Communities and Local Government

Residential Car Parking Research

planning

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Although this research was commissioned by Communities and Local Government, the findings and recommendations in this report are those of the author and DO NOT necessarily represent the views of Communities and Local Government

Introduction

This research, which was undertaken by WSP Ltd in association with Phil Jones Associates, TRL and David Lock Associates, considers expected levels of car ownership[1] and the factors which have a significant influence on car ownership and car parking demand, including:

- Dwelling size, type and tenure;
- Dwelling location;
- Availability of allocated and unallocated parking spaces;
- Availability of on-and off-street parking;
- Availability of visitor parking; and
- Availability of garage parking.

The Census is the most suitable source of car ownership data that is widely available, and one way of presenting this data is set out in Appendix A.

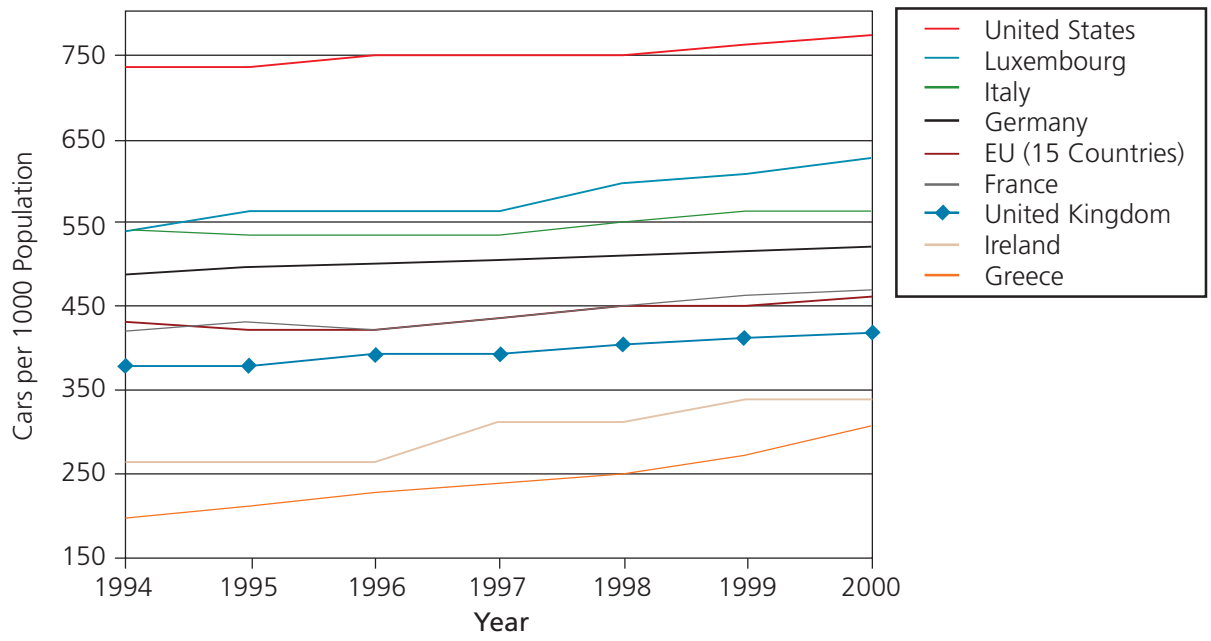
Growth in car ownership

Figure 1 shows how car ownership has grown in recent years in the United Kingdom (UK) and in other countries. It suggests that the number of cars per household in the UK does not appear to be reaching saturation level and that car ownership is:

- Lower in the UK than the average for the EU;
- Lower in the UK than in other similarly-developed countries; and
- Likely to continue to grow for the foreseeable future.

