

Impact at a local level of full-fibre and 5G investments

Broadband Stakeholder Group



The BSG has, over a number of years, worked closely with industry, government and the Local Government Association (LGA) on how best to remove barriers to digital network deployment and to foster collaboration. Our collective focus has been significantly sharpened by the critical role of digital connectivity during the current pandemic and the momentum required to realise future investments in support of the UK's 2025 gigabit deployment ambitions. Many of the levers for realising these ambitions and lowering these barriers are held at a local level. Challenges relating to deployments and geographies will always differ in their complexities, but the enablers will always hinge on effective co-ordination between local authorities (LAs) and telecoms operators.

The practical guidance and resources in the [government's Digital Connectivity Portal](#) in 2018, combined with the cross-departmental agenda pursued by the Government's 'barrier busting' team have secured significant improvements. The Summer 2020 [government guidance to councils to help deliver the UK's digital connectivity ambitions](#) represents further welcome progress. Among other enabling measures, ministers are calling for the appointment of 'digital champions' to ensure optimal co-ordination between respective LA functions, which the BSG has long advocated.

Allocations of significant amounts of capital for new digital infrastructure by industry need to be matched by economic returns, and the speed and ease of deployment in a given local area is a relevant consideration. Industry recognises the need to play their full part in facilitating local deployment by reinforcing their commitment to mirror best practice in their engagement processes so that councillors and LAs have a consistent experience when dealing with the sector. This is a critical enabler which will underpin the success of future full-fibre and 5G deployments.

This booklet—based on a more detailed report prepared by Oxera for the BSG¹—provides an overview of the evidence for the range of impacts on LAs, businesses and consumers at the local level arising from the improvements in connectivity, and the benefits that ultrafast networks—including full-fibre and 5G—can bring. It is intended as a practical guide, outlining the tools for LAs to evaluate the potential impact of investment in full-fibre and 5G networks locally and support an evidence-based assessment.

We look forward to pursuing dialogue with all stakeholders in support of this common endeavour.

Clare MacNamara
CEO Broadband Stakeholder Group

What are the local benefits of full-fibre and 5G investments?



Benefits for existing businesses

On average, existing businesses could see increased productivity, with the evidence showing an expected impact of between **0.3% and 3.8% increase in turnover per worker per annum**.²



New business start-ups

The evidence shows an expected impact of between **0.4% and 3.2% increase in the number of businesses operating** in areas with significantly improved broadband networks.³



Improved employment opportunities

There could be an **increase in employment in the area** (new jobs, inward migration and safeguarded jobs) of around **0.6–1.7%**.⁴



Private benefits to consumers

Private consumer benefits could be realised in terms of **access to a greater number of services**. Consumers may also experience improvements in subjective personal wellbeing, for example from the greater range of entertainment or education options or **increased social inclusion**.



Benefits to Local Authorities

At the local level, public service providers, such as LAs, could benefit from **cost savings in the delivery of public services** and benefits associated with the improved economic environment. Increased economic activity can have a number of benefits for a local area, both directly through some additional income (e.g. through business rates) and indirectly (through assisting with a range of other LA objectives facilitated by increased economic activity such as reduction in antisocial behaviour or deprivation).

Infrastructure at both the local and the national level is crucial for connecting areas, industries and individuals, and for facilitating interaction, collaboration, trade, which in turn lead to social and economic benefits.

In particular, in today's connected world, **having up-to-date and future-proof digital and telecommunications infrastructure is of fundamental importance, and has been identified as a strategic priority for the UK government.**⁵

While the existing basic and superfast fixed broadband and 4G have worked well for the vast majority, even under the increased demands arising from the COVID-19 pandemic, there is scope for substantial additional value in moving from 'good' to 'great' in terms of both the level of connectivity and its genuine availability for all.

In this context, **increased investment in ultrafast networks, such as full-fibre and 5G, has an important role to play**, and there are **clear targets from central government** for achieving nationwide coverage of gigabit-capable networks by 2025⁶ and 5G to the majority of the population by 2027.⁷

These are **ambitious timescales**. They are intended to be delivered primarily through investment by commercial players, with the addition of some public funds to support investments in more remote areas.

This upgrade in national digital infrastructure will require close engagement between government and the private sector, as well as **co-operation with LAs** to reduce any barriers to investment.

However, LAs need first to understand the likely impacts of improved connectivity on public service delivery, and on the businesses and individuals operating, living and working in their local area.

The information presented in this booklet—based on a more detailed report prepared by Oxera for BSG⁸—provides a **readily accessible overview of the existing evidence base on the expected impacts at a local level and aims to assist LAs in their assessments by providing a clear framework and worked examples.**⁹

LAs are best placed to understand the needs of their residents, businesses and partners, and, using the information set out in this booklet, to understand how better connectivity can support their local area.

