DETERMINES CAR DEPENDENCY, BUT THERE ARE OTHER IMPORTANT FACTORS

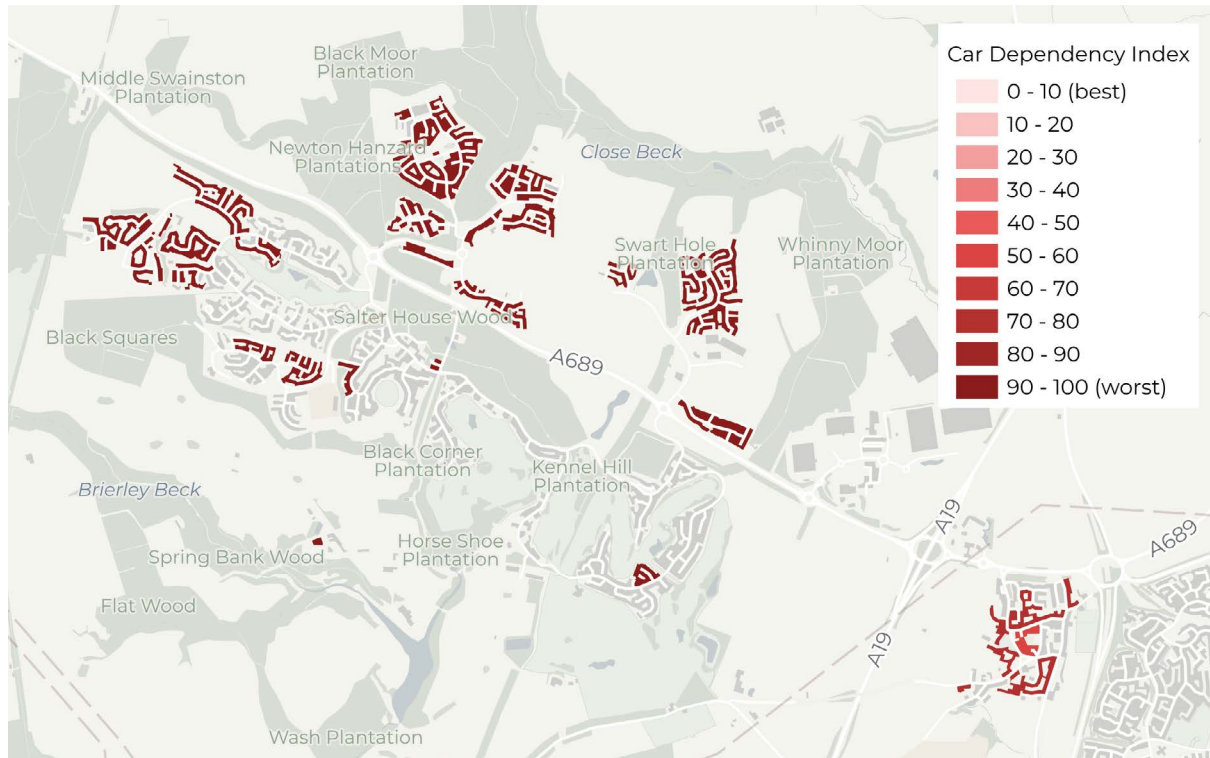
Median CDI by rural-urban classification for new dwellings in England since 2009 (inclusive), for a sample of high- and low-scoring LPAs.

Urban Conurbation			
Hackney	0.8	Ebbsfleet Dev. Corp.	70.6
Brent	5.5	Wigan	71.4
Manchester	10.4	South Staffordshire	80.1
Urban City and Town			
Brighton and Hove	7.46	Newark and Sherwood	82.8
York	23.5	Maldon	84.7
Plymouth	28.2	South Derbyshire	85.0
Rural Town			
North Devon	56.4	South Holland	92.9
Cumberland	62.1	East Hertfordshire	93.3
South Harris	66.9	Lichfield	94.9
Rural Village			
Isle of Wight	72.4	Stafford	98.9
Huntingdonshire	75.2	Derbyshire Dales	99.2
Chichester	76.8	Hartlepool	99.4

Source: NEF analysis of EPC, AI23, PTAI22, Census 2021, Census 2011, ONS Postcode Directory.

FIGURE 8: WYNYARD IS ONE OF THE MOST CAR-DEPENDENT DEVELOPMENTS IN ENGLAND.

Areas by CDI (brighter colours indicate post-2008 developments).



Source: NEF analysis of EPC, AI23, PTAI22, Census 2021, ONS Postcode Directory. Contains OS Open Zoomstack and OS Open UPRN data.

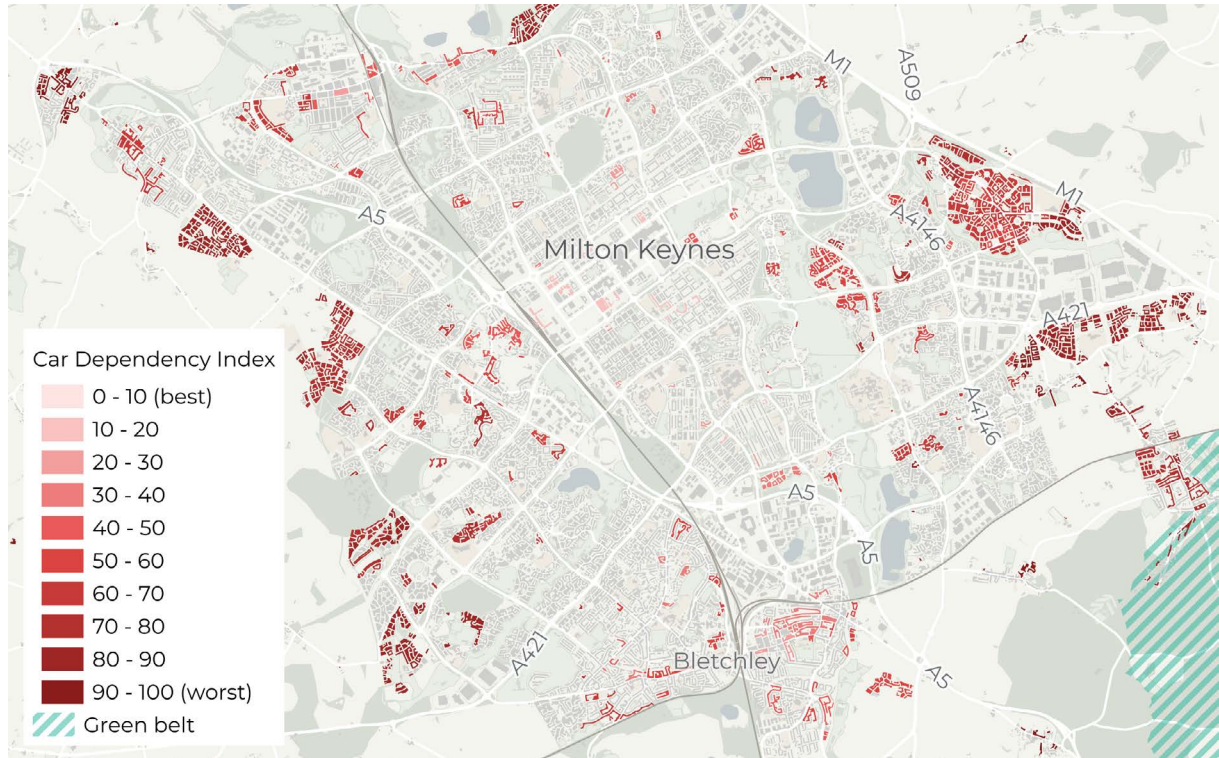
2.3.1 COWPAT: WYNYARD

Wynyard is a collection of developments at the border of Hartlepool and Stockton-on-Tees LPAs, marketed variously as a “thriving village concept” or a development “set deep in the heart of peaceful woodlands”.⁶⁷ The development is “only a short drive to the beautiful Hardwick Park” while “the A19 is a *stone’s throw* away perfect for commuting”.⁶⁸ Roughly half of the development – 1,023 dwellings according to the EPC dataset – are post-2008 completions. These are highlighted in Figure 8. The majority of the development area scores 99.1 on the CDI and ranks 13th (out of 35,672) in terms of car-oriented behaviour (journey to work and car ownership). The development is relatively close to the town of Billingham but is disconnected from the continuous urban area, save for a very circuitous bus service.

