Infrastructure Evidence Review

August 2019

This report was produced by José Carvalho Everton, with support from the University of Nottingham Business and Local Partnerships, Postgraduate Placements teams, and D2N2 LEP.
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1. EXECUTIVE SUMMARY

1.1.1. This report presents the evidence review of Infrastructure, one of the five productivity foundations according to the Industrial Strategy (BEIS, 2017), for the Derby, Derbyshire, Nottingham, Nottinghamshire (D2N2) Local Enterprise Partnership (LEP) and it will support D2N2’s forthcoming Local Industrial Strategy (LIS).

1.1.2. Built on the following documents: D2N2’s Strategic Economic Plan: Vision 2030; Productivity Review, and Science and Innovation Audit, this report is also based on public available data collected from various sources, including: Department for Transport (DfT); Office for National Statistics (ONS); Midlands Connect; East Midlands Councils; Office of Communications (Ofcom); Department for Business, Energy and Industrial Strategy (BEIS); Western Power Distribution (WPD).

1.1.3. The report is divided into 3 chapters: Transportation, Digital Connectivity and Electricity and for each of them, the current condition was assessed and the analysis was based on the principle of balancing D2N2 region in terms of access to services related to the above-mentioned three components, within its borders and externally, comparing to other regions, but also observing particular features of the region.

1.1.4. On the Transportation component, there are remarkable regional differences with regards to mode share and consequently, journey times to work. The report sought to understand this not only with the view of rural/urban divides but also concerning adopted long term policies for public transport. As a result, the availability of public transport showed a correlation with car ownership, and the less car-dependent regions had lower average journey time to job centre. Moreover, a negative correlation was established between average journey time to a jobcentre and productivity, corroborating with the benefits of a long-term view for public transport has.

1.1.5. While the region has good North-South connections, East-West connectivity is poor both in roads and railways, thus a few options were raised to improve regional connections, such as the A46 Newark, A52 Derby-Nottingham and Major Road Networks for roads, and Midlands Rail Hub for railways;

1.1.6. Central to D2N2 growth strategy, related to jobs, housing, travelling convergence and transportation investments, is HS2 Phase 2b, which includes HS2 Hub East Midlands in Toton; HS2 Station in Chesterfield and Maintenance Depot in Staveley. Given its position, it allows a joint effort from transport authorities to put in place strategies, such as a better link to East Midlands Airport and other associated regional investments.

1.1.7. In terms of digital connectivity, the region has yet to achieve its goal of superfast broadband coverage and currently is slightly behind UK average. On the low end of broadband availability, the region also lags behinds UK average on the proportion of premises unable to receive Universal Service Obligation (USO) of 10 Mbps, and this report sought to understand this condition, which is related to rural divide.

1.1.8. There is a potential relationship of lower broadband connection with income and education deprivation, which can be related to productivity. With digital transformation come opportunities to reskilling, upskilling and even telemedicine to decrease deprivation. In March 2020, the launch of the USO will create another mean to decrease the gap of Electricity.

1.1.9. With regards to Electricity, a theme where national policies are driving changes, the report also investigated what could be achieved at local level, thus it first
investigated the condition of the Distribution Network (Regional) by Electricity Supply Area (ESA), which is a geographic division used by Distribution Network Operators (DNO), considering spare demand capacity to install new developments and generation headroom to connect small and medium power plants to the Network. While it seems the area has a wealth of spare demand capacity, this needs to be further investigated together with new development areas to check for possible mismatches (i.e. new development in an area with lower capacity). The same applies for generation headroom, where there is already lack of capacity in some substations to allow new connections.

1.1.10. Secondly, the region’s demand for electricity was assessed confirming regional industry and residence densities. Future demand scenarios up to 2030 were also assessed, indicating demand growth will be higher than generation growth and due to the Net Zero targets which includes closing the region’s Coal Power Plants, the roll-out of projects from other regions, including nuclear and wind offshore plants will be important for the region’s sustainable growth, as well as investing on increasing Distributed Generation capabilities.
2. TRANSPORTATION

2.1. MODE SHARE TO TRAVEL TO WORK

2.1.1. As a first approach to understand transportation bottlenecks in the region, mode of travel to work was assessed in two different periods, the first being the 2011 Census and the second 2017 DfT Transportation Statistics.

2.1.2. Table 1 shows mode of travel to work in D2N2 region is more car dependent than England’s average and that it falls within the East Midlands (EM) average. However, it is noticeable the difference from Nottingham City to the region, with Bus share three times higher than EM average.

2.1.3. According to Buses in Urban Development research (1), towns with high bus use have relatively low car ownership compared to adjacent areas. To exemplify this, in 2011 Nottingham had a car ownership of 0.76 per person, while Derby had 1.06 per person and as a result, Nottingham appears as the second local authority in England (outside London) in terms of bus use [Figure 1]. The research states that long-term policies to support bus services are behind high bus use; those policies include traffic management, bus priorities, and park provision. For instance, it uses the example of Nottingham’s Workplace Parking Levy (WPL), which requires large business to pay an annual levy for every workplace car park space above a certain threshold.