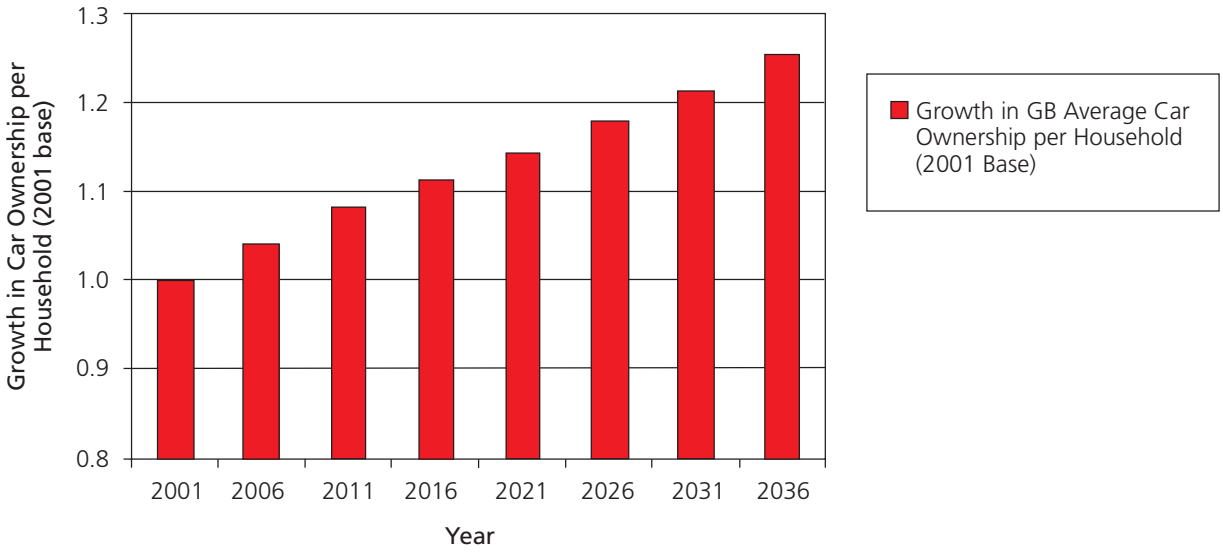
1 Throughout this research 'car ownership' is used to refer to the number of cars and vans that are available for use by one or more members of a household. It includes company cars and vans that are normally parked at the home.

Figure 1: Growth In Car Ownership Per Person (Source – EU)



Predictions of growth in car ownership (down to local authority level and below in some cases) can be derived from the TEMPRO[2] model. Figure 2 shows the increase in car ownership per household predicted by the model for Great Britain for the period up to 2036. TEMPRO forecasts take into account planning data, including forecasts of growth in population and households in each local authority area. These forecasts of car ownership growth are for all dwellings, and do not take into account dwelling size, type and tenure.

Figure 2: Tempro Forecasts Of Car Ownership Growth



2 TEMPRO is a computer program prepared and issued (as a free download) by the Department for Transport – see www.tempro.org.uk. It has also been used to derive the average 2026 car ownership values set out in this research.

Factors influencing car ownership and car parking demand

Dwelling size, type and tenure

Dwelling size and type are major factors in determining car ownership levels. This is logical as larger dwellings are more likely to be inhabited by more people of driving age and/or households with larger incomes. Conversely, smaller dwellings tend to be occupied by single-person households. The number of bedrooms has often been used as a proxy for size, however this is a coarse measure given the significant variation in car ownership that has been found between, say 4 and 5 room dwellings, and the fact that in most flats there is little difference between individual rooms (other than kitchens) and the uses to which they can be put. This research uses the number of rooms (as defined by the Census)[3] as the proxy for dwelling size.

Tenure is another influence on household car ownership. In particular, households occupying rented accommodation can have up to 0.5 fewer cars than owner-occupied households in dwellings of similar size and type. Local planning authorities will wish to consider tenure carefully when developing car parking policies given that any future changes in the tenure of dwellings may change the nature and demand for car parking.

Appendix A sets out car ownership levels for all households in England, based upon the 2001 Census. The data is categorised by dwelling type, tenure and size (number of rooms). This enables the car ownership levels for particular categories of dwelling to be identified.

Dwelling location

In terms of location, local planning authorities may wish to consider the effect on car ownership of the availability of local services that can be reached on foot and by cycle and access to public transport.

To assist their understanding of these effects within their areas, local planning authorities can obtain from National Statistics the Census data set out in Appendix A, broken down to smaller geographical levels such as wards or Census Output Areas (COAs)[4]. This data can then be used to examine in detail car ownership patterns in a particular settlement or for a part of an urban area, such as a city centre.

Basing expected car ownership upon Census or other survey data, as set out above, implicitly assumes that new housing will have similar car ownership characteristics to the existing housing stock in the area. Local planning authorities will want to consider whether this is an appropriate generalisation when developing car parking policies for their area.

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3 'Rooms' are defined in the 2001 Census as follows: The count of the number of rooms in a household's accommodation does not include bathrooms, toilets, halls or landings, or rooms that can only be used for storage. All other rooms, for example, kitchens, living rooms, bedrooms, utility rooms and studies are counted.

4 COAs typically consist of around 100-200 dwellings and there can be between 10-80 COAs in a Ward.

The availability of public car parking spaces should also be considered. In areas where all on-street parking is controlled by Controlled Parking Zones, it may be acceptable to provide parking below normal levels of demand.

Availability of allocated and unallocated car parking spaces

The allocation of spaces to individual dwellings can have an adverse impact upon the efficiency of car parking provision. Allocated parking spaces include any spaces within the curtilage of a property (eg garage or driveway parking) and any spaces in communal areas where the space is reserved for one particular property. On-street spaces upon public highways are always unallocated although they can be reserved for a particular purpose such as disabled persons' or residents' parking.

