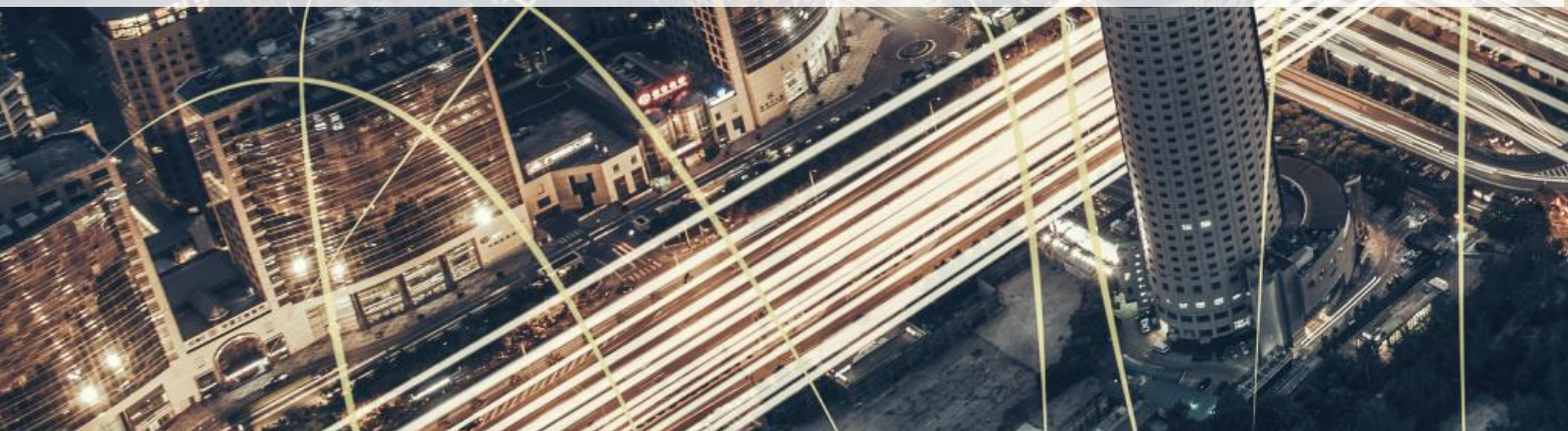
HATCH

The Economic Impact of Full Fibre Infrastructure from CityFibre's Network

A Report by Hatch

March 2022



City Fibre

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Contents Page

Executive Summary

i. CityFibre's Full Fibre rollout will deliver significant economic, social and environmental benefits for 285 locations across the UK. The ever-increasing importance of fast and reliable digital infrastructure has been made abundantly clear during the Covid-19 pandemic which has necessitated a significant level of social, commercial, professional and educational activity to be transferred online. This report provides an evidence-based set of measures that identify the range of positive impacts delivery of the network could generate, set against this backdrop.

ii. Greater access to reliable and affordable digital infrastructure through Full Fibre generates multiple, positive impacts outlined in this report. The impacts identified in the report are identified as 'core' and 'wider' impacts. Core impacts are those which directly arise from the network's construction and represent the most substantial benefits, including gains in productivity, house price uplifts and other benefits to businesses.

iii. Wider impacts are less straightforward to measure but centre on the key role of Full Fibre in the continuing transition to the use of internet based technology in day to day life, and to its contribution to action to tackle climate change. Drawing on a range of benchmark evidence, the core and wider impacts identified in this report are summarised below.

Core Impacts

iv. The report identifies direct benefits through the implementation of Full Fibre to the 285 locations, the most substantial of which are outlined below:

- The delivery of 16.4k jobs in construction with the activity to deliver the network and the supply chain activity it will support. This activity would generate an estimated £1.4 billion in construction GVA.
- Once operational, the completed network will generate significant economic benefit from 2026 including a £22 billion GVA impact associated with a boost to productivity, business innovation and start-ups, and a £15 billion impact on house prices.
- A £29 billion GVA impact generated by the accelerated shift to flexible home and remote working patterns the network rollout will support.
- A benefit to businesses valued at £4.9 billion through access to a larger supply of labour for employers, a key issue at a time when many face challenges recruiting talented people.

Wider Impacts

v. Alongside these direct economic benefits, the report identifies a broader range of positive impacts expected to arise from the deployment of Full Fibre to the 285 locations. Of these wider benefits, the following are the most substantial:

- 5G delivery is likely to be the most significant specific benefit of all those set out in the report, with a potential uplift of £53 billion in GVA estimated by the study. Full Fibre is critical in delivering 5G rollout, creating the backbone needed for phone masts and small

cells to function. It will have a transformative impact across different sectors including healthcare, smart utilities, consumer and media applications, industrial manufacturing and financial services.

- Internet of Things is becoming increasingly important to people's lives, impacting households, transport, business and health among other aspects of daily life. It is estimated the benefit of IOT will be £16 billion, while healthcare benefits alone through IOT are estimated at £2.7 billion.

vi. The Government's Levelling Up White Paper lists nationwide gigabit-capable broadband coverage by 2030 as one of the Government's key 'Missions', to be enshrined in law.[1] CityFibre will play a key role in delivering the Government's target. To achieve the Prime Minister's goal of 'levelling up', the UK must upgrade its digital infrastructure to reliable, future-proof, Full Fibre networks, with no home or business left behind.

vii. Hatch has monetised key impacts for the 285 locations that CityFibre is operating in. This provides a broad range of future benefits that may arise from Full Fibre over a 15-year appraisal period (except Network Build), with a breakdown included in the table below.

Headline Impacts for 285 CityFibre Locations

Direct/Wider Impacts	**Impact Category**	**Impact**	**Value, 285 Locations**
Direct Impacts	Network Build	Direct Build Impact	£1.4bn
		Construction Jobs	16.4k
	Business Impacts	Productivity and Innovation Benefit	£22bn
		Widened Workforce	£4.9bn
		Flexible Working	£1.3bn
	Private Household Impacts	House Value Increase	£15bn
	Local Government	LA Operational Efficiency Savings	£1.1bn
Wider Impacts	5G	5G Benefit	£53bn
	Smart Cities	Smart Cities	£9bn
	Internet of Things (IOT)	IOT	£16bn
		Healthcare Benefits	£2.7bn
	Environmental Impacts	CO_2 Emissions Reduction	2.2m tonnes
		Monetised value of carbon emissions reduction	£175m

Source: Hatch Note: Values over £5bn rounded to the nearest billion

viii. Where possible, Hatch has focused on the relative benefit of Full Fibre compared with superfast broadband in particular for the direct benefits. The wider benefits identified in the study cover a broader range of quantitative and qualitative impacts. Where benchmark evidence is used to assess impacts, the study generally takes the lower end of the range of figures to ensure that benefits are not being overestimated for any individual impact measure.

[1] Department for Levelling Up, Housing and Communities, Levelling Up the United Kingdom, 2022

1. Introduction and Essential Context

1.1 CityFibre has a £4 billion investment plan to deliver Full Fibre to 8 million homes, 800,000 businesses, 400,000 public sector sites, and 250,000 5G access points by 2025. They have recently reached 1 million premises ready for service, creating the UK's largest independent Full Fibre network.

1.2 This commercial rollout is an important part of the Government's target of a minimum of 85% gigabit-capable coverage by 2025. CityFibre's rollout in 285 cities, towns, and villages across the UK will represent a third of the market by 2025, providing users with the critical digital infrastructure benefits of Full Fibre (Appendix A contains a list of the 285 locations).

