
Heat Mapping and Decentralised Energy Feasibility Study

Phase 1: Data Gathering and Mapping

A Report for
Advantage West Midlands

April 2008

Halcrow Group Limited



Contents

1	Introduction	1
1.1	Purpose of the Study	1
1.2	Scope of Phase 1	1
1.3	Structure of this Document	1
1.4	Acknowledgement of Data Sets and Information Sources	2
2	Current Domestic Demand	3
2.1	Introduction	3
2.2	Methodology	3
2.3	Results of Current Domestic Demand Modelling	4
2.4	Conclusions	8
3	Current Non Domestic Demand	9
3.1	Introduction	9
3.2	Methodology	9
3.3	Results of Current Non Domestic Demand Modelling	10
3.4	Conclusions	14
4	Future Demand	15
4.1	Introduction	15
4.2	Domestic Demand	15
4.3	Non-Domestic Demand	20
4.4	Conclusion	25
5	Current Gas Supply	26
5.1	Introduction	26
5.2	State of the Region	26

1 Introduction

1.1 Purpose of the Study

Halcrow Group Ltd was commissioned by Advantage West Midlands in November 2007 to undertake the **Heat and Energy Mapping and Decentralised Energy Feasibility Study** for the West Midlands region.

West Midlands currently imports around 60% of its heat energy and an even greater percentage of its electricity. Considering the overarching role of Advantage West Midlands as an enabler of sustainable economic development in the region, the agency seeks to reduce the region's reliance on fossil fuels and improve energy security.

Promoting the uptake of decentralised energy is envisaged to contribute significantly towards achieving this vision. Within this context, the key aims of the study are to establish an evidence base to help inform the public and private investment on decentralised energy projects, combined heat and power (CHP) solutions in particular. Further, the specific objectives of the project include:

- Estimate the current and future demand for heat and electricity in the West Midlands Region
- Review the current gas and electricity supply networks in the Region
- Build on the demand and supply evidence to identify potential domestic, commercial and industrial opportunities for decentralised energy solutions, combined heat and power in particular
- Appraise the practical, economic and technical feasibility of above mentioned opportunities
- Stimulate the market for skills and business opportunities in the decentralised energy agenda across the region.

Based on the identified objectives, the study adopts a two phased approach:

- Phase 1: Data gathering and mapping including lower super output area level domestic, commercial and industrial heat and electricity demand estimation and review of the gas and electricity supply networks.
- Phase 2: Analysis of Phase 1 outputs to identify potential CHP scenarios, test their feasibility and engage key public and private stakeholders to promote these opportunities.

1.2 Scope of Phase 1

Any policy frameworks are only as good as the evidence base that guides their development process. Considering the scope of this study, the outputs of Phase 1 are vital to clearly establish the demand and supply side dynamics of the region's electricity and heat use, not least to identify:

- Areas within the West Midlands of high domestic and industrial energy use (electricity and heat/cooling use)
- Areas within the West Midlands that are off the gas grid and therefore more attractive for alternative fuels heat supply.

To facilitate such thorough analysis, the evidence base should entail the following:

- Small area level current domestic heat and electricity demand in the West Midlands region
- Small area level current non-domestic heat and electricity demand in the West Midlands region
- Small area level current gas supply within the West Midlands region.

Considering the nature of this study, it is equally necessary to establish the future heat and electricity demand from both domestic and non-domestic sectors in the region.

1.3 Structure of this Document

Based on scope of Phase 1 identified in paragraphs above, the remainder of this report is structured around the following:

- Chapter 2: Current Domestic Demand
- Chapter 3: Current Non Domestic Demand
- Chapter 4: Future Demand Trends
- Chapter 5: Current Supply
- Chapter 6: Conclusions and Way Forward.

The document includes the following annexes:

- Annex A: Technical Note on Average Energy Consumption for Domestic and Non Domestic Use
- Annex B: Demand Results – A Sub-regional Picture.

1.4 Acknowledgement of Data Sets and Information Sources

The preparation of Phase 1 outputs involved using various datasets from a range of sources from the public domain. These include:

- Census 2001 Household Spaces and Accommodation Type (at LSOA1 level), Office of National Statistics (www.neighbourhood.statistics.gov.uk)
- 2006 Dwelling Stock by Council Tax Band (at LSOA level), Department of Communities and Local Government – Housing Data and Statistics Department, (www.neighbourhood.statistics.gov.uk)
- 2005 Annual Business Inquiry Workplace Analysis employment and workunits (at LSOA level), Office of National Statistics (www.nomisweb.co.uk)
- 2006 UK Business Monitor: Local Units in VAT-based enterprises (at Local Authority level), Office of National Statistics (www.statistics.gov.uk)
- 2006/07 UK Annual Population Survey Workplace Employment (at Local Authority Level), Office of National Statistics (www.nomisweb.co.uk)
- High Pressure Gas Pipeline Location, National Grid (www.nationalgrid.co.uk)
- 2006/07 to 2015/16 Regional Housing Completions Projections (site level), RSS Draft Preferred Option, Regional Assembly
- Fifty most likely employment sites to be developed by 2021 in the West Midlands region, Advantage West Midlands
- Good Practice Guide 234: Guide to community heating and CHP, Energy Efficiency Best Practice, 2002
- 2004 Experimental High Level Energy Indicators (www.berr.gov.uk)
- Electricity and Gas consumption estimates 2005 for West Midlands Government Office (www.berr.gov.uk)
- 2005 Detailed Service Sector Final Energy Consumption by Sub-Sector and End Use by Fuel (www.berr.gov.uk)
- 2005 Detailed Industrial Final Energy Consumption by Sub-Sector and End Use by Fuel (www.berr.gov.uk)
- Household Gas Connections for the West Midlands (at Post Code Sector level), Advantage West Midlands
- 2004 Indices of Multiple Deprivation: Central Heating Indicator (percentage of households without central heating at LSOA level), former Office of Deputy Prime Minister (www.neighbourhood.statistics.gov.uk)
- Long Term Development Statement for Central Networks West 2006 – 2011, Central Networks – A Company of E-ON
- National Grid Gas and Electricity Transmissions System of England, Wales and Scotland 2007, National Grid.

¹ LSOA or Lower Super Output Areas are a geographic areas defined by the Office of National Statistics on the basis of resident population. All LSOA on average include 1,500 residents.

2 Current Domestic Demand

2.1 Introduction

This section presents the approach adopted and the results of Lower Super Output Area (LSOA) level current domestic demand for heat and electricity in the West Midlands. As mentioned earlier in the report Lower Super Output Areas or LSOAs are a geographic areas defined by the Office of National Statistics on the basis of resident population. All LSOA on average include 1,500 residents.

2.2 Methodology

The starting point of this exercise was the Census 2001 Household Spaces and Accommodation Type data. This data was sourced for the West Midlands region at LSOA level. This stock data was used to determine the percentage breakdown of housing stock by type of properties² for each LSOA in the region. The resultant percentages were assumed as constant for the remainder of this analysis.

Also worth noting is that, the 2001 Household Spaces and Accommodation Type data includes vacant properties. Assuming that vacant domestic properties will not consume any heat and electricity, they were excluded from the current demand estimation.

The per unit energy (heat and electricity) consumption estimates for dwelling type (pre and post 1980 averages) identified in Annex A were applied to the 2001 housing stock data minus vacant properties to calculate the **likely heat and electricity demand at LSOA level generated by domestic users in the West Midlands region in 2001**.

However, the housing supply in the region has changed since 2001. The 2006 Dwelling Stock by Council Tax Band provides an update for total housing stock

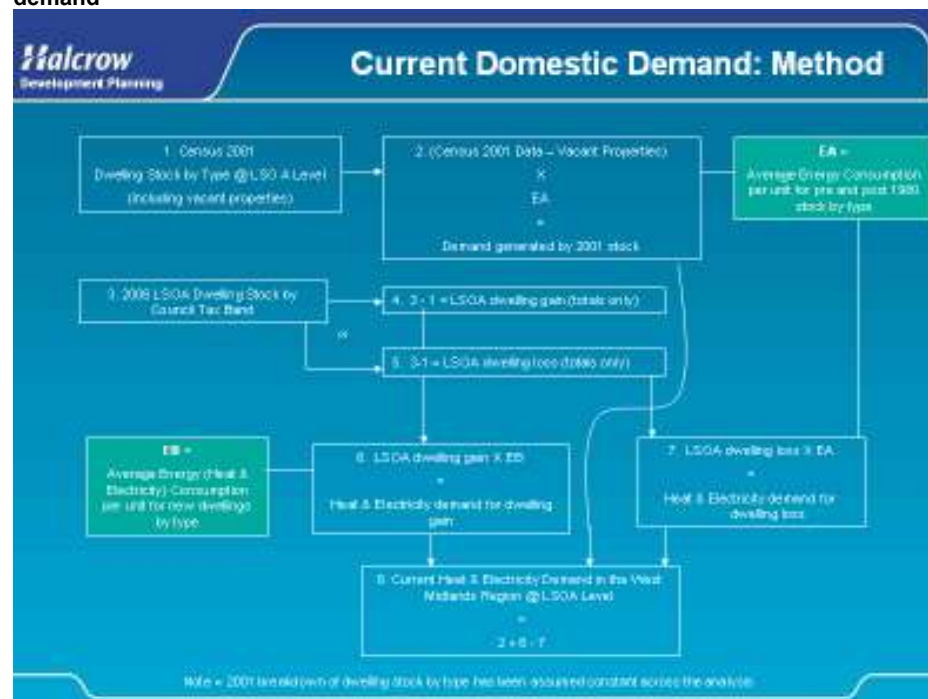
² Type of properties include: Detached, Semi-Detached, Terraced, Flats and Caravans / Other. Caravans / Other properties, which account for a marginal proportion of the regional stock, are excluded from this analysis.

at LSOA level for the region. The change between 2001 and 2006 LSOA level stock totals would imply:

- No change in an LSOA's housing supply, or
- Gain of dwelling stock in an LSOA, or
- Loss of dwelling stock in an LSOA.

The per unit energy (heat and electricity) consumption estimates for dwelling type (pre and post 1980 averages) identified in Annex A were applied to LSOAs which witnessed a loss of dwelling stock to calculate the **likely loss of heat and electricity demand at LSOA level by domestic users in the West Midlands region between 2001 and 2006**.

Figure 2-1: Approach to estimate current heat and electricity domestic demand



The remainder of this chapter presents the spatial results of the domestic demand densities at LSOA level in form of GIS maps.

In addition, Annex C presents results for annual estimates of domestic heat and electricity demand by DEFRA's Urban Rural Local Authority Classification in the West Midlands Region.