2.1.4. However, according to Local Bus Market study (2), commissioned by the DfT, Nottingham’s WPL is not seen as a way to manage demand but rather as a way to raise funds to support other transport projects, including the construction of the NET tram service. In doing so, the availability of such services would make public transport more attractive.

*Table 1 - Mode of travel to work (Table QS701EW Census 2011 (3))*

<table>
<thead>
<tr>
<th>REGION/MODE</th>
<th>CAR</th>
<th>BUS</th>
<th>RAIL¹</th>
<th>BYCICLE</th>
<th>WALKING</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGLAND</td>
<td>68.1%</td>
<td>7.8%</td>
<td>9.6%</td>
<td>3.1%</td>
<td>11.4%</td>
</tr>
<tr>
<td>LONDON</td>
<td>33.4%</td>
<td>15%</td>
<td>38%</td>
<td>4.2%</td>
<td>9.4%</td>
</tr>
<tr>
<td>EAST MIDLANDS</td>
<td>77%</td>
<td>6.6%</td>
<td>1.8%</td>
<td>3%</td>
<td>11.6%</td>
</tr>
<tr>
<td>DERBY UA</td>
<td>72.2%</td>
<td>9.3%</td>
<td>1.2%</td>
<td>4%</td>
<td>13.3%</td>
</tr>
<tr>
<td>DERBYSHIRE</td>
<td>80.5%</td>
<td>5%</td>
<td>1.9%</td>
<td>1.6%</td>
<td>11%</td>
</tr>
<tr>
<td>NOTTINGHAM UA</td>
<td>55.1%</td>
<td>21%</td>
<td>3.4%</td>
<td>3.7%</td>
<td>16.9%</td>
</tr>
<tr>
<td>NOTTINGHAMSHIRE</td>
<td>77.6%</td>
<td>7.3%</td>
<td>1.6%</td>
<td>2.9%</td>
<td>10.6%</td>
</tr>
</tbody>
</table>

1.1.1. Including tram
2.1.5. Although 2011 Census marked regional differences within D2N2, those tended to become wider with the NET expansion back in 2015, with a further increase in rail modal use in Nottingham and Nottinghamshire (encompassing Rail and Tram) as it can be seen on Figure 2 the increase in passenger journeys from 2015 onwards.

2.1.6. In 2018/2019, the Nottingham tram system carried over 18 million passenger/year [Figure 3], and even though is confined to just two cross city-routes in the city, the intermodal transport offer seem in Nottingham and parts of Nottinghamshire is not observed in Derby and Derbyshire, which corroborates with a higher car dependency in the latter regions.

2.1.7. In addition, the NET tram is England’s leader in passenger journey per head with 57.1 passenger journey per head [Figure 3]. Since this measure represents the ratio of total number of trips by the higher tier authority’s population, it can’t be use to compare with London systems (Docklands and Tramlink), as the city has a vast underground system and LRT and tram are only a minor system, but in cities like Manchester and Sheffield it is a good indicative of how representative the system is.
2.1.8. Looking in perspective, East Midlands region has been underfunded in transport investments compared to other regions, receiving some of the lowest spending from the government per head and as % of GVA. This fact can explain Table 1 and Table 2 disparities of the region compared to England, which except for Nottingham City figures, show a high car dependency. Thus, increasing availability of public transport modals is vital to balance demand within the region and it offers an opportunity to reduce congestion, improving air quality and liveability of the region.

Table 2 - Usual method of travel to work by region of residence (7)

<table>
<thead>
<tr>
<th>REGION/MODE</th>
<th>CAR (%)</th>
<th>BUS (%)</th>
<th>RAIL (%)</th>
<th>BYCICLE (%)</th>
<th>WALKING (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGLAND</td>
<td>68.7%</td>
<td>6.6%</td>
<td>11.5%</td>
<td>3.5%</td>
<td>9.7%</td>
</tr>
<tr>
<td>LONDON¹</td>
<td>31%</td>
<td>13%</td>
<td>41%</td>
<td>6%</td>
<td>9%</td>
</tr>
<tr>
<td>EAST MIDLANDS²</td>
<td>80.8%</td>
<td>4.8%</td>
<td>2.1%</td>
<td>2.4%</td>
<td>9.2%</td>
</tr>
</tbody>
</table>

2.2. CONGESTION AND JOURNEY TIMES TO JOB

2.2.1. A frame showing the typical afternoon peak-hour traffic is seen on Figure 4; the main cities and towns of D2N2 region have congestion in its surroundings, which in turn represents increased journey times, translated in less reliable travel times and delays. This condition is not only detrimental to commuters but to businesses located in cities surroundings, as emphasized in A46 corridor study stage one (8): Variability of journey times is often of most concern to businesses, especially those in the manufacturing, construction and distribution sectors; reliable journey times are critical to allow businesses to operate efficiently using complex just-in-time delivery processes.
2.2.2. It is known that such delays have an economic impact, with “direct” and “indirect” costs totalling £935m\(^1\) per year in the East Midlands region with only the ‘Three cities’ sub-region formed by Derby, Nottingham and Leicester accounting for £500m\(^1\) of this total. Congestion costs forecasted for a 10-year period from 2016 to 2025, places Nottingham and Derby in 12\(^{th}\) and 19\(^{th}\) for Economic Cost of congestion (9), respectively, from a top 20 UK cities. Comparing with 2011 Census for most populous conurbation areas, where Nottingham came as 9\(^{th}\) and Derby 29\(^{th}\) (10), it corroborates with previous analysis on high car dependency of the latter city.

