Title: New Build Developments: Delivering gigabit-capable connections. **RPC Reference No:** RPC-4290(1)-DCMS **Lead department or agency:** DCMS	**Impact Assessment (IA)**
Summary: Intervention and Options **RPC Opinion**: **Fit for purpose**	**Date:** 29 Oct 2018 **Stage:** Consultation **Source of intervention:** **Type of measure:** Primary legislation **Contact for enquiries**: newbuildconnectivity2018@culture.gov.uk

Cost of Preferred (or more likely) Option

Total Net Present Value	Business Net Present Value	Net cost to business per year	One in-Three Out	Business Impact Target Status
+£53.6m	-£46.7m	£9.6m	n/a	In scope

What is the problem under consideration? Why is government intervention necessary?

New Build Developments (NBDs) are being built with poor connectivity. Although there are indications that the market is realising the importance of high quality digital connections, we have seen evidence that a number of new homes suffer from no, or slow, connectivity. When a NBD is built there is real opportunity for quality, future-proof infrastructure to be deployed; when this does not happen residents suffer. Further, retrospectively deploying digital infrastructure to meet consumer demand is costly and disruptive. Developments with copper based networks cannot provide the world-class digital infrastructure the UK needs to grow the economy and provide consumers the digital services they require. Government risks ignoring the valid concerns of new homeowners if action is not taken. Intervention - in the form of supportive legislation - will provide a regulatory backstop, giving new owners high quality connections from the outset, and ensuring that new developments are future-proof.

What are the policy objectives and the intended effects?

The principle policy objective of this work is to deliver high-quality digital infrastructure to NBDs. A number of positive effects will be realised by this intervention. This includes productivity gains from remote working, increased labour force participation because of remote working, wellbeing improvements, potentially speeding up the rollout of ultrafast connectivity to nearby premises and other social benefits like access to public services, education and health. More widely, the deployment of fibre networks will also help strengthen the economy by growing the necessary infrastructure for digital sectors to thrive. Qualitative information currently suggests that more expensive new homes have better connections, creating an economically based digital divide. We will use the consultation to investigate this issue. If a divide is identified, this policy will combat this by providing fibre to the majority of new homes whatever the sale price.

What policy options have been considered, including any alternatives to regulation? Please justify preferred option (further details in Evidence Base)

A long list of options have been shortlisted to five policy options. This includes a mix of regulatory and non-regulatory options. They are:

1) Do nothing
2) 100% fibre to the premise (FTTP/Gigabit capable) coverage for all new builds
3) Partial FTTP/Gigabit capable coverage for new builds under a cost cap - Recommended
4) 100% fibre to the cabinet (FTTC/Superfast) coverage for all new builds
5) Connectivity certificate

The preferred option is (3), partial FTTP coverage under a cost cap. As set out in the accompanying evidence base, while the net present value of this option is negative, it is better - and to the largest extent - than doing nothing. The net present value is also likely to be an underestimate of the overall impact for three reasons: there

are several non-quantified benefits that should be considered alongside the economic appraisal; the cost estimates used are higher than industry benchmarks; and the optimism bias is arguably overly pessimistic.

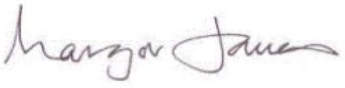
We propose that if a commercial agreement to deliver connections cannot be made, then a developer will be able to oblige a provider to connect homes under a 'duty to connect' provision. The policy design is currently based on a tiered, cost per premise regime. This policy option ensures that the majority of new developments are connected to fibre networks and balances financial outlay by industry against the requirements of new build residents.

Will the policy be reviewed? Yes **If applicable, set review date:** TBC

Does implementation go beyond minimum EU requirements?					
Are any of these organisations in scope? If Micros not exempted set out reason in Evidence Base.	**Micro** Yes	**< 20** Yes	**Small** Yes	**Medium** Yes	**Large** Yes
What is the CO_2 equivalent change in greenhouse gas emissions? (Million tonnes CO_2 equivalent)			**Traded:** N/A	**Non-traded:** N/A	

I have read the Impact Assessment and I am satisfied that, given the available evidence, it represents a reasonable view of the likely costs, benefits and impact of the leading options.

Signed by the responsible Minister:



Date: 29 Oct 2018

Summary: Analysis & Evidence

Policy Option 1

Description: Do nothing

FULL ECONOMIC ASSESSMENT

Price Base	PV Base	Time Period	Net Benefit (Present Value (PV)) (£m)		
2016	2016	15 years	**Low:** Optional	**High:** Optional	**Best Estimate:** £0

COSTS (£m)	Total Transition (Constant Price)	Years	Average Annual (excl. Transition) (Constant Price)	Total Cost (Present Value)
Low	Optional		Optional	**Optional**
High	Optional		Optional	**Optional**
Best Estimate	...		£0	£0

Description and scale of key monetised costs by 'main affected groups'

The cost focuses on the installation of digital networks to a new build premise. The installation costs can be split into the planning and survey costs, costs to connect the nearest exchange to the cabinet, and costs to connect the new build premise to the nearest cabinet. This is expected to be borne by telecoms operators and developers. In the do nothing scenario, the type of technology that a new build premise has varies from copper (ADSL) to full fibre to the premise (FTTP) which exhibit different costs. Overall, the total cost estimate is set at zero in this do nothing scenario.

Other key non-monetised costs by 'main affected groups'

In addition to the capital expenditure discussed above, there may also be additional operating costs. However, it has been assumed these will be covered by operators using wholesale and retail revenue. There could also be further administrative costs not covered by the planning and survey costs above, such as the time to arrange connectivity between developers and operators.

BENEFITS (£m)	Total Transition (Constant Price)	Years	Average Annual (excl. Transition) (Constant Price)	Total Benefit (Present Value)
Low	Optional		Optional	**Optional**
High	Optional		Optional	**Optional**
Best Estimate	..		£0	£0

Description and scale of key monetised benefits by 'main affected groups'

The main benefits relate to the ability of households to work remotely. As demonstrated by various studies (see accompanying evidence base), this includes increased labour force participation from carers and disabled people, as well as increased productivity of teleworkers. There are also other benefits that have been monetised, but are based on less robust evidence. These include improved wellbeing of households and potential spillover effects by bringing forward connectivity to nearby premises. In the do nothing scenario, benefits are set to zero.

Other key non-monetised benefits by 'main affected groups'

There are a range of additional benefits including the ability of households accessing public services like education and health and and social services; the ability to shop online; and a reduction in travel. The magnitude of these effects are not known and may take some time following connection to materialise.

Key assumptions/sensitivities/risks **Discount rate (%)** 3.5%

A key risk to this economic appraisal is the cost of installing digital networks. We have accounted for some of this risk by including an optimism bias of 44% (in line with HM Treasury Green Book guidance) though, as telecoms operators are already installing these technologies meaning the costs are relatively known, the bias could arguably be much lower than this. This, and other assumptions like the level of house building per annum, are tested as part of sensitivity. In addition, as noted above, some wider benefits are backed by less robust evidence. To account for this, we have presented the appraisal including and excluding these wider benefits.

BUSINESS ASSESSMENT (Option 1)

Direct impact on business (Equivalent Annual) £m:			**In scope of OIOO?**	**Measure qualifies as**
Costs: £0	**Benefits:** £0	**Net:** £0	n/a	

Summary: Analysis & Evidence

Policy Option 2

Description: 100% (FTTP/Gigabit capable) coverage for all new builds

FULL ECONOMIC ASSESSMENT

Price Base	PV Base	Time Period	Net Benefit (Present Value (PV)) (£m)		
2016	2016	15 years	**Low:** Optional	**High:** Optional	**Best Estimate:** +£17.9

COSTS (£m)	Total Transition (Constant Price)	Years	Average Annual (excl. Transition) (Constant Price)	Total Cost (Present Value)
Low	Optional		Optional	**Optional**
High	Optional		Optional	**Optional**
Best Estimate	£0.4		£13.3	£163.2

Description and scale of key monetised costs by 'main affected groups'

The approach to the costs of this policy option is similar to that outlined for the do nothing scenario. Where it differs is that the relative cost to upgrade the connection to FTTP has also been included. The upgrade cost varies depending on the type of connection that a new build premise would otherwise receive, with the upgrade cost being relatively higher for copper ADSL connections and relatively lower for fibre to the cabinet connections. Pending feedback from the consultation, we expect the base and upgrade cost to be shared between developers and telecoms operators. There are also feasibility costs with stakeholders understanding and implementing the new builds policy. Overall, the total cost of this policy option in comparison to the do nothing scenario is £163 million including an optimism bias.

Other key non-monetised costs by 'main affected groups'

As noted previously, there are also operating costs for maintaining the network. We assume this will be covered by the wholesale and retail revenue that telecoms operators receive. In addition, there is qualitative evidence to suggest that maintaining a fibre network is cheaper than a copper network, so there may be some opex savings in the long run. The consultation will be used to help assess the magnitude and timing of this saving. There can also be other administrative costs such as the time it takes to arrange a full fibre connection, but we envision this to be broadly the same as the do nothing scenario.

BENEFITS (£m)	Total Transition (Constant Price)	Years	Average Annual (excl. Transition) (Constant Price)	Total Benefit (Present Value)
Low	Optional		Optional	**Optional**
High	Optional		Optional	**Optional**
Best Estimate	..		£17.0	£181.0

Description and scale of key monetised benefits by 'main affected groups'

As with the do nothing scenario, the main benefits that have been monetised are around increased labour force participation and increased productivity of teleworkers. Wider benefits have also been included around the wellbeing gain to households and potential spillover effects from connecting nearby premises. Overall, the total benefit of this policy option in comparison to the do nothing scenario is estimated at £181 over a 15 year appraisal period.

Other key non-monetised benefits by 'main affected groups'

There can be wider benefits to households that have not been quantified. This includes access to public services like education and healthcare, the ability to shop online and a reduction in travel. Telecoms operators could also potentially charge a premium for ultrafast broadband packages (above the cost of other broadband packages), but this can be considered a financial transfer payment from consumers to operators and would not feature in an economic appraisal.

Key assumptions/sensitivities/risks **Discount rate (%)** 3.5%

A key risk to this policy option is the cost of providing FTTP connections to all new builds. The deployment cost is higher for rural areas compared with urban areas. It is also in these rural areas where the deployment cost becomes more uncertain due to specific geographical factors among others. Nonetheless, we argue that the cost estimates are likely to be high for two reasons. The first is that the cost estimates we use are higher than industry benchmarks. The second is that the optimism bias used (44%) could arguably be lower given that the technology and installation process are proven.

BUSINESS ASSESSMENT (Option 1)

Direct impact on business (Equivalent Annual) £m:			**In scope of OIOO?**	**Measure qualifies as**
Costs: £13.7	**Benefits:** £0	**Net:** -£13.7	TBC	

Summary: Analysis & Evidence

Policy Option 3

Description: Partial (FTTP/Gigabit capable) coverage under a cost cap

FULL ECONOMIC ASSESSMENT

Price Base	PV Base	Time Period	Net Benefit (Present Value (PV)) (£m)		
2016	2016	15 years	**Low:** --	**High:** --	**Best Estimate:** +£53.6

COSTS (£m)	Total Transition (Constant Price)	Years	Average Annual (excl. Transition) (Constant Price)	Total Cost (Present Value)
Low	--		--	**--**
High	--		--	**--**
Best Estimate	£0.4		£9.3	**£114.9**

Description and scale of key monetised costs by 'main affected groups'

As with policy option 2, the main costs include the initial 'baseline' cost of connecting a new build and the associated 'upgrade' cost to full fibre to the premise. The difference is that the upgrade costs have only been included for NBDs where the total cost of providing FTTP is below the cost threshold - set here as £3,000. We envision the cost to be shared by developers and operators pending feedback from the consultation. We will also explore whether any Government funding could be made available to help connect the most isolated developments. In addition to this capital expenditure, there will also be familiarisation costs as stakeholders understand and implement the policy. Overall, the total cost including optimism bias is £115 million over 15 years in comparison with the do nothing scenario. This is lower than option 2 given that some premises are excluded due to the £3,000 cost cap.