It follows a typical low-density estate design and layout with a central roundabout and a branching pattern of cul-de-sacs. Wynyard is a relatively large and relatively affluent version of a *cowpat* greenfield development isolated from existing urban areas and with limited local infrastructure.⁶⁹ Other examples of this type of development are Fernleigh Park “situated just a short drive to Stratford-upon-Avon”⁷⁰ or Albion Lock near Sandbach.

FIGURE 9: A DOUGHNUT OF CAR-DEPENDENT DEVELOPMENTS AT THE EDGES OF MILTON KEYNES.

Areas with post-2008 developments, by the CDI.



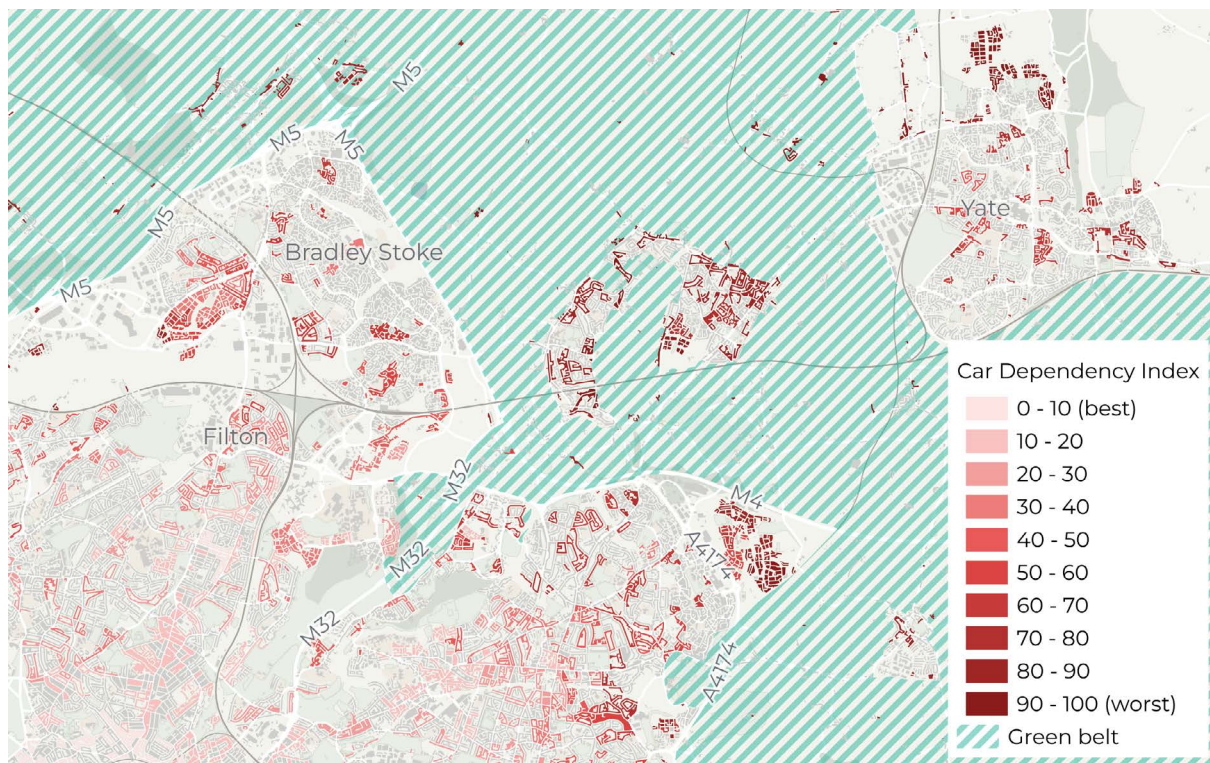
Source: NEF analysis of EPC, AI23, PTAI22, Census 2021. Contains data from OS Open Zoomstack, OS Open UPRN, and DLUHC (Green Belt).

2.3.2 DOUGHNUT: MILTON KEYNES

A third-wave new town just outside London's green belt, Milton Keynes is known for its grid development pattern, car-centric design, and low density which increases the cost of public transport provision. Not surprisingly, Milton Keynes scores poorly in terms of car dependency considering the city's size as reflected in existing city rankings.⁷¹ With the exceptions of Bletchley and Wolverton – two of Milton Keynes's historic towns, around which the city was originally built – new developments replicate Milton Keynes's car-oriented formula and create a highly car-dependent doughnut on the edges of the original new town (Figure 9). However, car-dependent *doughnut* development is not unique to Milton Keynes – a similar pattern can be seen in many cities without spatial development constraints, including nearby Bedford, Northampton, and Leicester.

FIGURE 10: THE NORTH-EASTERN EDGE OF BRISTOL DEMONSTRATES COMMON SHORTCOMINGS OF GREEN BELTS.

Areas with post-2008 developments, by the CDI.



Source: NEF analysis of EPC, AI23, PTAI22, Census 2021. Contains data from OS Open Zoomstack, OS Open UPRN, and DLUHC (Green Belt).

2.3.3 LEAPFROGGING: BRISTOL

Development in South Gloucestershire at the north-eastern edges of Bristol demonstrates some of the common issues with spatial development constraints. While Bristol itself is one of the best-ranking LPAs for car dependency in England, South Gloucestershire is among the worst-ranking due to a string of highly car-dependent developments just beyond Bristol’s green belt (ie developments that leapfrog the green belt), including at the edges of the towns of Yate and Thornbury. The case of Yate is interesting because the town is connected to Bristol by rail – but new developments in Yate are far from and poorly connected to the train station. Figure 10 also shows isolated islands of opportunistic car-dependent developments within Bristol’s green belt between Yate and Bradley Stoke (Coalpit Heath, Winterbourne), and inside the green belt next to