The potential impact of allocated car parking spaces is best illustrated through a worked example, as set out below. In 2001, the profile of car ownership for households in 5 room owner-occupied houses in England[5] was:

- 16% had no car;
- 53% had one car;
- 26% had two cars;
- 4% had three cars; and
- 1% had four or more cars.

Assuming a one to one relationship between households and dwellings (as this research does), this gives an overall demand of 1.2 car parking spaces per dwelling, assuming that the car parking spaces are unallocated (ie shared). However, if each dwelling were to be allocated one car parking space (which could not be used by any other household), then 16% of the allocated spaces would be unused (ie by households with no car). Also, there would be additional demand for parking spaces from households with two or more cars which would equate to:

ADDITIONAL DEMAND FOR PARKING PER DWELLING =

1 X (PROPORTION OF TWO CAR HOUSEHOLDS) +

2 X (PROPORTION OF THREE CAR HOUSEHOLDS) +

3 X (NO. OF FOUR CAR HOUSEHOLDS)

Which in this case would be:

Additional demand = (1 x 0.26) + (2 x 0.04) + (3 x 0.01) = 0.37 cars per dwelling

The overall parking requirement per dwelling would therefore be:

1.0 allocated space + 0.37 unallocated space = 1.37

5 See Table A1.2 in Appendix A for source data.

In other words, by allocating 1.0 space per dwelling, the overall parking requirement would increase to 1.37 spaces per dwelling, which would result in a 13% (1.37/1.2) increase in the space required for parking, compared to a situation where car parking is unallocated.

If this approach is applied to flats, the efficiency advantages of unallocated parking are even greater. For example, the profile of car ownership for households in 5 room owner occupied flats in 2001 for England[6] was:

- 24% had no car;
- 56% had one car;
- 17% had two cars;
- 2% had three cars; and
- 1% had four or more cars.

This gives an overall demand of 1.0 car parking space per dwelling, assuming that the car parking spaces are unallocated. The additional demand for car parking, if each dwelling were allocated one car parking space, is set out below.

ADDITIONAL DEMAND FOR PARKING PER DWELLING =

1 X (PROPORTION OF TWO CAR HOUSEHOLDS) +

2 X (PROPORTION OF THREE CAR HOUSEHOLDS) +

3 X (NO. OF FOUR CAR HOUSEHOLDS)

Which in this case would be:

Additional demand = (1 x 0.17) + (2 x 0.02) + (3 x 0.01) = 0.24 cars per dwelling

The overall parking requirement per dwelling would therefore be:

1.0 allocated space + 0.24 unallocated space = 1.24

When 1.0 allocated space per unit is provided there is still a demand for unallocated parking of an additional 0.24 spaces per unit, making 1.24 in total. Thus in this case there is a 24% (1.24/1.0) increase in the space required for parking, compared to a situation where car parking is unallocated.

The examples set out above illustrate how the allocation of one car parking space per dwelling can create additional demand for car parking. Local planning authorities will want to calculate the effect of allocating one or more car parking spaces per dwelling using their own local data on car ownership. For the purposes of this research, Table 1 considers the typical relationship between average car ownership and additional demand for unallocated parking based upon 2001 Census data. A worked example of how this table can be used to estimate car-parking demand is set out in Appendix C.

6 See Table A1.3, in Appendix A for source data.

Table 1: Typical Additional Demand for Unallocated Parking

Average Car Ownership Per Dwelling	Typical Additional Demand for Unallocated Parking	
	With 1 Allocated Space per dwelling	With 2 Allocated Spaces per dwelling
0.1	0.0	0.0
0.2	0.0	0.0
0.3	0.0	0.0
0.4	0.0	0.0
0.5	0.1	0.0
0.6	0.1	0.0
0.7	0.1	0.0
0.8	0.2	0.0
0.9	0.2	0.0
1.0	0.2	0.0
1.1	0.3	0.0
1.2	0.4	0.1
1.3	0.4	0.1
1.4	0.5	0.1
1.5	0.6	0.1
1.6	0.7	0.1
1.7	0.8	0.2
1.8	0.8	0.2
1.9	0.9	0.2
2.0	1.0	0.3
2.1	1.1	0.3
2.2	1.2	0.4
2.3	1.3	0.4
2.4	1.4	0.5
2.5	1.5	0.6
2.6	1.6	0.6
2.7	1.7	0.7

Availability of on and off street parking

In the past, local planning authority approaches to residential car parking have typically focused on off-street provision due to concerns that on-street parking may lead to problems of congestion and road accidents. Whilst these concerns may be well-founded in some existing streets, on-street parking does make a valuable and flexible contribution to the overall supply of parking and need not be problematic, especially when streets are designed so that traffic speeds are kept low and adequate space is allowed for moving vehicles and pedestrians. Recommendations for the design of on-street parking in residential areas are set out in *Manual for Streets*[7].