Other key non-monetised costs by 'main affected groups'

The above does not include operating costs as we envision this to be covered by telecoms operators revenue. There is also a potential opex saving from running a fibre network compared with a copper network but, given that some premises will not be connected using fibre, this saving is unlikely to be large. There may also be administrative costs in arranging and negotiating the connectivity.

BENEFITS (£m)	Total Transition (Constant Price)	Years	Average Annual (excl. Transition) (Constant Price)	Total Benefit (Present Value)
Low	--		--	**--**
High	--		--	**--**
Best Estimate	..		£15.8	**£168.5**

Description and scale of key monetised benefits by 'main affected groups'

The main benefits include increased labour force participation and improved teleworker productivity. Wider benefits also includes wellbeing improvements to households and potential spillover effects. These benefits are larger for premises that have been upgraded to full fibre and have faster broadband speeds than those that exceed the cost threshold and remain on their 'baseline' connection.

Other key non-monetised benefits by 'main affected groups'

Other benefits not monetised include access to public services, e-commerce and reduced travel. Telecoms operators could also potentially charge a premium for ultrafast broadband packages (above and over the cost of other broadband packages), but this can be considered a financial transfer payment from consumers to operators and the extent of any premium is unknown.

Key assumptions/sensitivities/risks	**Discount rate (%)**	3.5%

As noted above, a key assumption is the cost of installing FTTP to new build premises. This will especially affect this policy option as it can influence the number of premises above or below the cost threshold. Arguably, as the cost estimates used are higher than industry benchmarks (thus, the cost of installing full fibre is lower than currently estimated), the number of premises captured by this policy option could be greater than currently assumed. Acknowledging this, deployment costs are higher in rural rather than urban areas which could therefore lead to some distributional Issues which are illustrated further in the accompanying evidence base. There could be other solutions to deliver better connections to premises excluded by the cost cap, such as the use of alternative technologies. We plan to use the consultation to identify the practicality and feasibility of these alternative solutions.

BUSINESS ASSESSMENT (Option 3)

Direct impact on business (Equivalent Annual) £m:			**In scope of OIOO?**	**Measure qualifies as**
Costs: £9.6	**Benefits:** £0	**Net:** -£9.6	TBC	

Summary: Analysis & Evidence

Policy Option 4

Description: 100% FTTC coverage for all new builds

FULL ECONOMIC ASSESSMENT

Price Base	PV Base	Time Period	Net Benefit (Present Value (PV)) (£m)		
2016	2016	15 years	**Low:** --	**High:** --	**Best Estimate:** +£0.9

COSTS (£m)	Total Transition (Constant Price)	Years	Average Annual (excl. Transition) (Constant Price)	Total Cost (Present Value)
Low	--		--	**--**
High	--		--	**--**
Best Estimate	£0.4		£1.4	**£17.2**

Description and scale of key monetised costs by 'main affected groups'

While options 2 and 3 would mandate a full fibre to the premise (FTTP) connection, this options looks at a lower tech full fibre to the cabinet (FTTC) connection. FTTP is capable of providing ultrafast, Gigabit-capable speeds, whereas FTTC is capable of delivering superfast speeds up to ~100 Mbps. Nonetheless, the approach to the costs are similar to the previous options - we count the base cost to install a connection to a new build plus the upgrade cost to provide premises with at least FTTC. We envision this cost to be shared between developers and telecoms operators pending feedback from the consultation. In addition, there will be some feasibility costs as businesses understand and implement this policy option. Overall, this option is expected to cost £17 million over 15 years (including optimism bias) in comparison with the do nothing scenario.

Other key non-monetised costs by 'main affected groups'

The above does not include operating costs which are assumed to be covered by telecoms operators revenue from providing broadband services. There may also be additional administrative costs, such as arranging telecoms connectivity between developers and operators, though the process is expected to be largely the same as the do nothing scenario.

BENEFITS (£m)	Total Transition (Constant Price)	Years	Average Annual (excl. Transition) (Constant Price)	Total Benefit (Present Value)
Low	--		--	**--**
High	--		--	**--**
Best Estimate	..		£1.6	**£18.1**

Description and scale of key monetised benefits by 'main affected groups'

The main benefits include increased labour force participation and improved teleworker productivity. Wider benefits also includes wellbeing improvements to households and potential spillover effects. The benefits are larger for premises with faster broadband connections.

Other key non-monetised benefits by 'main affected groups'

Other benefits not monetised include access to public services, e-commerce and reduced travel.

Key assumptions/sensitivities/risks **Discount rate (%)** 3.5%

The key assumption for this option is the cost of upgrading copper lines to FTTC. The cost estimates used are based on BDUK approximations of the actual cost of delivery, but these could be an overestimate as they are usually higher than industry benchmarks. We have also included an optimism bias of 44% but, given that the technology and installation processes are proven, it could arguably be much lower than this.

BUSINESS ASSESSMENT (Option 4)

Direct impact on business (Equivalent Annual) £m:			In scope of OIOO?	Measure qualifies as
Costs: £1.4	**Benefits:** £0	**Net:** -£1.4	TBC	

Summary: Analysis & Evidence

Policy Option 5

Description: A 'connectivity certificate' for all new builds homes

FULL ECONOMIC ASSESSMENT

Price Base	PV Base	Time Period	Net Benefit (Present Value (PV)) (£m)		
2016	2016	15 years	**Low:** --	**High:** --	**Best Estimate:** -£12.0

COSTS (£m)	Total Transition (Constant Price) Years		Average Annual (excl. Transition) (Constant Price)	Total Cost (Present Value)
Low	--		--	**--**
High	--		--	**--**
Best Estimate	£0.4		£1.1	**£13.5**

Description and scale of key monetised costs by 'main affected groups'

The key monetised costs falling from this policy include the base cost for providing new builds with a connection, the cost of the certificate itself and any upgrade costs attributed to the certificate. The latter is on the basis that demand for premises with poor connectivity would fall (as consumers demand good connectivity), which could nudge the behaviour of developers to install better broadband connections. As with the previous options, we expect the cost of providing telecoms connectivity to be shared by developers and operators pending feedback from the consultation. However, the cost of the certificate itself would likely be paid by Telecoms operators only. Based on industry standard direct marketing costs, a certificate could cost around £3 each and would be required for all new builds (regardless of the size of developments). While this is much lower than the Energy Performance Certificate (EPC) which costs between £60 and £90 each, broadband connections can be tested remotely which would lead to substantial cost savings. There are also likely to be some familiarisation costs as businesses understand and implement the new builds policy.

Other key non-monetised costs by 'main affected groups'

There could be additional operating costs around maintaining the network, though this is expected to be financed by telecoms operators wholesale and retail revenue. There may also be operating costs associated with managing the certificate system and ensuring compliance but, as is usual practice with impact assessments, it is assumed that all businesses would be compliant with the policy.

BENEFITS (£m)	Total Transition (Constant Price) Years		Average Annual (excl. Transition) (Constant Price)	Total Benefit (Present Value)
Low	--		--	**--**
High	--		--	**--**
Best Estimate	..		£0.1	**£1.5**

Description and scale of key monetised benefits by 'main affected groups'

The key monetised benefits of this policy include increased labour force participation, increased productivity of teleworkers, improved wellbeing and potential spillover effects for rolling out connectivity to nearby premises.

Other key non-monetised benefits by 'main affected groups'

In addition to the monetised benefits, other benefits that have not been quantified but should nonetheless be considered include access to public services, online shopping and reduced travel (among others) that better broadband speeds can provide.

Key assumptions/sensitivities/risks	**Discount rate (%)**	3.5%

As with the other policy options, the key assumption is around the cost of installing telecoms connectivity. While we have accounted for this risk by including an optimism bias of 44%, arguably the bias would be much lower than this given that the technology and the installation process are proven. The installation cost estimates used are also higher than other benchmark figures further suggesting that the costs are likely to have been overestimated. There is a further key assumption around the cost of a connectivity certificate. We will use the consultation to gauge opinion as to what a realistic cost could be though, currently, we have also included an optimism bias of 44%. Besides cost, another key assumption is on the likely effect of the certificates on behavioural change (especially the speed of that change) - both in nudging developers to improve connectivity and on consumer demand. We have based our assumptions using available evidence where possible, though we will use the consultation to assess the validity of our approach.

BUSINESS ASSESSMENT (Option 2)

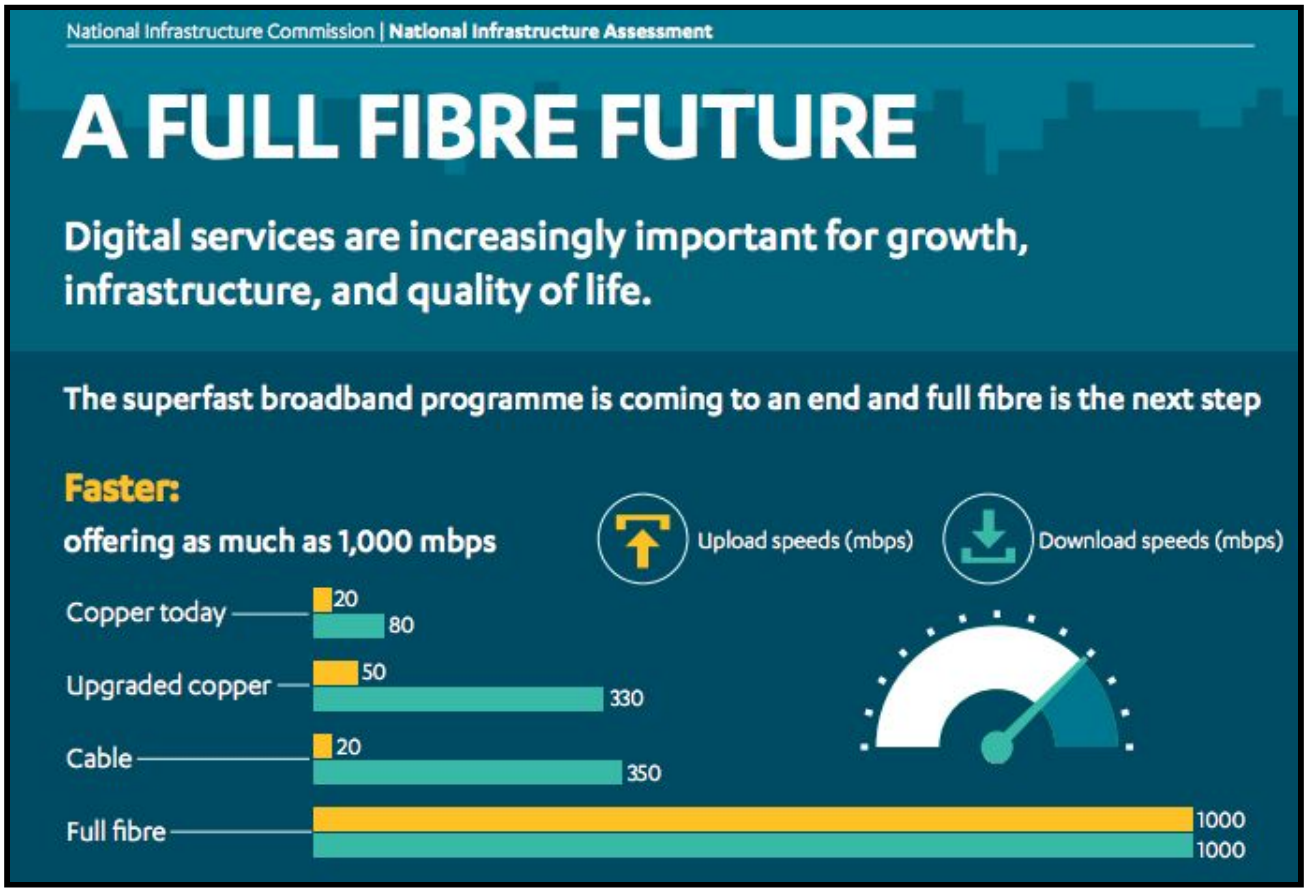
Direct impact on business (Equivalent Annual) £m:			**In scope of OIOO?**	**Measure qualifies as**
Costs: £1.1	**Benefits:** £0	**Net:** -£1.1	TBC	

Background

The Digital Strategy, Technology and Manifesto commitments

1. Overcoming the challenges and realising the opportunities of a shift to Gigabit[1] capable networks is at the heart of the UK's Digital Strategy[2]. World class connectivity is a key priority for Government as it enables socio-economic growth and innovation. Although a number of new technologies can deliver a quality service, full fibre and Gigabit capable networks are widely regarded as being able to deliver the fastest and most future-proof connections. Throughout this impact assessment the terms 'full fibre' and 'Gigabit' will be used to describe world-class networks - the kind of networks we believe new homes should be connected to - and in both cases we would expect the connection to be capable of achieving 1,000 Mbps download speeds. The graphic below, (taken from the National Infrastructure Commission's recent infrastructure assessment[3]) gives a clear indication of the speed superiority of full-fibre networks.