Figure 2-4: Domestic Heat Demand Density (demand per square km)

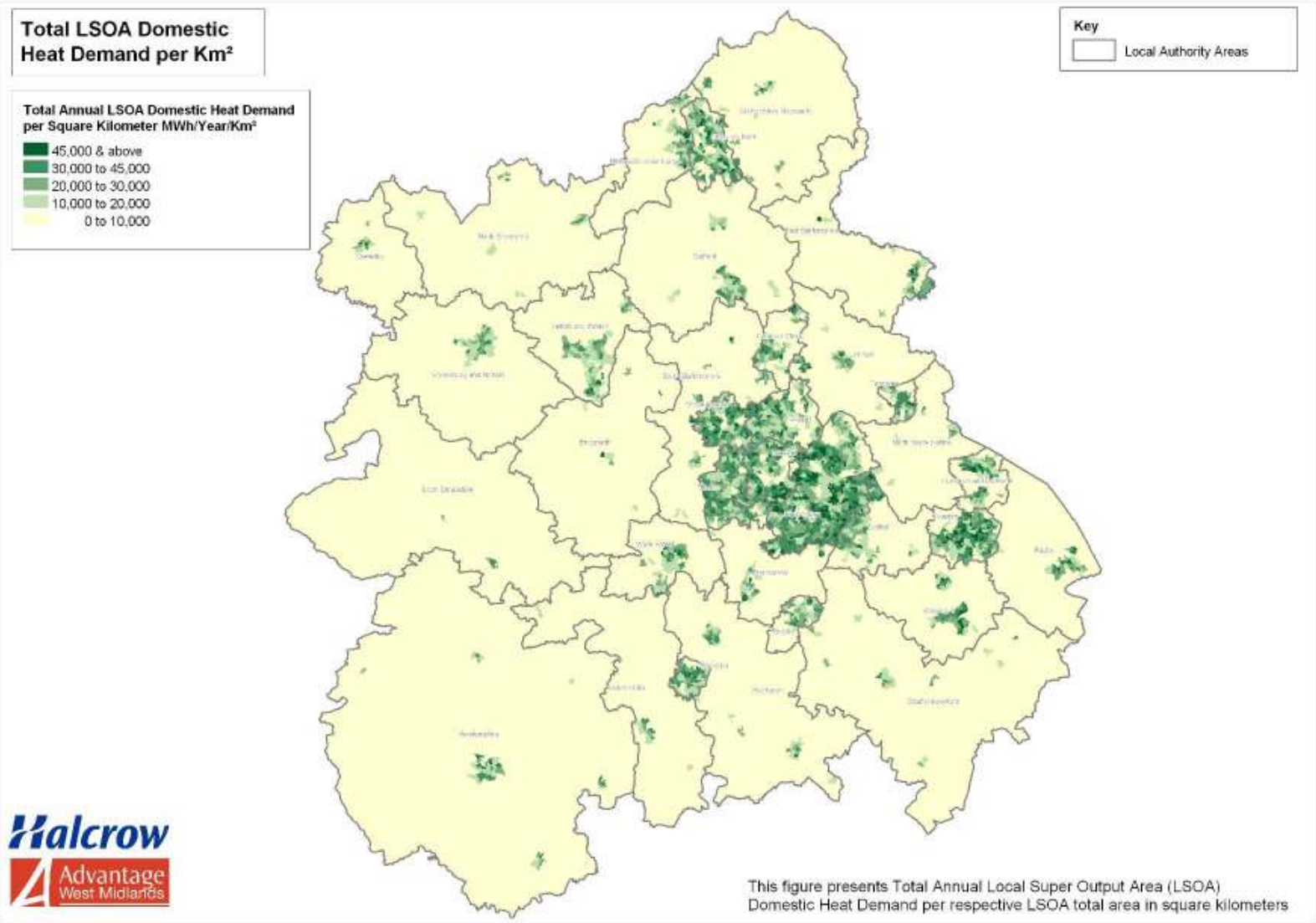
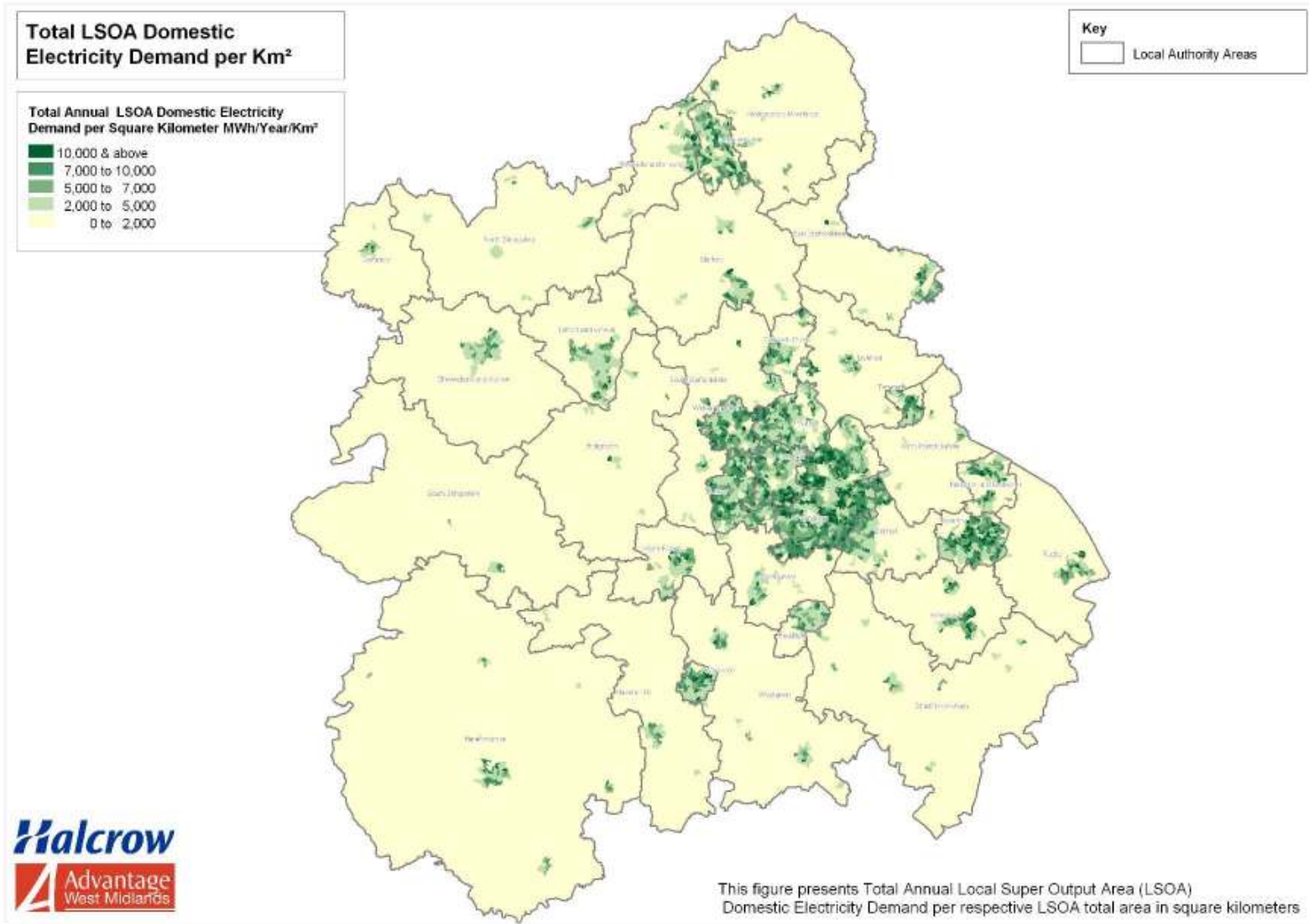


Figure 2-5: Domestic Electricity Demand Density (demand per square km)



2.4 Conclusions

The current domestic electricity and heat demand maps (Figures 2-4 & 2-5) clearly demonstrate that the areas of highest demand densities are very tightly concentrated to within the region's urban areas. The largest area with the highest concentration of non domestic heat and electricity demand lies within Birmingham, whilst the neighbouring local authorities of Sandwell, Dudley, Wolverhampton and Walsall also have large areas of high demand.

The plans highlights that there is clear split in demand levels between the east and the west of the region, with demand in the west being considerably less than that of the east half of the region. Energy demand for domestic uses is also high in Stoke on Trent and Coventry as well as towns located within predominantly rural areas.

3 Current Non Domestic Demand

3.1 Introduction

This section presents the approach adopted and the results of LSOA level current non-domestic demand for heat and electricity in the West Midlands.

3.2 Methodology

Non domestic energy (electricity and heat) users fall into two distinct categories: industrial and commercial. The consumption levels for the industrial or manufacturing uses, which is generally very high, associates to their respective production output. On the other hand, consumption levels of services led commercial uses, such as offices, retail, health centres, hospitals, leisure centres etc, correlates to their respective floor areas.

For these reasons, the current demand approximation exercise of non-domestic users in the West Midlands region is built on two sub-approaches, which run in parallel to each other:

- Industrial Demand: due to data limitation on production output for manufacturing uses at LSOA level, the current industrial demand estimates are based on workplace units data
- Commercial Demand: due to data limitation on floor area for service led commercial uses, the current commercial demand estimates are based on workplace employment data.

The following paragraphs provide a detailed explanation of process involved in industrial and commercial demand respectively.

3.2.1 Industrial Demand

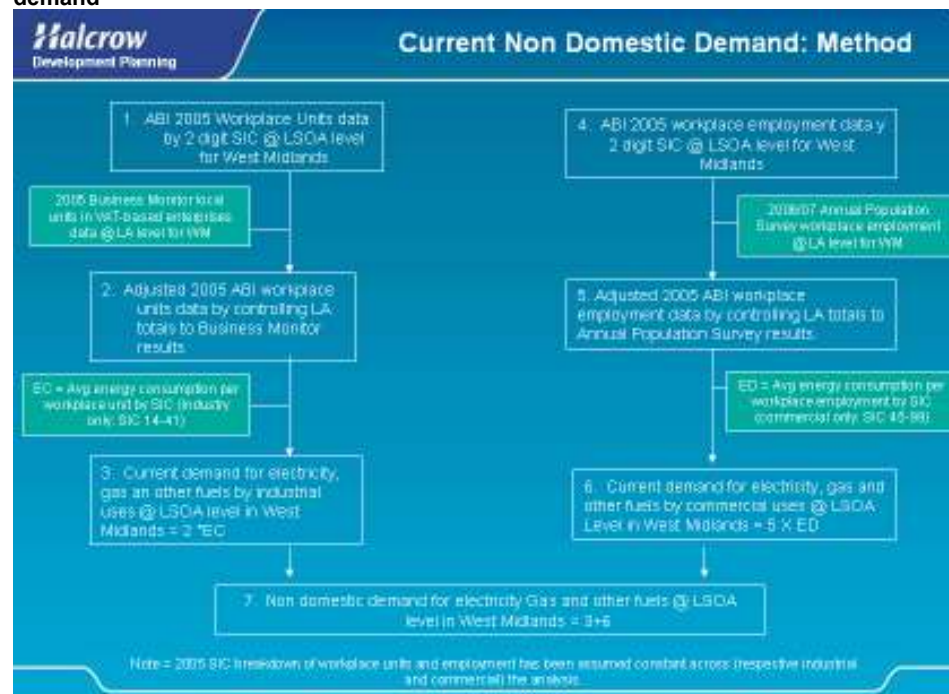
The starting point of this exercise was the 2005 Annual Business Inquiry Workplace Units data for two digit SICs³. This data was obtained for the West Midlands region at LSOA level. This workplace stock data was used to

³ The Industrial Heat / Electricity demand analysis excludes SIC 23: manufacturing of coke or petroleum, as with its unrealistically high per unit demand is likely to skew the demand results.

determine the percentage breakdown of workplace units by two digit SICs for each LSOA in the region. The resultant percentages were assumed as constant for the remainder of the current industrial demand analysis.