7 *Manual For Streets*, Department for Transport and Communities and Local Government, March 2007. See http://www.communities.gov.uk/planning.

This research recommends that well-designed on-street parking in residential areas can explicitly count towards the overall supply of unallocated spaces, regardless of whether the spaces are formally marked or are simply occasional spaces on the highway.

Availability of visitor parking

Whilst there are times, such as evenings and weekends, when residents are likely to receive significant numbers of visitors in cars, this demand can to some degree be offset by other residents being away at the same time. This balancing effect is most significant when a high proportion of parking spaces are unallocated (and so available to both visitors and residents). This research suggests that no special provision need be made for visitors where at least half of the parking provision associated with a development is unallocated. In all other circumstances, it may be appropriate to allow for additional demand for visitor parking of up to 0.2 spaces per dwelling[8].

Availability of garage parking

Local planning authorities will need to consider whether to count private garages as car parking spaces given that they are not used for this purpose by a significant proportion of residents[9]. This is a complex issue, as garage use depends upon a number of factors including the adequacy of storage within the dwelling, the ease of use of the garage and the difficulty (or otherwise) of finding a parking space outside the garage.

Local planning authorities will want to encourage approaches that provide well utilised car parking spaces within housing schemes. For example, this could involve requiring car ports rather than fully enclosed garages or dwellings that make adequate provision for storage. Where developers provide garages which are likely to be under-used, authorities will want to consider the effect of this in terms of additional parking demand, and its impact in terms of street design requirements. Further advice on this issue is set out in *Manual for Streets*.

Average car ownership: The National Matrix

To assist understanding of likely future car ownership growth, Tables 2 and 3 set out illustrative national matrices for average car ownership values for 2001 and 2026, based upon 2001 Census data and using the TEMPRO forecasting tool. The tables show a range of average car ownership values according to dwelling type, size,

8 This is based upon research by Jenks and Noble in their 1996 study of Lower Earley in Reading. They recommended that no special provision need be made for visitors when at least half of the parking provision associated with a development is unallocated. In all other circumstances it was advised that an additional demand, equivalent of up to 0.2 spaces per dwelling, would be generated by visitors.

9 This was re-affirmed by the case study questionnaires carried out as part of the research, where less than one third of respondents said that they parked their cars in their garages.

tenure and location and use regional-level forecasts for car ownership growth. Although Census data is available for different tenures (see Appendix A), these illustrative matrices focus on one particular tenure, ie owner-occupied dwellings. Both tables show that car ownership generally increases as the number of rooms in dwellings increase. Houses have higher car ownership levels than flats whilst in terms of location, rural and remote rural areas have the highest levels of car ownership. Background information on how the values in the tables were calculated is set out in Appendix B.

Table 2: 2001 Average Car Ownership Values[10]

2001	Remote Rural		Rural		Suburban		Urban		City Centre		Inner London	
Number of Rooms	Flats	Houses	Flats	Houses	Flats	Houses	Flats	Houses	Flats	Houses	Flats	Houses
1	X	X	X	X	0.4-0.9	X	0.4-0.8	X	0.3-0.6	X	0.4-.06	X
2	X	X	0.6-1.0	X	0.6-0.9	X	0.5-0.7	X	0.4-0.6	X	0.5-0.6	X
3	0.7-0.9	0.8-1.1	0.6-1.0	0.9-1.2	0.6-0.8	0.8-1.1	0.5-0.7	0.7-1.0	0.4-0.6	0.6-0.9	0.6-0.6	0.7-0.9
4	0.7-1.0	1.0-1.2	0.7-1.1	1.0-1.2	0.7-0.9	0.9-1.1	0.7-0.8	0.8-1.0	0.5-0.8	0.6-0.9	0.7-0.8	0.8-0.9
5	1.2-1.5	1.2-1.4	1.0-1.4	1.2-1.5	0.9-1.2	1.0-1.4	0.8-1.0	0.9-1.2	0.7-0.9	0.8-1.1	0.8-0.9	0.9-1.1
6	1.2-1.8	1.3-1.6	1.3-1.8	1.4-1.7	1.0-1.5	1.1-1.5	0.9-1.3	1.0-1.3	0.8-1.2	0.9-1.2	0.9-1.0	1.0-1.2
7	X	1.6-1.8	X	1.6-1.9	X	1.4-1.8	X	1.2-1.6	X	1.1-1.4	X	1.1-1.3
8	X	1.8-2.2	X	2.0-2.3	X	1.7-2.1	X	1.5-1.8	X	1.3-1.7	X	1.3-1.6

Table 3: 2026 Average Car Ownership Values[11]