Figure 1: Broadband speeds by type of connection



[1] A Gigabit is 1,000 Mbp/s. See: https://Gigabitvoucher.culture.gov.uk/home/how-fast/ Today, in 2018 Gigabit capable networks available to consumers are almost exclusively full-fibre. Some Hybrid Fibre Coax (HFC) and Fixed Wireless Access (FWA) technologies are theoretically able to provide Gigabit capable connections, though consumers of HFC and FWA are not currently experiencing these kinds of speeds.
[2] DCMS (2017), 'UK Digital Strategy 2017' https://www.gov.uk/government/publications/uk-digital-strategy/uk-digital-strategy#connectivity---building-world-class-digital-infrastructure-for-the-uk
[3] National Infrastructure Commission (2018), 'National infrastructure assessment 2018' https://www.nic.org.uk/publications/national-infrastructure-assessment-2018/

Source: National Infrastructure Commission (2018), 'National infrastructure assessment 2018'

2. The 2017 manifesto makes commitments on the subject of Gigabit connectivity and full fibre deployment[4]:

- *"We will work to provide gigaspeed connectivity to as many businesses and homes as possible"* and;

- *"...by 2022 we will have major fibre spines in over a hundred towns and cities, with ten million premises connected to full fibre and a clear path to national coverage over the next decade".*

History - The Universal Service Directive

3. The Universal Service Directive (the Directive[5]) was one of four pieces of European Telecoms legislation that was required to be enacted by the UK in 2003. The Directive was transposed to UK legislation in the form of the Universal Service Order (The Order). The Order was implemented by the regulator and required Universal Service Providers (USPs) to provide certain services (including to provide telephony services upon request). One defined service was a requirement for USPs (BT and Kingston) to provide 'functional internet access'. Oftel (now Ofcom) were given flexibility by the Directive to set the speed requirements. In the policy document, 'Statement and Notification issued by the Director General of Telecommunications on the implementation of the Universal Service Directive' Oftel commented on connection speeds[6]:

> *"In short, Oftel suggested that a minimum connection speed of 28.8 kbit/s achieved the right balance between the interests and reasonable expectations of end-users and the resulting burden upon designated providers."*

4. Given the period (approximately 10 years after the wide adoption of the internet by the public), it is understandable that Oftel made the decision to suggest a minimum connection speed of 28.8 kbit/s, especially as it was designed as a minimum baseline, and they were also concerned about costs industry could incur that could negatively impact the market. However, internet usage grew exponentially over the next decade, as did speeds.

5. The table below (Figure 2) shows average actual UK fixed-line residential broadband speeds since November 2008[7]. A speed of 28.8kbit/s is equal to 0.0288 Mbits/s, therefore the average speed in November 2008 (3.6Mbits/s) was 125 times faster than the suggested minimum required for 'functional internet access'. By all measures, 'functional internet access' requires speeds well beyond 28.8 kbit/s today. Ofcom reviewed

[4] The Conservative Party (2017), 'Forward together: our plan for a stronger Britain and a prosperous future' https://www.conservatives.com/manifesto

[5] Directive 2002/22/EC of the European Parliament and of the Council of 7 March 2002 on universal service and users' rights relating to electronic communications networks and services ('the Universal Service Directive').

[6] Oftel (2003), 'Designation of BT and Kingston as universal service providers, and the specific universal service conditions' http://webarchive.nationalarchives.gov.uk/20080712143755/http://www.ofcom.org.uk/static/archive/oftel/publications/eu_directives/2003/uso0703.pdf

[7] Ofcom (2013), 'Average UK broadband speed continues to rise' https://www.ofcom.org.uk/about-ofcom/latest/media/media-releases/2013/average-uk-broadband-speed-continues-to-rise

the Universal Service order in 2005 and decided against any increase in suggested minimum speeds[8].

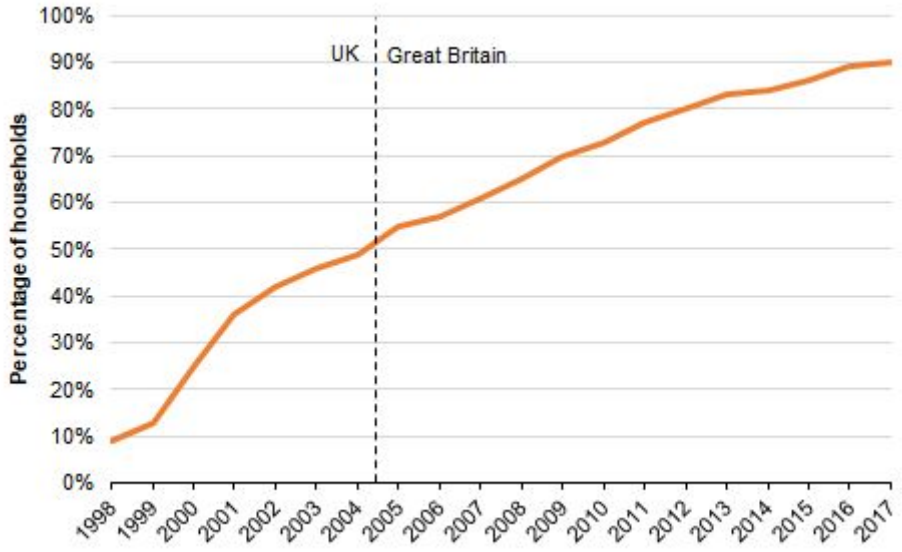
Figure 2: Average actual UK fixed-line residential broadband speeds since November 2008

Measurement period	Average speed
November 2008	3.6Mbit/s
April 2009	4.1Mbit/s
May 2010	5.2Mbit/s
November/December 2010	6.2Mbit/s
May 2011	6.8Mbit/s
November 2011	7.6Mbit/s
May 2012	9.0Mbit/s
November 2012	12.0Mbit/s
May 2013	14.7Mbit/s

Source: Ofcom (2013), 'Average UK broadband speed continues to rise'

6. In summary, the Universal Service Directive (and the subsequent order that BT and Kingston were obliged to adhere to) has never been used to deliver guaranteed high quality internet access. The Directive speed suggestions were not enforceable but could be used as context for a consumer complaint and set a benchmark which BT and Kingston routinely surpassed. Functional internet access, in the context of the Directive, is now understood to mean the ability to send a text email - functional internet access for people today means a service with far more power and reach. There are no plans to change the Directive to increase minimum suggested speeds. With such low speed requirements the directive did not, and does not, have the effect of improving connections to new homes.

Figure 3: Percentage of households with internet access



Source: ONS (2017), 'Internet access - households and individuals: 2017'

[8] Ofcom (2006), 'Revenue of the Universal Service Obligation'
https://www.ofcom.org.uk/__data/assets/pdf_file/0021/34266/statement.pdf

Recent policy context - The USO

7. The Universal Service Obligation (USO) for broadband is part of the Government's commitment to ensure that the UK has world class digital connectivity and inclusion. The USO was unveiled as part of the UK Digital Strategy (March 2017) and Ofcom have the responsibility to implement it. Reaching the whole of the UK, the new USO is intended to fill the gap left by the UK Government's existing Broadband Delivery UK (BDUK) programme. Acting as a 'safety net' the USO will roll out connections to the most isolated and remote premises in the UK. The USO is intended to provide a legal right to request a broadband connection of at least 10 Mbps download speed, up to a reasonable cost threshold. The Digital Economy Act 2017 gives the UK Government the power to implement the USO via secondary legislation. The USO, which is likely to offer universal access to download speeds of at least 10 Mbps, is planned to be in place by 2020 at the latest. Consumers will have a legal right to request a connection (with a current suggested threshold of £3,400 per premise).

8. The USO will bring much needed connections to the hardest to reach premises across the UK. It will not, however, solve the connectivity problems of new build developments (NBDs). We feel new homes should be designed and built with connectivity in mind, with the same planning and foresight afforded to digital connections as with traditional utilities. The USO model, in which a consumer requests a connection, is not one this policy seeks to replicate. Instead the proposed policy would ensure high quality connections are planned and deployed so as to be available as soon as the development is completed. Digital infrastructure, deployed at the same time as other utilities (sometimes called a 'dig once' model) offers two key benefits. Firstly, it avoids the barriers associated with a retrospective deployment (civil works, regulatory hurdles, disturbance and additional cost). Secondly, it allows consumers to utilise a connection from day one of moving into their home, avoiding delays and confusion at a particularly stressful time.

Other measures

9. **Letters to local government**. In 2015, Ed Vaizey MP and Brandon Lewis MP wrote to Council Leaders of English Local Authorities (LAs) highlighting the "vital role local planning authorities have in supporting the rollout of superfast broadband when developing and updating Local Plans and considering planning applications"[9]. The letter suggested that the National Planning Policy Framework (NPPF) "places the provision of telecommunications alongside other key infrastructure such as roads and utilities". Although LAs are increasingly aware of the importance of digital connections without supportive legislation we have been told that they can struggle to ensure that new developments have the most appropriate connections. This is because there is no obligation on developers or operators to provide a high quality connection, the only pertinent requirements are for a telephone line to be deployed and 'functional' internet access to be available (see paragraph 3).

[9] DCLG & DCMS (2015), 'Provision of high-speed broadband connections for commercial and residential new builds', 19 March https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/416827/superfast-broadband-new-builds.pdf

10. **Industry agreements**. In 2016, Ministers brokered a deal between the Home Builders Federation (HBF) and Openreach, where Openreach would provide full fibre connectivity for new developments, providing threshold conditions are met[10]. Originally, the threshold was for developments of 250 units or above, then lowered to 100, and is 30 today. This intervention has proved relatively successful, with Openreach and proactive developers forging strong relationships that result in well connected developments. However, as a voluntary measure the agreement is vulnerable to a lack of take up by developers. When developers do not engage with operators delays can occur in the deployment of high quality networks.