2.2.3. Moreover, congestion and high car dependency are among the causes for air quality issues. In that sense, both Derby and Nottingham have areas exceeding European air quality limits for nitrogen dioxide (NO\(_2\)) mainly due to traffic emission and are in the first wave of authorities required to comply in the shortest time (11) (12). Those Local authorities are currently undergoing mitigation measures to avoid exceeding permitted levels and new strategies need to consider air quality limits.\(^4\)

2.2.4. While this report will not address labour skills challenges of the region, building up on the D2N2 Skills Mismatch report, it can be inferred that an increased offer of public transport and increased connectivity within D2N2 region could put skilled labour at the doorstep of growing industries and enhance the economy as a whole as it will be presented later in this report the region lags behind others in terms of Rail share from commuters trips (13).

2.2.5. **Error! Reference source not found.** shows that some areas of D2N2 region: M1 vicinities and close to main cities and towns, are within 20-40 minutes to a job centre, and only the core of Derby and Nottingham are within 20 min min to a job centre. Because the maps show Middle Super Output Area, weighting those times by the population of each resulted in 54 minutes average time to travel by public transport and 27 minutes traveling by car.
2.2.6. In a comparison with other regions, it can be concluded that there is place to improve D2N2 average journey time to travel to work, especially in areas close to the main cities, to expand the area within 20 minutes to a job centre, as we observe in more densely populated areas as Greater Birmingham [Figure 6]. In the latter region, which form a LEP with Solihull, average time to travel by public transport is 40 minutes and by car is 20 minutes, such reduction in time taken to travel by public transport comparing with D2N2 region certainly plays an important role in modal share.

2.2.7. In Figure 7, Sheffield City Region LEP and Leicester LEP average journey times are presented and Table 3 summarises comparisons with D2N2, which sits the region closer to SCR and LLEP than GBS. However, looking in detail for regional differences, Table 4 summarises results by D2N2 Local Transport Authorities, given they have different features and rural/urban divides. These results confirm the modal share is directly proportional to time taken to travel to work, as the more car dependent the longer average travel times to a job centre. Besides, average travel time to job centre has a negative correlation with productivity as observed in Error! Reference source not found. where less productivity areas have higher average journey time. It also demonstrates differences within D2N2’s local authorities related to average journey time.
Figure 5 - Average travel time to job centre by public transport (minutes) and Productivity (GVA per FTE) by LAD (D2N2 analysis of ONS, Regional GVA, BRES, DfT)

Figure 6 - Birmingham and Solihul (GBS) journey time to job centre by public transport (14)
Figure 7 - Sheffield City Region (SCR) and Leicester LEP (LLEP) journey time to job centre by public transport (14)

Table 3 - Average journey time to job centre - LEP Comparisons [DfT time taken to travel (14) and ONS MSOA population (15)]

<table>
<thead>
<tr>
<th>MODE/REGION</th>
<th>D2N2</th>
<th>GBS</th>
<th>SCR</th>
<th>LLEP</th>
</tr>
</thead>
<tbody>
<tr>
<td>PUBLIC TRANSPORT</td>
<td>54 min</td>
<td>40 min</td>
<td>52 min</td>
<td>59 min</td>
</tr>
<tr>
<td>CAR</td>
<td>27 min</td>
<td>20 min</td>
<td>24 min</td>
<td>30 min</td>
</tr>
</tbody>
</table>

Table 4 - Average journey time to job centre - D2N2 region [DfT time taken to travel (14) and ONS MSOA population (15)]

<table>
<thead>
<tr>
<th>MODE/REGION</th>
<th>DERBY</th>
<th>DERBYSHIRE</th>
<th>NOTTINGHAM</th>
<th>NOTTINGHAMSHIRE</th>
</tr>
</thead>
<tbody>
<tr>
<td>PUBLIC TRANSPORT</td>
<td>52 min</td>
<td>55 min</td>
<td>41 min</td>
<td>53 min</td>
</tr>
<tr>
<td>CAR</td>
<td>26 min</td>
<td>27 min</td>
<td>24 min</td>
<td>27 min</td>
</tr>
</tbody>
</table>

2.3. STRATEGIC ROUTES

2.3.1. Parts of D2N2 enjoy excellent transport links, as Derby and Nottingham to the North and South by rail and road, through the Midland Main Line and M1 Motorway; Newark also enjoys of good North and South connections through the East Coast Main Line, being a 90 minutes travel to London and 45 minutes to Leeds. However, other routes are not as developed, preventing access to market and supply chain both regionally and in a national context (e.g. cross movements within D2N2 region, North-West and West Midlands access).