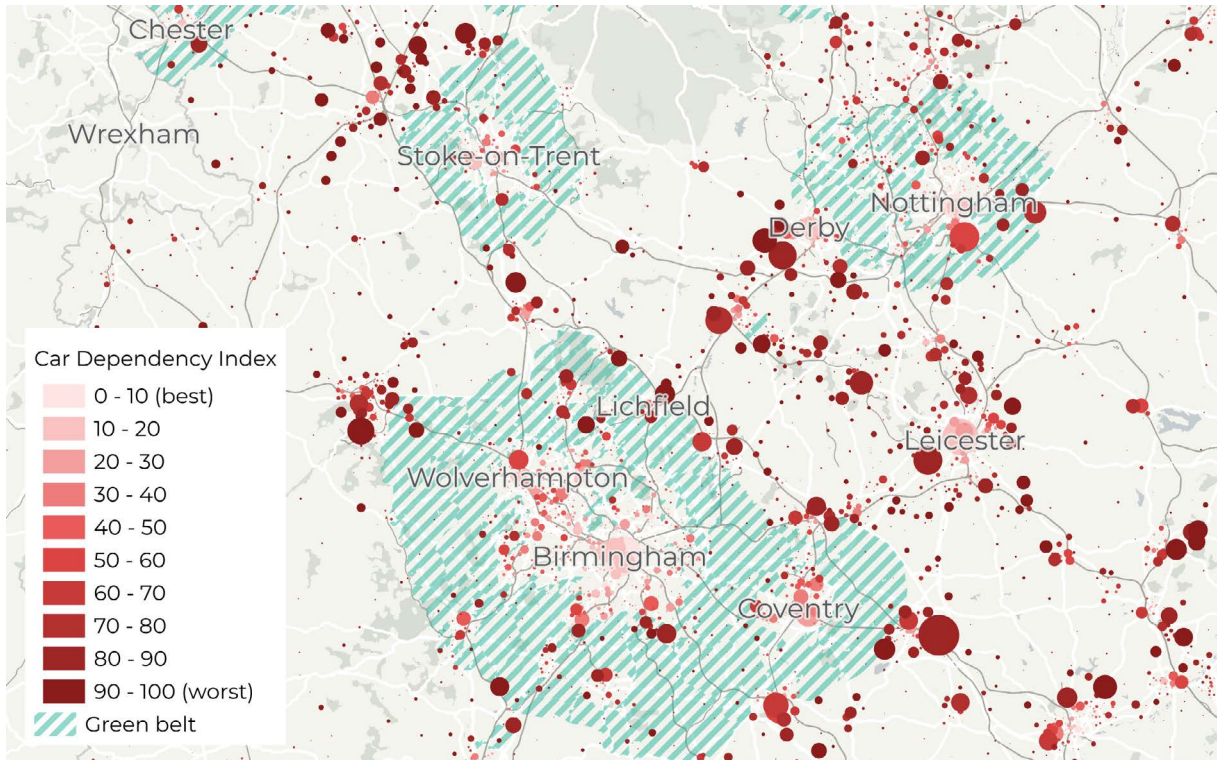
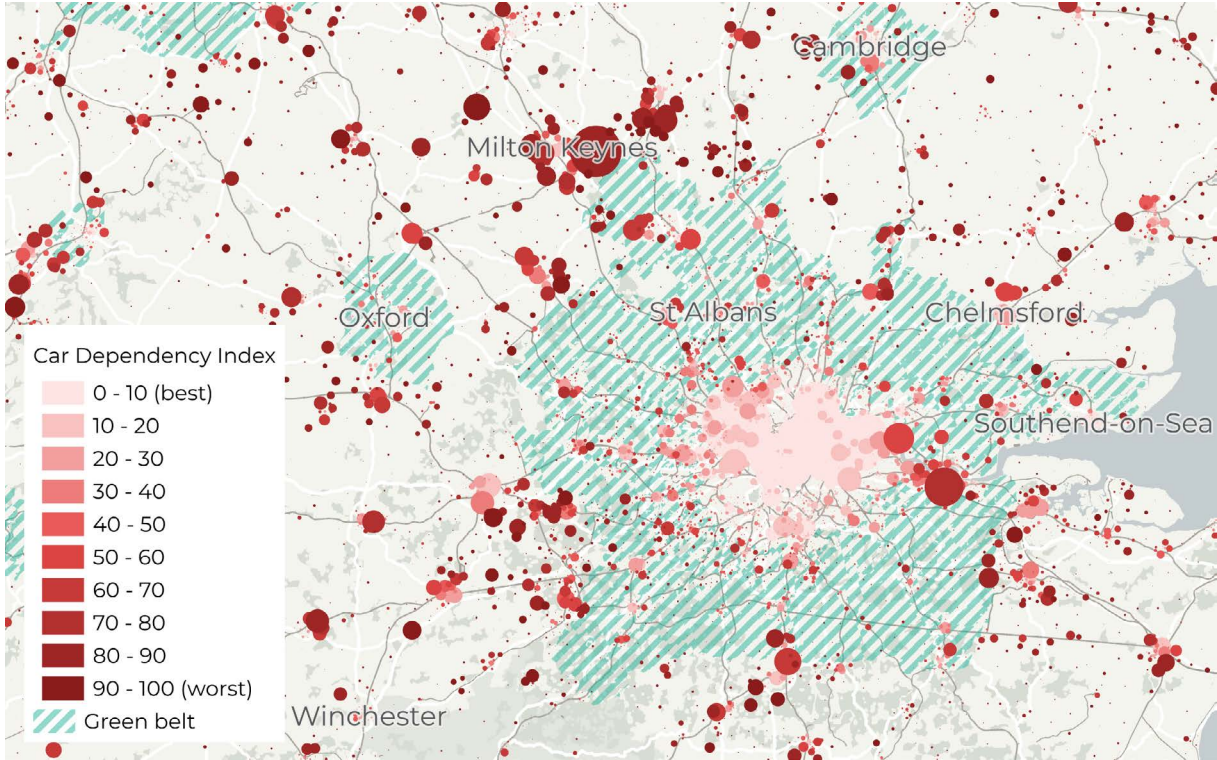
the M4, which suggests an absence of larger-scale strategic planning.

2.4 GREEN BELTS

Figure 11 shows how some of the green belts across England interact with housebuilding and car dependency at a regional level. As expected, fewer new dwellings are being built in green belt areas, and development constraints seem to reduce car dependency within cities, as discussed in Section 2.3. However, as the maps in Figure 11 illustrate, development often leapfrogs green belts, resulting in large and car-dependent development outside green belts. It is therefore not immediately clear whether green belts with leapfrogging development increase or simply displace car dependency. Where there are new developments within a green belt, they tend to be car-dependent too⁷² (Figure 12).

FIGURE 11: CAR-DEPENDENT DEVELOPMENT LEAPFROGS GREEN BELT.

Small areas in England (LSOAs) by number of new dwellings since 2009 and the CDI.



Source: NEF analysis of EPC, AI23, PTAI22, Census 2021. Contains data from OS Open Zoomstack, ONS Postcode Directory, and DLUHC (Green Belt).

In the context of ongoing debates about increasing housebuilding in the green belt and the release of grey belt land,^m we examine the possible effects these policies might have on car dependency. Specifically, we compare the performance of new dwellings either in green belts or in green belt pockets (ie settlements entirely contained within the green belt of a larger city, eg St Albans or Cannock) with the performance of new non-green belt dwellings (ie, dwellings in the centre of or outside green belts).

Our comparison is not a rigorous causal analysis but does provide useful insight. The performance of recently delivered dwellings in green belts and in green belt pockets (both counted as green belt developments) provides the best available reference data to assess the potential car dependency of future green belt communities, such as released grey belt land or a new wave of green belt new towns.ⁿ In total, our analysis includes 320,000 new green belt homes built between 2009 and 2023. Of these, 117,000 are classified as part of the main conurbations (ie city peripheries at the inner edge of green belts), 143,000 are classified as new builds in standalone cities and towns, 41,000 are classified as rural towns and fringe, and 19,000 are classified as villages or dispersed development.

Figure 12 summarises our findings. As far as rural developments are concerned (both *rural town and fringe* and *rural village and dispersed*), new dwellings are generally highly car-dependent and those in a green belt are just as car-dependent as those in other rural areas.

Developments within green belt parts of urban conurbations (ie city peripheries) are substantially more car-dependent than the rest of urban conurbations (ie the city proper). This result is not surprising as such peripheral developments essentially represent unabated urban sprawl enabled by green belt release or gaps in designation.

The scale of car dependency in these developments poses a challenge to potential plans to release more green belt land at the edges of cities.

The most striking finding from the comparison is that new builds in smaller cities and towns in green belt pockets – areas like St Albans, Cannock, Basildon, Bromsgrove, or Castleford – are on average not only more car-dependent than new builds in larger urban areas but also more car-dependent than their counterparts in small cities and towns in other parts of the country. This is contrary to the seemingly advantageous location of areas like St Albans with the potential for good public transport connections. The relatively high car dependency of these urban green belt developments highlights the transport challenges of what are often commuter towns.