11. **EU legislation[11]**. The European Parliament and The Council Directive 2014/61/EU requires that termination points in buildings can support superfast (and above) connections [12]. It requires all new buildings to be adequately equipped with the necessary infrastructure to support a connection to superfast broadband rather than provide the connection itself. The guiding principle of Directive 2014/61/EU is to contribute to a reduction of the future costs and obstacles to deploy superfast broadband. The directive was transposed onto the UK's statute via the following documents:

a) England Building Regulations Approved Document R
b) Scotland Building Standards Technical Handbook
c) Wales Building Regulations Approved Document R
d) Northern Ireland Building Regulations Technical Booklet M

12. **The National Planning Policy Framework (NPPF)**. The NPPF sets out the Government's planning policies for England and how these should be applied. It provides a framework within which locally-prepared plans for housing and other development can be produced. The revised NPPF was published in July 2018 and states[13]:

> *"Policies should set out how high quality digital infrastructure, providing access to services from a range of providers, is expected to be delivered and upgraded over time; and should prioritise full fibre connections to existing and new developments (as these connections will, in almost all cases, provide the optimum solution)."*

[10] DCMS & DCLG (2016), 'Delivering superfast connectivity in new builds', 4 February https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/498103/DCMS-DCLG_FINAL.pdf

[11] *On 23 June 2016, the EU referendum took place and the people of the United Kingdom voted to leave the European Union. Until exit negotiations are concluded, the UK remains a full member of the European Union and all the rights and obligations of EU membership remain in force. During this period the Government will continue to negotiate, implement and apply EU legislation. The outcome of these negotiations will determine what arrangements apply in relation to EU legislation in future once the UK has left the EU.*

[12] European Parliament (2014), 'Directive 2014/61/EU of the European Parliament and the Council' https://ec.europa.eu/digital-single-market/en/news/directive-201461eu-european-parliament-and-council

[13] MHCLG (2018), 'National Planning Policy Framework', section 10 https://www.gov.uk/government/publications/national-planning-policy-framework--2

Summary of existing policies

13. We believe that these interventions have had a positive impact on the connectivity of NBDs. However, even taken as a whole, these initiatives will not deliver the guaranteed world class digital infrastructure needed across the country. It is apparent that the market requires supportive legislation to deliver digital connectivity. None of the policies or measures highlighted above have the legislative power to ensure NBDs are well connected. We believe that due to this lack of a legislative framework too many new homes are: not connected, suffer delays, have speed or reliability issues or are connected to an inferior technology when the cost of upgrade would be relatively low.

Problem under consideration

14. New Build Developments (NBDs) are being built today with poor connectivity. In the worst cases this means residents are unable to use the internet via a fixed line connection. For residents who have bought new homes - at considerable cost - to be unable to connect to the internet for routine reasons (such as paying bills or contacting a new school) is frustrating. We believe that Government may need to intervene to ensure that modern homes are built with modern connections, that give consumers the speeds and reliability they need to be able to part of our increasingly digital society.

15. We have seen data that suggests just one in three new homes has access to an ultrafast connection, and that certain regional areas are worse off in terms of quality of connections[14]. We routinely hear from concerned residents who have had no success in gaining adequate connections from developers and operators, and new cases of market failure are brought to our attention by press articles highlighting the poor state of connections in some developments[15].

16. There are indications that some developers are realising the importance of high quality digital connections, however industry as a whole is not moving in a direction that prioritises or encourages great connectivity[16]. When a NBD is built there is a clear opportunity for quality, future-proof infrastructure to be deployed; when this does not happen residents suffer, often having to fight to gain connections appropriate for modern life in the UK. Further, retrospectively deploying digital infrastructure to meet consumer demand is costly and disruptive. Government also has ambitious targets to meet in terms of delivering fibre connectivity - ensuring new homes are connected to fibre networks at the first point of opportunity could be a part of the various actions required to allow these targets to be met.

[14] Thinkbroadband (2018), 'North East worst region for superfast broadband in new homes in 2017' https://www.thinkbroadband.com/news/7974-less-than-half-of-north-east-new-homes-in-2017-have-superfast-broadband
[15] Castle, R (2018), 'Uttoxeter new-build homes still without fibre broadband capability' 'https://www.burtonmail.co.uk/news/property/uttoxeter-new-build-homes-still-1739043
[16] Of the 18 largest housebuilders in the UK only 16 gave details regarding the type of connection new residents would receive on their websites, of the rest, the majority made no mention of digital connections at all. DCMS research (May 2018).

17. The Future Telecoms Infrastructure Review (FTIR)[17] reports that:

> *"In our manifesto, we said that over the next decade we want to provide at least 10 million premises with access to full fibre, with a clear path to national coverage. We want to go further, faster – and have set an ambitious target for 15 million premises to be connected to full fibre by 2025, with nationwide coverage by 2033."*

18. We believe that meeting this ambitious target can, in part, be facilitated by legislating that NBDs are connected to Gigabit capable networks. Currently there is no Government sponsored national fibre deployment planned; instead there is a combination of commercial network builds and Government policies and programmes. Throughout policy development we have considered how networks that meet the needs of new developments as well as wider Government objectives can be deployed and we have, therefore, factored this into our option selection in the next section.

19. Developments with copper based networks cannot provide the world class digital infrastructure the UK needs to add value to the economy and provide consumers the digital services they require. Government risks ignoring the valid concerns of new homeowners if action is not taken.

20. The scale of the problem is potentially large. Analysis of data from Ofcom's Connected Nations report suggests that 8% of new residential premises between April 2017 and January 2018 are connected to a solely copper based network (ADSL)[18]. These ADSL connections are likely to be poor. Across ADSL (solely copper) connection types the 'peak time' (20:00-22:00) mean average speed is 7.8 Mbit/s. Taking 215,000 new premises as an average number of new builds built across the UK we can identify a figure of 17,200 new homes which at 'peak time' cannot access a connection above 10 Mbps. This would put a number of these new homes in the scope of the broadband USO[19].

21. A further 34% have access to a Fibre to the Cabinet (FTTC) connection and, while potentially offering superfast speeds, there is a large variance in quality of FTTC connection with signal degradation over distance being of particular concern[20]. The remaining new builds either have access to Virgin's network (24%) which can deliver ultrafast (and potentially Gigabit) speeds, or have a FTTP connection (35%) which is the most capable technology available today, able to reach speeds of 1 Gbps (1000 Mbps) and beyond. Download speeds by connection type (less FTTP) are shown in Figure 4 below[21].

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[17] DCMS (2018), 'Future Telecoms Infrastructure Review' https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/727889/Future_Telecoms_Infrastructure_Review.pdf

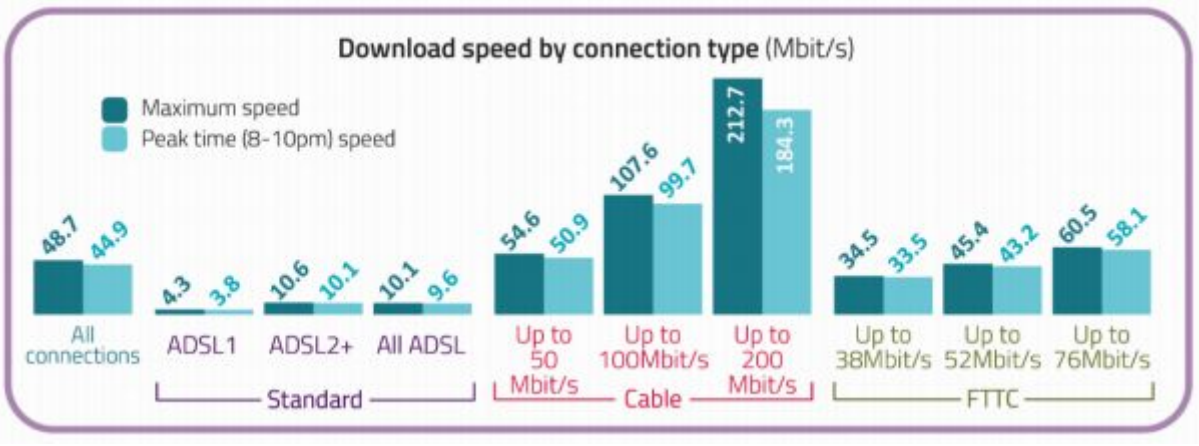
[18] Based on an adjusted sample - see paragraph 56.

[19] Source: Ofcom (2018), 'UK home broadband performance'

[20] "There are two main reasons why the majority fixed broadband connections do not provide their headline (advertised) speed at all times of the day. For copper-based technologies such as ADSL and FTTC, the maximum speed that a line can support is dependent on the length and quality of the line from the end-user's home to the local exchange (ADSL) or street cabinet (FTTC)". Source: Ofcom (2017), 'UK home broadband performance' https://www.ofcom.org.uk/__data/assets/pdf_file/0015/100761/UK-home-broadband-performance,-November-2016-Technical-report.pdf

[21] Ofcom (2018), 'UK home broadband performance' https://www.ofcom.org.uk/__data/assets/pdf_file/0027/113796/home-broadband-2017.pdf

Figure 4: Average download speed by connection type in 2017



Source: Ofcom (2018), 'UK home broadband performance'

22. The Ofcom data is similar to other estimates of broadband connectivity for new builds. Thinkbroadband estimated that just one in three new builds have access to ultrafast speeds in 2017[22]. Approximately 43% received superfast speeds (30 to 100 Mbps) and the remaining 24% received speeds less than 30 Mbps.

23. There are some issues with both sets of data (see Establishing the baseline section). The Ofcom Connected Nations data is based on Telecoms providers reporting the technology available when a premise is connected. A premise is identified as a new build if it is the first time it appears in the database, though instances when this might not be the case is if an existing premise simply gets connected for the first time. Similarly, the thinkbroadband data is based on premises within postcodes that had been created. Consequently, this excludes any new builds within existing postcodes. It also excludes areas where thinkbroadband have been unable to identify the number of premises. Nonetheless, both datasets still provide some insight into the type and quality of connections found in NBDs.

24. The Ministry of Housing, Communities and Local Government (MHCLG) reported that there were 183,570 new build completions across England in 2016-17[23]. Separate data from the Scottish Government, Welsh Government and Northern Ireland's

[22] Thinkbroadband (2018), 'More new build homes means lots more without decent broadband' (https://www.thinkbroadband.com/news/7969-more-new-build-homes-means-lots-more-without-decent-broadband
[23] MHCLG (2017), 'Housing supply: net additional dwellings, England, 2016-17'

Department of Finance suggests that the UK total was around 214,000[24]. Assuming that 8% of new builds receive ADSL and 34% receive FTTC connections (using Ofcom data) suggests that around 90,000 new builds per annum will not be Gigabit capable, and a significant proportion of these will not fulfil the basic needs of the average UK household[25].

25. The Department for Digital, Culture, Media and Sport (DCMS) is also routinely contacted by residents who have found, upon moving into a new home, they have either no, or slow, connectivity. It has been reported to us that in a number of cases a deterioration in communication and collaboration between the developer and network operator results in delays or poor connections. This often leaves new residents attempting to arrange workable connections retrospectively - often with a background of developers and operators blaming each other for the lack of connectivity. We believe a clear, efficient connection process and clearly understood responsibilities would mitigate these issues.

26. The scale of the problem is likely to remain in the future. The Government has a target of increasing new build construction to 300,000 homes per annum by the mid-2020s [26], implying a greater number with poor connectivity. However, offsetting this, is an expectation that the continual rollout of full fibre will mean proportionally less will receive copper or FTTC connections going forwards. Without intervention however, there will be nothing to stop developments being built with connections that do not fulfill the basic needs of the average UK household.

Rationale for intervention

Market failure

27. The broadband infrastructure market has many of the characteristics of a natural monopoly: very high fixed costs, low marginal costs, and high barriers to entry. The provision of broadband infrastructure requires the construction and maintenance of a large, extensive, and diverse network – with high fixed capital costs. The majority of fixed infrastructure in the UK is owned by the BT Group, with fixed services provided over Openreach's network, and is subject to regulation of its wholesale products, including obligations on it to offer access to its local access infrastructure to other operators, and price controls.