2001	Remote Rural		Rural		Suburban		Urban		City Centre		Inner London	
Number of Rooms	Flats	Houses	Flats	Houses	Flats	Houses	Flats	Houses	Flats	Houses	Flats	Houses
1	X	X	X	X	0.4-1.1	X	0.5-0.9	X	0.4-0.7	X	0.5-.07	X
2	X	X	0.7-1.1	X	0.7-1.0	X	0.6-0.8	X	0.5-0.7	X	0.5-0.7	X
3	0.8-1.1	1.0-1.3	0.7-1.1	1.1-1.4	0.7-1.0	1.0-1.2	0.6-0.9	0.8-1.1	0.5-0.8	0.7-1.1	0.7-0.7	0.8-1.0
4	0.9-1.2	1.2-1.4	0.9-1.3	1.2-1.4	0.8-1.1	1.0-1.3	0.8-1.0	0.9-1.2	0.6-0.9	0.8-1.1	0.8-0.9	0.9-1.1
5	1.4-1.7	1.4-1.7	1.2-1.7	1.5-1.7	1.0-1.4	1.2-1.6	0.9-1.2	1.1-1.4	0.9-1.1	0.9-1.3	0.9-1.1	1.1-1.3
6	1.4-2.1	1.6-1.9	1.6-2.1	1.6-2.0	1.2-1.7	1.4-1.7	1.0-1.5	1.2-1.5	0.9-1.4	1.0-1.4	1.0-1.2	1.1-1.4
7	X	1.8-2.2	X	1.9-2.3	X	1.6-2.1	X	1.4-1.8	X	1.3-1.7	X	1.3-1.5
8	X	2.1-2.6	X	2.3-2.7	X	2.0-2.4	X	1.7-2.1	X	1.6-2.0	X	1.4-1.8

10 Cells marked X are where insufficient data was available to provide representative values

11 Cells marked X are where insufficient data was available to provide representative values.

Calculating car parking demand

An example of how car parking demand may be calculated, taking into account the influencing factors already previously discussed (eg dwelling type, size, tenure and location) is set out in Table 4. This shows, for a particular dwelling category, ie owner-occupied houses in suburban locations, how the total demand for car parking spaces varies depending on dwelling size and the extent to which car parking spaces are allocated.

Table 4: Example Calculation Of Car Parking Demand

Type: Houses Location: Suburban Tenure: Owner Occupied	Total Demand for Car Parking Spaces (Allocated and Unallocated)		
No of Allocated Spaces Per Dwelling	0	1	2
3 Room House	1.1	1.5	2.2
4 Room House	1.2	1.6	2.3
5 Room House	1.4	1.7	2.3
6 Room House	1.6	1.9	2.3
7 Room House	1.9	2.1	2.4
8 Room House	2.2	2.2	2.6

The details of how this worked example was developed are set out in Appendix C. Local planning authorities may wish to develop similar approaches to calculating car parking demand, taking into account the characteristics of housing in their area and local assessments of future household and car ownership levels.

Appendix A: Car ownership cross tabulations, 2001 Census Data

The following tables set out for each household, car ownership levels related to the size, type and tenure of dwelling.

Table A1.1: Owner Occupied Houses in England – Number of Cars or Vans, 2001

	Total Number of households	Number of households with particular numbers of cars or vans				
		None	One	Two	Three	Four +
All owner-occupied houses	12743372	1680294	5885010	4115485	814097	248486
3 rooms	217234	56592	120334	34999	4301	1008
4 rooms	1710922	402101	964162	304202	32705	7752
5 rooms	3776671	602943	1997450	987355	153435	35488
6 rooms	3352073	441547	1611008	1061951	189438	48129
7 rooms	1651516	102099	643287	711826	149780	44524
8 or more rooms	1975592	58746	516546	1006050	283092	111158

Table A1.2: Owner Occupied Houses In England – Proportions owning particular numbers of Cars or Vans and Average Car Ownership, 2001

	Percentage of households with particular numbers of cars or vans					Average No. Cars and Vans/ Household
	None	One	Two	Three	Four +	
All owner-occupied houses	13%	46%	32%	6%	2%	1.4
3 rooms	26%	55%	16%	2%	0%	1.0
4 rooms	24%	56%	18%	2%	0%	1.0
5 rooms	16%	53%	26%	4%	1%	1.2
6 rooms	13%	48%	32%	6%	1%	1.3
7 rooms	6%	39%	43%	9%	3%	1.6
8 or more rooms	3%	26%	51%	14%	6%	1.9

Table A1.3: Owner Occupied Flats in England – Number of Cars or Vans, 2001

	Total Number of households	Number of households with particular numbers of cars or vans				
		None	One	Two	Three	Four +
All owner-occupied flats	1117262	358996	611677	127330	15007	4252
1 room	69604	29126	35806	4100	401	171
2 rooms	304680	118588	161578	21774	2088	652
3 rooms	520683	159366	293847	60253	5685	1532
4 rooms	143217	34270	80404	24249	3490	804
5 rooms	14082	6504	6781	678	78	41