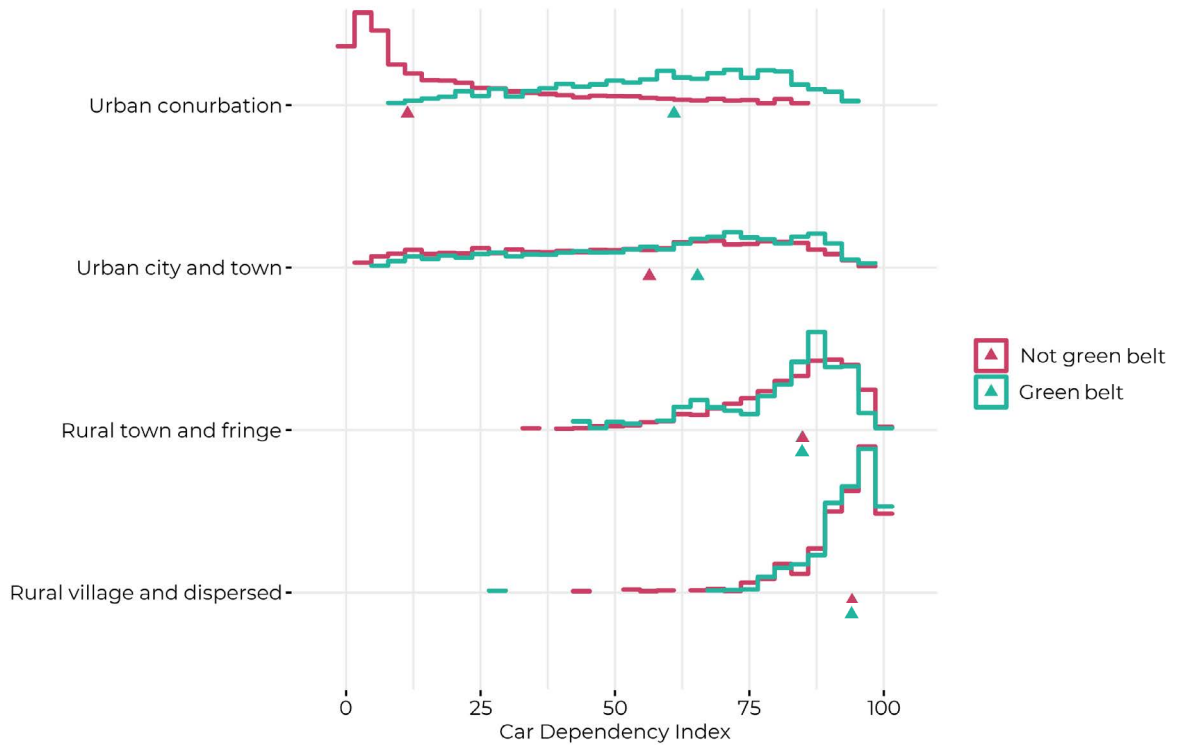
Overall, the existing pattern of car dependency in green belt developments suggests that the release of grey belt land could result in another wave of highly car-dependent housing and add further fuel to the car dependency crisis. This risk applies equally to any future new towns sited in green belt areas. This does not mean that cities and towns in green belt areas have to be car-dependent, but our analysis of recent trends suggests that they will be car-dependent unless they deliver a significant improvement in the quality of public transport infrastructure and urban design. The government's next steps in determining the rules for green belt development will need to take this risk into account and mitigate it.

^m This is defined as land in a green belt that was either previously developed, or makes a limited contribution to the five green belt purposes. These purposes are defined as follows: to check the unrestricted sprawl of large built-up areas; to prevent neighbouring towns merging into one another; to assist in safeguarding the countryside from encroachment; to preserve the setting and special character of historic towns; and to assist in urban regeneration, by encouraging the recycling of derelict and other urban land.

ⁿ This approach requires making fairly arbitrary choices about which settlements to count as the centre of a green belt and which settlements to count as green belt pockets. In our analysis, we expanded green belt to cover all discontinuities within the external boundary of green belt designations other than the following areas, which are treated as the centres of their respective green belts: London, Bristol, Bath, Oxford, Cambridge, Birmingham, Coventry, Nottingham, Stoke-on-Trent, Sheffield, Liverpool, Manchester, Bradford-Leeds, and York.

FIGURE 12: URBAN DEVELOPMENTS IN GREEN BELT AREAS ARE MORE CAR-DEPENDENT THAN THEIR COUNTERPARTS.

CDI for all new dwellings since 2009 (inclusive) in England, by rural-urban classification and whether located within a green belt area (N = 2,497,211).^o The triangles indicate the CDI of the median dwelling in that type of area.



Source: NEF analysis of EPC, AI23, PTAI22, Census 2021, Census 2011, OS Open UPRN, and DLUHC (Green Belt).

^o Note: median is shown by an arrow in each case. The median for green belt and non-green belt areas in rural categories is identical.

3. WHAT IS DRIVING INCREASING CAR DEPENDENCY?

The analysis presented in Chapter 2 shows that newly built homes since 2009 have been more car-dependent than pre-existing homes in nearly every region of England, and that the problem has been getting worse in the past five years. This further confirms the findings of first-hand qualitative research in major new developments and previous analyses of planning permissions.⁷³ In the section that follows, we draw on a small number of interviews with topic experts (interviewees listed in Appendix B) and a review of existing literature to take a deeper look into what is driving increased car dependency in new homes. We then outline a set of recommendations for how the next generation of new builds can achieve more sustainable transport outcomes.

3.1 FACTORS CREATING CAR DEPENDENCY IN NEW DEVELOPMENTS

The evidence on car dependency suggests several different ways in which new homes make it difficult or impossible to make the journeys essential to everyday life without driving:

- **Location:** new homes that are located far from key amenities such as town centres, employment sites, shops, and public services. Where the location is remote enough, this can negate any attempts to address provision and design.
- **Provision:** new homes where sustainable transport options (public transport, walking, wheeling, and cycling) are not well provided for.
- **Design:** places where the local built environment within the residential area favours cars over sustainable modes of travel. Similarly, the design of local amenities can encourage car dependence, eg by providing car-focused retail parks instead of shops that are more accessible to pedestrians.

Car-dependent places typically contain at least one of these factors, although some of the most car-dependent places exhibit all of them. The factors are also mutually reinforcing, meaning that the presence of one factor tends to make the others more difficult to mitigate.

3.2 ECONOMIC AND POLICY DRIVERS OF CAR DEPENDENCY IN NEW DEVELOPMENTS

3.2.1 LOCATION OF NEW HOMES

We saw in Chapter 2 that new builds in the past 15 years have been located in places with a relatively high CDI. Rural areas make up a disproportionately high share of new builds in all non-London regions and new builds in small and medium-sized urban areas tend to be located in the most car-dependent parts.

Land value is an important driver of where new builds are located. Greenfield land is usually less expensive and simpler to develop than brownfield.⁷⁴ For example, a review of transaction data and industry knowledge across Greater Manchester in 2020 estimated that large-scale strategic greenfield sites cost £250,000 per hectare (ha), compared to £310,000 per ha for greenfield land at the edge of existing settlements, and £430,000 to £660,000 per ha for brownfield industrial land.⁷⁵ Provided that the final sale price of the homes built can be maintained at a reasonable level, cheaper land in rural areas or on the edge of urban areas tends to improve financial viability. Similarly, the **condition of land** on greenfield sites means they typically require less complex and expensive remediation when being developed. For sites of 500 homes or more, greenfield has a build-out rate that is 34% quicker than brownfield.⁷⁶

Given that private, profit-maximising firms build more than three-quarters of England's new homes,⁷⁷ and typically require a profit margin of 20% on any market-price housing that they build,⁷⁸ it is not surprising that new builds have favoured rural, greenfield locations where land can help to improve financial viability and profitability. Likewise, new homes in urban areas are more likely to occur on the fringes due to land value, feeding a tendency towards urban sprawl. Land cost also works in the opposite direction, to make housebuilding more difficult in areas that are well

served by public transport or cycle routes, more walkable, or supplied with more local amenities, all of which tend to increase land value. This makes it more difficult to buy land in these kinds of locations on the open market and develop it into homes that people can afford to buy while making a sufficient return. The legal concept of 'hope value', which means that all land prices are artificially inflated to reflect planning permission that may be secured at a future date,^{79, 80} tends to exacerbate the impact of land costs on car-dependent development by driving up land costs and squeezing viability.