The nationally known concerns about accuracy of small area level results of the ABI data, implied much needed adjustments to the LSOA level workplace units data based on more reliable sources e.g. 2006 UK Business Monitor. This was achieved by controlling the Local Authority level totals of 2005 ABI workplace units to Local Authority level totals of 2006 Business Monitor results for local units in VAT-based enterprises.

Figure 3-1: Approach to estimate current heat and electricity non-domestic demand



The average energy (gas, electricity and other fuels) consumption estimates per workplace unit for industrial / manufacturing uses (SICs 14 to 41) derived in Annex A were applied to the adjusted 2005 ABI workplace units data (SICs 14 to 41 only) to determine the **industrial energy (gas, electricity and other fuels) demand at LSOA level in the West Midlands region.**

3.2.2 Commercial Demand

The starting point of this exercise was the 2005 Annual Business Inquiry Workplace Employment data for two digit SICs. This data was obtained for the West Midlands region at LSOA level. This employment data was used to determine the percentage breakdown of jobs by two digit SICs for each LSOA in the region. The resultant percentages were assumed as constant for the remainder of the current commercial demand analysis.

Again, in light of the nationally recognised concerns about accuracy of small area level results of the ABI data, it was adjusted based on the results of a more reliable source i.e. 2006/07 Annual Population Survey Workplace Employment data.

This was achieved by controlling the Local Authority level totals of 2005 ABI workplace employment data to Local Authority level totals of 2006/07 Annual Population Survey Workplace Employment data.

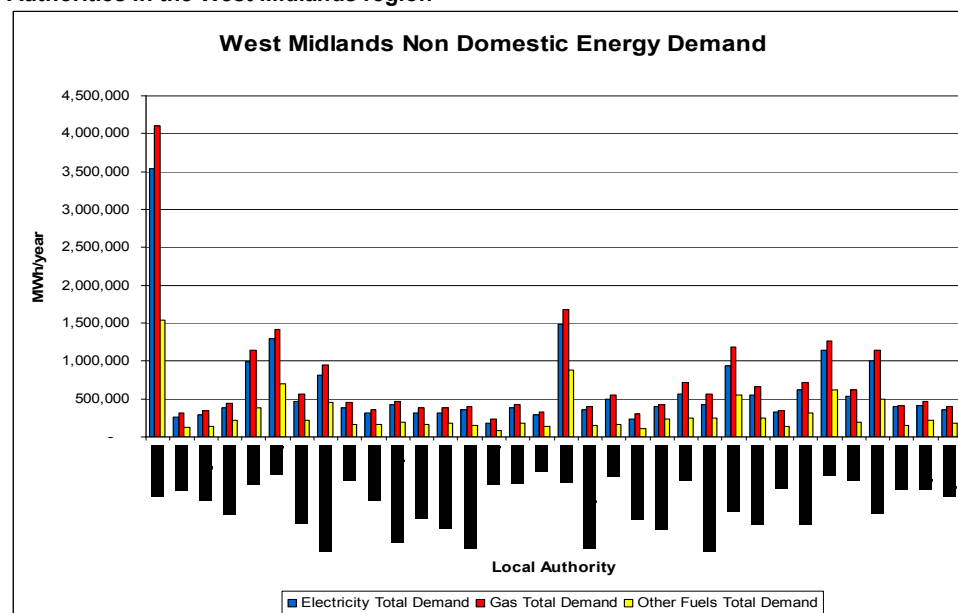
The average energy (gas, electricity and other fuels) consumption estimates per employee for service led commercial uses (SICs 45 to 99) derived in Annex A were applied to the adjusted 2005 ABI workplace employment data (SICs 45 to 99 only) to determine the **commercial energy (gas, electricity and other fuels) demand at LSOA level in the West Midlands region.**

Addition of industrial and commercial LSOA level different energy (gas, electricity and other fuels) demand estimates results in approximation of LSOA level non-domestic heat (gas and other fuels) and electricity demand in the West Midlands region.

3.3 Results of Current Non Domestic Demand Modelling

The modelling exercise suggests that non-domestic users in the region create an annual heat (gas and other fuels combined) and electricity demand of 34.9 million MWh⁴ and 21.2 MWh respectively. Nearly 46% of the region's non-domestic heat demand is generated within Birmingham and its surrounding urban Local Authorities (including Black Country LAs, Solihull and Coventry). Spatial results at such a strategic level for domestic electricity demand in the region are identical.

Figure 3-2: Current heat and electricity non-domestic demand by Local Authorities in the West Midlands region



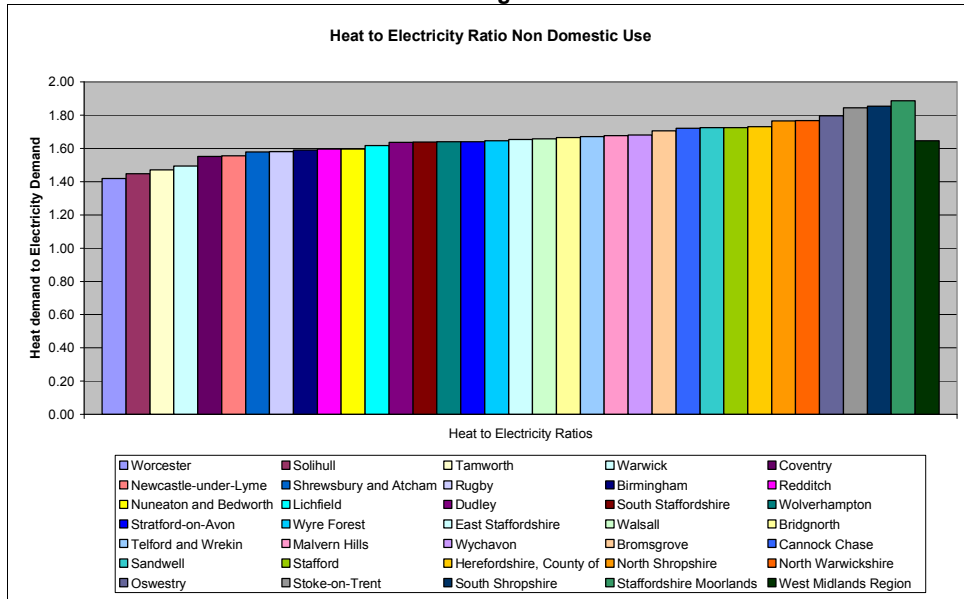
⁴ Annual non-domestic gas demand in the region is estimated at 24.6 million MWh and annual non-domestic demand for other fuels is estimated at 10.3 million MWh.

Like domestic results, Birmingham is the largest driver of non-domestic energy demand in the region. The remaining urban Local Authorities with industrial heritage such as Coventry, Dudley, Sandwell, Stoke-on-Trent, Walsall and Wolverhampton generate an annual non-domestic gas and electricity demand of 1 - 1.5 million MWh each. Most other Local Authorities create an annual non-domestic gas and electricity demand of up to 0.5 million MWh each.

In addition, annual non-domestic demand for other fuels in the region ranges from almost negligible levels in most rural areas to 1.5 million MWh in Birmingham.

In addition, Annex C presents results for annual estimates of non-domestic heat and electricity demand by DEFRA's Urban Rural Local Authority Classification in the West Midlands Region.

Figure 3-3: Current heat to electricity non-domestic demand ratios by Local Authorities in the West Midlands region



The remainder of this chapter presents the spatial results of the non-domestic demand densities at LSOA level in form of GIS maps.

Figure 3-4: Non-Domestic Heat Demand Density (demand per square km)