1.3 COVID-19 has accelerated the requirements of households across the UK for improved levels of broadband connectivity. A widespread shift to remote working has resulted in multiple users on home networks at the same time, which can cause reliability issues and impede this form of working. This in turn affects the businesses they work for or run, and Full Fibre infrastructure is key to the efficiency and effectiveness of this shift. Wider social engagement and leisure activity have also been increasingly concentrated at home during the pandemic. Ofcom estimates that average monthly data use grew to 453 GB per connection in 2021, up from 315 GB in 2019.[2]

1.4 Full Fibre technology uses fibre optic in entire networks, which enables the fastest download and upload speeds (both capable of over 1 Gbps). Full Fibre is also the most reliable technology for broadband, with the lowest fault rates, and is energy efficient.[3]

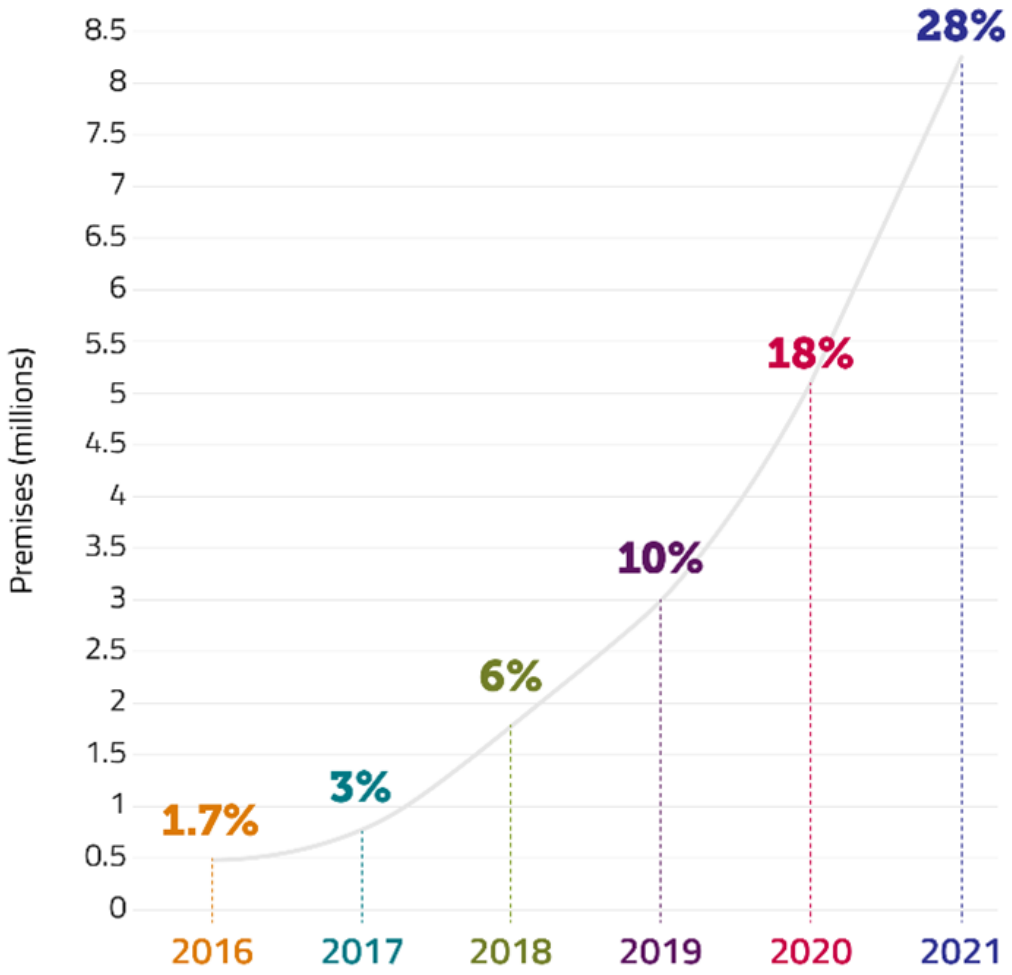
1.5 Currently in the UK more than 8 million homes (28% of homes) have access to Full Fibre following the recent expansion of Full Fibre roll-out. The rapid rate of recent growth in coverage is shown in Figure 1.1 below. Ofcom data indicates that 6.5 million of the 8 million homes across the UK with Full Fibre availability are located in England.

1.6 In order to quantify the impacts, this analysis focuses on the gross value added (GVA) growth that could be generated by particular aspects of full fibre roll out. GVA is a measure of the goods and services produced in an economy. GVA can be raised by increasing economic output through greater levels of production, increased productivity and innovation.

[2] Ofcom, Connected Nations 2021: Main report, December 2021

[3] The Infrastructure Forum, What does tomorrow look like?, April 2021

Figure 1.1 Growth of Full Fibre Broadband Availability in the UK



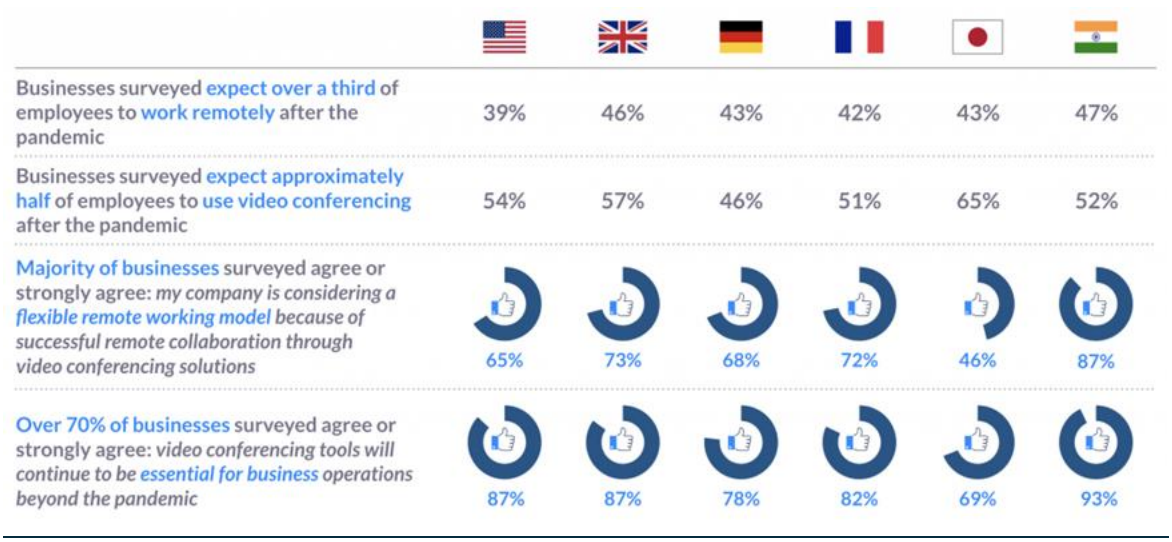
Source: Ofcom, Festive movie favourites in less than a minute – Full Fibre reaches 8m homes, December 2021

1.7 Research undertaken by Boston Consulting Group on behalf of Zoom points to the business benefits of expanded working from home, which has enabled business continuity and growth in some sectors despite the pandemic's wider and adverse economic impacts.[4]

1.8 In the UK, the ability to work from home is estimated to have helped safeguard 550,000 jobs, representing around 2% of all employment. Figure 1.2 below shows 57% of businesses surveyed expect at least 50% of employees to use video conferencing beyond the pandemic, with 73% of businesses considering extending flexible remote working (hybrid) models after successful remote collaboration. High quality broadband provision will be essential to supporting the extension of home-based and flexible working patterns.