In doing so, LAs can make an **evidence-based assessment** of the likely benefits to their locality from supporting the roll-out of full-fibre and 5G.

Increased investment in ultrafast broadband networks, such as full-fibre and 5G, has an important role to play in supporting many of the key focus areas for LAs—as identified by the LGA—including economic recovery, public health, adult social care, the vulnerable, and climate change.¹⁰

By understanding how their local area can benefit, LAs can **work closely with operators to identify how they can support the roll-out process in a way that maximises the benefits to their area**, and work to integrate the new connectivity with other local developments to realise such benefits.

LA engagement will be important, not least given the need for a locally led role in supporting a post-COVID-19 recovery, as recognised by the LGA:¹¹

‘Locally-led action will be key to ensuring that the economy recovers in a way that addresses the long-term inequalities we have seen across the country...’

‘...we can get local economies started again and deliver a pipeline of long-term investment that will revive the economy and deliver long term economic, social and environmental transformation.’

Source: Local Government Association (2020), [‘Re-thinking local’](#), p. 17.

Examples of strong local benefits arising from investment in full-fibre and 5G

While the exact impacts and outcomes of improved connectivity will depend on who takes up the services and how they take advantage of the improved capabilities of these high-speed networks, there are a number of examples of **investment in full-fibre and 5G helping to deliver measurable outcomes and benefits for businesses, individuals and LAs**.

For example, the case studies below illustrate how take-up of full-fibre and 5G by public bodies could lead to improved communication services, and to the deployment of **smart sensors and IoT** to improve the **provision of home care services**, which in turn leads to **cost savings**. Connectivity can support local, rural economies through improving agricultural processes and tackling the **digital divide**. Take-up of full-fibre and 5G by businesses to support smart sensors could also lead to **productivity improvements** through preventive maintenance in an industrial environment, also lowering cost savings and environmental impacts.

‘Fibre to the home(care)’—fibre-enabled digital homecare services in Sweden¹²

Fibre-enabled digital services aimed at improving health and social care services in the home have been experimented with by several municipalities in Sweden, where full-fibre networks are currently much more widely available than in the UK.

For example, the City of Västerås has introduced four digital services to provide social care—taking advantage of the improved digital connectivity enabled by fibre broadband connections to allow for improved communication with homecare recipients and for remote monitoring of patients. These services reduce the need for physical access to the patient or their living environment.

This provides an interesting example of how LAs can take advantage of improved connectivity to make changes to how they deliver public services. Furthermore, the evidence from Sweden shows that providing services in this way can generate extensive cost savings in service delivery. For example, one study has quantified the cost savings achieved by the authority when these services were deployed for 300 residents in the area (around 10% of homecare users). The cost savings included:

- reduced transport costs (because physical visits could be reduced) = €2.2m saving;
- shorter missions (the project showed that supervised visits via ICT could often be shorter) = €0.28m saving;
- decreased need (the knowledge of being able to contact personnel more easily made users feel safer and not require physical visits to the same degree) = €0.38m saving.

Examples of strong local benefits arising from investment in full-fibre and 5G

‘Putting Rural First—improving connectivity in rural areas’: the 5G RuralFirst co-innovation project led by Cisco¹³

The ‘RuralFirst’ project, which is part of the Department for Digital, Culture, Media & Sport’s 5G Testbed and Trials Programme, is seeking to pioneer new approaches to deployment and use of connectivity in rural areas, supporting agriculture, tourism, renewable energy and manufacturing. For example, the programme is testing how 5G can be used for ‘Agritech’, ‘with the aim of improving yield, efficiency and profitability’ by focusing on ‘achieving high speed connection to autonomous tractors and drones providing high definition image analysis of cross, weeds and soil’.

This project is also hoping to demonstrate the value of high-speed wireless services for the most rural or isolated areas in the UK (focusing on the Orkney Islands), testing use cases that are expected to ‘result in many significant benefits for the communities, homes, schools, stores and industries’ in the area. 5G in these remote areas is expected to help create ‘a more connected rural United Kingdom, tackling the digital divide, enabling (in cases for the first time) digital delivery of public services and working towards a smarter country, and smarter world.’

‘Liverpool is smart when it comes to keeping healthy’: Liverpool’s 5G Testbed¹⁴

Liverpool is the centre of a 5G Testbed and Trials Programme to demonstrate how 5G can be used to support improvements in the delivery of health and social care.

‘The Liverpool 5G testbed is working to demonstrate the capabilities of a blend of advanced low cost 5G technology and modern applications to provide services that will revolutionise the future delivery of health and social care.’