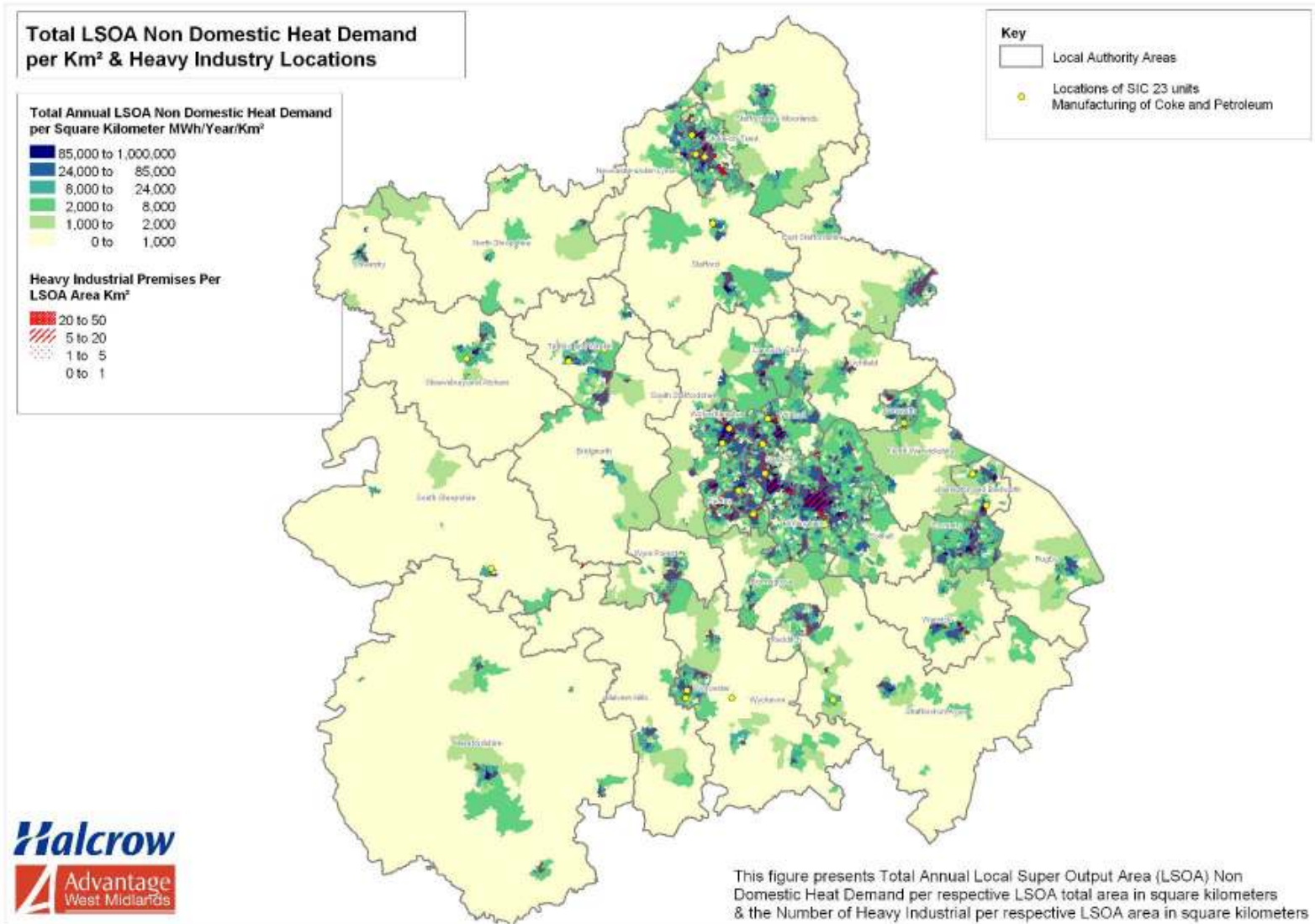
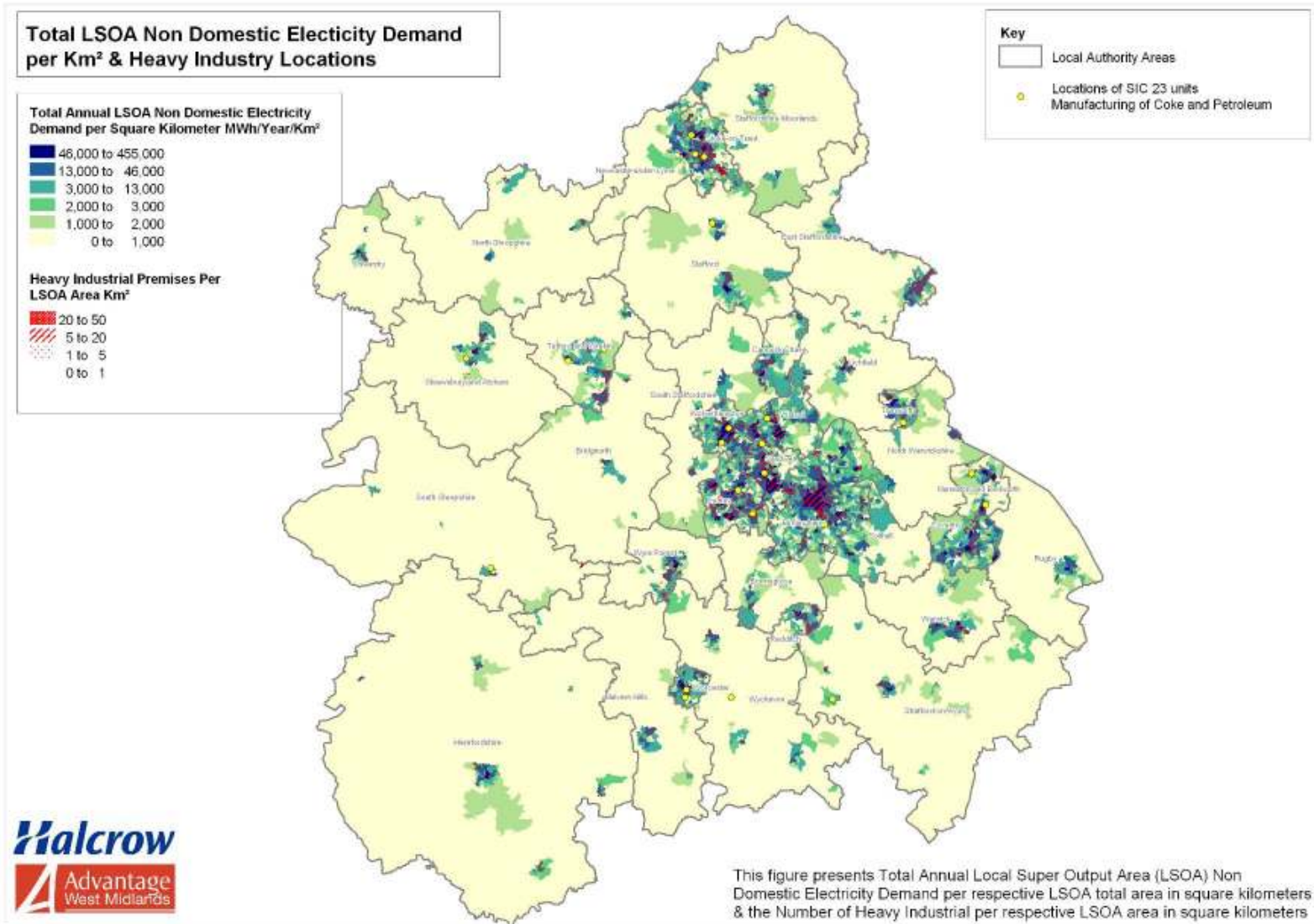


Figure 3-5: Non-Domestic Electricity Demand Density (demand per square km)



3.4 Conclusions

The current non domestic electricity and heat demand maps (Figures 3-4 & 3-5) both clearly show how areas of high current non domestic demand densities are concentrated within the region's major urban centres. The plans also show how there is a clear correlation between the locations of heavy industrial premises and locations of high non domestic electricity heat demand.

The largest area with the highest concentration of non domestic heat and electricity demand lies within Birmingham, whilst the neighbouring local authorities of Sandwell, Dudley, Wolverhampton and Walsall also have large areas of high demand. Non domestic energy demand is also high within Stoke on Trent and Coventry as well as the region's other large service centres. Like the domestic demand analysis, the plans for non domestic energy demand also suggest that there is clear split in demand levels between the east and the west of the region, with demand in the west being considerably less that of the east half of the region.

4 Future Demand

4.1 Introduction

This section presents the approach adopted and the results of LSOA level future demand for heat and electricity in the West Midlands from both domestic and non-domestic users.

4.2 Domestic Demand

The Regional Assembly holds site level projected housing completion totals for the West Midlands between 2006/07 and 2015/16. These site level totals were used to establish LSOA level estimates for housing projections for the next ten years in the West Midlands.

Average per unit heat and electricity consumption estimates project for new / future developments, presented in Annex A, were applied to these LSOA level housing forecast to derive the likely additional domestic demand generated in the region.

Addition of previously established LSOA level current domestic demand to the estimates of additional domestic demand results in approximation of likely future domestic demand for heat and electricity in the West Midlands up to 2016.

The results of this assessment in form of additional and future domestic demand densities are presented in Figures 4-2, 4-3, 4-4 and 4-5.

Figure 4-1: Approach to estimate future heat and electricity domestic demand

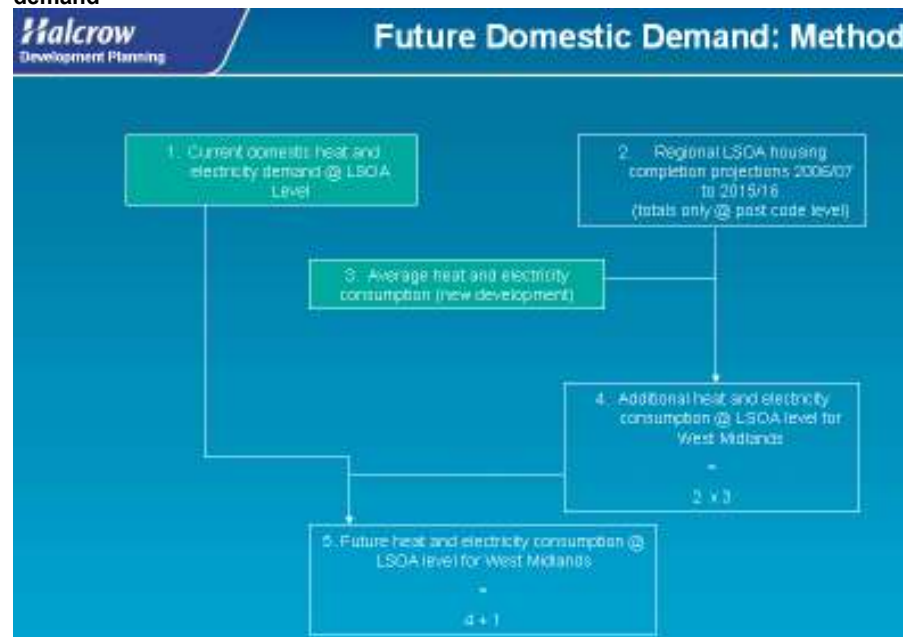


Figure 4-2: Additional Domestic Heat Demand Density (demand per square km)