[4] Zoom, A Story of Agility and Innovation: Findings from the Impact of Video Communications During COVID-19 Report, March 2021

Figure 1.2 BCG Video Conferencing Customer Survey



Source: Zoom, A Story of Agility and Innovation: Findings from the Impact of Video Communications During COVID-19 Report, March 2021

1.9 The UK Government has undertaken analysis to highlight where Levelling Up funds could be targeted, creating three levelling up categories into which local authorities were assigned. Category 1 are places which the Government believes have the most need for levelling up investment, and a third of the places where CityFibre will roll out Full Fibre broadband are in Category 1.

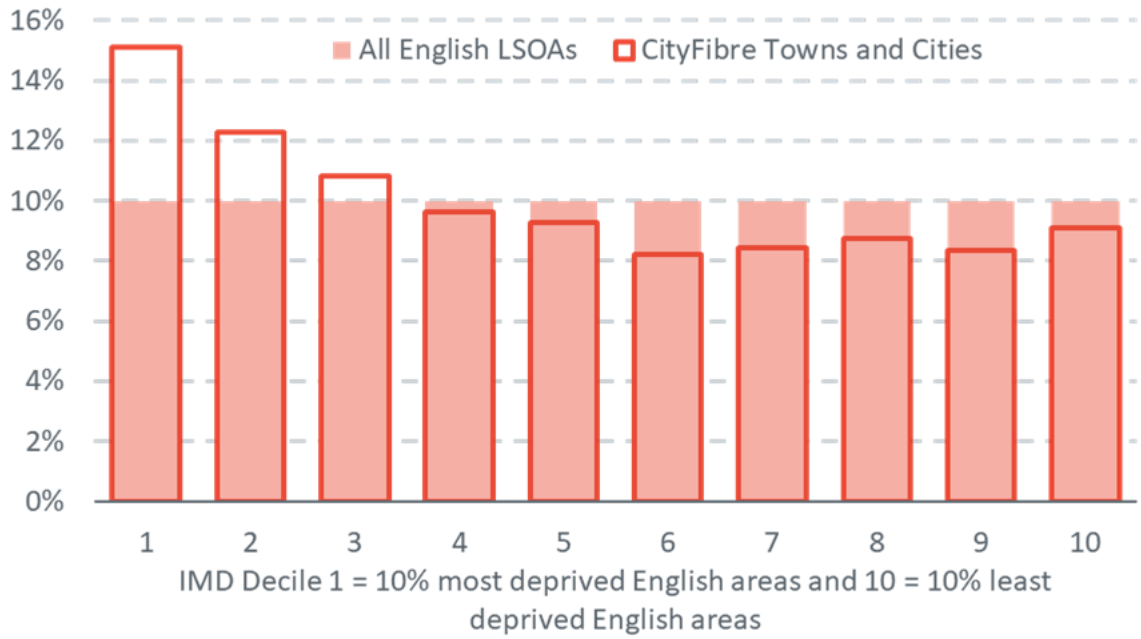
1.10 Need is defined in part by the Index of Multiple Deprivation (IMD), a widely-recognised source of data on deprivation. The IMD for England is built upon seven factors: income, employment, education, health, crime, barriers to housing and environment.

1.11 To understand the distribution of CityFibre activity against deprivation analysis of English LSOAs has been undertaken. Due to discrepancies of deprivation data this analysis has only been undertaken for English areas and therefore does not include CityFibre locations outside of England.

1.12 All English LSOAs are given a decile ranking based on their deprivation scored, based on factors outlined above. As such there is an even distribution of LSOAs in each decile (of 10%). Matching CityFibre locations to English LSOAs allows for an examination into the relative deprivation position of these areas.

1.13 Figure 1.3 shows that CityFibre's rollout plan will reach a higher number of LSOAs which are ranked in the 10%, 20%, and 30% most deprived areas in England. Therefore, CityFibre's build is more highly concentrated in those areas of the country that are in most need of the benefits arising from levelling up, pointing to how important the Full Fibre network build could be for those areas.

Figure 1.3 Distribution of CityFibre Locations by English Index of Multiple Deprivation Decile



Source: Hatch calculation based on MHCLG Index of Multiple Deprivation data, 2019

1.14 The importance of new digital infrastructure is reflected in the Government's Levelling Up White Paper. It lists nationwide gigabit capable broadband coverage by 2030 as one of the Government's key 'Missions', to be enshrined in law. CityFibre will play a key role in delivering the Government's target.

1.15 The digital mission in the Levelling Up White Paper follows on from issues identified in the National Infrastructure Strategy, which sets out the UK's plan to improve the quality of physical and digital infrastructure. It describes how the Government will boost growth and productivity, put the UK on the path to meeting its net zero emissions target by 2050, and support private sector investment.

1.16 The Government's approach to improving infrastructure is 'underpinned by high levels of government investment, with record levels of investment for the railways, strategic roads, broadband networks and flood defences.'[5] The strategy makes many references to improving gigabit technology and recognises that digital infrastructure is particularly important for rural communities. Investment in gigabit connectivity is endorsed in the Strategy on the grounds that it can help:

- deliver economic, social and well-being benefits for the whole of the UK;
- help rural businesses innovate, grow, and create jobs;
- reduce some of the highest levels of road congestion in Europe;
- continue to catch up to international competitors;
- spend more time working from home in future.

1.17 The National Infrastructure Strategy underlined the Government's target to ensure that the UK reaches a minimum of 85% gigabit capable coverage by 2025, with most investment coming

[5] HM Treasury, National Infrastructure Strategy, 2020

from the private sector. The total level of investment is estimated in the region of £30 billion, and through the Government's 'ambitious strategy, rapid increases in the rate of digital infrastructure deployment are already being seen and the UK is expected to see record speeds of deployment in the coming years…creating thousands of new jobs'. CityFibre's proposed network rollout plans will make a major contribution to achieving these goals.[6]

Report Structure

1.18 The analysis undertaken for this study is therefore timely in light of the enhanced weight now attached to transforming digital connectivity. To capture the benefits of CityFibre's roll-out programme, the study monetises the impacts of Full Fibre for the 285 locations CityFibre is operating in. The impacts identified in the study are categorised as follows:

- Core Impacts:
  - Network Build - Construction impacts (employment and Gross Value Added or GVA)
  - Consumer Impacts - Flexible working; Consumer experience
  - Business Impacts - Productivity and innovation; Access to wider labour pool
  - Private Household Impact - Impact on house prices
  - Public Sector - Council savings from moving services online
- Wider Impacts:
  - 5G
  - Smart Cities
  - Internet of Things (IOT)
  - Healthcare benefits
  - Environmental impacts

1.19 This report deals with each of these impacts in turn, explaining the assumptions used to estimate them. To provide further context, the report also highlights some qualitative benefits of Full Fibre. CityFibre's rollout programme will clearly have positive impacts outside of benefits that can be captured using standard economic methodology, and as such the report identifies some of the largest qualitative benefits.

1.20 The following are the key features of the methodology used to generate the benefits set out in the report:

- The benefits are expressed in 2021 prices, and figures used from a different year have been rebased accordingly. The figures have also been discounted in line with HM Treasury's Green Book discounting rate of 3.5%.[7]
- A 15-year appraisal period from 2026-2040 has been used to quantify all the output values, except for benefits that arise from network construction (which has already

[6] CityFibre, Transforming the UK's Digital Infrastructure, 2021

[7] HM Treasury, The Green Book (2020)

started). A 15-year period is also consistent with the European telecommunication infrastructure assessment guidance.[8]

- CityFibre provided Hatch the 285 locations, and construction job numbers where available, which were used to calculate benefits.
- A regional average was used to estimate construction job numbers in specific areas where data was not available. An indirect multiplier of 1.9 has been used to measure the indirect jobs and GVA associated with each location.[9]
- For each of the locations, Hatch matched the area to Lower Super Output Areas (LSOAs), the best statistical unit to use for this type of analysis.[10]
- A 35% take-up rate of FTTP has been applied to calculate benefits accruing to CityFibre's network. This is a conservative estimate used for modelling purposes, rather than a prediction of actual take-up in the 15-year appraisal period used for this report.