The objective is to demonstrate how health and social care applications are enhanced and integrated through the advanced capabilities of 5G networks (including high bandwidth and low latency). Therefore, the project is focusing on the trial of bandwidth-intensive applications that require very fast processing (relying on edge or cloud computing).

For example, patients triaged at A&E departments might be sent home with a monitoring device rather than being admitted for observation and taking up a bed in hospital. The hospital can continue to monitor the patient and determine which patients can stay at home and which should be admitted.

Other services to be trialled include:

- high resolution video and distributed AI for patient event and movement monitoring;
- teleconferencing, AR, VR, etc. to manage loneliness in older adults;
- high resolution video and remote diagnostics, facilitating communication between hospitals and patients.

Allowing people to return home from hospital sooner, or live longer in their own homes before going into care, can improve their wellbeing as well as that of their families. It can also ease a city’s budget; the cost of adult social care to the City of Liverpool is around £15,000 per person per annum.

Examples of strong local benefits arising from investment in full-fibre and 5G

This small selection of case studies also demonstrates the role of improved connectivity in supporting the key focus areas identified by the LGA going forward, including policies and initiatives on:¹⁵

- **Economic recovery**
- **Health care**
- **The vulnerable**
- **Adult social care**
- **Public health**
- **Climate change (green local recovery)**

Advanced telecommunications networks have a key role to play in supporting each of these areas and in stimulating a ‘green recovery’.

- **Economic recovery**—better connectivity can support increased productivity, new business start-ups, and improved employment opportunities.
- **Public health, adult social care and supporting the vulnerable**—the examples above illustrate how full-fibre and 5G can support remote monitoring and health care applications.
- **Climate change (green local recovery)**—full-fibre and 5G networks can help to support rising data usage in a sustainable way (through improvements in networks’ energy efficiency), as well as facilitating improved energy efficiency in other sectors such as industry and transport.

While there are many examples of the potential for strong local benefits, a framework is needed for thinking about the full range of potential benefits, the mechanisms through which these can be realised, and how the impacts may vary across different local areas. We set out such a framework in the following pages.

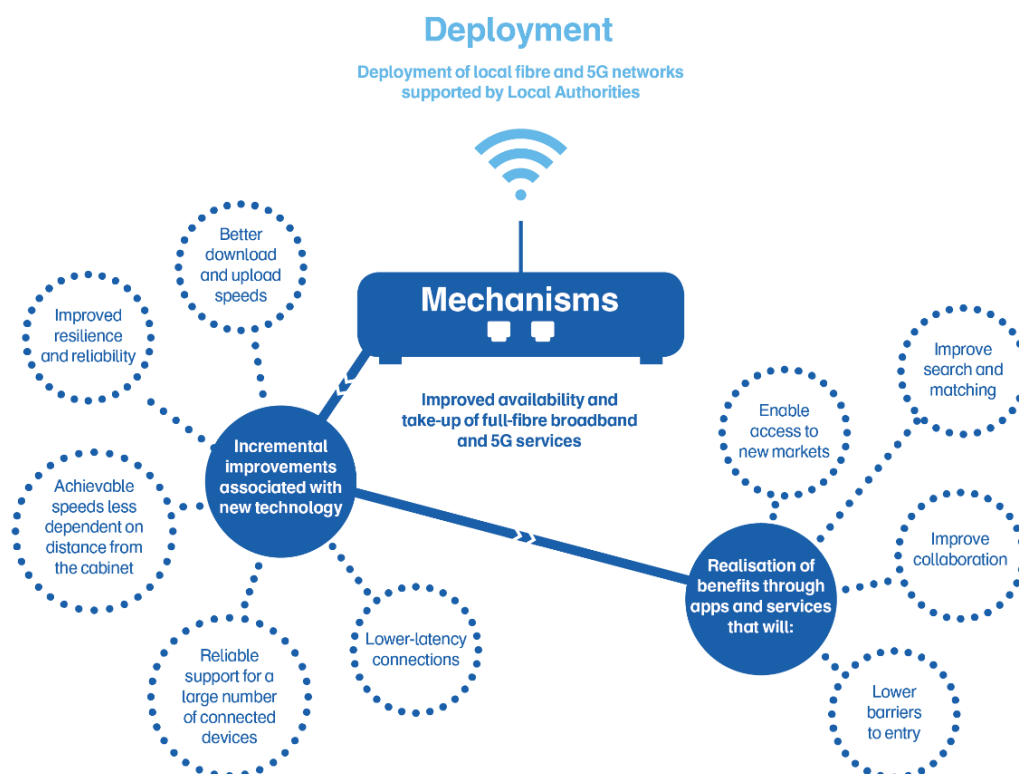
How investment in gigabit-capable networks can drive local benefits

The key input to improvements in connectivity at the local level is the deployment of a full-fibre network, providing a fibre connection all the way to the home or business and/or improvements in mobile connectivity through the deployment of 5G networks.