Within the current planning system, **public opinion** also tends to encourage more development in isolated and rural locations. One interviewee highlighted the scale of opposition from the public to development in urban areas, where there are more residents and there is a higher density of economic activity that will be disrupted during the construction of a new development. Another interviewee cited examples of local councillors encouraging the district's housebuilding target to be met in parts of the district other than their own ward, to minimise pushback from voters. On the other hand, in rural areas where disruption to through traffic does occur during construction, those affected are less likely than residents to have their opinions captured by council consultation processes.

Public opposition to new development is encouraged under the system of top-down **housing targets** that the central government applies to determine the volume of new homes to be built in every LPA. These were seen by interviewees as a driver of poorly located, car-dependent development, via the combination of pressure put on councils to deliver a set volume of homes each year regardless of transport provision to those areas, and the effects of land value, public opinion, and an atrophied public planning system unable to push back against unsustainable developments:

Housing targets seem like quite a crude way to bypass the fact that you don't do planning properly, to bypass doing that work. - Gareth Fearn, University of Manchester

[Political parties are] misunderstanding the role of local authority housing targets, and how setting them blindly, without dialogue with local authorities first and an understanding of public transport, environmental, local employment and social implications, is just going to cause trouble.

- Jenny Raggett, Transport for New Homes

The role of housing targets in driving car-dependent development, especially in rural and semi-rural local authorities, was emphasised in previous research,⁸¹ which also suggested that the pressure created by the targets leads to sustainable transport being deprioritised in the absence of strong guidance from the relevant local plan.⁸² Capacity in the public planning system is weak, with public spending on planning services in England having fallen by one-third in real terms from 2009–10 to 2022–23 and the number of public-sector planners having fallen by one-quarter from 2009 to 2020.⁸³

At the same time, **national planning legislation** through the wording of the National Planning Policy Framework (NPPF) does not allow for proposed developments in poor locations to be successfully challenged. Nick Small, Head of Built Environment and Infrastructure at Oxford Bus Company and Go South Coast, explained that paragraph 115 of the NPPF stipulates that developments "should only be prevented or refused on highways grounds if there would be an unacceptable impact on highway safety, or the residual cumulative impacts on the road network would be severe".⁸⁴ While the word severe is not properly defined in the NPPF, this clause sets a high enough bar to make it nearly impossible to refuse a planning application due to the effect a new, isolated development will have on congestion.⁸⁵

Interviews also identified a **lack of early integrated planning** of transport, housing, and development sites as a cause for car-dependent locations being built on. One interviewee felt that the lack of sufficient analysis of sustainable transport potential when identifying sites, sifting them, and finalising the locations for development in local planning processes meant that inappropriate locations are brought forward for development, creating car dependency and complex issues in mitigating the effects of poor site selection.

This in turn can delay housing delivery on such sites and necessitate expensive road infrastructure to try to contain the impact of additional motor traffic on local roads and the environment. What early planning did occur was considered to be more heuristic than evidence-led, eg assuming that locations on the edge of towns would be less car-dependent than rural areas. Two interviewees identified this kind of integrated regional planning of transport and housing as the norm in other countries saying that in Europe, it's quite normal but in the UK we are different. They echoed previous findings on a lack of funding, capacity and capability within local planning authorities to properly scope, commission or deliver transport-related evidence.⁸⁶ The lack of capacity has been driven by deep funding cuts since 2010⁸⁷ and causes delays to approvals of new development, with officers tending to say no or delay a decision if they are overwhelmed by their workload, aggravated by the need to await responses, and frustrated by multiple negotiations between the planning authority, statutory consultees, and developers. The complex and inconsistent structure of local government places local transport and highway functions apart from the planning function in many instances. Respondents highlighted the highly variable participation of national infrastructure providers in plan-making in particular and pointed to the absence of regional-level local government bodies in the UK that would operate at the most suitable scale for this integrated planning. Where local plan strategies and policies fail to effectively address transport challenges and opportunities, including lacking supporting evidence, it is very difficult for non-statutory third parties including bus operators to challenge them during the policy preparation process. Following adoption, there are no realistic options available for challenges, as judicial review or complaints to the Local Government and Social Care Ombudsman cannot overturn duly made decisions.

A final factor that worsens the car dependency of locations is the lack of local amenities, such as community facilities, recreational spaces, and retail, which is difficult to address due to the flaws in the **Section 106 (s106)** system of developer contributions. Several interviewees felt that s106 negotiations gave too much power to the

developer over the LPA, making it difficult for the latter to require local amenities that would allow for more sustainable travel patterns:

Developers are just required to tick boxes at the moment on the amenities and transport. [Section 106 discussions are] not about how the developers are going to make a place where people want to live. - Cllr Jenny Wilson-Marklew, Milton Keynes Council

3.2.1 PROVISION OF PUBLIC TRANSPORT AND ACTIVE TRAVEL

The level of car dependency in new developments is affected in part by the standard of **public transport provision**, particularly for buses, which vary significantly in different parts of England. Net government revenue expenditure on buses was cut by 26% between 2010–11 and 2018–19, with sharper cuts outside cities (-41%) than in metropolitan areas (-23%).⁸⁸ This coincided with a reduction of 58% in local-authority-supported bus services – where the council subsidised socially necessary routes that are not commercially viable – in the decade to 2020–21.⁸⁹ Private bus operators require routes to make a return, meaning that some socially valuable but non-profitable routes have been underprovided at times⁹⁰ and a general decline in ridership tends to lead to a spiralling process of route reductions. Bus fares also increased faster than inflation, rising by 40% between 2010 and 2021, with steeper than average increases in non-London (48%) and non-metropolitan areas (51%) of England.⁹¹ The recent £2 fare cap applying during 2023 and 2024 has temporarily offset some of this increase,⁹² but it is unclear for how long this will continue and it came in after a prolonged period of rising fares had already had an impact on ridership. As a consequence, the level of public transport use for commuting in major cities other than London lags well behind comparable cities in Germany, France, and other European countries.⁹³ Between March 2012 and March 2021, the level of bus ridership fell by 27% in non-London English regions while the number of bus services provided fell by 29%.⁹⁴ The weaker provision means that for a given location, car dependency in new builds is likely to be higher for lack of alternative ways to travel, especially in parts of England where public investment in public transport is weaker.

In the initial two years following the onset of Covid-19, bus use fell sharply, with some evidence that rural areas were more severely affected.⁹⁵ Ridership has since recovered significantly, with bus journeys in areas of England outside London between autumn 2023 and spring 2024 sitting at around 90% of their January 2020 level.⁹⁶ This strong recovery was helped by the impact of the £2 fare cap from January 2023 onward,⁹⁷ although bus journeys had already risen by 19% year-on-year by March 2023 as pandemic effects lessened.⁹⁸ Nonetheless, challenges remain in the provision of local bus services across England, which will need to be overcome if buses are to maximise their attractiveness relative to private car travel. One interviewee cited recent issues with the reliability of their local buses, a limited bus network, and a lack of trained drivers and pointed out that once a bus service is cut, it is very difficult to get it running again as the public's travel patterns tend to change quickly as they find an alternative mode of transport. Similarly, successfully setting up a new route tends to be more difficult than maintaining an existing one, due to the need to convince people to use it. A vicious cycle was observed where falling provision leads to lower ridership, which reduces the viability of remaining routes and encourages further cuts to provision.