1.21 How the methodology was applied is described for each of the individual benefits assessed in the report.

[8] In line with European guidance on the assessment of major telecommunications infrastructure; EU (2008). 'Guide to Cost Benefit Analysis of Investment Projects', Table 2.2

[9] HM Treasury, The Green Book (2020)

[10] The analysis uses 12,666 LSOAS and Scottish Data zones to measure the impacts of each metric on a local scale

2. Direct Impacts: Network Build and Consumers

Network Build

Network Build – Construction Impacts - Employment

2.1 To build Full Fibre networks across 285 locations, data from CityFibre is the basis for estimates of the significant employment impacts that network construction will generate. For several locations, efficiencies have been found by CityFibre in network build activity where single contractors are commissioned to build out networks in more than one location. Efficiencies will include economies of scale resulting from fewer contractors commissioned, in some areas one contractor, and therefore the same jobs, will be used to construct the network in neighbouring towns/cities.

2.2 Based on information provided by contractors, the number of construction jobs and full-time equivalents (FTEs) are known. For areas where the number of construction jobs is not known a regional average of construction jobs is used. Applying an employment multiplier[11] enables estimates to be provided for the average number of indirect jobs[12] created as a result of the network build.

2.3 The largest places (for example, Edinburgh, Glasgow, Nottingham, Sunderland) which are the focus of the most substantial volume of construction activity, are anticipated to see the largest number of direct and indirect construction jobs generated.

2.4 The total direct employment associated with network build is projected to be **9k** with a further **7K** indirect jobs emerging. In total, around **16k** jobs will be created as a result of network build. All jobs are considered to be temporary and in place for the network build period.

285 Locations: 16.4k jobs created

Network build - Construction Impacts - Gross Value Added

2.5 As a result of construction employment, each town where network build is to take place will see economic benefits in the form of direct GVA uplifts linked to new construction and related supply chain jobs created.[13] GVA is an expression of economic output, employment is a factor that will create this output, and as such we are able to estimate the additional GVA resulting from the network build via construction jobs. To estimate the direct economic impacts of network construction, the assessment draws on UK Office for National Statistics (ONS) data to identify the GVA contribution of the UK construction sector from direct construction job contribution, and employment data for the sector to establish the GVA per person employed in the sector. This measure is then used to determine the direct GVA contribution per construction job.

[11] A construction multiplier of 1.9 has been used in line with HM Treasury's Green Book

[12] Indirect jobs are those created through the expenditure on goods and services (supply chain) generated by the direct delivery of the network build. The study estimates these effects by applying multiplier assumptions to direct employment.

[13] Jobs are those generated for the installation and deployment of the network.

2.6 In addition to the direct GVA impact, an indirect GVA uplift is estimated based on the additional jobs across the supply chain linked to the direct network construction activity. The total direct GVA associated with network build employment is estimated to be approximately **£730m** with a further **£660m** from indirect GVA uplift, leading to a total GVA uplift of **£1.4bn**.

285 Locations: £1.4 billion in Construction GVA

Private Household Impacts

2.7 Full Fibre connectivity is expected to lead to increases in the value of housing. The housing value related benefits of Full Fibre availability to residential dwellings are quantified relative to those of dwellings with standard broadband speeds.

2.8 Full Fibre broadband is becoming an increasingly popular consideration for homebuyers when deciding which property to purchase. Research undertaken by Omdia shows that, in the UK, high speed and reliable broadband is the second highest factor for home buyers as rated by 294 estate agents.[14] Additionally, 30% of the surveyed estate agents ranked high-quality broadband as the factor that house buyers were least willing to compromise on. Evidence on homebuyers' enquiries into broadband connection showed that 74% have been concerned with the availability of Full Fibre connectivity. This is indicative of the higher profile of the availability of gigabit broadband, and the importance attached to it by consumers, compared with standard superfast broadband.

2.9 In a previous report by Regeneris[15], an estimate of 0.5% uplift in house prices for Full Fibre relative to superfast broadband was applied to a dwelling located within the 50 and 100 towns that CityFibre will be operating in.

2.10 Additionally, analysis of broadband coverage and local house prices in the US by the Fibre to the Home (FTTH) Council Americas found that gigabit connectivity boosts the price of a house by 3.1% on average against no provision of household broadband.[16] More recent evidence, including analysis which looks at the impact of superfast broadband, suggests an uplift of between 0.56% and 1.16%[17] compared with no broadband provision.

2.11 Omdia research estimates that a house with no broadband connection compared to the same house with a broadband connection of **300Mbps** would be **worth over £5,000 more**.

2.12 Recognising the evidence points to a broad range of impact figures, Hatch has made a conservative assumption that house prices will increase by **0.8%** on average for Full Fibre relative to superfast broadband. This is based on a judgement about the incremental increases from no broadband to superfast broadband, and from no broadband to Full Fibre. The quantified value on house prices in the 285 locations is estimated at **£15 billion**.

285 Locations: £15 billion uplift in value of housing

[14] Omdia, Bricks and clicks: The importance of moving to a gigabit society, November 2021

[15] Regeneris, The Economic Impact of Full Fibre Infrastructure in 100 UK Towns and Cities, March 2018

[16] FTTH Council Americas: White Paper, June 2015

[17] Ipsos Mori, State aid evaluation of the UK Broadband Scheme, Technical Appendix 3 – Economic and Social Impacts, December 2020

3. Direct Impacts: Business

Productivity, Innovation and Start-Ups

3.1 The investment in Full Fibre by CityFibre will lead to significant productivity and innovation benefits for the UK for existing businesses, support innovative business activity and contribute to the formation of new businesses. Businesses benefiting from faster broadband download and upload speeds, and much greater reliability, have advantages in generating higher levels of turnover, which in turn will contribute to higher levels of GVA. Amongst the types of businesses which are likely to benefit knowledge-based industries, healthcare, manufacturing and construction.

3.2 The provision of Full Fibre will help address the digital divide between different areas of the country which experience differences in coverage and speeds. **The assessment is only looking at the impact associated with the 285 locations.**

3.3 Research from Openreach (2019) found a productivity boost of c.£59 billion in 2025 and a projected uplift to c.£70 billion by 2038.[18] This applies a 3% uplift in turnover associated with the roll-out of Full Fibre relative to the current baseline (which assumes superfast provision). The 3% figure is based on a 2018 report by DCMS's Superfast Broadband Programme which estimates the impact for firms benefitting from a 200 to 500 Mbit/s increase could see an increase by 3% in turnover and ultimately increase in GVA.[19]

3.4 An updated evaluation of the Superfast Broadband Programme was published in December 2020[20] by Ipsos Mori. It showed that turnover for businesses could increase by 1.2% with the provision of superfast broadband relative to no broadband provision.

3.5 Whilst there is no mention of the incremental increase in speeds between 200 to 500Mbit/s as stated in the original report, it is reasonable to assume that the impact of Full Fibre would result in an uplift in GVA of 1.2%. To avoid over-stating the benefits, Hatch has therefore assumed a **1.2% uplift** in GVA for Full Fibre relative to superfast fibre which would account for start-up impacts as well as innovation and start-up benefits.

3.6 The monetised value of Full Fibre on productivity, innovation and start-ups is **£22 billion** over the appraisal period.