The presence of the physical infrastructure in itself will not necessarily bring direct benefits. However, these new networks will bring **technological and service quality improvements** over previous generations of fixed and mobile networks. It is the improvements in the functionality of these networks that is important, not the underlying technology.

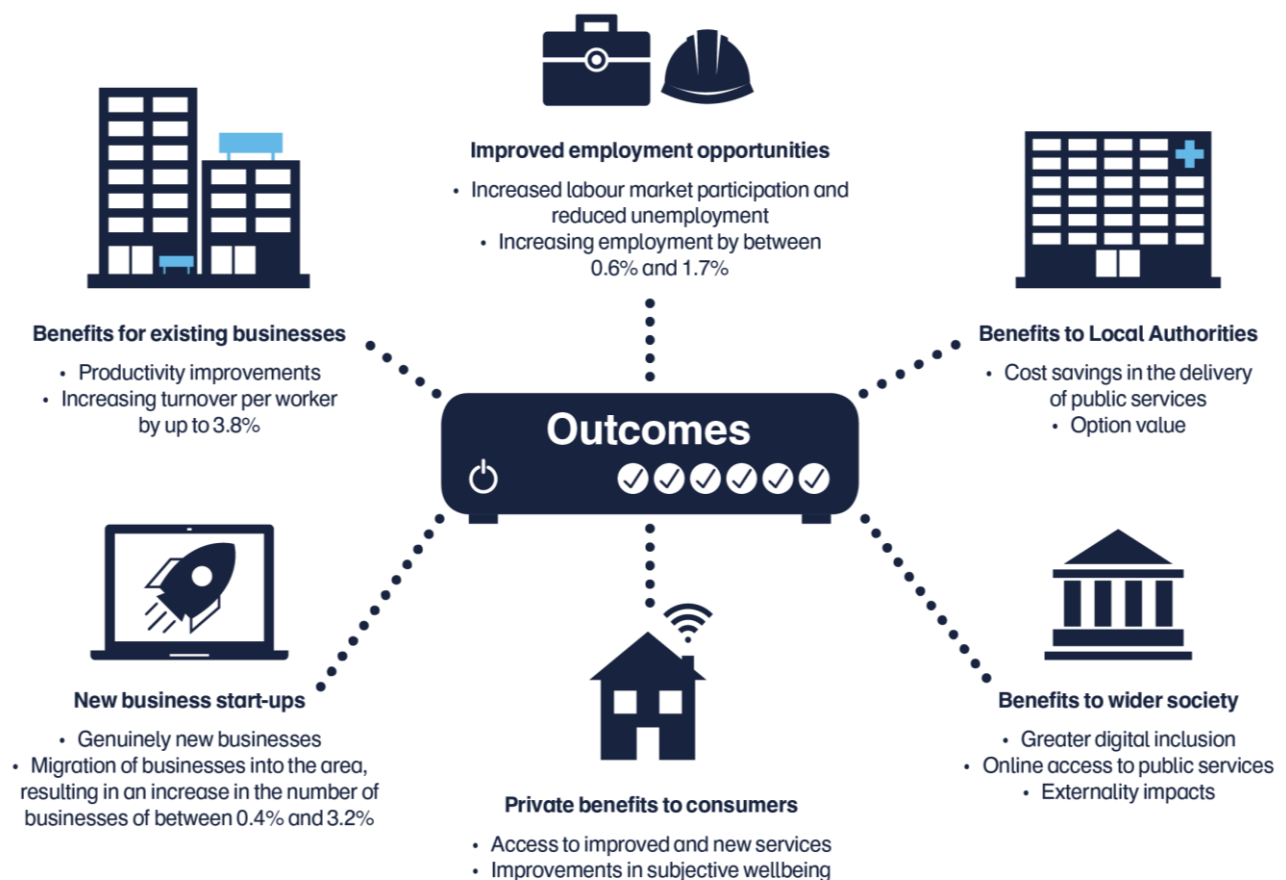
They will provide **faster and more reliable connectivity**, as well as a conduit for new applications and services that can take advantage of the technological improvements these new connections will bring.

These new services and applications that exploit these greater capabilities will enable the realisation of benefits by, for example, improving search and matching, improving collaboration, enabling access to new markets, and lowering barriers to entry.



Who will benefit and how?

These new applications will enable new and improved business practices and end-user services such that increased availability and take-up of full-fibre broadband and 5G will lead to positive outcomes for businesses, consumers, local government and wider society



Existing businesses can expect to benefit from business expansion, improved productivity and greater turnover, as a result of improved access to existing markets, entry into new markets enabled through improved communication and distribution channels, and the ability to offer innovative new services.