28. Regulation has to a large extent been successful in mitigating potential adverse effects of the monopoly power available, and ensuring an efficient and competitive retail market. The broadband market is largely a well-functioning and competitive market, with a choice of services for consumers available at a reasonable price. Firms such as TalkTalk, and Sky, have made use of BT's wholesale products to provide their own broadband

[24] See: Scottish Government (2018), 'New house building in Scotland'; Welsh Government (2018), 'New house building, 2017-18' (excludes information from private approved building inspectors); and Department of Finance (2018), 'New dwellings statistics'

[25] "Around 1.4 million, or 5%, of UK premises are unable to receive a download speed greater than 10Mbit/s. We continue to regard this as the minimum download speed required to fulfil the basic needs of the average UK household." Source: Ofcom (2016), 'Connected Nations 2016' https://www.ofcom.org.uk/research-and-data/multi-sector-research/infrastructure-research/connected-nations-2016

[26] MHCLG (2018), 'New housing agency to boost housebuilding', 11 January 2018 https://www.gov.uk/government/news/new-housing-agency-to-boost-housebuilding

services, leading to BT's retail market share being 32.6% in Q2 of 2017[27]. Virgin Media is the second largest provider of broadband services in the UK, predominantly through their cable product but also through full fibre connections. Smaller fixed operators such as Gigaclear, Hyperoptic and CityFibre are also covering a growing number of premises.

29. This evolving and competitive market is increasingly delivering Gigabit capable networks. However, not all developers prioritise delivering excellent connections. We believe far more new homes could be connected to FTTP networks but are not because developers would need to financially contribute to those connections. This assertion is made on the premise that network operators have told us they routinely offer FTTP packages to developers but these are often only installed when the cost to the developer is nil. Although these developer costs could be passed on, (to original landowners or home buyers) some developers are reluctant to change their known practices - especially, if change includes an increase in capital expenditure. When developers are unwilling to contribute to the cost of providing high quality connections, this in turn impacts upon an operators ability to deploy that network. Without a contribution from a developer, operators will only deploy networks which are commercially viable. In practice, this may mean that although over time more new homes are built with future-proof connections - without any obligation on industry to provide such a connection - a segment of the new homes market may remain poorly connected. This lack of provision has negative effects on both the economy and society, and is partly due to market failures. Key examples being:

- **The environmental benefits** not fully recognised through consumer choice, where increased cloud use and reduced travel (related to increases in teleworking and increased use of online services) leads to less pollution and reduced carbon emissions;
- **The wider benefits to the economy and society** of equality in access to information, commercial and public online services through better broadband. Benefits stemming from better-functioning markets, better health outcomes and increased employment will not be fully incorporated into individual consumer choices; and
- **The spillover effects** associated with fibre based or Gigabit capable networks.

30. In other words, when considering purchasing a home with a (poor, good or excellent) broadband connection, consumers may not consider the external benefits to wider society in their decision. As a result consumers and end-user firms do not demand the socially optimal level of infrastructure and therefore infrastructure providers do not invest to the optimal level. Thus, Government intervention is necessary to facilitate the realisation of these benefits.

31. Other examples of market failure includes:

[27] Ofcom (2017), 'Telecommunications market data update Q2 2017' https://www.ofcom.org.uk/research-and-data/telecoms-research/data-updates/telecommunications-market-data-update-q2-2017

- **Averts future negative externality**. In the future, residential premises will transition from solely copper or FTTC connections to FTTP. This will cause significant disruption to people living within an area. This will include increased traffic congestion and noise pollution as lines are converted. Installing FTTP lines while constructing the development (and property) will mean this additional disruption is no longer necessary.

- **Information failure - home buyers**. Prior to purchasing a premise a home buyer has insufficient information to accurately assess the quality of broadband available in the property. This is especially true for home buyers purchasing new build properties as they are the first people to use broadband in the property. In other words, prospective home buyers of new build properties are not able to accurately judge the value of the internet available at a property prior to purchasing. This also lowers the incentive for house builders to provide high quality broadband to a property.

- **Information failure - consumers**. Households are not fully aware of the extent of the benefits that improved broadband brings them, and therefore do not make optimal choices about purchasing a broadband connection. For example, residential broadband consumers found that, while common drivers to upgrade were faster download speeds for entertainment services or facilitating home working, a key improvement not fully taken account of before upgrading is increased reliability of the internet service, leading to more frequent use of online services[28]. For example, the ability to use online shopping or banking without service disruptions.

- **Information failure - developers**. Not all developers are fully aware of the extent of the benefits that delivering Gigabit capable connections could bring them. In other words, not all developers seem to understand the premium that consumers may place on a fast, reliable internet connection, which in turn developers could charge for. For many years developers have had to facilitate the installation of a copper phone line (which would provide functional[29] internet access). In practice this meant a relationship was built up between developers and (in the majority of cases) BT group - with copper connections and laterly FTTC providing the technological solution. We believe developers are not fully aware of the range of technological solutions available and as such routinely request a copper or FTTC connection from operators even when a Gigabit solution could be viable. Conversely, some developers *may* be aware of the kind of technologies they could facilitate, yet will not contribute to the cost of the best connections available as they do not believe these costs can be recouped.. Developers -especially ones operating under tight profit margins[30] - are therefore unwilling to contribute to the cost of better connections, perhaps believing that they cannot pass on these costs to consumers.

[28] Research carried out for the Superfast Broadband Programme evaluation due to published later in 2018.
[29] Though not by todays standards (see paragraph 5).
[30] https://www.ey.com/Publication/vwLUAssets/UK_Construction_Industry_-_Margin_matters/$FILE/ATTJK7IP.pdf

32. The Government's Digital Strategy sets out that people and businesses should be able to make use of digital services, and participate in the digital economy, wherever they are based[31]. Part of the rationale for Government intervention is to address this concern.

33. The digital divide is the inequality in access to and use of information communication technology, across economic, social, or geographical boundaries. It manifests in the lesser ability of certain groups, particularly people who live and work in rural areas or hard to connect urban areas, to access the benefits that derive from access to these technologies. The divide also naturally widens over time; as digital technology and applications become more prevalent in life, those groups without access to fast, reliable speeds get left further behind.

34. This lack of access includes the digital economy (such as e-commerce, online banking, etc.) and the digital society (such as e-government, VoIP services, online news, etc.) and so has both economic and social consequences. Research has shown the link between technological access and economic growth[32].

35. Much of the argument for addressing the digital divide is focussed on equality - access to the internet tends to increase with wealth[33]. One of the effects of the digital divide is the growth in 'information poverty', where the less privileged do not have the skills or material means to access information, and apply it appropriately. Addressing this digital divide is a core part of the Government's digital ambitions, and a significant part of the rationale for this intervention. Improving access to broadband will help reduce the digital divide, reducing information poverty, and create social and economic benefits to consumers and businesses.

Policy objectives

36. Our key objective is to provide residents of new build premises guaranteed access to Gigabit capable broadband. This will improve social equity and productivity. Further, we aim to build wider Gigabit capable networks that are recognised drivers of economic growth. Finally, we wish to further understand whether there is an identifiable 'digital divide' in this area - and if so, reduce or eliminate it. These objectives are discussed in more detail below:

37. **Growing Gigabit capable networks**. The Government has made a commitment to growing digital networks in order to drive growth. In a speech to the Confederation of

[31] DCMS (2017), 'UK Digital Strategy' https://www.gov.uk/government/publications/uk-digital-strategy
[32] SQW (2013), 'UK broadband impact study' https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/85961/UK_Broadband_Impact_Study_-_Literature_Review_-_Final_-_February_2013.pdf
[33] Smith, A (2013), 'Technology adoption by lower income populations' http://www.pewinternet.org/2013/10/08/technology-adoption-by-lower-income-populations/

British Industry (CBI) in May 2018, the Chancellor stated that the deployment of full fibre networks will be intrinsic to the economic growth of the UK[34]:

> *"In the 21st century, fibre networks will be the enabling infrastructure that drives economic growth. We've already connected more than 95% of the UK to superfast broadband. But we must now take the next big leap forward. Full-fibre networks are faster, more reliable, and cheaper to operate than their copper predecessors...So I am now setting a new target to see full-fibre to the premises connections being available to 15 million premises, that's the majority of homes and businesses, by 2025."*

38. Moreover, in a recent NERA report for DCMS, the following statement is made[35]:

> *"If the UK Government wishes to foster FTTP deployment, specific policy measures tailored to UK circumstances ought to be designed and implemented."*

39. In the Future Telecoms Infrastructure Review (FTIR), the Government sets out five key areas that will allow nationwide full fibre connectivity[36]:

> *"This strategy relies on getting five things right:*
>
> *1. Making the cost of deploying fibre networks as low as possible by addressing barriers to deployment, which both increase costs and cause delays;*
>
> *2. Supporting market entry and expansion by alternative network operators through easy access to Openreach's ducts and poles, complemented by access to other utilities' infrastructure (for example, sewers);*
>
> *3. Stable and long-term regulation that incentivises competitive network investment;*
>
> *4. An 'outside in' approach to deployment that means Gigabit-capable connectivity across all areas of the UK is achieved at the same time, and no areas are systematically left behind; and*
>
> *5. A switchover process to increase demand for full fibre services."*

40. The proposed policy is closely linked to points (1 and 5) made in the FTIR strategy. New build developments present opportunities for world class infrastructure to be deployed at the time of building. Deploying older, less reliable and poorer quality copper based

[34] HM Treasury (2018), 'Chancellor speech: CBI annual dinner 2018' https://www.gov.uk/government/speeches/chancellor-speech-cbi-annual-dinner-2018
[35] NERA (2018), 'Telecommunications infrastucture international comparisons' https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/727891/FTIR_Annex_B-_NERA_Telecommunications_Infrastructure_International_Comparison.pdf
[36] DCMS (2018), 'Future Telecoms Infrastructure Review' https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/727889/Future_Telecoms_Infrastructure_Review.pdf

connections makes it more difficult for retrospective fibre-based deployments to be delivered. For example, once roads are adopted it can be difficult for operators to get permission to conduct civil works. This links to the inevitable process of copper networks being 'switched' to full fibre ones. Even in a scenario absent of consumer or operator desire to switch from copper to fibre, it is very likely that in the near future copper networks will need to be upgraded, time and costs can be saved by installing fibre at the first opportunity. Finally, full fibre will provide the bedrock for improved mobile connections. In simple terms, 5G needs full fibre backhaul networks in order to work properly[37]. The National Infrastructure Commission (NIC) in its recent (July 2018) National Infrastructure Assessment[38] noted:

> *"The UK faces a choice between continuing to upgrade the existing copper network, or replacing what is left of it with fibre optics. Full fibre, a connection without any copper, is the best available broadband technology on the horizon. It can provide consistent, Gigabit speeds, which are less affected by rain and flooding, uses less energy, costs less to maintain and has no long term foreseeable capacity constraints. Nationwide full fibre would also provide the foundation for 5G mobile connectivity and could improve 4G coverage in harder to reach places."*

41. **Reducing the digital divide**. We have seen some evidence that there are (connection quality) divides across the UK; they appear to be based on geographic location and the spending power of consumers. Thinkbroadband have produced evidence to suggest that certain parts of the UK are less well served than others in terms of quality of connection[39]. Linked to this, evidence from the Superfast Broadband Programme evaluation suggests that the impact of improving connectivity is relatively larger in rural rather than urban areas[40]. Further, luxury developers often offer FTTP as standard[41], not something seen at the less expensive end of the new build housing market. We believe this is a crucial issue and would particularly welcome evidence and information from stakeholders during the consultation process.

42. **Addressing market failure**. Beyond meeting Government objectives for digital networks and confronting a possible digital divide linked to the connectivity of new homes, Government is considering intervening in order to simply fix the problem of no, or slow, connections found in some new build homes. There is a clear opportunity for new homes to be connected to Gigabit capable networks in the first instance. This means, deploying fibre (or equivalent Gigabit technologies) when developments are being built. This negates a requirement to 'retro-fit' copper connection based developments at a later date. As has been stated, although some elements of industry are beginning to address the issue there are routinely failures to deliver high quality connections to NBDs.