2.3.2. Using the Strategic Economic Plans (SEP) developed by the Local Enterprise Partnerships to perform an independently economic analysis and engaging with private sector, Midlands Connect, a pan-Midlands partnership of public and private representatives working with the Department for Transport and its key delivery bodies, has identified how economic growth across sectors is achieved with better transport connectivity, and how the lack of it is a barrier to growth (16).

2.3.3. In line with the recently launched D2N2 SEP, the strong evidence base gathered for the Midlands Connect Strategy established a spatial framework for investment based on four strategic economic hubs and six intensive growth corridor, which are identified as critical to both the Midlands and the UK as a whole.[Figure 8] (16).
Strategic Economic Hubs:

- Birmingham, Solihull and the Black Country;
- Nottingham and Derby;
- Leicester and Coventry; and
- North Staffordshire.

Intensive Growth Corridors:

1. Birmingham – Coventry/Leicester – Northamptonshire – Milton Keynes and the South, and includes connections to Kettering, Corby and the East of England;
2. Birmingham – Black Country – Staffordshire and the North, and includes connections to Telford, Shrewsbury and North Wales;
3. Nottingham and Derby – the North;
5. Nottingham – Leicester – Coventry – Warwick and Thames Valley, and includes connections from Leicester to Birmingham; and

Figure 8 - Midlands Connect Strategic Economic Hub and Corridors (16)

2.3.4. In addition to the Midland Connect Strategy, D2N2 SEP has taken a deeper regional approach to identify key investment areas to boost productivity and strengthen core innovation and industrial specialisms: Advanced Manufacturing in
2.3.5. Having a better transport and digital connectivity is vital to guarantee access to supply chain and realise the full potential of the previously identified areas, as well as create a prosperous place to live and work (17).

2.3.6. There is limited evidence reporting what policies have worked to improve productivity. Most policies are targeted at the growth of firms, but there is no evidence that this enhances productivity (19). Thus, academic research can be used to identify the reasons behind productivity gap in a region. The factors impacting productivity are usually split in two groups: internal and external factors to the firms. Internal factors account for management, investment, skilled labour, R&D and globalisation, whereas external factors include market access, competition and agglomeration (19).

2.3.7. Each internal factor can contribute with more or less intensity, depending on the region’s features, but economic research has demonstrated that the advantages related to external factors are more easily seen particularly around competition and market access, as a productivity study undertaken by D2N2 states: “Weaker competition and limited market access tend to be associated with lower productivity, in part because they discourage investment in new types of capital and in R&D. Disentangling the effects of agglomeration has proved more difficult, although cities with better transport infrastructure (including road, rail, airports and information highways) have been found to grow more quickly than those with weaker access” (19).

2.3.8. There is a clear picture from both the D2N2 Productivity Report and Midlands Connect strategy of how the transport unlocks growth and some of the wider impacts observed with transport intervention are related to productivity [Figure 9]. However, transport authority bodies constantly found themselves providing responsive measures for capacity problems due to budget restrictions. In order to move out from this loop of lagging investment, a long-term vision needs to be taken to finally meet the connectivity demands before transportation infrastructure assets reach capacity, creating a barrier to growth. This is exactly the intention of the Local Industrial Strategy and it finds support in the work of Midlands Connect,
which intends to have a shovel-ready future proofed programme of priority schemes.

2.3.9. As part of Midlands Connect strategy to unlock growth, a simulation of 20% reduction in Generalised Journey Times (GJTs – the time taken for a whole journey door-to-door) for key movements across Midlands found significant economic benefits, which has motivated setting Conditional Outputs to achieve those figures (16).

**Condition Outputs:**

- Highways Journey Times: achieve average speed of **60 mph** on the SRN between key centres, national and international destinations.
- Highways Journeys Times: journey time should be **no more than 20% higher** than the average journey, any time, everyday.
- Rail Services: Journey with end to end **speed of 70 mph** where possible.
- Rail Capacity: everyone has a seat during off peak; no more than 20 minutes standing in peak time; and sufficient rail freight capacity.

**Strategic Economic Hub: Derby - Nottingham**

2.3.10. As a hub, both cities are key centres of economic activity in the Midlands and places where travelling needs converge (16). The Derby-Nottingham area is home to 1.4m inhabitants (64% of D2N2),GVA of £ 30bn (66% of D2N2)and a high level of self-containment.

2.3.11. The two cities have grown with different industries, whereas Derby holds a well-developed manufacturing sector, Nottingham’s strengths are professional services, thus their economies are often referred as complimentary. According to research commissioned jointly by Derby and Nottingham City Councils, there is economic evidence that support operating at the Metro scale would provide opportunity for this region as **linking places helps drive productivity through widening labour markets and employment opportunities, improving skills provision, creating relationships between drivers of innovation and expanding markets for products. It can also provide the scale necessary to attract additional investment** (20).

2.3.12. A successful joint bid for the Department for Transport’s Transforming Cities Fund was built on two main approaches: exploiting mass transit in key corridors and tackle the challenge of the first and last mile of a travel journey, exploring flexible public transport solutions and responsive technology (12).