**Up to 3.8% increase
turnover per worker**

**Increase in
employment in the
area of 0.6–1.7%**

Improved connectivity may lead to **increased participation in the labour market** and higher employment levels linked to the creation of new jobs.

Furthermore, as a result of improved communication channels and opportunities for remote working, there will be new employment opportunities or a **reduction in migration away from the area** that might otherwise have been at a disadvantage in terms of broadband availability/speeds (this is referred to as 'safeguarding jobs').

Improved connectivity can **encourage new business start-ups**, enabled by easier access to markets, lower barriers to entry and the development of new business models that are digitally dependent and more flexible than established businesses. At a local level, if speeds are higher relative to other surrounding areas (or similar, competing areas), **new or established businesses may also be attracted into the area** from elsewhere, thereby boosting the level of business activity in the local area.

**Between 0.4% and
3.2% increase in the
number of businesses
operating in the area**

There will be private consumer benefits in terms of **access to a greater number of services**. These benefits will be reflected in increased consumer surplus, i.e. the difference between willingness to pay (value) and the actual price. Consumer surplus will increase where price declines as a result of increased competition and/or willingness to pay rises as a result of increased connectivity and enables access to new and valuable services. Consumers may also experience **improvements in subjective personal wellbeing**, for example from the greater range of entertainment or education options or increased social inclusion.

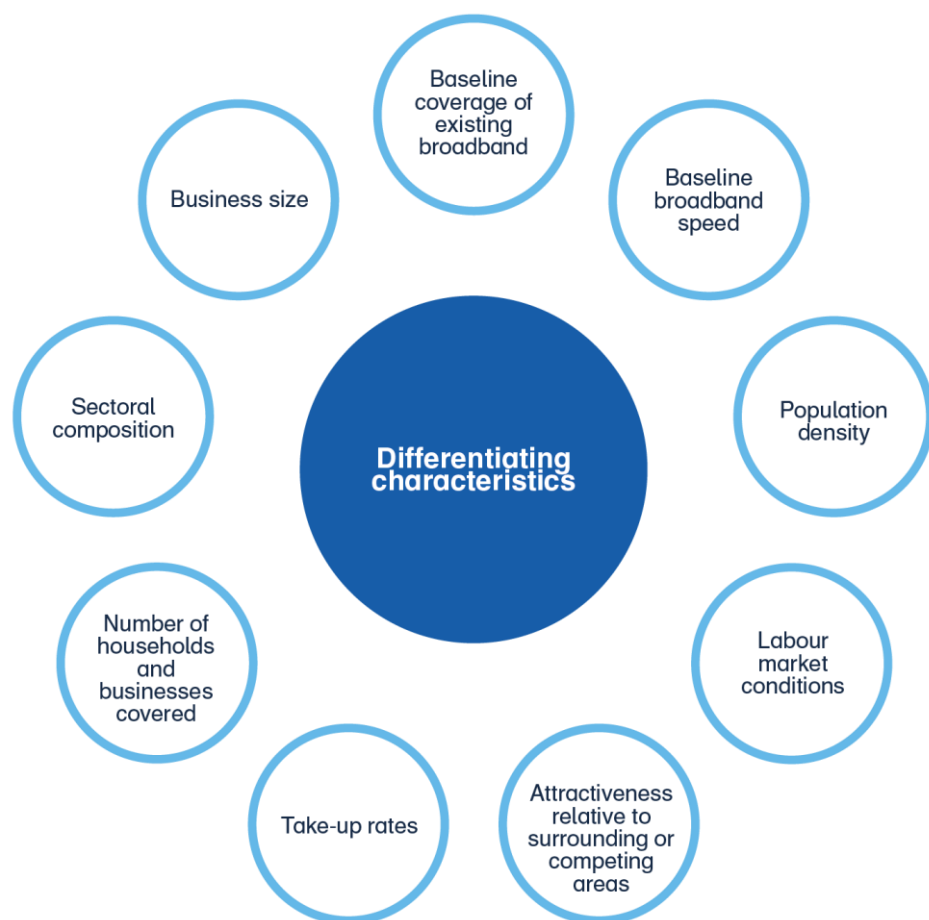
Wider society may benefit through network externalities, or positive spill-over effects. As more people are connected, further developments have a greater impact, and benefits might also accrue more widely than just to the subscribers and producers of such services. This could also deliver important, but often unquantifiable, social benefits such as **greater social inclusion**.

How might these impacts differ across local areas?

As highlighted by the LGA, **each and every area is different.**¹⁶

Therefore, the impacts and outcomes described above will not apply uniformly across all local area types. Investors and LAs that are considering how their areas will benefit from full-fibre and 5G connectivity should seek to understand the differentiating characteristics that could affect the variation of impacts and outcomes across areas, in order to maximise the benefits in their area.