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[37] http://carrier.huawei.com/~/media/CNBG/Downloads/Industry-Perpectives/white_paper_fiber_5g_digital-summit_en.pdf
[38] https://www.nic.org.uk/wp-content/uploads/CCS001_CCS0618917350-001_NIC-NIA_Accessible.pdf#page=19
[39] Thinkbroadband (2018), 'North East worst region for superfast broadband in new homes in 2017' https://www.thinkbroadband.com/news/7974-less-than-half-of-north-east-new-homes-in-2017-have-superfast-broadband
[40] Pending publication
[41] ISPreview (2017), 'Berkeley Group UK home builders say ultrafast broadband is a "must have"' https://www.ispreview.co.uk/index.php/2017/07/berkeley-group-uk-home-builders-say-ultrafast-broadband-must.html

Long list of options considered

43. The Government has considered a broad range of options to ensure that new homes are built with reliable, future-proof connections. There are a number of commercial and Government led programmes that are bringing better connectivity to premises across the UK; the options we have considered are not designed to replace these policies. Instead, these options (and in particular the preferred option) are designed to work within the existing framework of initiatives. The long list of options considered are at Annex 1 and summarised in Table A.

Table A: Summary of long list of options considered

Option		Score	Comment
1	**Do nothing**	**1**	**Included as counterfactual**
2	Mandate Gigabit-ready physical infrastructure for all NBD	1	Not Included (added as part of policy)
3	**Mandate Gigabit-capable connections for all NBD**	**1**	**Included to understand costs**
4	**Mandate Gigabit-capable connections for all NBD within a cost cap**	**3**	**Recommended**
5	**Mandate superfast (24Mbp/s) connectivity for all NBD**	**0**	**Included to understand Gigabit benefits**
6	Penalise (through fines) developers who build homes with 'no or slow' connectivity	-3	Not included
7	**Introduce a Government-endorsed and ratified 'Gigabit-Ready Certification Mark'**	**1**	**Included as non-regulatory option**
8	Legislate for all housebuilders to clearly show connectivity levels (technology and likely speed) on their websites	0	Not included; certificate deemed better choice

Short list of options considered

44. Five scenarios have been considered for the purpose of the consultation. The consultation will help Government refine these options in order to develop the most appropriate policy design. They are:

Regulatory

1. Do nothing - the counterfactual scenario
2. 100% FTTP/Gigabit capable coverage for all new builds - a FTTP connection for all residential new build developments
3. Partial FTTP/Gigabit capable coverage for new builds under cost cap - FTTP coverage based on cost thresholds for all residential new build developments
4. 100% FTTC (Superfast) coverage for all new builds - 100% FTTC coverage for all residential new builds

Non regulatory

5. Connectivity certificate - an operator produced certificate allowing consumers to understand the connectivity levels of their new home

Policy option 1: do nothing

45. This represents the counterfactual scenario, against which the other options will be compared. Under this option there is no mandatory FTTP for new builds so rollout of FTTP to NBDs is determined by market forces and with Government programmes like the LFFN [42] also having an impact. Under this option - with no intervention specific to new homes - residents would rely solely on developers and operators to ensure they were provided with high quality connections.

Policy option 2: 100% FTTP coverage for all new builds

46. This option is designed to examine the upper cost thresholds if a 100% coverage approach was to be used. This option would see every new build home connected to a FTTP (or Gigabit capable) connection. It would use the same cost process as policy option 3 (described below) but with no cap.

Policy option 3: Partial FTTP coverage for new builds under cost cap

47. This option is designed to deliver the best connections to the widest number of homes whilst ensuring stakeholders are not liable for unreasonable costs, in order to do this we propose a dual obligation on developers on operators and would set a cost threshold for each as well as a total cap. A diagram showing the proposed process is at Figure 5 (below).

- The suggested upper limit cost cap is £3,000 - this is later checked as part of sensitivity analysis.We will use the consultation to refine the cost cap thresholds.

- Similar to all of the policy options which mandate a connection type, commercial agreements would be encouraged to be utilised in the first instance. This policy

[42] DCMS & HM Treasury (2018), '£95 million for local full-fibre broadband projects' https://www.gov.uk/government/news/95-million-for-local-full-fibre-broadband-projects

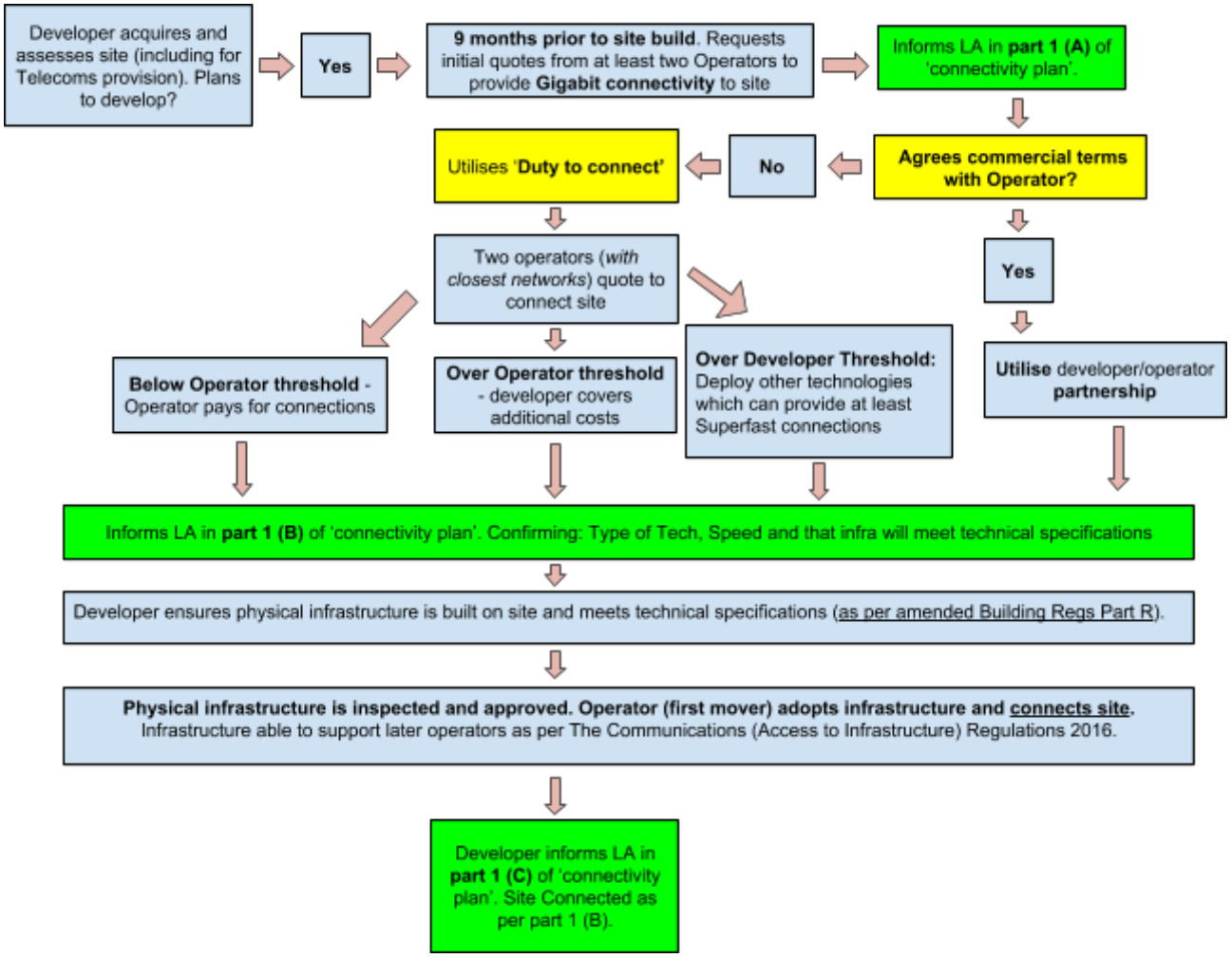
would act as a backstop when developers and operators cannot agree to provide a FTTP connection to new homes.

- If no commercial agreement can be achieved then developers would be able to oblige an operator to connect under a 'duty to connect' provision. Operators with networks closest to the development would be subject to this duty.

- The developer would also have an obligation to ensure that the physical infrastructure required to deliver FTTP or Gigabit capable connections is in place on the site.

- The operator would then be obliged to quote for the connection and to pay for it (up to a cost cap that meets commercial norms[43]). If this cap is exceeded then a developer would be obliged to contribute.

Figure 5: Proposed policy design of partial FTTP coverage for new builds under cost cap



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Policy option 4: 100% FTTC (superfast) coverage for all new builds

48. This option is designed to examine the costs associated with bringing quality connections to new homes. This option does not consider wider Government aims to grow Gigabit capable networks. This option would see predominantly copper-based solutions being utilised. Although FTTC can offer a quality connection, which is able to handle a number of current applications (video streaming, downloading music) the copper portion of the network suffers more from reliability issues and contention problems than full fibre. Again, we would also need to consider the validity of encouraging copper based network deployments in the context of a likely copper 'switch-off' in the next decade.

Policy option 5: Connectivity certificate

49. This option explores the potential merits of a connectivity certificate (similar to the Energy Performance Certificate - EPC), this would inform consumers and could encourage developers to prioritise high quality connections. We assume that an intervention such as this would take some time to achieve maximum effectiveness as is relatively common in behavioural change policies. One reason is because once the product is released, iterative amendments are required to ensure its potential to create change is realised[44].

Options appraisal

Proportionate approach

50. The impact of the new builds policy is expected to affect almost all new house builders and, consequently, the majority of new house buyers. Consequently, this calls for a reasonably robust and clear impact assessment. Given this, this section outlines:

- A description of the **baseline** which forms part of the do nothing scenario. This identifies the current state of telecoms connectivity for new builds and the likely future path.
- A description of the **modelling approach** including the modelling assumptions.
- An economic appraisal of a **range of regulatory and non-regulatory options**. This includes monetised (and the approach taken to value them) and non-monetised benefits and costs.
- An assessment of the main **distributional effects** which includes first time buyers, disabled people (who can access telework given better connectivity) and rural and urban differences.
- An initial assessment of the likely impact on **small and micro businesses**.
- **Sensitivity** testing of the main modelling assumptions: the number of new builds, costs to install or upgrade connections, level of optimism bias, the rate of take up of broadband services, and the cost thresholds for policy option 3.
- A discussion of the main **risks** affecting the new builds policy.

[44] See: Applying behavioural insights to Energy Performance Certificates. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/48123/2135-behaviour-change-and-energy-use.pdf

- An outline of the plan for **monitoring and evaluating** the new builds policy.

51. The new builds connectivity policy is currently at the consultation stage. This means the impact assessment includes some evidence gaps that we seek to fill in dialogue with stakeholders. Given this, the analysis presented below may be strengthened in between the consultation and final stages.

Establishing the baseline

52. The underlying model for which the costs and benefits have been estimated is based on the Ofcom 'Connected Nations' data. This includes information about the type of connection a premise has, as reported by the three main telecom providers, (BT, Virgin and KCOM) as well as seven smaller operators[45]. The data is cleaned and validated by Ofcom by, for instance, using the Unique Property Reference Number. Overall, the database contained 29.3 million premises in 2017 of which 99.4% were successfully matched and validated.

53. Premises that are new to the Connected Nations database are considered to be new builds (approximately 255,700), though some could be existing premises that have been connected for the first time. It could also be a reflection of previously unmatched properties now being matched but, given the high matching/validation rate (above), this is judged to be a low risk. Only residential premises that are habitable have been included. Given this criteria, the Ofcom data suggests that there were 161,500 habitable, residential new build premises between April 2017 and January 2018[46].

[45] Ofcom (2017), 'Connected Nations 2017: data analysis' https://www.ofcom.org.uk/__data/assets/pdf_file/0016/108511/connected-nations-2017.pdf
[46] Epoch dates 49 and 55.