2.3.13. Some projects supporting this Hub are (21):

- Improving bus priority by using advanced technologies for urban and inter-urban bus services operating along key growth corridors between Derby, Nottingham and the East Midlands Airport employment zone, and within the two-cities' urban areas. This included upgrading and extending the network of tram and bus-based Park & Ride sites across the area.
- Major public realm, walking and cycling investments focused on ongoing and allocated housing and employment developments in the immediate vicinities of Derby and Nottingham’s main rail and bus stations – improving links from them to the city centre and the new developments.
- Key strategic cycling improvements identified through the D2N2 LCWIP. Priority schemes included lighting and widening the traffic-free Derby Riverside Path and
Canal Path routes, and the extension of Nottingham’s cycle routes though the Boots Enterprise Zone and Beeston to the edge of the urban area. The development of the LCWIP has identified opportunities to link these arterial urban cycle routes through green gaps between Derby, Nottingham and the airport.

**Intensive Growth Corridor 3.: Derby and Nottingham to the North**

2.3.14. The North Derbyshire manufacturing zone and Northern Gateway project in Chesterfield. This area will benefit with an HS2 station in Chesterfield and HS2 Maintenance Depot at Staveley, in addition the journey time from HS2 Hub will be only 11 minutes (22), reducing significantly journey time from Nottingham.

2.3.15. The potential benefits of HS2 for the Chesterfield area include: better connectivity for the 1 million plus people already living within 30 minutes of the station; 4,740 new homes and 10,220 new jobs; £270m net additional GVA; and 176 ha of brownfield land brought back into use with the HS2 Maintenance Depot (22).


2.3.16. Creating opportunity to bond strong relationship in the professional services sector between the hubs of Midlands and expanding access to market and supply chains makes the case to invest in faster city-to-city Rail services. This sector makes up to more than a quarter of jobs in cities like Nottingham and Birmingham but have lower than average economic productivity (16). Professional services take advantage of good connections to trade domestically and internationally. In addition, clustering enables better flow of information between firms, enhancing business efficiency (refer to Figure 9).

2.3.17. Moreover, manufacturing firms are located in the suburbs and along strategic corridors with access to exporting gateways, such as airport and ports. In that sense, increasing reliability on our highways (especially in suburbs as observed in Figure 4) and access to international destinations need to be addressed (16).

2.3.18. As for Rail Connectivity, currently, a 52 miles journey from Nottingham to Birmingham takes 69 minutes, with an average speed of around 45 mph (16); from Nottingham to Lincoln it takes 60 minutes, with an average speed of around 40 mph; and from Derby to Stoke-on-Trent it takes 51 minutes, with an average speed of around 50 mph. As observed, these speeds are way behind the aspiration of 70 mph, and there is evidence that investing in them will release a brake on Midlands’s economy. Currently, Midlands Connect is investigating the business case for these routes and has already found economic case for the Nottingham-Birmingham route (16).

**Intensive Growth Hub 6.: Nottingham – Leicester – Coventry – Warwick and Thames Valley, and includes connections from Leicester to Birmingham:**

2.3.19. Although not part of D2N2 region, Leicester forms an important regional hub along with Coventry, and as business do not necessarily operate within these boundaries, providing better connection between Nottingham and Leicester whose economy relies on professional services makes sense from a business perspective of market access and companies attraction for agglomeration, which enhances productivity.

2.3.20. As one of the priorities for the region in the Road Investment Strategy 2 (2020-2025) is to upgrade the M1 to Smart Motorway between Junction 19 and 23A,
increasing reliability in the Nottingham and Derby to Leicester route while reducing journey time (23)

2.3.21. As for Rail Connectivity, aligning with the Condition Outputs set in Midlands Connect Strategy (2017) for Rail Capacity, which used forecasts up to 2036, there is space to study an increment of trains at routes from Derby (+1) and Nottingham (+2) to Leicester (16).

2.4. STRATEGIC ROADS

Strategic Road Network

2.4.1. A46, including Newark North bypass

- National impact:
  - Matrix Origin/Destination data analysis shows this section is already being used by strategic east-west traffic but is constrained by poor performance in the Leicester area including Hobby Horse and Leicester Western Bypass. The route has the potential to support travel to/from the Nottingham area which could relieve the M1 and the A52 in Nottingham (16).
  - Minimise greenhouse gas emissions from traffic (8).
- Sub-regional:
  - Inter-hub connectivity (journey times and reliability): There is less economic interaction than would be expected between cities the size of Coventry, Leicester and Nottingham. Investment would support agglomeration between these centres and complement SRN-dependent industries such as advanced manufacturing. It would also improve access to labour markets in these centres, and Birmingham (8).
  - Connections to the UK and international gateways (journey times and reliability) (8).
  - Strategic employment growth sites: The Newark and wider Nottinghamshire area contains a series of Midlands Connect Growth Sites including Newark Futures and A46 Corridor Sites. Total of circa 4,500 jobs (8).
  - Strategic housing growth sites: The Newark and wider Nottinghamshire/Nottingham city area contains a series of strategic housing sites including Newark Futures, A46 Corridor Sites and locations to the East of Nottingham including Gamston and Waterside. A total of 16,500 homes planned for delivery (8).