Table A1.4: Owner Occupied Flats In England – Proportions owning particular numbers of Cars or Vans and Average Car Ownership, 2001

	Percentage of households with particular numbers of cars or vans					Average No. Cars and Vans/ Household
	None	One	Two	Three	Four +	
All owner-occupied flats	32%	55%	11%	1%	0%	0.8
1 room	46%	48%	5%	1%	0%	0.6
2 rooms	42%	51%	6%	1%	0%	0.7
3 rooms	39%	53%	7%	1%	0%	0.7
4 rooms	31%	56%	12%	1%	0%	0.8
5 rooms	24%	56%	17%	2%	1%	1.0

Table A2.1: Non-Owner Occupied Houses in England – Number of Cars or Vans, 2001

	Total Number of households	Number of households with particular numbers of cars or vans				
		None	One	Two	Three	Four +
All non–owner occupied houses	3442231	1549632	1404323	397187	69324	21765
3 rooms	269702	173573	83645	10656	1360	468
4 rooms	859826	428482	351526	70687	7009	2122
5 rooms	1262422	546938	541266	146109	22664	5445
6 rooms	676021	269556	286919	95658	18755	5133
7 rooms	179635	58416	74148	35344	8594	3133
8 or more rooms	126836	31076	44500	35522	10465	5273

Table A2.2: Non-Owner Occupied Houses In England – Proportions owning particular numbers of Cars or Vans and Average Car Ownership, 2001

	Percentage of households with particular numbers of cars or vans					Average No. Cars and Vans/ Household
	None	One	Two	Three	Four +	
All non-owner occupied houses	45%	41%	12%	2%	1%	0.7
3 rooms	64%	31%	4%	1%	0%	0.4
4 rooms	50%	41%	8%	1%	0%	0.6
5 rooms	43%	43%	12%	2%	0%	0.7
6 rooms	40%	42%	14%	3%	1%	0.8
7 rooms	33%	41%	20%	5%	2%	1.0
8 or more rooms	25%	35%	28%	8%	4%	1.3

Table A2.3: Non-Owner Occupied Flats In England – Number of Cars or Vans, 2001

	Total Number of households	Number of households with particular numbers of cars or vans				
		None	One	Two	Three	Four +
All non-owner occupied flats	2651616	1648454	852753	127495	16544	6370
1 rooms	135426	100294	32371	2005	416	340
2 rooms	318327	220365	88502	7950	893	617
3 rooms	995152	671041	289518	29717	3451	1425
4 rooms	852259	478818	312278	54390	5007	1766
5 rooms	254332	131966	95505	22171	3753	937

Table A2.4: Non-Owner Occupied Flats In England – Proportions owning particular numbers of Cars or Vans and Average Car Ownership, 2001

	Percentage of households with particular numbers of cars or vans					Average No. Cars and Vans/ Household
	None	One	Two	Three	Four +	
All non-owner occupied flats	62%	32%	5%	1%	0%	0.4
1 rooms	74%	24%	1%	0%	0%	0.3
2 rooms	69%	28%	2%	0%	0%	0.3
3 rooms	67%	29%	3%	0%	0%	0.4
4 rooms	56%	37%	6%	1%	0%	0.5
5 rooms	52%	38%	9%	1%	0%	0.6

Appendix B: Definition of location types and calculation of average car ownership values

This appendix outlines the methodology used by this research to select representative samples of car ownership data based upon six location categories: Inner London, city centre, urban, suburban, rural and remote rural as a basis for development of the national matrices described on p11 and set out in Tables 2 and 3.

The data was obtained from the 2001 Census using the format set out in Appendix A. This spreadsheet provides car ownership data at household level for all districts across England. The cross-tabulations show the number of households with particular numbers of cars or vans (none, one, two, three and four+ cars) compared by dwelling size. Separate tables were obtained for different dwelling types (houses and flats) and for different tenures (owner occupied, rented and shared equity). In order to examine car ownership patterns within districts, Census Output Area (COA)[12] data on car ownership, dwelling size, type and tenure was obtained for all regions in England.

The analysis considered owner-occupied flats and houses across England. Although the cross-tabulated data is available for non-owner occupied dwellings, it was not possible to carry out a similar analysis for these tenures within the timeframe of this research. Regional variations in car ownership were assessed by taking samples in all regions.

The method used to determine typical car ownership levels compares sample ward data for the six categories of location with the relevant district-wide car ownership data, as described below.

Inner London

2001 Census data was taken for the 14 districts in Inner London and the average car ownership values for owner-occupied flats and houses was calculated for dwelling sizes of 1-8 rooms. Ranges of average car ownership values were then calculated by taking 1 standard deviation either side of the mean and these are presented in the final two columns in Table 2.