The current **funding streams** for public transport in new developments, such as s106 funds, were found to be generally insufficient to fund the kind of public transport provision and active travel infrastructure needed to shift travel patterns, reinforcing the findings of previous research.⁹⁹ Again, the power imbalance in these negotiations between developers and councils, reinforced by councils' lack of funding and capacity and the housing targets they face, led to them having to trade off between important elements of new housing developments to allay the developers' concerns over viability:

It falls down more on the smaller developments, where you have a developer telling you what they are going to do. As soon as you start making demands, they cite a lack of viability. You then have to sacrifice one big thing, like affordable housing or transport. - Cllr Jenny Wilson-Marklew, Milton Keynes Council

Nick Small, from Oxford Bus Company and Go South Coast, described the typical order in which these funds from developer contributions are spent. While education is usually the first priority, followed by community facilities, transport is typically second from last on the list, just before social housing. Transport is at times portrayed in this process as something nice to have rather than an essential for any new development. When the choice is between affordable housing and transport, the latter often loses out. Additionally, the planning system doesn't offer sufficient recourse to transport operators to object to new developments on the grounds of difficulties in providing public transport and sometimes allows developers to over-promise on this aspect as a way of getting approval without ultimately delivering the funding for infrastructure that they promised.¹⁰⁰

On the other hand, existing research has highlighted examples of how transport provision on new estates often focuses heavily on **expensive car-centred investment**. Research into 20 developments funded by the 2018 Garden Communities programme found that in nearly every case there was large-scale investment in road capacity, with half of the developments adding or enlarging a motorway junction and some garden community housing developments sited in part to finance new bypasses or link roads.¹⁰¹ In the same developments, none had a fully costed and planned public transport plan or cycle network. The Housing Infrastructure Fund (HIF) spending on garden communities as of April 2020 included £700m for roads, but only £61m for walking and cycling and £45m for buses.¹⁰² Although some spending on roads is necessary and can serve sustainable modes such as bus travel and cycling, the allocation of HIF money appears in many instances to have subsidised measures that focus on enabling widespread private car trips rather than sustainable travel.

This pattern of spending is reinforced by the dominant car-focused **transport planning** approach, which frequently assumes that population growth creates more car travel and congestion and inevitably recommends increased road construction as a response.¹⁰³ Although sector guidance has progressed from the predict and provide paradigm to more proactive approaches,¹⁰⁴

in practice there remains a reluctance to implement the new planning policies that could reduce car dependency. The timing of transport planning late on in the development process reduces its role to one of trying to mitigate the increase in car traffic that will arise from new developments,^p rather than planning the location and design of these developments with sustainable transport in mind. An interviewee cited the example in Frome where the development of 1,700 new homes was forecast to add 1,400 to 1,900 extra vehicles per hour on the network for the morning and evening peak.¹⁰⁵ This volume of traffic necessitated a large new access roundabout, extra capacity at two more roundabouts, and numerous other changes to the local road system. In another development in Trowbridge, a major bypass was required to accommodate the additional traffic, creating funding challenges and risks around biodiversity impact.

Even in new developments where good public transport provision is agreed, issues with **implementation and phasing** can affect whether this is delivered in a way that new residents can use sustainable modes of transport from the moment they move in. One interviewee cited frequent delays in getting bus services running in new areas. Similarly, even when a timeline for new buses is agreed with the developer, transport operators have little recourse in making sure this is met, allowing deadlines to be missed. Nick Small stressed the need for incentives between the different actors (councils, developers, transport providers) to be aligned and for greater collaboration, beginning from the early integrated planning stages and throughout the development pipeline: "If you collaborate upstream, it de-risks downstream."

The provision of routes for walking, wheeling, and cycling was found to be inhibited by **wider issues with active travel provision**. Encouraging regular use of active travel requires a full network of safe routes between people's homes and the amenities and destinations they regularly visit. However qualitative research in new estates found that even where there were well-designed active travel routes, these tended to end at the boundary of the estate and become noticeably worse.¹⁰⁶ In this way, the car dependency of adjacent neighbourhoods and the

recent cuts to public funding for active travel that was needed to address this,¹⁰⁷ tend to increase the car dependency of new estates. A related concern raised in interviews was whether active travel routes were safe to use, given that they often ran through secluded areas that are not overlooked by '*eyes on the street*' from homes or businesses.

Issues of provision-based car dependency tend to be made worse by siting new developments in **car-dependent locations**. The financial viability of public transport becomes more difficult to achieve where population density is lower and roads are more circuitous, while active travel becomes less attractive when new homes are located far from amenities. Traffic congestion in surrounding neighbourhoods causes problems in providing convenient bus services to common destinations, even if the bus infrastructure within the new residential area is well-designed.

Likewise, **poor design** can make the provision of sustainable transport more difficult. Maze-like street layouts tend to reduce the financial viability of bus routes and a lack of attention to the siting of bus stops or train stations can deter the use of those modes of transport. Car-dominated street designs and large parking areas tend to make the physical environment less pleasant and safe for active travel. Nick Small mentioned recent challenges in areas where councils' transport policies are focused on reducing car speeds for safety, but due to poor design, have an unnecessary side effect of slowing down buses and reducing the attractiveness of that more sustainable mode of travel.

3.2.3 DESIGN OF NEW HOMES AND AREAS

Evidence from visits to new developments reveals that streets and roads are typically designed around cars first and foremost, with much of the common space in estates being used for driving or parking and streets often laid out in a maze-like pattern of cul-de-sacs that makes walking and wheeling more difficult than they should be.¹⁰⁸ Two interviewees suspected that this was driven by land value considerations, with developers tending to favour estate layouts that achieve the maximum number of houses per hectare of land to maximise returns and minimise the cost of associated infrastructure.

^p Attempts to address increased congestion through road building are likely to fail in any case, due to the phenomenon of induced demand.

Councillor Wilson-Marklew observed that estates in Milton Keynes built in the 2000s or later tend to have fewer cut-throughs for pedestrians to easily walk across, which may be related to the increase in land values since the 1990s. The impact of land costs and their primacy within the business models of volume housebuilders on the size of new homes has been demonstrated by academic researchers with experience in land buyers' behaviour in the sector:

As greenfield sites are typically larger than brownfield sites, have limited constraints below ground or adjacent to the site and have fewer (if any) existing structures to consider in design, housebuilders have been able to treat these sites as blank canvasses in design terms. This means that housebuilders can cram as many houses as possible on to the site in order to generate maximum house sales and drive up the return on capital employed. In the greenfield context, little regard is paid to how the layout of the site relates to the existing or surrounding fabric. Design, both in terms of product and process, has therefore been of limited consideration in most conventional greenfield developments, since improved design was not seen as essential in delivering as many housing units as possible to ensure a healthy and viable development profit.¹⁰⁹

LPAs have limited power to challenge car-dependent design through negotiations over **developer contributions** via s106. While a council can set policies requiring certain minimum transport integration standards – such as the requirements in Milton Keynes that every new development is connected to the city's network of active travel 'red ways' – they have little power in practice to challenge designs that meet the minimum requirements and are disincentivised from doing so by housing targets, lack of planning capacity, and developers' viability concerns.

Parking policies for new developments can contribute to car dependency in areas that are well-supplied with sustainable alternative ways to travel such as the centres of major cities. Many LPAs require two or more free parking spaces per new home, making driving more convenient, using up large areas of land that could be put to other uses, and making the physical environment less

conducive to walking and cycling.^{110,111} In London, where evidence showed that more parking spaces led to higher car ownership and more car use, even in areas where public transport provision was high,¹¹² the application of maximum parking standards in 2004 reduced the number of parking spaces per unit of new housing from 1.63 to 0.44.¹¹³ There is precedent for the successful delivery of car-free or car-reduced development in such areas, eg in the London Borough of Hackney.¹¹⁴ Despite this, the government abolished national maximum parking standards in 2011¹¹⁵ and removed much of the power of councils to limit car parking in new builds through changes to the NPPF in 2019.¹¹⁶

On the other hand, in places that are heavily car-dependent at present, parking policies need to be carefully considered to avoid unintended consequences. Where parking provision is reduced, however, it is crucial to provide alternative sustainable ways to travel to avoid getting the worst of both worlds: residents and visitors still use cars for most journeys but block roads and pavements with parked cars.¹¹⁷ One interviewee mentioned that this issue arose at times under related policies in the 2000s,^q with the effect of making bus services more difficult to provide in these areas. In such instances, a balance needs to be struck to find the designs that are most effective in actually reducing car dominance of public space, while remaining ambitious in the need to make travel more sustainable and not incurring huge expenses to accommodate high car use.