2.4.2. A38 – Derby Junctions: Reduce congestion in Derby surrounding areas while improving journey time variability in this road that connects A5 to M1 J28;

2.4.3. A52 – M1 J25: Enhance connectivity between Derby and Nottingham, while providing car access for HS2 East Midlands Hub from both cities and M1;

2.4.4. A50 – West of Uttoxeter and Infinity Park Link: By connecting M6 to M1 an increase in reliability will be experienced by road users and it will support growth along the corridor, vital for multinational companies;

2.4.5. M1 – Smart Motorway J19 to J23A: Improve in journey time variability from D2N2 region to the South (EM Airport).
Major Road Network (MRN)

2.4.6. Local Roads, including the newly proposed Major Road Network [Figure 11] carries two thirds of all traffic and a third of the freight. Investment in these roads are essential to reduce congestion, support economic growth, support housing delivery, support all road users and at last support Strategic Road Network, providing alternative routes to an ever growing traffic demand. Not surprisingly, when traffic conditions during peak time is overlayed in the proposed MRN [Figure 12], it is possible to verify the most congested parts of the network are in cities surroundings, composed by local roads.

2.4.7. At the Budget announced by the Government a total of £3.5 billion in expected to be spent on local roads between 2020-2025 (24). DfT consultations with sub-national transport bodies and local authorities will create a middle-tier of the country’s busiest ‘A’ Roads, known as Major Road Network and a pipeline of projects to invest on.
2.5. STRATEGIC RAILWAYS

Midlands Hub Rail

2.5.1. Railway regional connectivity experience for D2N2 population is slow and crowded, with forecasts predicting this condition to worsen in the future. By investing in increasing trains availability and faster services, creating 85,000 extra seats, it will directly benefit users, professional and logistic services (13).
2.5.2. The Rail Hub is needed to support the high levels of growth in business and professional services over forthcoming years in key centres such as Nottingham and Derby.

2.5.3. Side benefits: Improved air quality due to a more balanced mode of travel between car and train. In addition, increase in freight transport by rail will reduce the carbon footprint by 76 per cent (13).

Figure 13 - Midlands Rail Hub: (R) Comparison of D2N2 main cities journeys with other inter-city routes (L) Routes and number of trains (13).

Other Rail Improvements: East West Connectivity and movements within D2N2

2.5.4. Midlands Main Line Electrification: This much awaited project is essential to provide line speed improvement and benefit the wider MML corridor, central to D2N2 North-South connectivity and regional movements.

2.5.5. Ashford and Mansfield to HS2 Hub: The modelling evidence created by the HS2 Gateways study confirms the potential for a rail corridor linking Mansfield/Ashfield with the Hub Station. However further work required on to determine the level of engineering improvements required to enable passenger services on the Kirkby Freight Line, also known as the Maid Marian Line. There is also potential for a route via the Robin Hood line making use of the proposed Trowell Chord (26).

2.5.6. Newark-Nottingham line improvements: Currently, Newark is served with two rail stations, one attending the East Coast Main Line, which provides good connections North-South to the city and the other serving the Nottingham-Lincoln Line, which provides East-West connectivity. However, the city centre is entangled with a flat Crossing from the above-mentioned rail lines, the only of its type in England, causing traffic congestion for road users and low performance in both rail lines. Investing on a separated-grade junction is necessary to increase train frequencies on this corridor, improving connectivity and supporting a shift to travel by train on this key regional corridor (27). According to East Coast Main Line Study from National Rail (28), potential benefits are:

- Lincoln would not be ‘locked in’ for rail growth: passenger and freight service levels to the midlands could increase. Journey times could also be reduced.
• Long distance train operators could travel faster through the section, reducing journey times.
• An adjacent level crossing could be closed, further reducing safety risk and delay for road traffic.
• Network Rail would save money on maintaining a bespoke asset and reduce risk to the service it provides.

Because the benefits involve multiple stakeholders, their benefits need to be considered jointly. Individually the costs of such intervention may not compensate the benefits, however, as part of a broader economic case encompassing the ECML and the Lincoln – Nottingham corridor, they may have merit, thus further study is required to identify economic feasibility of such interventions and fuller range of potential funders.

### 2.6. GETTING THE MOST OUT OF HS2

2.6.1. East Midlands Gateways Connectivity Study was established to provide a framework of interventions that would maximise the EM Hub station benefits for the region. It is jointly funded by the 4 local transport authorities in the D2N2 area, Highways England and Midlands Connect and an in-kind contribution from HS2 Ltd (26). Built on the East Midland HS2 Growth Strategy, it has advanced on the proposals of the latter, proposing alternative routes and assessing engineering and economic feasibility of projects.

2.6.2. HS2 represents one of the greatest opportunities of economic shift for East Midlands, contributing with an extra £ 4bn and 74,000 jobs by 2043 [Fig 7], with 20% of the estimated growth delivered in the proposed Innovation Campus at Toton and the other 80% in surrounding locations. Realising this potential will be dependent on delivering high quality strategic connectivity between the Hub Station and these areas by a mix of transport modes (26).