285 Locations: £22 billion Uplift in GVA from Productivity, Innovation & Firm Start-Ups

[18] Openreach, Full Fibre Broadband: a platform for growth, October 2019

[19] Ipsos Mori, Superfast Broadband Programme Evaluation, Annex B: Economic Impacts, July 2018

[20] Ipsos Mori, State aid evaluation of the UK National Broadband Scheme, December 2020

Flexible Working

3.7 Flexible working patterns, with time spent at a workplace and at home, and full home-working, have been trending upwards over the past decade. The start of the COVID-19 pandemic in 2020 and the restrictions this has continued to impose on travelling and working from offices or other workplaces have seen this trend rapidly accelerate. Between 3rd - 14th November 2021, 30% of working adults reported working from home at some point in the past seven days.[21] With many professions continuing to operate from home, it underlines the scale of the shift that is occurring.

3.8 From these trends it is clear that flexible and homeworking will become more significant in a lot of people's working habits. It is also clear that for a large proportion of people, flexible working and homeworking can be achieved with standard or superfast broadband connectivity - as shown by the large volume of homeworking which occurred during the pandemic by people who lack a Full Fibre connection.

3.9 However, Full Fibre will allow for more processes to take place at home that were originally only feasible in the workplace. These include complex AI and VR programming, and internet based collaborative processes that require strong connectivity, which include graphic design and video editing. Using estimates in the 2019 Openreach report[22] 'Full Fibre Broadband: a platform for growth', we assume that Full Fibre connectivity will result in an additional 1.7%[23] of the workforce being able to work from home.

3.10 In order to understand the quantifiable economic impact of home working, we apply a 4% productivity uplift rate, indicating home workers will be 4% more productive than those working in offices. This uplift is based on a study undertaken by Stanford University showing a total 13% uplift in productivity[24] from working from home, although we have not included a 9% productivity improvements factor which cannot necessarily be attributed to high quality telecommunication technology. This includes, for example, fewer sick days taken by employees. Further research by Nicholas Bloom et al. published in January 2021 further supported the benefits of working from home during COVID-19[25] in terms of productivity gains.

3.11 We have undertaken analysis on the 285 CityFibre locations to demonstrate the individual productivity gain (in the form of a GVA uplift) each location will experience as the result of the uptake of an additional 1.7% of employees working from home or working flexibly. Following these assumptions, we expect productivity to increase by 4% for 1.7% of workers in each location.

3.12 In GVA terms, this uplift will equate to an **additional £1.3bn** in economic value through creating improved access to home working and flexible working and the productivity benefits that result from this.

285 Locations: £1.3 billion in GVA benefits from Flexible Working

[21] ONS, Coronavirus (COVID-19) latest insights: Work, December 2021

[22] Openreach, Full Fibre Broadband: a platform for growth, October 2019

[23] Calculated from the difference between the Continued trend scenario (14.5% of employees expected to be working from home) and the Accelerated trend scenario (16.2% of employees working from home due to the rollout of Full Fibre, therefore allowing us to consider the Full Fibre attribution)

[24] Stanford University, Does Working from Home Work?, March 2015

[25] Stanford University, Why Working from Home will Stick, January 2021

Access to a Wider Talent Pool of Labour

3.13 The continuing transition to home and flexible working, coupled with advances in the development of e-recruitment software, contribute to businesses being able to exercise greater choice from a larger pool of labour.

3.14 In a 2021 Openreach report, it was estimated that the UK could benefit from 1 million new jobs[26] as a result of Full Fibre. Based on this assumption we have applied a Compound Annual Growth Rate of 0.3%, derived from the gain stated in the Openreach report spread across the time period to 2025 which equates to a 0.3% gain per annum. This has then been applied to the time period covered in the analysis of the Full Fibre rollout. These new employees who are now able to enter the job market will provide a further boost to GVA. This uplift is estimated to be around **£4.9 billion** from a widened talent pool of labour over the 15 year appraisal period used in the study.

3.15 In addition to the quantified impact described above, there are several other advantages from access to a wider talent pool which are facilitated by high quality internet connectivity:

- Specific advantages to rural areas, where labour is typically much more dispersed and remote working may be impeded by a lack of high speed internet connections.
- Benefits to sectors in which there are workforce or skills shortages. Industries including customer service centres, financial services, software development and coding are among those which experience the combined effects of an ageing UK population and shortages of key skills which are pushing employers to extend their recruitment reach.
- Reputational advantages to employers that are gaining traction with greater emphasis on work-life balance and the value of a positive approach to flexible working. Fast and reliable connectivity better enables employers to adopt such policies.
- Benefits to employees for whom there may be cost and other barriers to operating from a workplace, including distance from a site, accessibility by public or private transport and, in some places, prohibitive house prices.
- At a time when the UK government is pursuing the Levelling Up Agenda to reduce economic disparity and tackle deprivation, the availability of Full Fibre connections and remote and flexible working patterns may have a useful contribution to make by enabling employers and employees to operate in areas of the country which are distant or disconnected from major economic centres.

285 Locations: £4.9 billion GVA impact from widening pool of labour

[26] Openreach, Full Fibre Broadband: a platform for growth, April 2021

4. Direct Impacts: Public Sector

Local Government

4.1 COVID-19 has created significant financial pressures affecting nearly all parts of local government. Initiatives which deliver cost savings and waste reduction are now a well-established part of enabling local authorities to safeguard vital front-line services. Managing budgets under financial constraints creates pressure to maintain the delivery of public services to individuals without compromising quality. The impact measured here is based on the efficiency-saving potential of the uptake of Full Fibre connections.

4.2 We have estimated that, based on moving services to online platforms from offices and other physical locations, local authorities have the potential to see a cost saving of **1.2% per year**.[27] To arrive at this figure our analysis has taken the estimated eleven year saving of 13% expressed in the 2016 NESTA report and calculated the compound aggregate saving of 1.2% and applied this saving to each year of the appraisal period.

4.3 Using local authority expenditure data[28], a per-person local government spend was then calculated for each local authority. This was aggregated up based on the population of each CityFibre town and city to provide an estimate of local government spend across each of the 285 locations. Once this aggregation was completed the 1.2% per annum efficiency saving was applied, leading to a total efficiency saving over the 15 year appraisal period of **£1.1bn**.

4.4 Full Fibre connectivity has several other advantages in enabling local authorities to deliver services under pressure:

- Increasing the reach of services to individuals or communities such as those in isolated rural areas, those in the most deprived areas who may require multiple services support, and those for whom physical access to services, including disabled and housebound people, may be a particular challenge. The pandemic has underlined the scale of the challenge, with the NHS estimating over 2 million[29] individuals in England who were shielding at home during the peak of the crisis in 2020.
- Lowering the cost of delivering services by enabling access online. This may free up valuable staff time to deal with residents with more acute needs, extend the reach of one-to-many services and facilitate the delivery of advice and guidance via online platforms.
- Through the development of health and well-being software platforms, cost and reach benefits through technologies such as remote monitoring which support the role local authorities have in delivering adult social care.

285 Locations: £1.1 billion of local authority efficiency savings

[27] NESTA & Public Service Transformation Network, Connected Councils: A Digital Vision of Local Government in 2025, 2016

[28] DLUHC, Local authority revenue expenditure and financing, 2021-2022, June 2021

[29] ONS, Coronavirus and shielding of clinically extremely vulnerable people in England: 28 May to 3 June 2020, June 2020

5. Wider Impacts

5.1 The direct economic impacts appraised in the previous section are those generated as a result of Full Fibre implementation across 285 CityFibre locations in the UK. This section considers the wider benefits that go beyond the direct economic benefits of Full Fibre, including those for which there is robust evidence based on UK studies.