Average car ownership values were then extrapolated to 2026 using TEMPRO[13]. Forecasts given in TEMPRO for total car ownership and the total number of households in London were generated for 2001 and 2026 and a growth factor calculated by dividing [cars per household for 2001] by [cars per household for 2026]. This growth factor was then applied to 2001 Census data. The resulting 2026 car ownership results are given in the final two columns in Table 3.

12 COAs typically consist of around 100-200 dwellings and there can be between 10-80 COAs in a Ward.

13 TEMPRO is a computer program prepared and issued (as a free download) by the Department for Transport – see www.tempro.org.uk.

City Centre

'City Centre' was a more complex category to define. The method for extracting city centre car ownership data was to firstly rank all metropolitan and unitary authorities by population. Areas were selected from the 20 authorities with the highest population, if they fulfilled the following criteria:

- The area was defined as a city; and
- At least 75% of one of the wards in the city covered the city centre.

For each of the selected cities, COAs from the city centre ward were selected if they had greater than 75% owner occupied properties.

Average car ownership values against average number of rooms per COA were then plotted for these COAs and a power law line of regression was calculated[14]. A similar exercise was carried out for the district as a whole. A geographic factor was then calculated by examining the differences between the district regression line and the city centre regression line, comparing average car ownership values by COA for 4 points on both trend lines.

Once geographic correction factors had been established for all the selected locations, they were applied to the respective district wide (household level) cross-tabulation data to obtain values representative of each city centre. The resulting car ownership values were then averaged and a range of results calculated for 1 standard deviation either side of the mean, as with the Inner London data, giving the results in Table 2.

The regional growth factors from TEMPRO were then applied to the relevant factored district wide data. Averages and standard deviations were subsequently calculated and the 2026 City Centre car ownership results can be seen in Table 3.

Urban

To establish 'Urban' locations, all wards in England were firstly ranked by population density, with the top 20% of wards being selected. These wards were then ranked according to the ratio of people who live in the ward to the number of people who work in the ward. From this, the central 50% band of wards were selected and separated into regional groups. This process identified wards in each region that are relatively densely developed and comprise a reasonably balanced mix of residential and employment areas.

From each regional group, three wards were selected at random. Each selected ward was studied on a ward map to check that it covered an urban area. Three adjoining wards were then selected that were also within an urban area. The three adjoining wards did not necessarily have to border the original ward but all four wards had to border at least one of the four. These four wards were then considered to make up a 'cluster'.

14 A power law regression line is a mathematical approach whereby a curve is fitted against a set of plotted points.

By this process three urban ward clusters were selected for each of the nine English regions (excluding Inner London), making 27 ward clusters in all.

For each ward cluster, COAs with greater than 75% owner occupation were selected. A similar process of regression analysis to that described above was then carried out to establish average car ownership values for urban areas, as given in Table 2. Values for 2026 were obtained by applying the relevant TEMPRO factors and the results are given in Table 3.

Suburban

To identify 'Suburban' areas, all English wards were ranked by their live to work ratio with the bottom 10% being selected, ie those wards with a large number of residents compared to the number of employees. These wards were then ranked by population density and those wards with more than 40 persons per hectare were selected and grouped regionally. This process identified wards in each region that are reasonably densely developed and are mainly residential in character.

As with the urban wards, three wards were selected at random from each English region. Each ward was studied on a map to assess if the area could reasonably be considered suburban. For each selected ward, three adjoining wards were then chosen to form a suburban cluster.

As with the previously-described location types, geographic correction factors and growth factors were calculated using COA data and the 2001 and 2026 car ownership results can be seen in Tables 2 and 3.

Rural and Remote Rural

To identify 'Rural' and 'Remote Rural' locations, all wards in England were ranked by population density and the lowest 10% were selected. These wards were then sorted by region and a number of wards randomly selected from each region. These wards were then categorised as 'Rural' or 'Remote Rural' using the following method:

- Rural – there are no 'Urban Centres' within the ward, but the spatial centre of the ward is less than 10 km from the nearest 'Town'; and

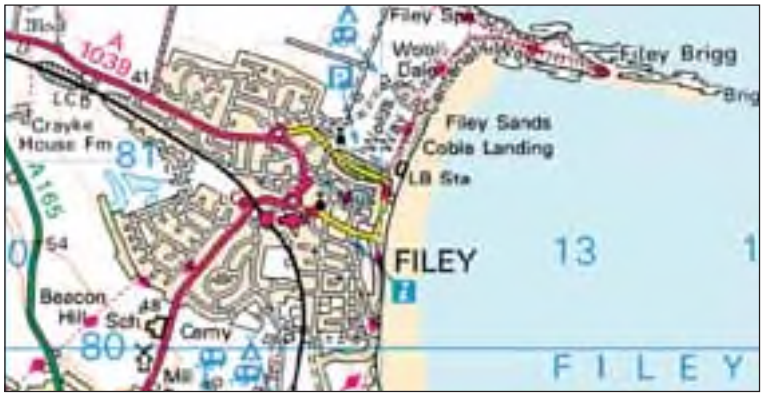
- Remote Rural – there are no 'Urban Centres' within the ward and the spatial centre of the ward is greater than 10 km from the nearest 'Town'.