![Figure 14 - Facts and Figures EM Hub (26)](image)

2.6.3. Projects associated with HS2 East Midlands Hub Station:

- Commercial and Housing Development
  - Innovation Campus at Toton

- Conventional Rail:
  - Mansfield/Ashfield Conventional Rail:
  - Derby to Nottingham through EM Hub:

- Mass Transit options:
  - West of Nottingham to EM Hub – Tram extension:
- Derby/Derbyshire to Hub via Pride Park:
- EM Hub to East Midlands Airport.

**HS2 Chesterfield Station and Depot:**

- North Derbyshire Growth Zone: potential to generate thousands of new local engineering jobs and be the heart of a mixed-use housing and employment zone
- Staveley Depot: Potential to become a rail industry ‘centre of excellence’. Investing in the recovery of a brownfield site can energise landowners to put forward a new garden village.
3. DIGITAL CONNECTIVITY

3.1. PREMISES

3.1.1. Digital Derbyshire and Better Broadband for Nottinghamshire planned to achieve **98%** of premises covered with superfast broadband by the end of 2018 (17). According with Ofcom, in September 2018 **92.47%** of premises in the region were covered with at least superfast broadband, which is below UK average of 96%. (29)

3.1.2. While it is important to keep the plan to achieve 98% of premises covered in the region, a proactive attitude is required to plan for the next generation digital connectivity: Fibre broadband and 5G connection.

*Figure 15 - Ultrafast broadband coverage (>300 Mbit/s) (29)*

*Figure 16 - Superfast broadband coverage (>30 Mbit/s) (29)*
3.1.3. The area in pink in the maps above [Figure 15 and Figure 16] covers the section of the strategic route A46 that crosses D2N2. This road consists on a corridor connecting two ports with a great appeal for logistics and manufacture. Thus, upgrading broadband for at least superfast connection should be a priority.

*Figure 17 - Location of HS2 Hub and broadband coverage (29)*

3.1.4. The location in which the HS2 Hub is located [Figure 17] does not have access to Ultrafast broadband, thus certainly this area should be prioritised.

*Figure 18 - Premises unable to receive 30 Mbit/s (29)*
3.1.5. Despite the large geographic areas without access to 30 or 10 Mbit/s broadband, they account for around 7% of premises and are located in some isolate regions as the Peak District National Park. This puts the region above the UK average by 4 points (30) and with the launch of Universal Service Obligation (USO) in March 2020, guaranteeing access for at least 10 Mbps connections, this difference is expected to decrease. Despite the low density of such regions, better digital connectivity can improve life quality, e.g.: telemedicine can be lifesaving in rural communities and can harness the power of the internet to provide clinical consultations (31).

3.1.6. There is a potential relationship of lower broadband speed with deprivation, as there is a decreasing trend in ‘<2Mbps/s’ connections when income and education deprivation decreases (32). Two critical areas can help boost productivity: promote workforce skills and digital adoption. By upgrading skills, either upskilling or reskilling of the current workforce it is one way to maintain a high level of employment even in an era of rapid digital transformation (33). Thus, new education programs can be associated with the roll-out of USO to harnesses digital connectivity to decrease deprivation.

3.2. GROWTH ZONE CONNECTIVITY

Figure 20 – Derby (Left) and Nottingham (Left) Enterprise Zones
3.2.1. To realise the full potential of the Enterprise Zone, it is very important access to ultrafast broadband. It can be seen from the maps above, that only Nottingham Enterprise Zone is fully covered with ultrafast broadband and Derby EZ is only partially covered.

3.3. NEXT STEPS

3.3.1. Keep the plan to achieve 98% of premises covered in the region and adopt a proactive attitude to plan for the next generation digital connectivity: Fibre broadband [Figure 21] and 5G connection. The roll out of those two technologies need to be further investigated so the region does not lag behind others as it is currently with broadband connectivity.

3.3.2. Road Schemes to convert A-Roads into Expressways, such as A46, A1 (M), A38 and A50 [highlighted in Figure 21] can enhance digital connectivity in the road network, with approximate level of information found in Smart Motorways, increasing journey time reliability in those key corridors.

Figure 21 – Fibre readiness and the SRN
4. ELECTRICITY

4.1. CAPACITY

4.1.1. Assessing the capacity of electric network by means of its substation’s capacity can help to understand where possible constraints to growth are. For better understanding this, there are two definitions: Demand and Generation Headroom.

4.1.2. Demand Headroom accounts for the difference between Firm Capacity of a substation and Measured Peak Demand. It gives an idea of spare capacity in the system and whether or not there is room for growth (real estate developments) in the area covered by each substation and Electricity Supply Area (ESA) [Figure 22]. Overall, D2N2 area has over 2000 MW in Demand Headroom, which is 37% of the network capacity, giving the region a wealthy position for new developments. However, there are 6% of substations, roughly estimate in 10, with no capacity or less than 10% spare capacity [Figure 23], which could possibly represent a constraint to growth (34). Spare demand capacity is the ratio of Demand Headroom by Firm capacity of each substation.