5.2 The wider impacts set out in this section cover a broad range of economic, social and environmental benefits over the 15 year appraisal period. These are more challenging to accurately monetise and attribute to the deployment of Full Fibre. To reflect this uncertainty, the study has taken a cautious view of reporting impacts to minimise the risk that these are over-stated when the evidence is limited.

5.3 The following are the wider impacts described in this section:

- 5G
- Smart Cities
- Internet of Things (IOT)
- Healthcare benefit (subset of IOT benefit)
- Environmental benefit from carbon saving

5.4 As part of the assessment each factor has been investigated, and any overlap between the effects described is noted.

5G Benefit

5.5 The Government has set an aim for achieving completion and full roll out of fifth generation mobile services (5G) by 2027.

5.6 The roll-out of 5G has already started in some areas of the UK, with the four mobile network operators (Three, Vodafone, EE and O2) offering 5G data as part of mobile packages. Full Fibre enables 5G, because the small cell access points required connect to a Full Fibre network.

5.7 The roll-out of 5G will have significant benefits across the UK including:

- Higher speeds, with the current provision of 5G expected to potentially deliver 10 times faster speed[30];
- Shorter latency (how long it takes to send data and receive a response), which allows for quicker responses, enabling new services;
- Estimated that the energy usage from 4G to 5G will reduce by 90%.[31]

5.8 Studies have shown that the impact of 5G will have wider economic benefits, for example:

- GSMA[32] estimated that over a 15 year period (2020-2034) the following benefits would accrue for Europe and worldwide in brackets:
  - $135 billion for Europe ($2.2 trillion globally) boost in GDP
  - $55 billion for Europe and ($588 billion globally) in taxes generated.

5.9 Analysis by PWC[33] found that 5G technology could add US$1.3 trillion to global GDP by 2030. The full report shows the breakdown of the impact across different services including healthcare, smart utilities, power consumer and media applications, powered, industrial manufacturing and financial-services applications. The same report also shows the uplift in GDP potentially delivered by 5G from 2020 to 2030. In the final analysis year, the equivalent impact of 5G would be a **1% GDP uplift per annum** with growth likely to be higher for the period 2031-2040.

5.10 To ensure that the benefits associated with 5G are not overestimated, Hatch has taken the smaller of the stated benefits from the PWC report and assumed for the analysis period of this assessment that a 1% uplift in GDP per annum would translate into a 1% uplift in GVA and this has been applied to the 285 CityFibre Locations. Based on applying a **1% uplift in GVA per annum** it has been estimated that the benefit of 5G to CityFibre locations would be **£53 billion** over the 15 year appraisal.

285 Locations: £53 billion uplift in GVA as a result of 5G

[30] Synopsys, 5G vs 4G What's the Difference, 2021

[31] Thales 5G vs 4G: What's the Difference?, August 2020

[32] GSMA, Study on Socio-Economic Benefits of 5G Services Provided in mmWave bands, December 2018

[33] PWC, The global economic impact of 5G, 2021

Smart Cities

5.11 Smart Cities describes the use of intelligent technological solutions to address key urban challenges located in urban areas.[34] Key challenges addressed by the Smart Cities concept cover a variety of different issues including:

- Traffic and air quality
- Energy usage
- Occupancy and activities
- Security
- Environmental change

5.12 Operationalising Smart Cities is increasingly important with an estimated 55% of the world's population currently living in urban areas and by 2050 this is forecasted to increase to 68%.[35] Emissions from transport are one of the largest contributors to global greenhouse gas emissions with smart cities at the heart of meeting global net zero targets.

5.13 Estimates from transport data firm Inrix estimate the average UK driver loses £1,317 each from congestion and wastes an average total of four days every year looking for a parking space at their final destination.[36]

5.14 The implementation of Smart Cities measures is rapidly increasing with the overall market value of Smart Cities estimated to be $714.6 billion in 2020, and projected to increase to $2.5 trillion by 2026, representing a substantial compound annual growth rate of 22.5% over the analysis period.[37]

5.15 A recent study 'Role of Smart Cities for Economic Development' estimates that smart cities could boost economic development by over 5% and deliver at least $20 trillion in additional economic benefits by 2026.[38]

5.16 As part of the assessment of the impacts of Smart Cities for 285 locations across the UK, Hatch has opted to monetise the transport management impact across the appraisal period as the evidence base is more widely available and comprehensive for this sector. Estimates from the Smart Cities Pitchbook forecast that the global market value for smart transport solutions for highways and public transport services is £100 billion.[39] The assumption used in the study is based on evidence that the benefits of improved transport management would create a minimum of £100 billion in economic benefits per annum. The UK government aimed to have 10%[40] of the value in Smart Cities based on UK's share of OECD tradable services. Hatch has

[34] UK Trade and Investment, Smart Cities Pitchbook, March 2016

[35] Frontier Economics, How Smart Cities can help tackle Climate Change, October 2018

[36] Land mobile, Are we embracing the true potential of Smart Cities, March 2020

[37] ReportLinker, Global Smart Cities Industry, May 2021

[38] The Smart City Journal, Smart cities predicted to deliver more than USD 20 trillion in additional economic benefits by 2026, April 2019

[39] UK Trade and Investment, Smart Cities Pitchbook, March 2016

[40] Department for Business Innovation and Skills, Smart Cities, October 2013

analysed the latest values published by the OECD and the UK proportion of approximately 10% has been applied in our analysis.[41]

5.17 Apportioning the Smart Cities benefit to the 285 locations based on the level of economic development (% of GVA of UK total), generates an economic benefit of **£9 billion** over a 15 year appraisal period.

285 Locations: £9 billion uplift in GVA as a result of Smart Cities

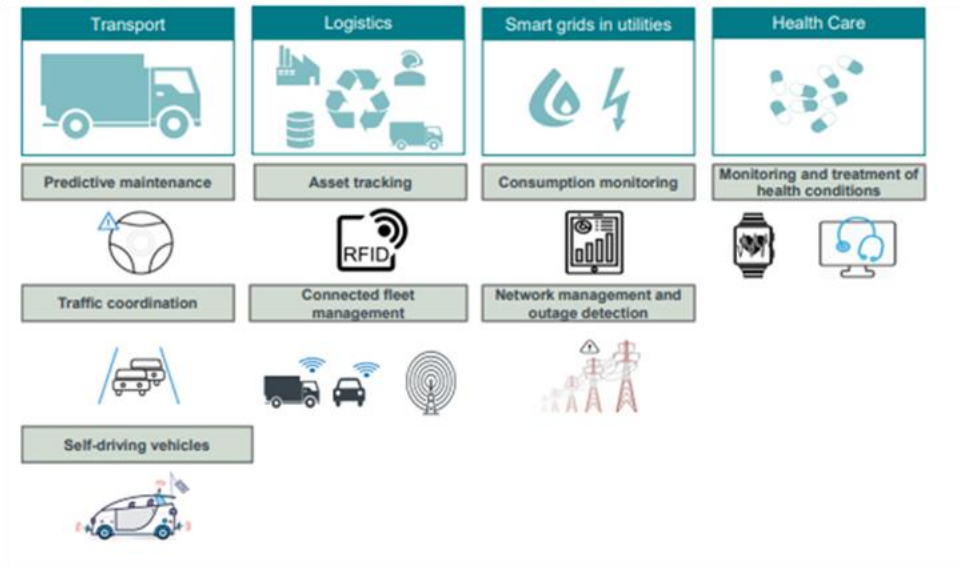
[41] Hatch has calculated this based on published data for 2019 by the World Bank

Internet of Things

5.18 Internet of Things (IoT) is the use of a network to a variety of technological devices including computer devices, mechanical and digital machines with the ability to transfer data without the requirement of human interference.