An 'Urban Centre' was defined as any settlement with a geographical extent greater than 1km^2 and a Town was defined as any Urban Centre which exceeds 2km^2 in geographical extent. As an example, Clun in Shropshire (below) is less than 1km^2 in geographical extent (the overlain grid represents 1km squares), so it was not classed as an urban settlement.



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Filey in North Yorkshire (below), is between 1km^2 and 2km^2 in geographical extent and is classified as an Urban Centre. A rural or remote rural ward would not contain a settlement of this size.



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Truro (below), in Cornwall, is greater than 2km^2 in geographical extent and was classified as a Town. A rural or remote rural ward would not contain a settlement of this size. In addition, the geographical centroid of any remote rural ward would not lie within 10km of a settlement of this size.



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Once a ward had been categorised as rural or remote rural, the process of forming clusters, developing geographic correction factors and applying growth were as described above, resulting in the values given in Tables 2 and 3.

Appendix C: Worked example of calculating car parking demand

This appendix explains how Table 4, described on p12 of this research, was created following 5 steps:

Step 1: Take average car ownership values for suburban, owner-occupied houses for 2026 from Table 3 (p11), using values that are in the centre of the range given in the table (rounded to the nearest 0.1 space per dwelling).

Table C1: Average Car Ownership per Dwelling, 2026

Rooms	Average 2026 Car Ownership Per Dwelling from Table 3 (nearest 0.1)
3	1.1
4	1.2
5	1.4
6	1.6
7	1.9
8	2.2

Step 2: Using average car ownership levels in Table C1, look up in Table 1 (p9) to find additional demand for unallocated parking arising as a consequence of up to 1 or 2 spaces being allocated per dwelling.

Table C2: Additional Demand for Unallocated Parking

	Additional Demand for Unallocated Parking	
Rooms	1 Allocated Space per Dwelling	2 Allocated Spaces per Dwelling
3	0.3	0.0
4	0.4	0.1
5	0.5	0.1
6	0.7	0.1
7	0.9	0.2
8	1.2	0.4

Step 3: Combine Tables C1 and C2 to produce total demand for residents' parking. The values in the '1 Allocated' and '2 Allocated' columns in Table C3 are obtained by adding 1 and 2 to the values in the relevant columns in Table C2.

Table C3: Total Demand for Residents' Parking

	Total Demand for Residents' Parking		
Rooms	0 Allocated Parking Spaces per Dwelling	1 Allocated Parking Space per Dwelling	2 Allocated Parking Spaces per Dwelling
3	1.1	1.3	2.0
4	1.2	1.4	2.1
5	1.4	1.5	2.1
6	1.6	1.7	2.1
7	1.9	1.9	2.2
8	2.2	2.2	2.4

Step 4: Calculate the proportion of total demand for residents' parking that is for additional unallocated spaces. The percentages are calculated by dividing the additional demand for unallocated spaces (cells in tables C1 and C2) by the total demand for residents' parking (cells in table C3).

For example, for 5 room dwellings, with 1 allocated space:

Additional demand for unallocated parking = 0.5

Total demand for residents' parking = 1.5

Proportion of total demand that is for additional unallocated parking = 0.5/1.5 = 33%

Table C4: Proportion of Total Demand for Residents' Parking that is for Additional Unallocated Parking

Rooms	Proportion of Total Demand for Residents' Parking that is for Additional Unallocated Parking		
	0 Allocated Parking Spaces per Dwelling	1 Allocated Parking Space per Dwelling	2 Allocated Parking Spaces per Dwelling
3	100%	23%	0%
4	100%	29%	5%
5	100%	33%	5%
6	100%	41%	5%
7	100%	47%	9%
8	100%	55%	17%

Note – Shaded cells are where less than 50% of total demand would be for additional unallocated parking

Step 5: Allow for 0.2 spaces per dwelling for visitors for the shaded cells, to produce the final table.

Table C5: Total Demand for Residents' Parking

Type: Houses Location: Suburban Tenure: Owner Occupied	Total Demand for Residents' Spaces (Allocated and Unallocated Spaces)		
Number of Allocated Spaces Per Dwelling	0	1	2
3 Room House	1.1	1.5	2.2
4 Room House	1.2	1.6	2.3
5 Room House	1.4	1.7	2.3
6 Room House	1.6	1.9	2.3
7 Room House	1.9	2.1	2.4
8 Room House	2.2	2.2	2.6