4.1.3. Generation Headroom is calculated by the difference of reverse power capabilities of each substation (roughly, half substation’s installed power designed to attend demand: ‘Firm Capacity’) and the sum of: connected generation, accepted but not yet connected generation and offered and not accepted generation. It provides an indication of the network’s capability to connect large-scale developments to major substations. In a scenario with less offer of centrally generated electricity (Major Power Station, such as Coal Power Station), Distributed Generation (“DG” as opposed to centrally generated) is key to decarbonise the electricity generation supply chain, because DG typically use renewable energy source. Thus, creating the conditions to sustain growth in Distributed Generation is paramount.

4.1.4. Currently, D2N2 area has only 329 MW of Generation Headroom (about 20% of the Generation Connected, currently at 1,691 MW) and 23% of its substations with no room for new connections [Figure 25]. Figure 26 illustrates the location of substation and it is possible to observe almost all districts suffer from this lack of generation headroom (34).

4.1.5. Generation Headroom can result in a negative value [Figure 22], which means the ESA has no room to accommodate new connections to its substations. The generation capacity is limited by the power reverse capability of each substation, hence the generation not yet connected to the network (to account for more DG power) falls in two categories: generation accepted and not connected and offered and not accepted.

4.1.6. Thus, Demand Headroom accounts for the availability of electricity in the area and Generation Headroom for the capability to connect small and medium power plants to the existing distribution network. Both are important to the development of the area.
Figure 22 - Generation and Demand Headroom by ESA (34)

Figure 23 - Spare Demand Capacity (34)
Figure 24 - Spare Demand Capacity by substation (34)

Figure 25 - Generation Headroom (34)
Figure 26 - Generation Capacity by Substation (34)

Note: No data available for High Peak District*
4.2. DEMAND BY REGION

4.2.1. Electricity consumption in D2N2 accounts for 3.25% (9,125 GWh) of Great Britain consumption. Consumption distribution within D2N2 reflects residential and industrial densities.

4.3. FUTURE DEMAND SCENARIOS

4.3.1. Published by National Grid, *Future Energy Scenarios 2018 (FES)* forms the backbone to assess future demand and generation:
Following extensive analysis and consultation, we have created a new framework for our scenarios this year. We continue to use our 2x2 matrix [Figure 29], however, the scenarios are now aligned to two new axes:

- speed of decarbonisation
- level of decentralisation.

The speed of decarbonisation axis is driven by policy, economics and consumer attitudes. All scenarios show progress towards decarbonisation, with Community Renewables and Two Degrees meeting the 2050 target. The level of decentralisation axis indicates how close the production and management of energy is to the end consumer, moving up the axis from large-scale central to smaller-scale local solutions. All scenarios show an increase in decentralised production of energy compared with today. (36)

Figure 29 - Scenario matrix in 2018 by National Grid (36)

4.3.2. As the owner of England and Wales Electricity Transmission System, National Grid defines boundaries for its Network Transmission Systems (NETS) to provide an overview of existing and future transmission requirements, and report the restrictions we will see on the NETS, we use the concept of boundaries. A boundary splits the system into two parts, crossing critical circuit paths that carry power between the areas where power flow limitations may be encountered (36).

4.3.3. Figure 30 and Figure 31 represents the NETS area covering D2N2 and it is possible to verify a significant drop in fossil fuel generation in the coming years, mainly due to the closures of coal power stations in D2N2 area and the uptake by low carbon and renewable energy sources in the future, this replicates the importance of having spare capacity in the grid for distributed generation.
4.3.4. Using a similar approach with data from Future Scenarios 2017 (FES), Western Power Distribution has contributed with the data for demand and generation measured every half hour of a day for 31 Electricity Supply Areas covering most of D2N2 area.[Figure 32]
4.3.5. The half-hour measures accounts for the variation in generation and demand throughout the day in a total of 48 half-hour measures, representing a peak day (summer peak day for generation and winter peak day for generation). Converting the Electricity Power in Megawatts to Electricity Energy in Gigawatts-hour, using the following equation: \( Power [MW] \times 0.5 \text{ [hours]} \times 365 \text{ [days]} / 1000 \) and factoring by real demand and generation according to BEIS data (2017), the following figures were reached:

**Figure 33 - Demand growth by user (37)**
4.3.6. The figures above represent a Gone Green scenario (FES 2017) (37), which is similar to the Community Renewables scenarios (FES 2018) (36) and it shows the demand uprise exceeding the generation in D2N2 region, despite of the forecasted renewables energy generation increase. This emphasizes the challenge of the region to generate electricity, which according to National Grid, “will depend on Future nuclear generation combined with wind and biomass generation, connecting in North Wales,[and] will potentially drive increased power flows eastward into the Midlands (36).

4.3.7. Finally, a second conclusion from the same report emphasizes the opportunities arise from Distributed Generation (see section 3.1): In a highly decentralised scenario like Community Renewables, local generation capacity connected at the distribution level in this western region could reach up to more than 50 GW by 2040. Of that capacity, a typical embedded generation output on average might be around 19 GW. This will vary depending on factors like wind speeds, and how other local generators decide to participate in the market. (36).
REFERENCES