5.19 The adoption of IoT is extending into many areas of the economy and society, with impacts that are recognised to include reducing healthcare costs, improving quality of life, reducing carbon footprints and improving transportation safety.[42] This is achieved through full fibre which provides higher bandwidth and low level of latency, both essential to dealing with large volumes of data at high intensity rapidly evolving technologies such as self-driving cars and automated 'dark' warehousing operations are amongst the higher profile examples of other important applications of IoT. Frontier Economics research shows that Amazon is increasingly using IOT through connected robots in its warehouse shelves. It used connected robots to locate products and transport them to workers rather than using warehouse workers to collect goods, delivering time and cost savings.[43]

Figure 5.1 Key Applications of IoT



Source: Frontier Economics, The Economic Impact of IoT, March 2018

5.20 Whilst for wider benefits such as IOT, the benefits of Full Fibre relative to superfast broadband are not monetised, Full Fibre provides critical connectivity to realise the benefits of IoT.[44] It requires high bandwidth, low latency and ubiquitous connectivity to connect to different locations which can be achieved through the deployment of Full Fibre.

5.21 All aspects of the economy are likely to benefit from IOT, including telecoms, professional services, healthcare, transport and logistics. Manufacturing is likely to generate the highest amount of benefit from IOT with CEBR estimating the benefit for 2015-2020 to be £27.1 billion.[45]

[42] GSMA, IoT Opportunities and Impacts, April 2016

[43] Frontier Economics, The Economic Impact of IoT, March 2018

[44] OFCOM, Technology Futures – spotlight on the technologies shaping communities for the future, January 2021

[45] GSMA, IoT Opportunities and Impacts, April 2016

(2015 prices), the highest component representing approximately one third of the total IOT benefit.

5.22 Drawing on the Frontier Economics report, this estimates that IoT is expected to generate a total benefit of £15.8 billion per year (2021 prices).[46] Apportioning this IOT benefit to the 285 locations based on their share of GVA in the UK total, generates an estimated economic benefit of **£16 billion** over a 15 year appraisal period.

5.23 To date there is relatively limited economic impact research on IOT, although the existing evidence indicates that it is already generating very substantial benefits to businesses, households and governments.

- GSMA estimates[47] that the value added of IOT by 2020 was estimated to be in the region of $4.5 trillion through both revenue impacts and cost savings.
- CEBR on behalf of SAS[48] estimates the economic benefit of big data and IoT to the UK economy from 2015 - 2020. Its study identified the following economic benefits:
  - £322 billion over the period 2015-2020 or £54 billion per annum;
  - This represented a potential increase in UK GDP over the 2015-20 period of 2.7% per annum, which the study contextualises as twice the size of the combined education, NHS and defence budget.

285 Locations: £16 billion uplift in GVA as a result of IOT

[46] Using HM Treasury GDP deflator, a factor value of 1.16 has been used to convert 2015 prices into 2021 prices. This gives a yearly benefit of £15.8 billion of IOT covering all sectors and £0.9 billion for healthcare.

[47] GSMA, IoT Opportunities and Impacts, April 2016

[48] SAS, The Value of Big Data and the Internet of Things to the UK Economy, February 2016

Healthcare Benefits Through IoT

5.24 The UK's healthcare expenditure (government and non-government) was estimated to be £225.2 billion[49] in 2019, which is the equivalent of £3,371 per person. Already under significant demand pressures, the COVID-19 pandemic has resulted in a rapid change in which many more appointments are being carried out via video on online calls rather than face-to-face. When the UK Government's then Health Secretary, Matt Hancock announced in 2020 that NHS general practitioners (GPs) should see patients virtually (by default), the number of virtual GP appointments increased to 71%[50] by mid-April 2020, compared to 25% in the same period a year before. Additionally, the number of users of the NHS app increased by 111% from February to March 2020.

5.25 The healthcare impact has been quantified by using the concept of Internet of Things (IOT), using the Frontier report referenced above. It was estimated that the sector generated economic benefit worth £4.8 billion (2015 prices) over the 6 year period 2015-2020 inclusive. Rebasing this £4.8 billion to 2021 prices gives a GVA benefit of c. £0.9 billion[51] per year to the UK economy. The yearly benefit has been apportioned to the 285 CityFibre locations based on the level of economic development (% of GVA of UK total) and the benefit is **£2.7 billion** over a 15 year period.

5.26 More generally, growth in the range of services being delivered by the NHS online has also accelerated significantly during the pandemic. The NHS itself highlights the following key benefits of moving some services online[52]:

- Reduced administrative workload for practice staff;
- Improved communication between patients and practices;
- Reduced travel time for patients;
- Expanded health knowledge for patients.

5.27 The implication is that healthcare benefits of online-based services extend well beyond the growing number of people engaging with GP services online. Some of the key benefits associated with IOT in healthcare include[53]:

- Increased patient comfort, convenience, satisfaction and faster recovery times;
- Wearable technology and data access allows medical staff to monitor patients with greater accuracy;
- IoT security systems increase safety for patients and medical staff;
- UV light sanitation systems keep spaces clean and prevent illness.

285 Locations: £2.7 billion uplift in GVA as a result of IOT in Healthcare

[49] ONS, Healthcare expenditure, UK Health Accounts: 2019, released June 2021

[50] Morgan Lewis, Telehealth in the United Kingdom: Considerations for Providers, February 2021

[51] Rebased using HM Treasury GDP Deflator factor value of 1.16 to rebase from 2015 prices to 2021 prices

[52] NHS, GP online services: the key benefits

[53] Igor, Using IoT Technology to enhance Healthcare Environments, December 2020

Environmental Impacts

5.28 Climate change is creating a critical need to rapidly reduce greenhouse gas emissions. Access to Full Fibre connectivity provides individuals and organisations with options that reduce their impact on the climate through CO2 emissions. The mechanisms through which Full Fibre will support global action to reduce emissions include:

- Dematerialisation: existing fibre broadband has already fuelled a shift in the production and consumption of news, books, music and films to digital platforms. This reduces the need to manufacture, publish, print and ship a range of physical products and results in reduced CO2 emissions. The capability of Full Fibre will expand the range of physical products that can be provided digitally and further reduce CO2 emissions from manufacturing.
- E-commerce: a more seamless online shopping experience and drive increased e-commerce, both business to consumer (B2C) and business to business (B2B). E-commerce reduces the need for commercial, retail and wholesale floorspace and associated energy requirements, as well as travel to retail by private vehicle.
- Telecommuting: everyday use of cloud and video conferencing and the more general rise of online communications and commerce will, as the study suggests, opened up opportunities for many more people to work and do business remotely and from home. This will have direct impacts on the need to travel and particularly on private vehicle use, a significant source of CO2 and other emissions.

5.29 According to a PWC study, 330kg of C02 will be saved per person over a 15 year period as a result of Full Fibre connectivity. This is likely to understate CO2 emissions savings as it only considers teleworking, telemedicine and home assistance using high-end videoconferencing and so represents only a portion of the total CO2 abatement that will be achieved.[54] However, this is the most recent data available that provides a benchmark relevant to the method used in this study.