While the evidence base is still evolving and is incomplete, below, we provide an overview of the key factors for LAs to consider when assessing which effects might be most important in their area.



How might these impacts differ across local areas?

Baseline coverage—if there are a number of customers who currently have little or no broadband, improving digital connectivity will result in the improved availability of, or access to, services for these customers. This could bring social benefits, such as improved digital inclusion, in addition to transformative impacts associated with all broadband users gaining access to new services or applications enabled by the improved capabilities of these networks.

Take-up rates—benefits to businesses or consumers can be realised only by those actually taking up and using the service. Take-up rates must be accounted for to adjust the total number of premises passed to give a meaningful measure of those that will benefit.

Number of premises covered—the larger the coverage area (for example, in terms of premises passed), the greater the number of consumers and businesses that have the opportunity to take up the service and the larger the absolute potential impact.

Sectorial composition—knowledge-intensive sectors are shown to benefit most.¹⁷ Education and health sectors have also been shown to experience larger-than-average productivity impacts of increased connectivity.¹⁸

Baseline speeds—the level of broadband speed available in the area prior to upgrades will be an important determinant of the magnitude of any benefits. Evidence suggests that larger changes in broadband speed can lead to larger impacts on productivity and employment.¹⁹

Business size—smaller businesses that are reliant on mass market or business broadband services based on standard broadband connections are more likely to benefit from a step change in broadband speeds and the associated improvements compared with large businesses that may already have access to dedicated high-speed connections (leased lines).

Population density—areas with low population density without full-fibre connections might be more likely to suffer from long line lengths provided over copper, which will result in poorer quality connections. So, the potential for gains from a shift to full-fibre or 5G connections is more significant in terms of increases in achievable speeds and reliability.²⁰

Labour market conditions—complementary policies supporting training and education may be needed to re-train the long-term unemployed and economically inactive so they can gain the skills to fill the new jobs being created.

Attractiveness relative to surrounding or competing areas—the post-investment speeds relative to surrounding areas will be important. Studies have found that regions with higher fibre penetration attract more business registrations and employment and have reduced migration away from rural areas.²¹

The examples described above and the assessment framework provided give a clear basis for LAs to identify the types of benefits that could be expected in their areas, and how those benefits will be realised.

While any quantification of the expected impacts on specific LA areas would benefit from being assessed on a case-by-case basis with a dedicated impact assessment, initial, indicative quantitative estimates for the direct impacts of improved connectivity on productivity, number of businesses, employment and consumers can be estimated using metrics from the existing literature, as set out on the following page.



Productivity (per annum)

*(Turnover per worker of firms taking up full-fibre broadband * estimated percentage increase in productivity) * the number of employees of those firms taking up full-fibre broadband*

The average impact ranges from around **0.3% to 3.8%** per annum depending on the change in broadband speed. The impact on productivity will be felt by businesses not already obtaining full-fibre services that can expect a change in speed and reliability.

Firms in sectors such as education, health, manufacturing, and professional services see larger-than-average increases for the same change in speed.



Employment (number of people employed in the area)

*Number of employed * estimated increase in employment*

The literature that focuses on change in employment includes both new jobs and jobs as a result of inward migration due to the improved attractiveness of the area. The local jobs market may also be protected by reduced migration away from areas (safeguarding jobs). Urban areas are shown to benefit more than rural areas.

The evidence shows that there could be an **increase in employment** in the area (new jobs, inward migration and safeguarded jobs) of around **0.6–1.7%**.



Change in number of businesses

*Number of local businesses * estimated increase in businesses in the area*

The evidence from the literature demonstrates a measurable impact of greater speeds and increased fibre penetration on the number of firms in an area. Taking a conservative estimate, the average impact of increased speed on the number of firms operating in the area is **0.4%**, but may be as large as **3.2%**.



Impact on consumers

*Households taking up the service * (willingness to pay for full-fibre/5G per month – price for full-fibre/5G services per month)*

The value consumers place on the benefits associated with improved experiences enabled by improved connectivity can be estimated as being at least the difference between their willingness to pay for their connection and the prices paid.²²



Impact on LAs

Measured by cost savings in service delivery based on LA initiatives

Quantifying the impacts on productivity, new businesses and employment: a worked example

Suppose the LA area has:

- 9,000 local business units;
- 90,000 jobs;
- 60,000 households;
- turnover per worker (average) = £80,000.

Data on these metrics is readily available from the Office for National Statistics, and reported at an LA level.²³

Impact on productivity (per annum)

Findings from the literature show the *average* impact of increased speed on productivity ranges from around 0.3% to 3.8% per annum, with the upper bound of this range related to a step change in broadband download speeds of 200Mbps or more (a change which could reasonably be associated with a shift to a full-fibre connection).