Another driver of car-dependent design comes from the design of **non-residential property**, which was found in some new developments to create car-dependent destinations. Research by Transport for New Homes visiting new developments found that local retail outlets and restaurants were typically in roadside locations and designed to favour access by car, encouraging a more car-dependent way of living.^r This effect was even observed to spill over to less car-dependent adjacent areas:

Out-of-town-ness [of retail, amenities, etc.] affects the town centres. As everything moves out of town, you increasingly need a car even if you live in the centre of town. - Jenny Raggett, Transport for New Homes

q Specifically, Planning Policy Guidance Note 3, published in March 2000, aimed among other things at reducing the level of parking

r Forthcoming publication from Transport for New Homes. provision in new developments.

An exception to this phenomenon was in Poundbury, where the Duchy of Cornwall had substantial power as a landowner to require that new areas be mixed-use and forbid out-of-town design of local amenities. While the merits of other aspects of development in Poundbury are the subject of debate, it demonstrates the feasibility of designing places with a mix of amenities for lower car dependence where there is political will and sufficient power.

4. TOWARDS A SOLUTION

In Chapter 3, we outlined how car dependency is caused by the complex interactions of key factors such as land value, local politics, national housing targets, national and local policies, local planning capacity, and the absence of integrated region-level strategic planning. This chapter suggests how the coming years of housebuilding can take a different approach to provide sustainable transport as standard. The unmet housing need that forms part of the ongoing housing crisis means that new homes will be needed in the coming five years, and it is unlikely to be possible to focus these on brownfield sites alone. Industry experts suggest that the quantity of brownfield land is only sufficient for 90,000 new homes per year,¹¹⁸ and the fact that policies to encourage development towards brownfield land are already in place suggests that a further concentration on sites of this kind would be difficult to achieve. Given that some greenfield development will be needed, it should be well-planned and integrated with sustainable transport, which implies a shift from developing isolated rural sites to strategically located and larger developments.

Broadly speaking, the recommendations that follow aim to replace a haphazard geography of new builds determined by crude public policies, an atrophied public planning function, and private profit and land value. Instead, they would encourage a move towards a system where the public sector delivers high-quality public services and amenities via a strong planning system that intervenes early on, creating plans democratically, and using holistic evidence and integration of transport, housing, and land plans at the appropriate geographic scale.

Policies of this kind have to take account of the inherent tension between the construction of new homes at scale and local public opinion that can

be resistant to new development.¹¹⁹ We propose that a stronger public planning system that is democratically accountable to residents can achieve new development that builds public support in the process, rather than requiring strict top-down targets to override public opposition. There is also a need for policies that overcome the car dependency bias of private land value capture, which renders car-dependent places cheap enough to build on and precludes affordable development in areas that are well served by sustainable transport. Following best practices used abroad and previously applied in earlier English new towns, our proposals would empower the sub-national government to acquire land at existing use value and to proactively plan sites and locations to minimise car dependency.

We believe these ambitious, transformative solutions are the best because they are the ones that will really work, and there are precedents, policy levers, and a new government elected with a mandate for this kind of change in place. There is a need for ambition because the many second-best solutions that present themselves are unlikely to fully solve the problem. For example:

- Marginal improvements are possible by making better use of existing development contributions such as s106, but the funding available from private developers in the current land market is unlikely to ever be sufficient to achieve sustainable transport and other outcomes, such as affordability and local amenities, all in one place.
- Improvements to the design within housing estates will not achieve reduced car dependency unless they are in the right locations and are linked to stronger sustainable transport provision in the surrounding area to give people alternative ways to travel.
- The delivery of more sustainable developments without local democratic input will encounter political opposition that could prevent a new model from being sustainable in the long term. While there will inevitably be some opposition to most new developments in a given area, using democratic mechanisms to hear and respond to residents' concerns and allow them to feed into

the planning of these developments is more likely to lead to positive, sustainable outcomes than just ignoring or overriding local concerns.

- The full effects of policies to acquire development land more cheaply will not be realised unless the value that is captured is used to provide the features of good places that everyone can benefit from, such as good design, green spaces, sustainable transport infrastructure, mixed community uses, and social housing.

4.1 INTEGRATED STRATEGIC PLANNING OF NEW HOMES AND TRANSPORT

A more deliberate, considered process for determining the location of new homes is needed, to ensure that they are as well-connected as possible to public transport and active travel infrastructure over time. To achieve this, we propose the following:

- A **regional** strategic spatial planning exercise, based on a thorough review of data on car dependency, transport provision, and the location of employment and key amenities to inform the identification, sifting, and selection of development sites. These plans could be refined every five years to reflect changing circumstances.
- The exercise should have multiple criteria for the selection process, which could include measures of housing need as well as minimum standards of sustainable transport potential (eg decision rules on how car dependency would be minimised). It should aim to achieve transport-led development, with homes sited along expanded public transport networks, as far as possible.
- This process should involve a wide range of local stakeholders, including public transport providers, from the beginning. It should seek democratic input from residents of the region as far as possible, eg through the mandate of locally elected mayors, through citizens' assemblies on the priorities for the spatial plan, or even by the election of stakeholders designated to feed into the development of the plan.

- This would ideally occur at a larger scale than the LPA, covering combined authorities or even regions that incorporate a combined authority and surrounding counties, to allow for the development of integrated transport networks at the appropriate scale.
- The regional strategic planning process could replace top-down housing targets by determining a target for each LPA and a recommendation of where to locate the homes within each LPA, which could be finalised by the LPA. The regional targets for new housing could be determined by the central government in line with parameters like population growth and household formation, while the allocation within regions would be handled by the planning process.
- Any release of green belt land within the strategic spatial planning process should be conditional on achieving a good minimum standard of sustainable transport in the resulting developments.

4.2 DELIVERY OF DEVELOPMENT LAND

Delivering developments that are not car-dependent will require overcoming the current constraints on land and funding of amenities through a public-led development model. For this, we propose the following:

- Providing powers to the sub-national government (combined authorities, their mayoral development corporations, and councils) for compulsory purchase of land at or close to existing use value for housing development.
- Providing sufficient quantities of upfront public funds to these sub-national government bodies to allow them to masterplan and deliver the infrastructure and layout needed for high-quality new developments with sustainable transport, eg estate layouts that encourage active travel, public transport use, and a mix of uses on-site (eg workspace, retail, and other employment together with residential), routes, stations, an attractive public realm, green spaces, and selected amenities, such as community centres. This capital funding could take the form of a

loan from HM Treasury in a similar fashion to the funding for the first wave of new towns, which was eventually repaid in full. After this point, plots could be leased or sold to private developers to construct the new homes.

- Incorporating the priorities of residents in the master planning and design of these sites wherever possible, in a way that goes beyond the current standard approach to consultation, which is often seen as tokenistic, lacks genuine accountability,¹²⁰ involves only a tiny proportion of the public, and is difficult for the average person to access.¹²¹ These approaches could include local assemblies with voting rights over the masterplan, or design competitions with elected local representation in the jury.
- Setting missions for the quality of homes and places that these organisations should aim to deliver on sites where they acquire the land and plan. These could include a targeted modal split of sustainable transport, a target share of social homes to ensure the benefits are broadly shared, and high design standards.