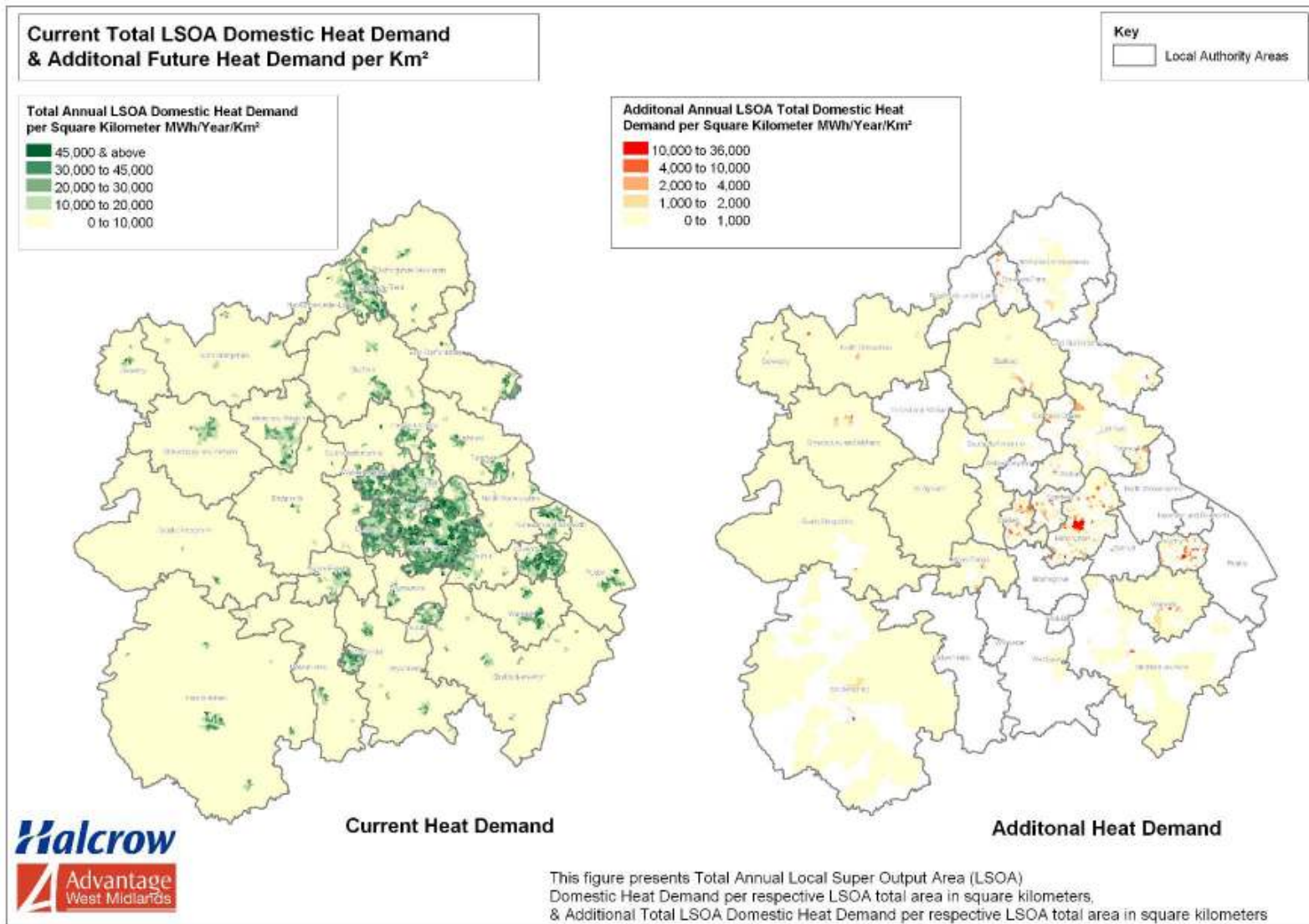


Figure 4-3: Future Domestic Heat Demand Density (demand per sq km)

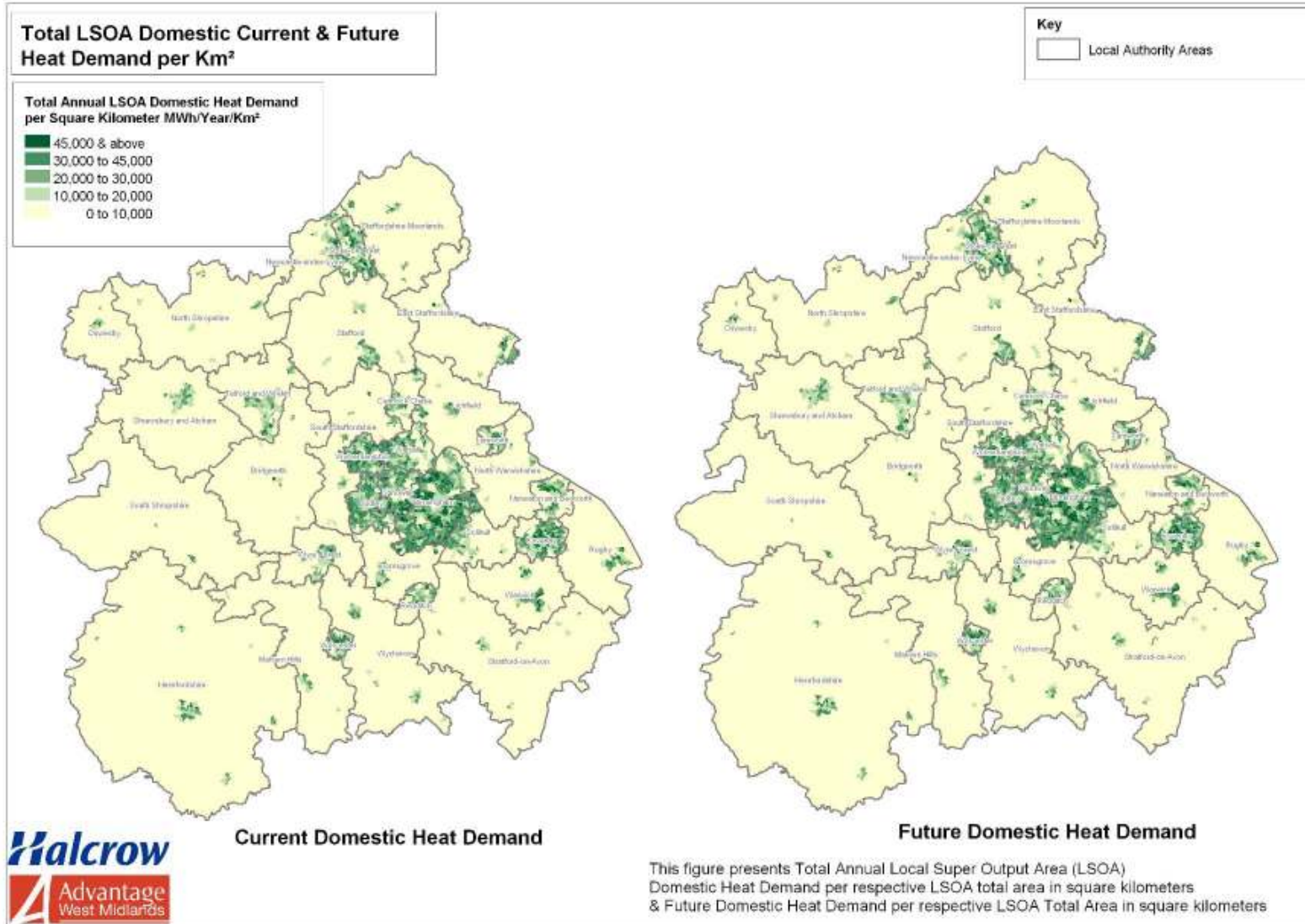


Figure 4-4: Additional Domestic Electricity Demand Density (demand per sq km)

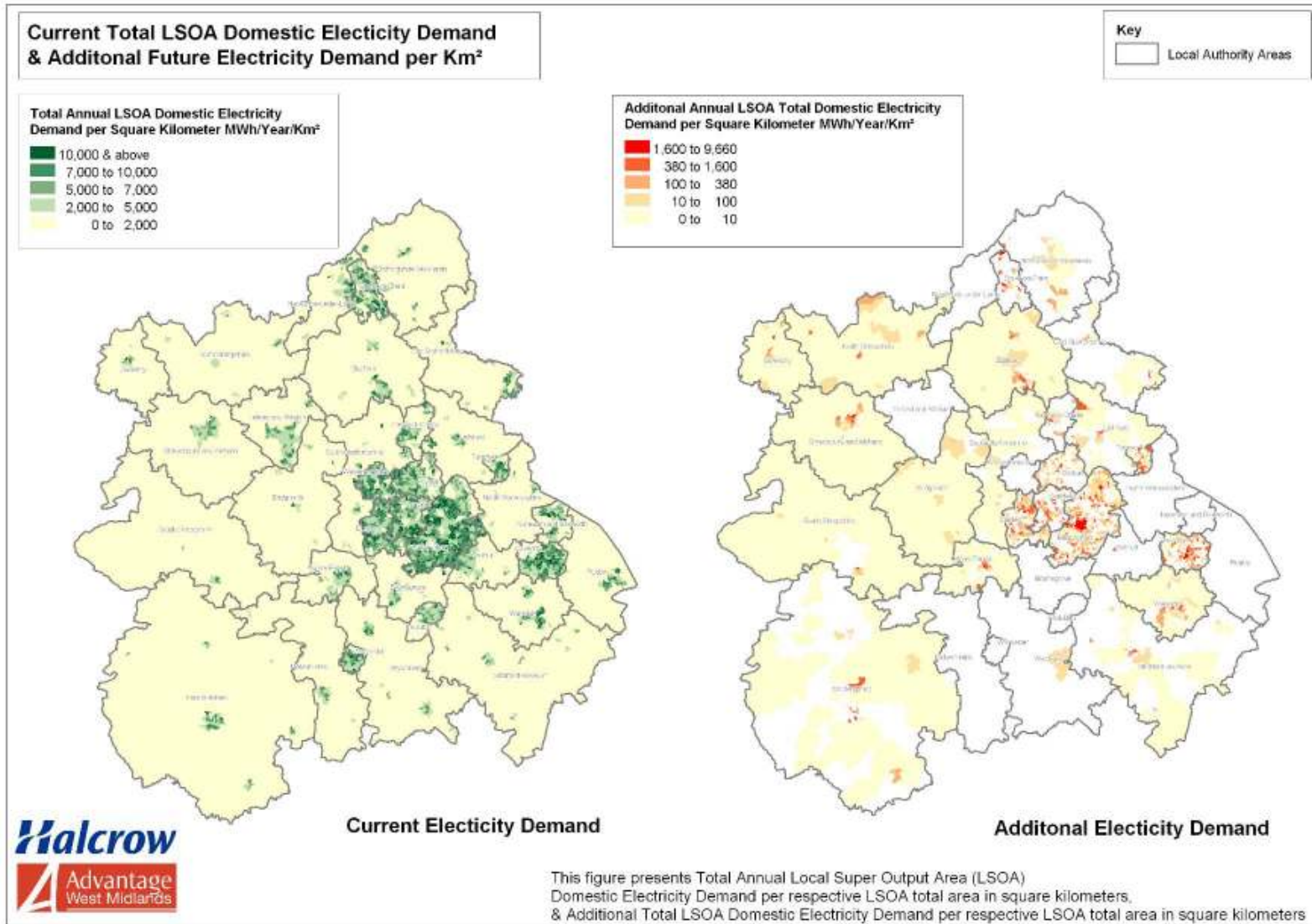
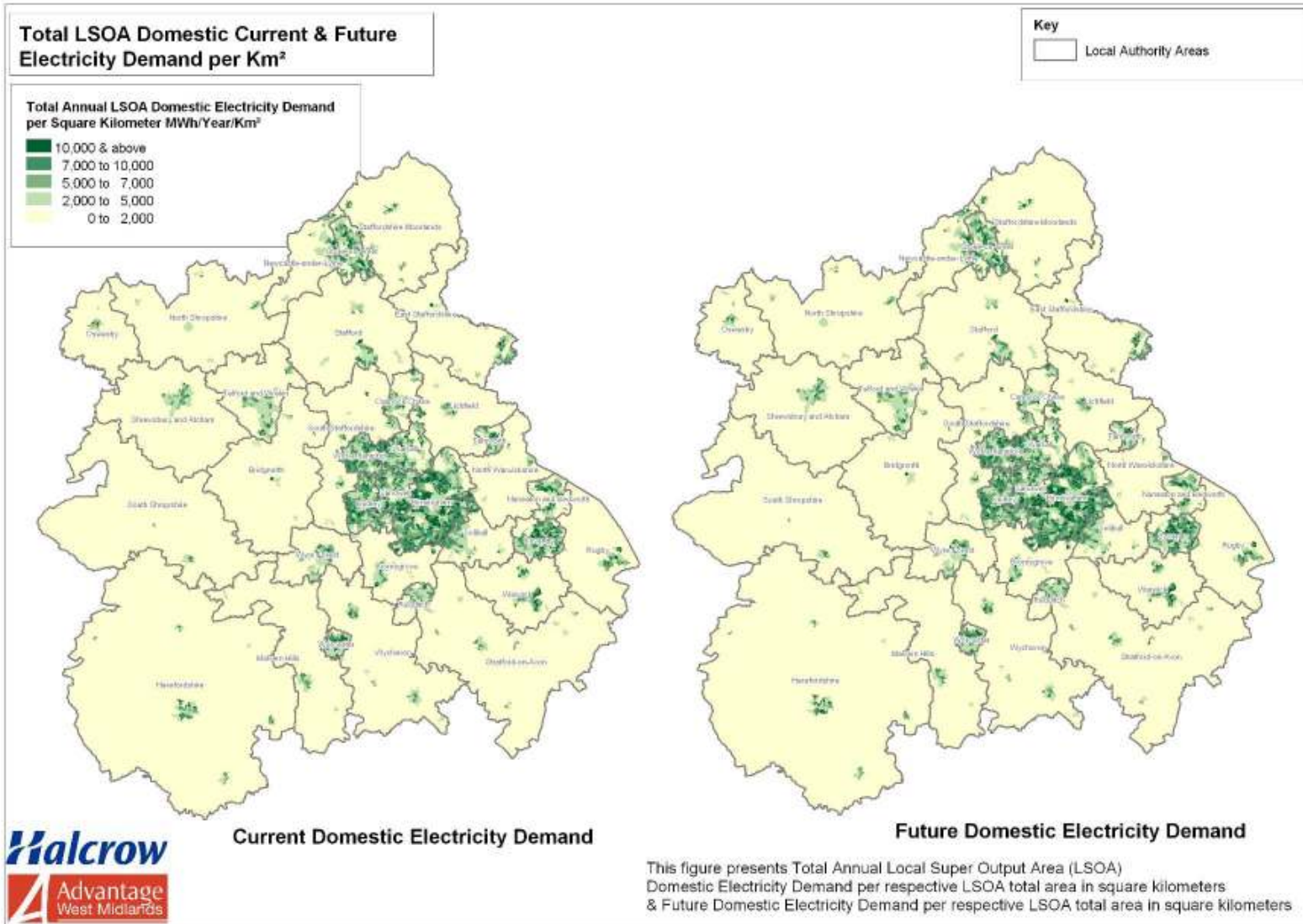