5.30 To establish a CO2 savings impact from the roll out of Full Fibre connections, we have considered this CO2 saving per person (tonnes) and applied the shadow price of carbon through the value per year of non-traded carbon taken from the Department for Transport published data for monetising carbon reductions.[55] This has allowed us to estimate the total CO2 reduction anticipated in each CityFibre town and city that will occur due to Full Fibre connectivity by aggregating individual CO2 reductions by each town or city's population. In total we are able to estimate a CO2 saving of **2.2 million tonnes**, equating to a **£175m** benefit to the economy based on the application of the shadow price of carbon

285 Locations:

CO2 emissions reduction – 2.2 million tonnes

Monetised reduction in CO2 emissions - £175 million

[54] PwC and Ecobilan for FTTH, Developing a generic approach for FTTH solutions using LCA methodology

[55] Department for Transport, Transport Analytical Guidance (TAG), July 2021

Appendix A - City Fibre's 285 Locations

City Fibre's 285 Locations for Analysis				
Aberdeen	Bentley	Brierley	Chester	Datchet
Adur and Worthing	Bentley Heath	Brighton & Hove	Chesterfield	Derby
Alexandria	Billericay	Brixworth	Chester-le-Street	Dewsbury & Batley
Anstey	Billingham	Brockworth	Chichester	Dickens Heath
Ashington	Bingham	Burghfield Common	Christchurch	Dinnington
Ashton in Makerfield	Binley Woods	Burton Latimer	Claydon	Doncaster
Aspull Moor	Bishopton	Burtonwood	Clitheroe	Dorking
Aston	Blackburn (incl. Beardwood, Blackburn Town Centre, Higher Croft)	Bury St Edmunds	Coalville	Dronfield
Atherstone	Blackpool	Calverton	Colnbrook	Dumbarton
Balsall Common	Blaydon on Tyne	Cambridge	Conisbrough	Dundee
Bank Hey	Bognor Regis	Canvey	Consett	Durham (incl. Durham, Gilesgate, Pity Me)
Barnby Dun	Bolton	Carcroft	Cookham Rise	Earl Shilton
Barnsley	Bournemouth	Carlton in Lindrick	Coppull	Earlestown
Barrhead	Bracebridge Heath	Carnoustie	Cosby	Earls Barton
Barton Seagrave	Bracknell	Catcliffe	Cotgrave	Easington
Bath	Bradford	Chapeltown	Countesthorpe	East Grinstead
Beccles	Bramford	Charvil	Coventry	East Murton
Bedlington	Branton	Chatham, Gillingham	Crawley	Eastbourne
Bedworth	Breaston	Cheltenham	Darwen	Eckington
Edinburgh	Halifax	Huddersfield	Littlehampton	Neilston
Emsworth	Halling	Hullbridge	Longford	New Edlington
Eton Wick	Harrogate	Innsworth	Loughborough	Newark on Trent
Eye	Hartlepool (incl. Hartlepool, Seaton Carew, Hart Station, High Throston, Rift House)	Inverness	Lowestoft	Newcastle-upon-Tyne (incl. Gosforth, Heaton, Jesmond, Lemington, Newcastle city centre, Walker,

				Westerhope, Throckley, Newburn, Walbottle, Chapel House, Denton, Kingston Park, Fawdon, Blakelaw, Fenham, Benwell, Leazes, Byker, Shieldfield)
Felixstowe	Harworth	Ipswich	Luton (incl. Dunstable, Houghton Regis, Luton)	Newsham
Ferndown	Hatfield	Kenilworth	Maghull	North Tyneside (incl. Backworth, Brunswick Village, Dudley, Killingworth, North Shields, Seaton Burn, Shiremoor, Tynemouth, Wallsend, Whitley Bay, Wideopen, Monkseaton, Longbenton, Benton, Forest Hall, Howden, Cullercoats, Earsdon, Whitley Lodge, Annitsford)
Ferryhill	Havant	Kessingland	Maidenhead	North Walsham
Forfar	Haydock	Kettering	Maidstone	Northampton
Gateshead (incl. Quays, Dunston, Bensham, Felling, Pelaw, Teams, Low Fell)	Hayling	Keyworth	Maltby	Norwich
Glasgow	Hethersett	Killamarsh	March	Nottingham
Glinton	Hetton-le-Hole	Kirkby	Market Harborough	Nuneaton
Gloucester	High Wycombe (incl. Bourne	Knaresborough	Melton Mowbray	Ormskirk

	End, Hazlemere, High Wycombe, Holmer Green, Tylers Green, Widmer End, Wooburn Green)			
Golborne	Hinckley	Larkfield	Middlesbrough (incl. Linthorpe, Middlesbrough, Nunthorpe, Stainton, North Ormsby, Marton Grove, West Lane, Whinney Banks, Acklam, Tollesby, Easterside, Hemlington, Coulby Newham, Normanby, Marton-in-Cleveland, Ormsby)	Oughtbridge
Goldthorpe	Hollins Green	Leamington Spa	Milton Keynes	Pangbourne
Great Glen	Hoo St. Werburgh	Leeds	Minster	Perkinsville
Great Houghton	Horley	Leicester	Monifieth	Peterborough
Great Wakering	Horsford	Leicester Forest East	Moodiesburn	Peterlee
Great Yarmouth	Horsham	Lenzie	Morpeth	Platt Bridge
Groby	Hoyland	Lincoln (incl. Birchwood, Lincoln, North Hykeham)	Narborough	Plymouth
Plymstock	Rochdale (incl. Littleborough, Milnrow, Rochdale)	Sileby	Stocksbridge	Wellingborough
Poole	Rochester	Sittingbourne	Stockton-on-Tees (incl. Stockton-on-Tees, Thornaby, Norton, Newtown, East Hartburn, Preston Farm)	Westhoughton
Poringland	Rochford	Skellingthorpe	Sunderland (incl. Boldon, Houghton-Le-	Weston-super-Mare

			Spring, Hylton, Sunderland, Washington, Whitburn, Seaburn, Roker, Monkwearmouth, Hendon, Ryhope, Doxford Park, Shiney Row, Penshaw, Hastings Hill, Castletown, Blackfell, Lambton, Biddick)	
Portsmouth	Rossington	Skelmersdale	Sunniside	Whetstone
Preston	Rotherham	Slough	Sunnymeads	Whickham
Prudhoe	Rothley	Snodland	Swindon	Whiston Lane Ends
Queens Hills	Rothwell	Solihull	Tangmere	Whittlesey
Queniborough	Rugby	South Tyneside (Cleadon, Hebburn, Jarrow, South Shields, Marsden, Harton, Bolden, Whitburn, Primrose)	Tavistock	Widnes
Radcliffe on Trent	Rushden	Southend	Thorne	Wigan (incl. Hindley, Pemberton, Springfield, Wigan)
Rainford	Ryton	Spencers Wood	Thorpe Hesley	Windsor & Eton
Rainhill Stoops	Saltash	Spixworth	Thurnscoe	Wokingham
Ratby	Seaham	St Helens (incl. Marshalls Cross, Prescot, St Helens)	Tollerton	Wolverhampton
Rayleigh	Seaton Delaval	Standish	Treeton	Woodbridge
Reading	Seghill	Stanford-leHope	Twyford	Woodlands
Redcar & Cleveland (incl. Brotton, Eston, Grangetown, Lazenby, Loftus, North Skelton, Redcar,	Sheerness	Stanley	Wales	Worcester

Saltburn-by-the-Sea, Skelton, Skelton Green, Southbank, Teesville, Marske-by-the-Sea, Carlin How)				
Redhill	Sheffield	Staveley	Warrington (incl. Great Sankey, Latchford, Padgate, Warrington)	Worksop
Renfrewshire	Shepshed	Stepps	Warwick	Wymondham
Ripon	Shevington	Steyning	Washingborough	Yaxley
Roade	Shevington Vale	Stirling	Wath upon Dearne	York

Source: CityFibre

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