54. A key determining factor which can affect the rollout of fixed broadband is the size of development. As noted in the background section, Openreach already offers a service where they will install full fibre to NBDs with more than 30 units (subject to a cost cap). Within the New Builds model, new build premises have been allocated to a development based on whether it is within 50 metres of another new build premise. Consequently, removing developments with more than 30 units (as they are out of scope for this intervention - based on the assumption that developments over 30 premises are commercially viable for the incumbent) means that the number of records within the Ofcom data falls from 161,500 to 107,600 premises.

Table B: Number of premises included in the New Builds model

Source: New Builds model using Ofcom Connected Nations data

	Number of records
New build records in Ofcom Connected Nations dataset	255,700
Less:	
Uninhabitable premises	49,000
Non-residential premises	45,100
Developments with more than 30 premises	53,900
Records in New Builds model	107,600

Source: Ofcom Connected Nations

55. The percentage of NBDs by size as indicated by the Ofcom data is shown in Table C. Comparing these estimates with benchmarks from other sources like the House Builders Federation suggests the Ofcom data has proportionally more small developments. Further analysis of this suggests the issue is due to timing differences (see Annex 2). Many large developments would be completed and connected (and subsequently reported to Ofcom) in phases, so the model is potentially only capturing a single phase rather than the development as a whole. To correct for this, the proportion of NBDs by size as indicated by the benchmarks (and, which are largely consistent with each other), has been superimposed on the model. That is, while maintaining the geographical and technology information from Ofcom, the size of NBDs have been changed to roughly match the benchmarks.

Table C: Proportion of new build units by size of development

Size of development		New builds model		Openreach	House Builders Federation	National House Building Council
		No adjustment	With adjustment			
Very small	1-2 units	25%	**2%**	4%	2%	..
	3-4 units	7%	**2%**		10%	..
Small	5-9 units	11%	**6%**	5%		..
Medium	10-29 units	24%	**10%**	11%	88%	..
Large	+30 units	33%	**80%**	80%		..
Average		**10-29***	**+30***	**..**	**..**	**30-40**

*Median. Source: New Builds model using Ofcom Connected Nations data; Openreach; HBF (2018), 'New housing pipeline'; NHCB (2018), 'Housing market report'

56. To further simplify the modelling, new build premises/developments have been allocated to a decile group based on the level of housing density.

57. The Ofcom Connected Nations data includes information about the type of fixed broadband connectivity a premise has. A premise may have more than one technology type, but it is assumed that the highest speed technology would be used. Also, a premise which does not have a tech indicated has been excluded. Acknowledging this, around 7% of new builds (as part of a development with less than 30 units) have access to ADSL connections, 48% have FTTC, 32% have Virgin Media cable which is assumed to be capable of ultrafast speeds, and just 13% have full fibre to the premise.

Table D: Proportion of new build units by telecoms connectivity

Size of development		**ADSL**	**FTTC**	**Virgin**	**FTTP**
Very small	1-2 units	6%	58%	32%	3%
	3-4 units	6%	48%	40%	6%
Small	5-9 units	6%	47%	36%	10%
Medium	10-29 units	7%	47%	27%	19%
Large	+30 units	8%	30%	22%	40%
Average (all developments)		**7%**	**45%**	**29%**	**19%**
Average (1-29 sized developments)		**7%**	**48%**	**32%**	**13%**

Note: based on the adjusted sample and excluding premises with unknown connections. Source: New Builds model using Ofcom Connected Nations data

58. This can be compared with other estimates of broadband connections for new builds, most notably from thinkbroadband (Table E)[47]. This is based on average download speed, so is not directly comparable with the specific type of connection technology (like above). Nonetheless, making assumptions about the download speed of each technology [48], some simple comparisons can be made. On this basis, the New Builds model is broadly in line with thinkbroadband for FTTC (30-100 Mbps) connections, but estimates proportionally more Virgin/FTTP (more than 100 Mbps) and proportionally less ADSL (less than 30 Mbps). Despite this, the thinkbroadband data should be used with some caution. It is estimated by looking at premises within new postcode areas, so it does not include any new premises in existing postcodes or areas where they were unable to estimate the number of premises in that area.

Table E: Thinkbroadband estimates of new build (all units) download speeds

Year	Less than 10 Mbps	10 to 30 Mbps	30 - 100 Mbps	More than 100 Mbps
	≅ ADSL	≅ ADSL	≅ FTTC	≅ FTTP / Virgin
2016	10%	10%	50%	30%
2017	12%	12%	43%	33%
2018 (partial)	14%	16%	33%	37%

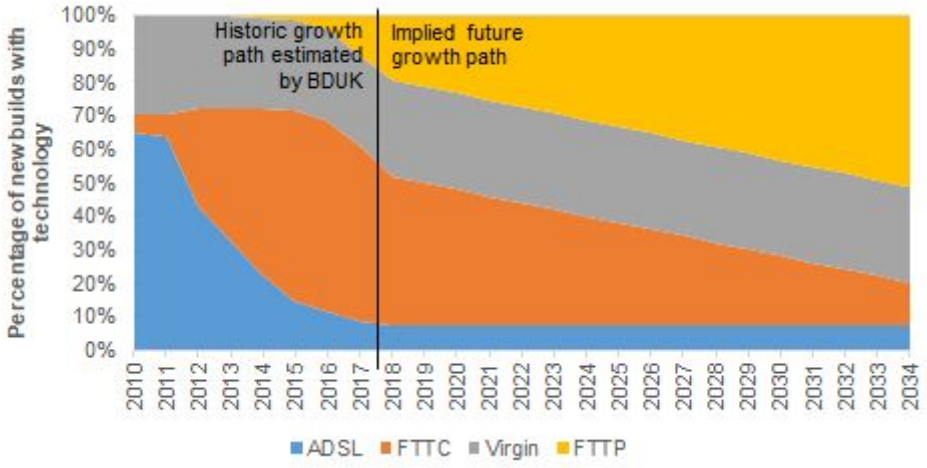
[47] Thinkbroadband (2018), 'More new build homes means lots more without decent broadband' https://www.thinkbroadband.com/news/7969-more-new-build-homes-means-lots-more-without-decent-broadband

[48] Virgin and FTTP can deliver 100 Mbps or more; FTTC can deliver between 30 and 100 Mbps; and ADSL (including ADSL2+) can deliver less than 30 Mbps.

59. The proportion of premises receiving full fibre has been increasing and this trend is likely to continue (see the first half of Figure 6). For the Future Telecoms Infrastructure Review (FTIR), Frontier Economics illustrated the potential rollout of full fibre based on the possible rollout decisions of telecoms operators. They estimated that ultrafast coverage (including Virgin) will increase from 41% in 2018 to 67% in 2034 for all residential properties[49]. The Government intends to increase this to all areas by unlocking deadlock areas and providing additional funding to support rollout to uneconomic areas - of which a policy option is this New Builds policy[50].

60. If assuming that the growth rate of ultrafast coverage will indeed match that estimated by Frontier, the proportion of new builds with ultrafast connections could increase from 48% (Virgin: 29% and FTTP: 19%) to 80% over the next 15 years. Frontier assumes that Virgin's penetration will remain constant over time, so all of this growth is allocated to FTTP. This growth is at the expense of FTTC connections if ADSL is similarly assumed to keep its market share rather than fade out completely (i.e. no copper fade-out). Overall, the shares by technology is assumed to evolve over time at the same rates as shown in the second half of Figure 6.

Figure 6: Assumed path of technology shares over time



Source: New Builds model using Ofcom Connected Nations data; Frontier Economics (2018), 'Future Telecoms Infrastructure Review: annex A'; and BDUK assumptions

61. Figure 6 shows that FTTP coverage is assumed to increase annually by around 2 percentage points. This compares favourably with other estimates. For example, Ofcom reported that all residential properties with full fibre increased from 2% in May 2016 to 4% in May 2017 - a 2 percentage point increase[51]. Similarly, thinkbroadband reported that the percentage with ultrafast coverage increased from 30% in 2016 to 33% in 2017 - a 3 percentage point increase.

[49] Frontier Economics (2018), 'Future Telecoms Infrastructure Review: annex A' https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/727890/FTIR_Annex_A_-_FE_Report.pdf
[50] DCMS (2018), 'Future Telecoms Infrastructure Review' https://www.gov.uk/government/publications/future-telecoms-infrastructure-review
[51] Ofcom (2018), ' Connected Nations Spring Update' https://www.ofcom.org.uk/__data/assets/pdf_file/0017/113543/Connected-Nations-update-Spring-2018.pdf

62. In summary, the above analysis provides an estimate of the proportion of NBDs by size, density decile and highest technology available. Of which, the latter is assumed to change over time to reflect the rollout of FTTP at the expense of FTTC.

63. A more detailed discussion about the New Builds modelling approach is in Annex 2.

Modelling assumptions

64. In addition to the above, there are several modelling assumptions used within the New Builds model including:

- **Number of new builds per annum**. The modelling assumes that there will be 215,000 new homes across the UK each year. This is based on the reported number of new homes built in 2016-17 by MHCLG, Scottish Government, Welsh Government and Northern Ireland's Department of Finance[52]. This assumption is tested as part of sensitivity later. The Government has ambitions to build many more homes, more quickly - the modelling is based on historic norms and is not based on future targets.

- **Characteristics of new builds**. It is assumed that the average size of developments is held constant over time. Consequently, given the above assumption of 215,000 new homes per year, there is a further assumption that 44,000 would be on developments with fewer than 30 units (20% - see Table C).

- **Take up of broadband services**. While premises may have access to superfast or ultrafast connections, the broadband speed that households actually receive can vary depending on the broadband package chosen. In this analysis it is assumed that it will take five years for households to upgrade from their current broadband speed to the maximum speed possible with their connection. The increase is assumed to be equal across the years, so take up will increase by 20% (in absolute terms) per annum. This is based on Ofcom data previously showing it took around five years for average download speeds to go from 3.6 Mbps to speeds of 14.7 Mbps[53]. This assumption is later tested as part of sensitivity analysis.

- **DOCSIS is Gigabit-capable**. The DOCSIS (data over cable service interface specification) cable used by Virgin is assumed to be capable of reaching Gigabit speeds[54]. In some cases, this may require an upgrade to the cable technology to reach these speeds. Consequently, in the New Builds model, it is assumed that Virgin connected homes are equivalent to FTTP.

- **Appraisal period and prices based year**. We have opted to use a 15 year appraisal period and reported monetary values in constant 2016 prices unless

[52] See: MHCLG (2017), 'Housing supply: net additional dwellings, England, 2016-17'; Scottish Government (2018), 'New house building in Scotland'; Welsh Government (2018), 'New house building, 2017-18' (excludes information from private approved building inspectors); and Department of Finance (2018), 'New dwellings statistics'
[53] Ofcom (2013), 'Average UK broadband speed continues to rise'
https://www.ofcom.org.uk/about-ofcom/latest/media/media-releases/2013/average-uk-broadband-speed-continues-to-rise
[54] The New Builds model splits Virgin into RFoG and DOCSIS. RFoG (radio frequency over glass) is already a type of FTTP and, consequently, included in the FTTP figures.

otherwise stated. We have also discounted values using a rate of 3.5%. The 15 year appraisal period has been chosen for several reasons:

- To reflect the lifetime of assets - most of the capital purchased will last at least 15 years or longer;
- To match the appraisal period typically used for capital investment in telecoms, which is generally 15 to 20 years; and
- For consistency, as other DCMS telecoms impact assessments (such as the Universal Service Obligation) have also used a 15 year appraisal period.

Costs

Capital expenditure

65. The cost of installing a digital network to a new build can be estimated within the New Builds model. In the model, costs are broken down into three segments:

- Planning and survey costs;
- Cost of connecting a cabinet to an exchange; and
- Cost of connecting a cabinet to a premise.