Figure 4-5: Future Domestic Electricity Demand Density (demand per square km)



4.3 Non-Domestic Demand

A recent research exercise carried out by Advantage West Midlands identified 50 most likely employment sites to be developed in the region between 2007 and 2021. This exercise is underpinned by an employment capacity appraisal of these sites. This appraisal also highlights the likely broad land use classes that estimated jobs will originate from. Despite this, the appraisal doesn't provide a breakdown of employment by land use for every site. Where such breakdown wasn't available, Halcrow's Development Economists have made relevant assumptions to establish a breakdown of employment estimates by land uses for every site.

These site level employment estimates were used to establish LSOA level estimates for employment projections up to 2021 in the West Midlands. The relevant average per employee energy (gas, electricity and other fuels) consumption estimates for two digit SICs presented in Annex A, were applied to these LSOA level employment forecast (by land use) to derive the likely additional non-domestic demand generated in the region.

Addition of previously established LSOA level current non-domestic demand to the estimates of additional non-domestic demand results in approximation of likely future non-domestic demand for heat and electricity in the West Midlands up to 2021.

The results of this assessment in form of additional domestic demand densities are presented in Figure 4-7, 4-8, 4-9 and 4-10.

Figure 4-6: Approach to estimate future heat and electricity non-domestic demand

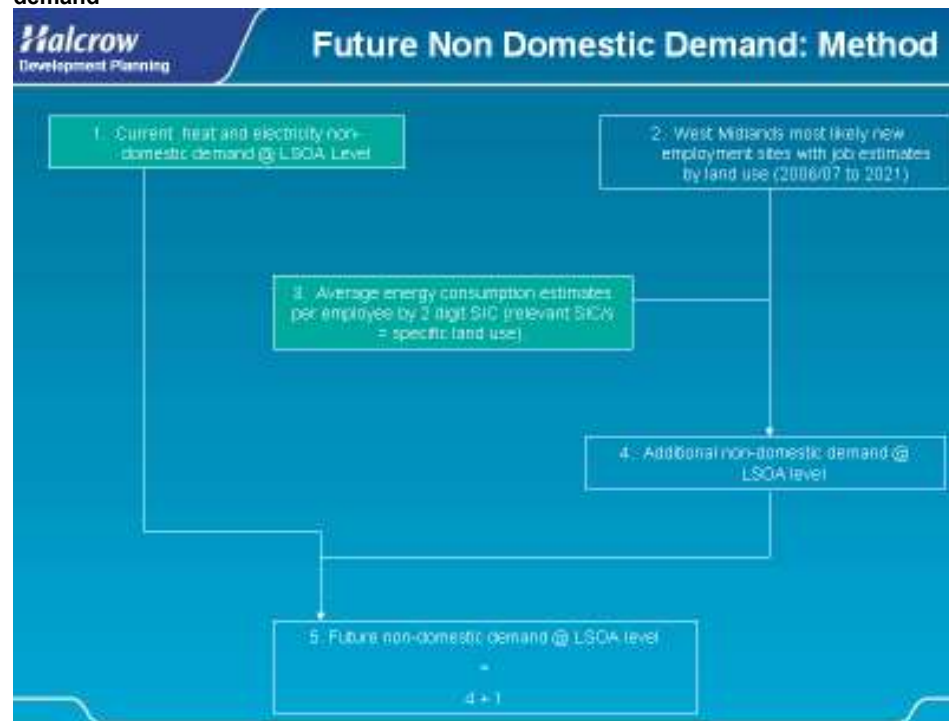


Figure 4-7: Additional Non-Domestic Heat Demand Density (demand per sq km)

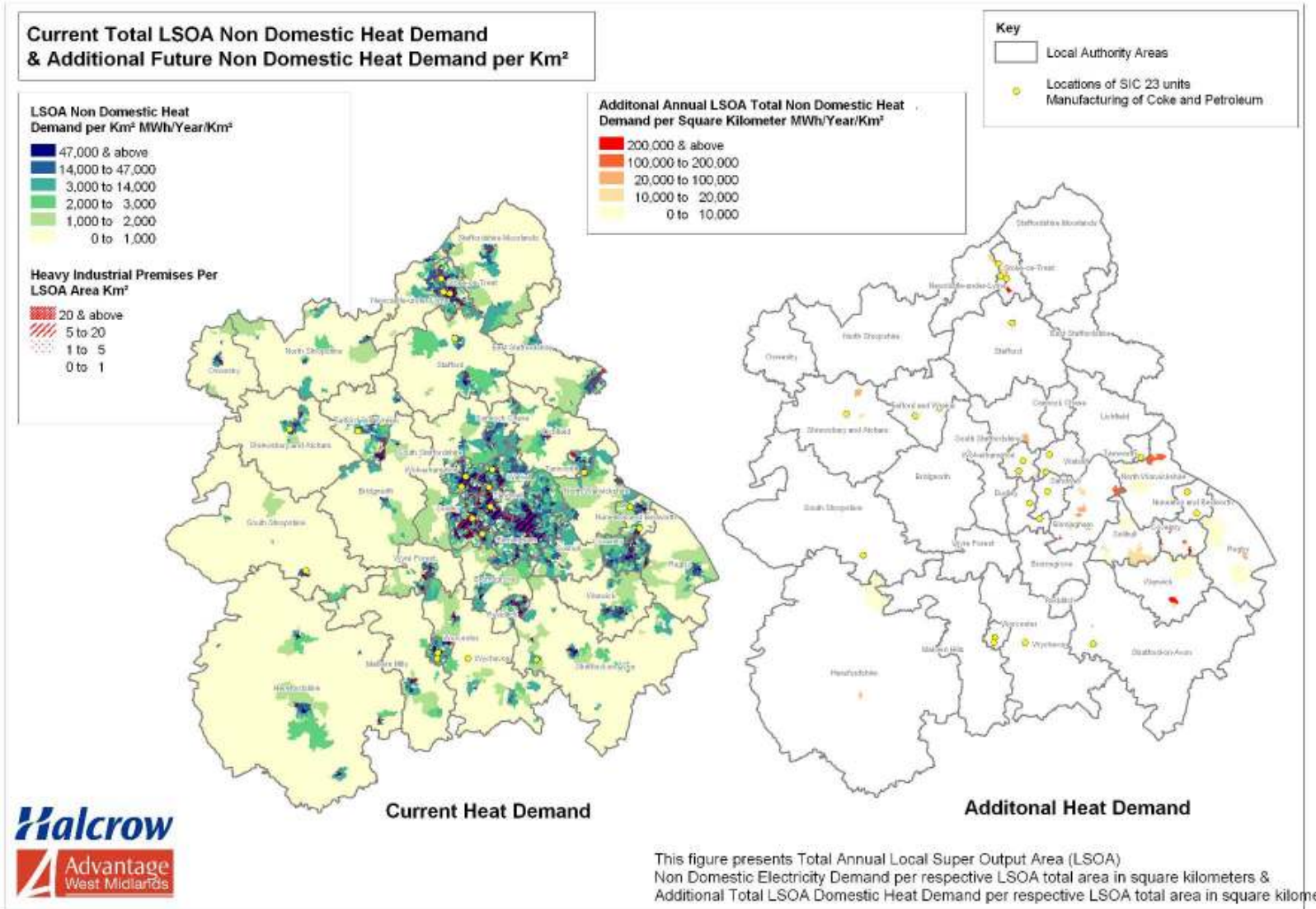


Figure 4-8: Future Non-Domestic Heat Demand Density (demand per square km)