4.3 PUBLIC PLANNING CAPACITY AND POLICIES

Underpinning the planning and delivery of better developments should be a restoration of capacity within the public planning system. To do this, we are proposing the following:

- Restoring revenue funding within local authority planning departments to pre-2010 levels in real terms, to improve capacity, invest in training planners for better capability, and provide the means to deliver the development planning and strategic spatial planning proposals outlined above.
- Using national planning policies to set minimum standards or targets, with local areas empowered to determine their own policies, on key features of new homes and local transport, such as mixed uses, 15-minute neighbourhoods,¹²² parking guidelines, and sustainable transport standards to aim for. In the NPPF, this should include stating that sustainable modes of transport should be the natural first choice to meet travel needs in new developments.

- Providing capital funding for city-regions to invest in new public transport capacity to unlock sustainable transport provision for new homes, eg additional light rail networks.

5. CONCLUSION

This paper highlights the unintended consequences of the economic and planning systems governing transport and new housing in recent years, which not only lead to poor transport outcomes but also take us further away from wider policy objectives around regional inequality, poverty reduction, expanding economic opportunity, and preserving a liveable environment. As outlined in Chapter 4, we propose several broad but transformative changes to policies and systems to redress these issues and chart a course towards sustainable development, including:

- Integrated regional strategic planning of housing, land, and sustainable transport informed by a thorough data analysis considering housing need alongside ways of minimising car dependency. This should occur at the region or city-region level, involving a wide range of stakeholders including democratic input from residents, and would replace housing targets as a means of allocating new development sites within each region.
- Conditioning any release of green belt or grey belt land on achieving a good minimum standard of sustainable transport in the resulting developments. Current green belt areas have higher car dependency and our analysis suggests that without careful consideration, grey belt developments will be car-dependent unless they deliver a significant improvement in the quality of public transport infrastructure and urban design.
- Powers for the sub-national government (combined authorities, their mayoral development corporations and councils) for compulsory purchase of land at or close to use value for development and upfront public funding to these bodies for master planning and delivery of infrastructure, layout, active travel routes, public transport integration, mixed uses, and green space, applying a similar model to what was used in the first wave of new towns.

- Setting missions for mayoral development corporations or similar bodies, shaped with residents' input, for the sustainable transport mix and quality of homes and places that they aim to achieve in new developments.
- Restoring funding and improving capacity and capability within local authority planning departments, providing the means to deliver the planning and strategic spatial planning proposals outlined above.
- Providing capital funding for city-regions to invest in new public transport capacity to unlock sustainable transport provision for new homes, eg additional light rail networks.

Past eras of development serve as reminders of both the potential and risks inherent in the coming ramp-up in housebuilding. The first wave of post-war new towns showed that with sufficient upfront public investment, it is possible to plan and build entire communities that work well, where land value made up just 1% of the cost of new homes, with a high share of social housing, and with the whole project paying for itself in a few decades.¹²³

A more recent cautionary example of what can go wrong is Elmsbrook, originally called the North West Bicester Eco-Town, the sole surviving neighbourhood from the mid-2000s Eco-Towns programme, which fell victim to defunding following a change of government. The programme sought to bypass the planning system to create new towns that were carbon neutral, excluding transport. While Elmsbrook has achieved impressive outcomes in its neighbourhood energy system and related emissions,¹²⁴ and the co-location of a primary school and business centre point create some mix of uses, it sits in an isolated location beyond the edge of town that condemns it to car dependency. As a commentary on the development put it:

The development is disconnected from its surroundings and offers no incentives for residents to change their behaviours... Residents who live there are unlikely to take a walk because there is nowhere to walk to, and they would be unlikely to go for a bike ride due to the lack of safe bicycle routes. Although the development will

save many tons of carbon over its useful life, it could have saved many more if it had considered the impacts of providing a healthier, happier and more connected lifestyle to the residents that would ultimately bring the site to life.¹²⁵

By approaching the next few years with fresh thinking, there is an opportunity to reshape the pattern of development to make a lasting impact on sustainable transport, fulfilling the potential of new homes and towns, and developing great places in which to live well.

APPENDIX A: METHODOLOGY

TABLE A1: THE RESPECTIVE CALCULATIONS FOR THE FIVE MEASURES UNDERPINNING OUR CAR DEPENDENCY INDEX (CDI).

Measure	Calculation
<p>Employment car advantage</p> <p>The ratio of the number of jobs within reach in 45 minutes by car and by public transport.</p>	$\frac{E_{\text{car}}}{E_{\text{PT}}}$ <p>E_{car} = number of jobs within reach in 45 minutes of travel by car</p> <p>E_{PT} = number of jobs within reach in 45 minutes of travel by public transport</p>
<p>Services car advantage</p> <p>The difference in average travel time to a secondary school, supermarket, hospital and local urban centre by car and public transport. The travel time to the nearest of each of the four services is averaged for each mode, and then the difference in the averages is calculated.</p>	$S_{\text{PT}} - S_{\text{car}}$ <p>S_{PT} = average of time in minutes to the nearest secondary school, supermarket, hospital, and local urban centre by public transport</p> <p>S_{car} = average of time in minutes to the nearest secondary school, supermarket, hospital, and local urban centre by car</p>
<p>Journey to work</p> <p>The proportion of commuters who travel to work by car or van (either as drivers or passengers) or by taxi.</p>	$\frac{R_{\text{car}}}{R - R_{\text{home}}}$ <p>R_{car} = residents in employment who normally travel to work by car, van or taxi</p> <p>R = all residents in employment</p> <p>R_{home} = residents in employment who normally work from home</p>
<p>Car ownership</p> <p>The proportion of households with one or more cars and vans.</p>	$\frac{H_{\text{car}}}{H}$ <p>H_{car} = households with access to one or more cars or vans</p> <p>H = all households</p>
<p>Residential sparsity</p> <p>The number of usual residents per square kilometre (reversed so that a lower number indicates higher sparsity)</p>	<p>- D</p> <p>D = residential density</p>

All data used is at the LSOA level. Where needed, LSOA11 geographies are fully converted to LSOA21 geographies using exact match look-up tables. The use of LSOA geographies for accessibility data in PTAI22 and AI23 possibly results in some inaccuracies in rural and low-density areas where LSOAs cover larger geographies.

To construct the composite index, all five variables were first transformed to a rank using an empirical cumulative distribution function. Rank transformation was chosen to eliminate an influence of skew in some of the variables (and to bring measures to a common scale). The index and each of the three domains – the extent of the car's advantage over public transport in accessing services and employment, residents' car-oriented behaviour, and development sparsity – were calculated as a mean of respective measures for each small area. Each of the domains and the index were subsequently rank transformed again for ease of interpretation.

The EPC dataset provides a nearly complete record of new dwellings, but a small proportion of the data could not be used in our analysis due to missing or inaccurate information used for the geolocation. For most of the analysis, we geolocated properties at the postcode level (a postcode usually covers around 15 addresses). Of the 2,787,475 new dwellings in the dataset for the period from 2009 to 2023, 0.4% of records have missing or non-existent postcodes and as such could not be used in the analysis.

For mapping and the green belt analysis, we geolocated new dwellings at a property level using unique property reference numbers (UPRNs). This has resulted in slightly higher missingness as 6.5% of the EPC records for the period from 2009 to 2023 do not have a UPRN.

APPENDIX B: LIST OF INTERVIEWS

Many thanks to our interviewees for their support in shaping the findings and recommendations of this report:

- Councillor Jennifer Wilson-Marklew, Cabinet Member for Public Realm, Milton Keynes City Council
- Gareth Fearn, School of Environment, Education and Development, University of Manchester
- Jenny Raggett, Director, Transport for New Homes
- Nick Small, Head of Built Environment and Infrastructure at Oxford Bus Company and Go South Coast, part of the Go-Ahead Group

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