Therefore, on average, the productivity gain to a firm taking up a full-fibre connection can be estimated as:

$$\text{Turnover per worker of firms taking up the service} * 3.8\%$$

Assuming turnover per worker for each firm taking up full-fibre is £80,000 per annum, each firm can expect to see an increase of turnover per worker of around **£3,040 per annum**.

To estimate the aggregate impact for the local area, we must scale this up by the number of employees working for those businesses taking up the services.

Assuming a take-up rate of around 13% (the average take-up rate for FTTH/B in the UK in 2019), and the average of 10 jobs per business, the total expected benefit will be approximately **£3.5m per annum**. This will increase as take-up increases.

Change in number of businesses

Taking a conservative estimate, the average impact of increased speed on the number of firms operating in the area is 0.4%, but may be as large as 3.2%.

In our example, this implies an increase of between **36 and 288 businesses** in the area as a result of increased connectivity.

Employment impact

The average impact of increased broadband speed on employment is 0.8%, but could be higher for an urban area at 1.3%.

This implies between 720 and 1,170 new jobs in the area as a result of increased connectivity. We have not monetised these impacts as they are likely to overlap with the increased number of businesses: on the basis that more businesses are likely to, at least to some extent, rely on newly employed people to work in them.

How LAs can measure the outcomes of a specific investment

While LAs will not necessarily be making the investments in connectivity themselves, they may wish to monitor the impact of private investments in full-fibre and 5G networks to assess progress towards expected impacts.

In order to support this investment, information and data should be collected alongside the roll-out of the networks in order to allow for robust and meaningful evaluations in future.

As outlined earlier, there are a number of differentiating area characteristics that could affect the variation of impacts. Gathering data on these local area characteristics will be important for two main reasons:

- it will allow future evaluations to compare across area types to distinguish which area characteristics have a significant impact on the relative success of the investment;
- the more data that is available on the characteristics of the area being investigated, the greater the scope for identifying an appropriate control group (i.e. an area with similar characteristics that has not yet invested in improved connectivity).

To measure the impact, it is important to ensure that the data necessary to measure the 'outcomes' is collected before, during and after the investment project for both the treatment and the control groups.

The data collected to measure outcomes can then be used to compare changes from before and after the investment for the treatment group (where the investment has taken place), accounting for how those factors have changed in the control group (where the investment has not taken place).

In line with guidance from the 'What Works Centre for Local Economic Growth', using before and after data, combined with a suitable control group against which to assess changes, is a

key building block of a robust evaluation.²⁴ The net economic impact is the value of economic effects over and above any impact that would have arisen if the project/investment had not gone ahead (the counterfactual).