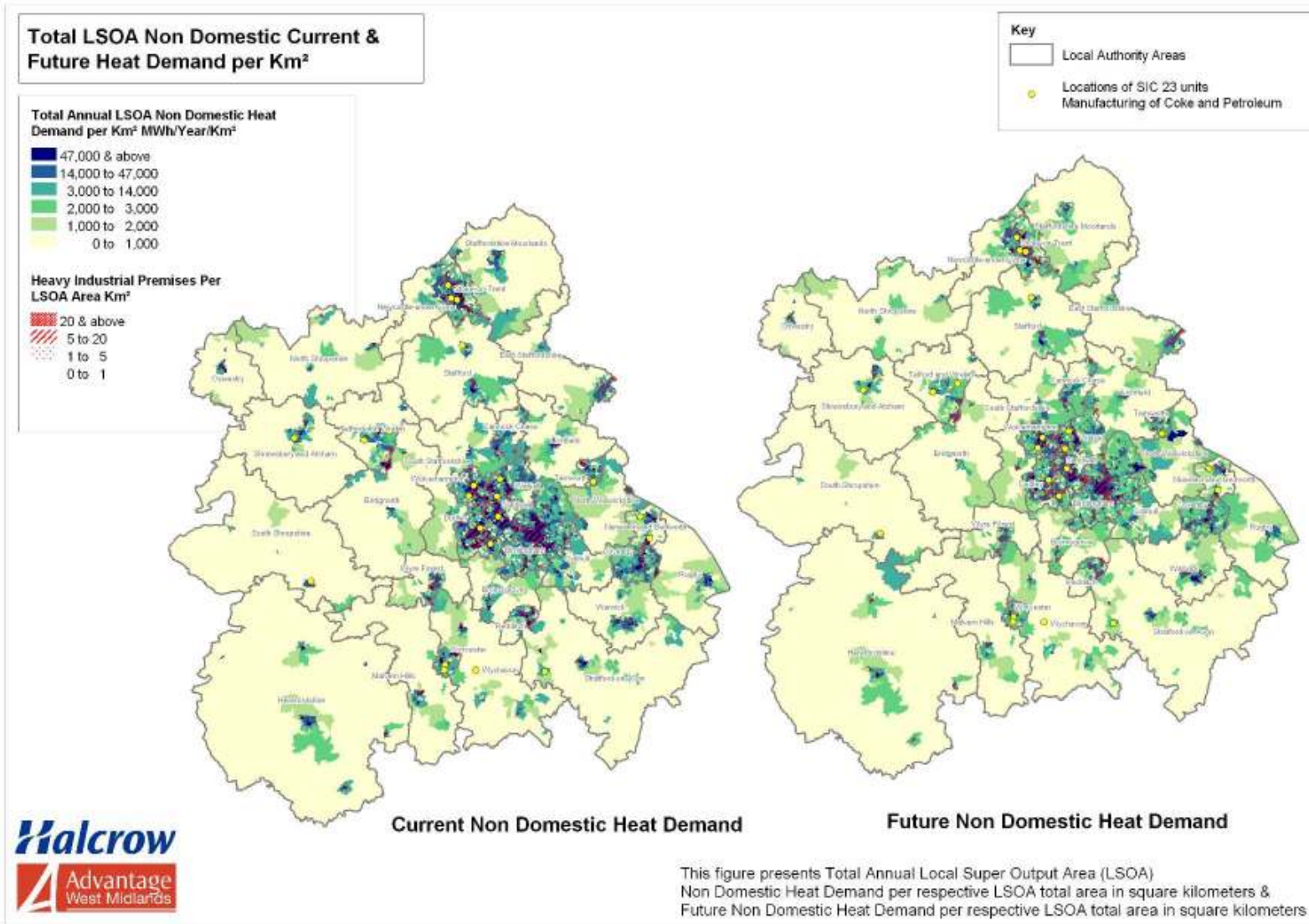


Figure 4-9: Additional Non-Domestic Electricity Demand Density (demand per sq km)

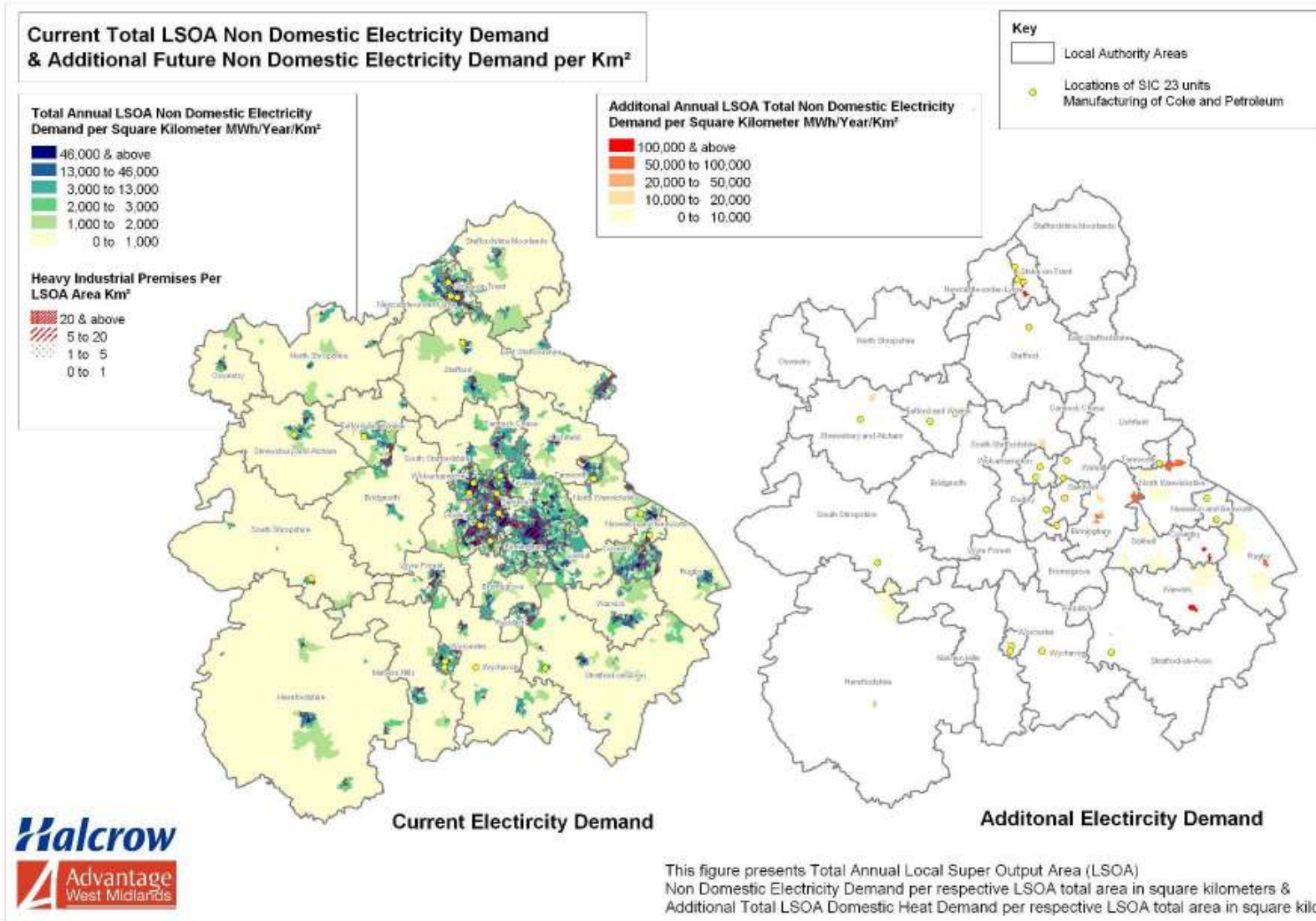
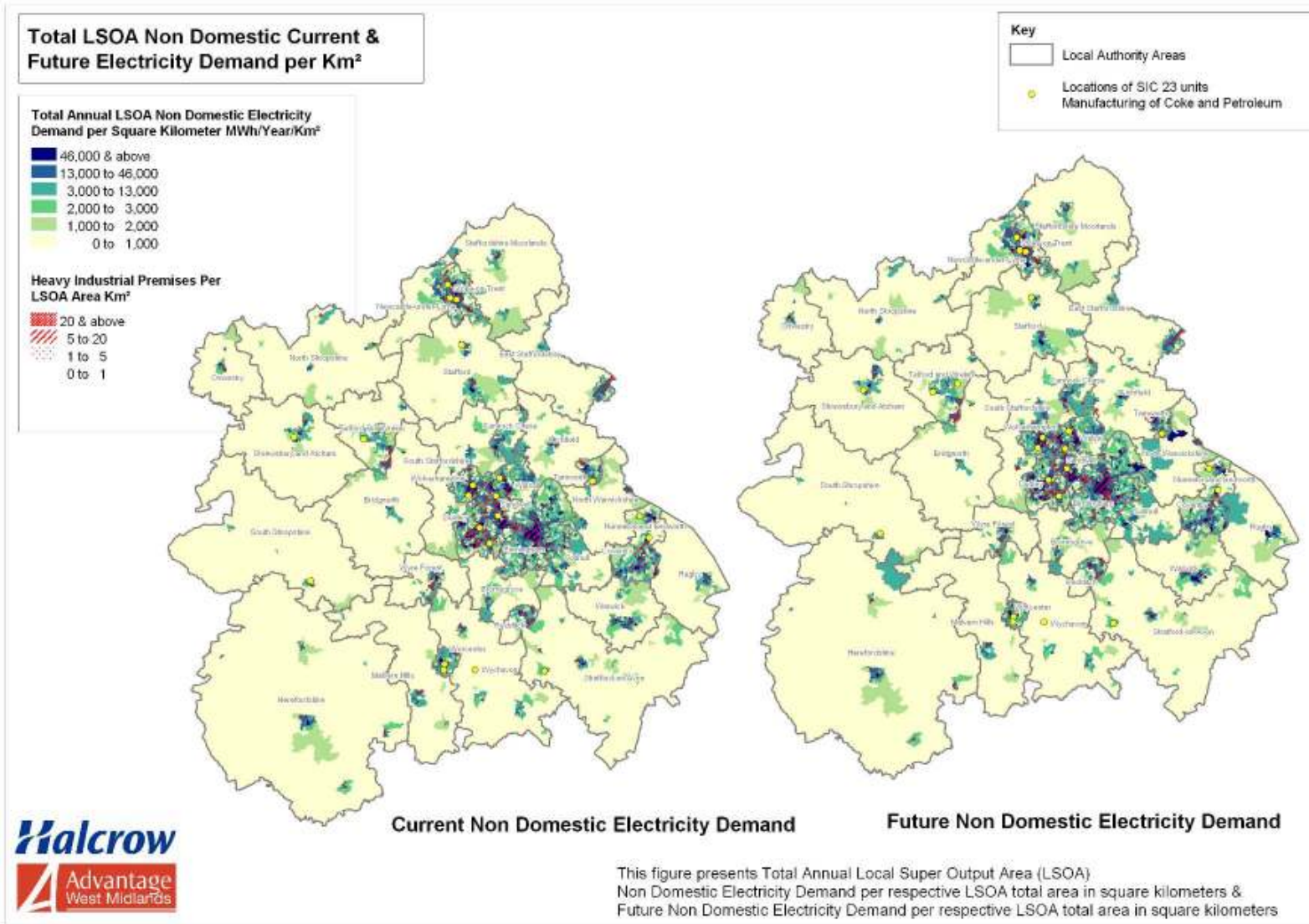


Figure 4-10: Future Non-Domestic Electricity Demand Density (demand per sq km)



4.4 Conclusion

Trends for future domestic energy demand (Figures 4-2 and 4-4) suggest that new demand will predominantly be generated within the region's core cities and towns. However, these new developments are more likely to be extensions of existing residential centres.

Trend for future non domestic energy demand (Figures 4-8 and 4-10) doesn't differ significantly from the current situation, with demand concentrated within the region's urban areas. Areas of high demand densities are particularly concentrated around areas of heavy industrial manufacturing. The additional non domestic heat and electricity demand maps (Figures 4-7 and 4-9) show that the areas which will demand will increase the most are located within Birmingham and to the east of city, in particular in the Local Authority areas of North Warwickshire, and Coventry.

5 Current Gas Supply

5.1 Introduction

The assessment of current gas supply is limited to the following sources:

- Household Gas Connections for the West Midlands (at Post Code Sector level), Advantage West Midlands
- 2004 Indices of Multiple Deprivation: Central Heating Indicator (percentage of households without central heating at LSOA level), former Office of Deputy Prime Minister
- High Pressure Gas Pipeline Location, National Grid
- Long Term Development Statement for Central Networks West 2006 – 2011, Central Networks – A Company of E-ON
- National Grid Gas and Electricity Transmissions System of England, Wales and Scotland 2007, National Grid.

In addition, due to the format of the latter three sources, it has not been possible to undertake a detailed quantitative assessment of current supply.

5.2 State of the Region

Figure 5-1 suggests that, within the West Midlands region, Birmingham City Region is the best served area with gas supply. However, western parts of the region have poor gas supply. In particular, most post code sectors in North Shropshire, Oswestry, Shropshire and Atcham, South Shropshire and Herefordshire have 50% or more households without mains gas connection. Such trends seem to correlate with the location of high pressure gas pipes.

This said, despite the prominent location of high pressure gas pipes, some southern parts of the region still appear to have poor gas supply. In particular, significant proportions of post code sectors in Malvern Hills, Wychavon and Stratford-Upon-Avon have 50% or more households without mains gas connection. Such trends seem to correlate with the location of high pressure gas pipes.

These results generally correlate to the former ODPM's Central Heating Indicator (Figure 5-2), which appraises percentage of households without central heating at LSOA level. The data suggests a vast proportion of households in western LSOAs in the region have no central heating. However, the data suggests that very few households in the southern LSOAs, earlier identified as areas with poor gas supply, don't suffer from lack of central heating. It is likely that households in these areas rely on other energy sources for central heating purposes.

In addition, the Central Heating Indicator also suggests that some urban parts of West Midlands suffer from lack of central heating. This is likely to be down to the type of local housing stock, which will include significant proportion of high rise flats that are generally not served by central heating.

Figure 5-1: Households Gas Connections in the Region

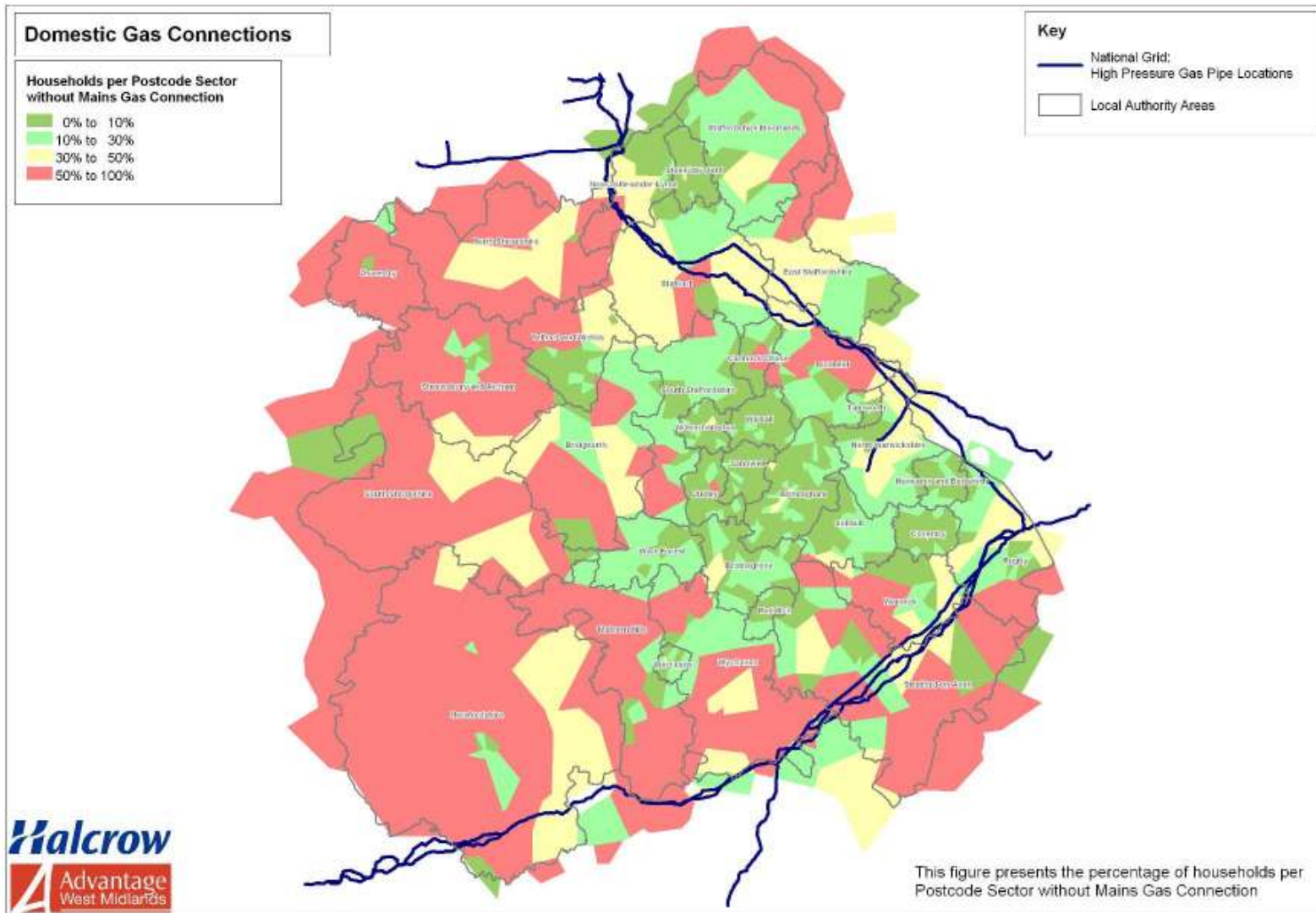


Figure 5-2: Households without Central Heating

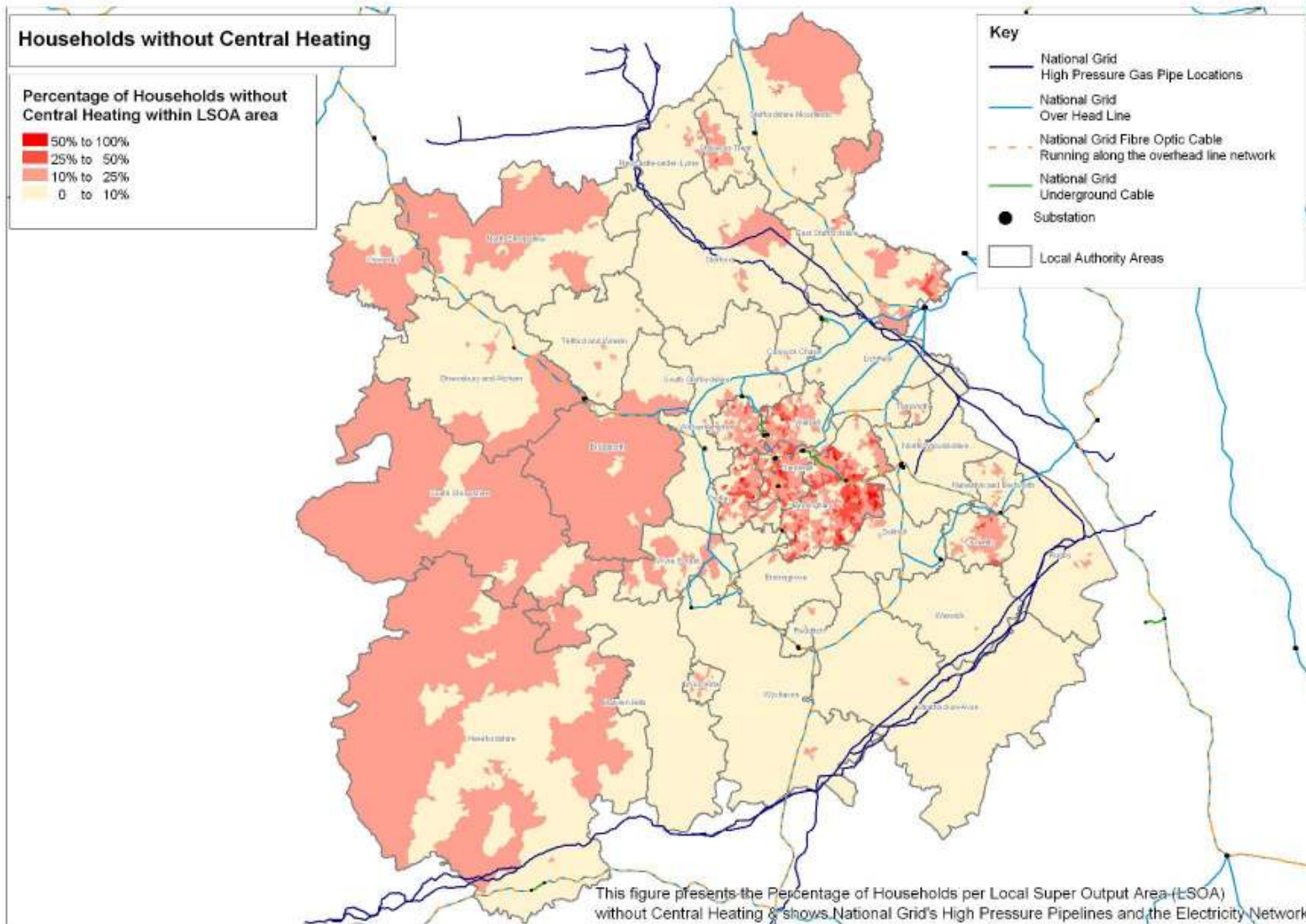


Figure 5-3: Central Networks Primary Infrastructure