- ¹ Oxera (2019), 'Impact at a local level of full-fibre and 5G investments', prepared for Broadband Stakeholder Group, 12 September.
- ² Upper-bound estimates based on the findings of Ipsos MORI (2018), showing the impact of an increase in connection speed of greater than 200 Mbit/s. 0.3% based on SQW (2013), which estimated productivity gains based on an assumption of the impact of a doubling of speed, for which the central estimate is 0.3%. See Ipsos MORI (2018), 'Evaluation of the Economic Impact and Public Value of the Superfast Broadband Programme – Final report', prepared for the Department for Digital, Culture, Media & Sport, August; and SQW (2013), 'UK Broadband Impact Study', November.
- ³ Ipsos MORI (2018), op. cit.; and Hasbi, M. (2017), 'Impact of very high-speed broadband on local economic growth: Empirical evidence', 14th International Telecommunications Society (ITS) Asia-Pacific Regional Conference, which estimated the impact of very high speed broadband availability in the local area.
Note that some of this growth will be a result of taking business from elsewhere.
- ⁴ Ipsos MORI (2018) op. cit.; and OECD (2015), 'Development of High Speed Networks and the role of municipal networks', 9 November.
Note that some of this growth will be a result of inward migration to the area.
- ⁵ Department for Digital, Culture, Media & Sport (2018), 'Future Telecoms Infrastructure Review', July.
- ⁶ The Conservative and Unionist Party (2019), 'Get Brexit Done: Unleash Britain's Potential: The Conservative and Unionist Party Manifesto 2019', December.
- ⁷ National Infrastructure Commission; (2018), 'National Infrastructure Assessment', July.
- ⁸ Oxera (2019), op. cit.
- ⁹ The approaches and metrics may need to be updated over time to reflect the latest emerging evidence as it becomes available.
- ¹⁰ Local Government Association (2020), '[Re-thinking local](#)'.
- ¹¹ Local Government Association (2020), op. cit.
- ¹² Forzati, M. and Mattsson, C. (2014), 'FTTH-enabled digital home care - A study of economic gains', ICTON, 6–10 July.
- ¹³ 5G RuralFirst website, '[About 5G Rural First](#)'; 5G RuralFirst website, '[Agritech](#)'.
- ¹⁴ UK 5G Innovation Network website, '[Liverpool 5G Testbed](#)'; and UK 5G Innovation Network (2019), 'Keeping Liverpool Healthy', Testbeds and Trials special issue, pp. 32–35.
- ¹⁵ Local Government Association (2020), op. cit.
- ¹⁶ Local Government Association (2020), op. cit.
- ¹⁷ Industrial classifications J (information and communication), K (financial), M (professional, scientific and technical).
- ¹⁸ Ipsos MORI (2018), op. cit.
- ¹⁹ For example, Ipsos MORI (2018) finds that turnover per worker (average) sees larger increases at greater speeds, and firm turnover (average) also sees significantly larger increases at greater speeds. The idea of larger returns is also supported by evidence presented by Bai (2017), which shows that an increase in broadband speed from 100 Mbit/s to 1 Gbit/s has a greater impact on country-level employment than increasing speeds from 3 Mbit/s to 100 Mbit/s. Singer, Caves and Koyfman (2015) finds that fibre deployment to 100% of a region is associated with an increase in employment of approximately 2.9%. The authors explicitly recognise that 'the positive employment impact is specific to FTTP deployment, and is over and above the employment benefits that arose from previous broadband deployment', implying that there is an incremental impact over standard broadband. See Ipsos MORI (2018), op. cit.; Bai, Y. (2017), 'The faster, the better? The impact of internet speed on employment', *Information Economics and Policy*, 40:C, pp. 21–25; and Singer, H., Caves K. and Koyfman, A. (2015), 'Economists Incorporated: The Empirical Link Between Fibre-to-the-Premises Deployment and Employment: A case study in Canada', Annex to the Petition to Vary TRP 2015-326, Bell Canada.
- ²⁰ Services provided over a copper connection (even if just over the 'last mile' from the street cabinet to the home) experience degradation of service over distance. Fibre can carry much wider bandwidth over much longer distances without degradation.
- ²¹ As noted in WIK-Consult (2018), 'The benefits of ultrafast broadband deployment', prepared for Ofcom, February.
- ²² In the absence of readily available willingness-to-pay figures, local surveys may be needed.
- ²³ Local business units: Office for National Statistics (2018), UK BUSINESS: ACTIVITY, SIZE AND LOCATION - 2018 (Table 22 - Number of VAT and/or PAYE based local units in districts, counties and unitary authorities within region and country by employment sizebands (UK, 2018)).
Jobs: Office for National Statistics, LI01 Regional labour market: Local indicators for counties, local and unitary authorities.
Households: Office for National Statistics, '[Estimated number of households by local authorities of England, 2004 to 2016](#)'.
Turnover per worker: Accurate Turnover figures provided in the Office for National Statistics Business Structure Database (available only to government bodies and LADs).
- ²⁴ What Works Centre for Local Economic Growth (2016), '[How to evaluate local growth programmes](#)', April.



Oxera Consulting LLP is a limited liability partnership registered in England no. OC392464, registered office: Park Central, 40/41 Park End Street, Oxford OX1 1JD, UK; in Belgium, no. 0651 990 151, branch office: Avenue Louise 81, 1050 Brussels, Belgium; and in Italy, REA no. RM - 1530473, branch office: Via delle Quattro Fontane 15, 00184 Rome, Italy. Oxera Consulting (France) LLP, a French branch, registered office: 60 Avenue Charles de Gaulle, CS 60016, 92573 Neuilly-sur-Seine, France and registered in Nanterre, RCS no. 844 900 407 00025. Oxera Consulting (Netherlands) LLP, a Dutch branch, registered office: Strawinskylaan 3051, 1077 ZX Amsterdam, The Netherlands and registered in Amsterdam, KvK no. 72446218. Oxera Consulting GmbH is registered in Germany, no. HRB 148781 B (Local Court of Charlottenburg), registered office: Rahel-Hirsch-Straße 10, Berlin 10557, Germany.

Although every effort has been made to ensure the accuracy of the material and the integrity of the analysis presented herein, Oxera accepts no liability for any actions taken on the basis of its contents.

No Oxera entity is either authorised or regulated by any Financial Authority or Regulation within any of the countries within which it operates or provides services. Anyone considering a specific investment should consult their own broker or other investment adviser. Oxera accepts no liability for any specific investment decision, which must be at the investor's own risk.

© Oxera 2020. All rights reserved. Except for the quotation of short passages for the purposes of criticism or review, no part may be used or reproduced without permission.