66. The New Builds model estimates the cost of installing an ADSL, FTTC and FTTP connection to each new build by density decile. Different approaches have been taken depending on the cost itself, for example whether a per metre or per structure basis is most appropriate. If a per metre measure has been used, the cost will greatly be influenced by the distance between a premise and a cabinet/exchange. We have assumed that a premise will be connected to the nearest cabinet/exchange and this can vary between premises in the same development. An alternative assumption is that all premises in a development will be connected to the same cabinet/exchange which usually means the overall distance is larger as a premise might be connected to a cabinet/exchange that is further than its closest. Furthermore, the cost of delivery is usually higher in rural areas and lower in urban areas. This trend has been emphasised in the model by adjusting the costs by density decile using a linear trend, though alternatively the costs can be left unchanged. We illustrate the impact of both of these assumptions as part of cost sensitivity later.

67. In all cases, the cost estimates (by density decile) are informed by the median of BDUK approximations of the cost of delivery experienced by different suppliers and in different areas. This information predominantly relates to the Superfast Broadband Programme and other programmes that BDUK manages.

68. The cost output of the New Builds model is the relative cost to upgrade a telecoms connection. However, the absolute (or base) costs can nonetheless be inferred. Openreach have shared with us the average cost of installing an ADSL line. The BDUK approximations suggest that the average cost to install FTTC is roughly £1,250 and FTTP is around £1,700 on average. This does vary between rural and urban areas, and between different suppliers though.

69. These cost estimates can be benchmarked against estimates from other studies. However, these estimates generally assume that an ADSL connection will already be in place, so they are more representative of the 'upgrade' rather than the 'absolute' cost. These benchmarks include:

- **Tactis and Prism estimates for the National Infrastructure Commission**. Tactis and Prism estimated the costs for installing FTTP as part of their work for the National infrastructure Commission[55]. They estimate the capex per premise passed (i.e. to install the network) and the capex per premise connected (i.e. premises that take up the service) for six geotypes that vary from rural to urban areas.

- **Frontier Economics estimates for the FTIR**. For the FTIR, Frontier Economics modelled the potential rollout of full fibre across the UK[56]. As part of this, they also looked at the cost to rollout full fibre which are loosely based on the Tactis and Prism estimates discussed above. The capex costs were broken down into duct, fibre and equipment per home passed (similar to the New Builds model approach) and cost per home connected. They did this for 13 geotypes ranging from whether it is a low or high cost area, and existing competitive market conditions.

- **Openreach estimates**. Openreach provided us with some commercially sensitive capex cost estimates of installing full fibre to new builds in confidence. They do not vary by geotype, but does illustrate the capex by size of new build development.

70. Overall, the New Build modelled cost estimates are broadly in line with these benchmarks (Table F); they are within the range for the various geotypes but often a little higher than the average estimate. The main explanation for this is different approaches. For instance, the Tactis and Prism's and Frontier's models estimate the cost for a geotype as a whole, whereas the New Builds model is more granular and can look at the individual components of cost within a specific density decile. Nonetheless, the relative difference between technologies are reasonably in line. Given the differences, the cost estimates within the New Builds model are tested later as part of sensitivity. We also seek to gather more cost information during the consultancy to ensure accuracy.

[55] Tactis & Prism (2017), 'A cost analysis of the UK's digital communications infrastructure options 2017-2050' https://www.nic.org.uk/wp-content/uploads/Cost-analysis.pdf
[56] Frontier Economics (2018), 'Future Telecoms Infrastructure Review', Annex A https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/727890/FTIR_Annex_A_-_FE_Report.pdf

Table F: Benchmarking the upgrade capex costs per premise passed (excluding connection costs), range of estimates by geotype shown in brackets

Note: costs assume use of existing ducts and poles infrastructure where appropriate. Frontier Economics figures include cost of replacing equipment.

Source: New Build modelling using Ofcom Connected Nations and BDUK data; Tactis and Prism (2017), 'A cost analysis of the UK's digital communications infrastructure options 2017-2050'; Frontier Economics (2018), 'Future Telecoms Infrastructure Review'; Openreach

	ADSL to FTTC	ADSL to FTTP	FTTC to FTTP (implied)
New Build model	**Based on commercially sensitive figures**	**≅ £1,000**	**≅ £450**
Tactis and Prism	£250 (£150 to £350)	£700 (£550 to £900)	£450 (£400 to £600)
Frontier Economics	£200 (£150 to £1,400)	£550 (£400 to £2,500)	£350 (£250 to £1,200)
Openreach	..	Commercially sensitive figures shared.	..

71. Over time, there can be some cost efficiencies from installing connectivity to new builds that could lower these estimates. For example, operators may become more efficient at installing digital networks to new builds over time, which can help reduce the overall installation cost. Similarly, developers could coordinate construction further leading to efficiency gains, such as coordinating civil work so that dig costs only occur once. However, the extent of these cost efficiencies are highly uncertain and, therefore, not accounted for in the New Builds model.

Operating expenditure

72. The above relates to the capital expenditure associated with installing telecoms connectivity. In addition to this, there are also ongoing operating costs to maintain the network. However, it has been assumed that these operating costs are recovered by telecoms operators through wholesale and retail revenue. This is similar to the assumptions made by other studies like Frontier Economics for the FTIR[57]. Nonetheless, it is often reported that fibre networks have lower ongoing costs than copper networks, so there can be some genuine cost savings from upgrading to fibre. For instance, the NIC estimated that running a fibre network can save up to £5 billion in operating costs compared with copper[58]. This cost saving has not been estimated in this analysis due to uncertainty around the likely magnitude, especially as operators are likely to run both a fibre and copper network in the short to medium run, but we plan to use the consultation to understand this saving better.

Familiarisation costs

73. In addition to the capital expenditure, there will likely be some familiarisation costs as developers and operators get ready for the policy. This includes reading the regulations and planning how to meet them. It is hard to estimate the potential time it will take to do this, but a broad assumption could be that 10% of non-construction staff at developers (around 5,500 employees) and 5% of non-technician staff at telecom operators (around 4,400 employees) will spend eight hours each reading and implementing the policy[59]. The median hourly pay for SOC 11.22: Production managers and directors in construction was £4 per hour and SOC 1136: Information technology and telecommunication directors was £6 per hour in 2016[60]. Consequently, the overall familiarisation cost is estimated at approximately £0.4 million. This will only occur in Year 1 of the intervention, but across all policy options apart from do nothing.

[57] DCMS (2018), 'Future Telecoms Infrastructure Review' https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/727889/Future_Telecoms_Infrastructure_Review.pdf

[58] NIC (2018), 'National Infrastructure Assessment' https://www.nic.org.uk/wp-content/uploads/CCS001_CCS0618917350-001_NIC-NIA_Accessible.pdf

[59] The number of employee jobs has been estimated using ONS Business Register and Employment Survey 2016 data. SIC 41.20/2 Construction of domestic buildings has been used for developers and SIC 61.1 Wired telecommunication activities and SIC 61.9 Other telecommunication activities for telecoms operators. The percentage of non-construction and non-technician staff is assumed to be the proportion of jobs in professional and associate professional occupations (SOC 1-3). Using information from the ONS Census 2011 (table: CT0144) these percentages have been estimated at 22% for developers (using SIC F Construction) and 55% for operators (using SIC 61 Telecommunications).

[60] ONS Annual Survey of Hours and Earnings data. Uprated by 30% to account for non-wage costs.

Other costs considered

74. For connectivity certificates (policy option 5), there may be additional costs relating to the checking of broadband speeds and issuing certificates. Based on industry costs of direct marketing, a certificate could cost around £3 each[61]. The energy performance certificate - which is similar in practice - costs between £60 and £90 each[62], though this requires an on-site visit. In the case of connectivity certificates, broadband speeds can be assessed remotely which can reduce the cost by some margin. The £3 certificate would be mandatory for all new builds. Furthermore, as discussed later, the certificates may nudge developers to provide better broadband connections (see paragraph 95). The upgrade costs associated with this are also included in this policy option.

75. There could also be administrative and operational costs. This includes the time it takes for developers to engage with telecoms providers or arranging a connectivity certificate, as well as the costs associated with managing the policy. However, these have not been considered for several reasons:

- Developers currently contact telecoms providers to arrange broadband installations (regardless of technology). Some operators may contact developers of larger new build sites themselves. Under this policy, the engagement is not expected to take any more time than it does currently.

- There may be some operational costs around ensuring compliance. However, as is usual practice, it is assumed that all companies will be compliant with the policy.

Benefits

76. The benefits of this policy proposal is primarily based on those included in the UK Broadband Impact Study model developed by SQW[63]. This included increased labour force participation from disabled people and carers (made possible by teleworking), improved productivity from commuting time savings (again made possible by teleworking), productivity growth of broadband-using businesses and safeguarded employment. Only the first two are applicable to this programme which is focussed on residential new builds.

77. The UK Broadband Impact Study also identified several non-monetised social benefits like improved sense of wellbeing, improved access to education and health services and increased civic participation. Since that publication, some work has been undertaken to try and monetise these benefits, most notably the Superfast Broadband evaluation has estimated the monetary impact of broadband on wellbeing. These have been used - with caution - to supplement the benefits model.

[61] Cost of certificate ~£1 and administration cost of ~£2 per premise (to record the connection).See: https://www.royalmail.com/business/system/files/Advertising-Mail-rate-card-March-2018-102.pdf
[62] Uswtich (2018), 'Energy performance certificates' https://www.uswitch.com/energy-saving/guides/energy-performance-certificates/#step6
[63] SQW (2013), 'UK broadband impact study' https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/257006/UK_Broadband_Impact_Study_-_Impact_Report_-_Nov_2013_-_Final.pdf

Monetised benefits

78. The monetised benefits is estimated using the UK Broadband Impact Study adjusted to fit to this new builds programme. In all cases, it is assumed that interventions such as the Superfast Programme and the Local Full Fibre Network will continue, which feeds into our wider assumption that the rollout of full fibre will continue and gather pace affecting the baseline (see paragraphs 59 to 61).

Teleworker productivity

79. The UK Broadband Impact Study reported that "as levels of connectivity at home improve, this will tend to encourage higher levels of working from home"[64]. The time that these teleworkers save by not commuting could be put to more productive use, which is assumed here to be split between leisure and business in a ratio of 40:60. There is also some evidence that teleworkers may also be more efficient, but this is not counted.

80. To quantify the impact of improved internet connectivity, the model first estimates the proportion of home workers by standard occupational classification (SOC) and by density decile using ONS Census 2011 data[65]. Then, a function (i.e. a curve) of internet speed use and the number of days worked from home is calculated. Given that not everyone will work from home, the relative propensity to do so is also estimated using Census data[66]. Overall, combining an increase in internet speed, which translates into number of days working at home and multiplied with the propensity to do so produces an estimate of total number of days worked from home attributed to a change in speed. The benefit itself is the time saved from commuting. This is estimated by combining Census data that shows the average distance travelled to work[67] (9 to 16 km) and the National Travel Survey that reports the average commuting travel time[68] (49 to 87 minutes) for each density decile.

81. Displacement has also been included. This refers to the case where a policy may lead to an increase in outputs in one area, but also a reduction in outputs elsewhere. In this specific case, this could include a change in the use of transport modes, or more widely, the effect on other businesses providing similar telecoms services. SQW estimated displacement using ready-estimates and tested these using Monte Carlo analysis[69]. Overall, they judged displacement for teleworkers productivity to be 50%[70].

82. The time savings can be converted into monetary units by multiplying the number of hours saved with the gross value added (GVA) per hour worked. Using the latest data[71],

[64] Ibid.
[65] SQW analysis of ONS Census data. See: SQW (2013), 'UK Broadband Impact Study'.
[66] SQW analysis of ONS Census data. See: SQW (2013), 'UK Broadband Impact Study'.
[67] SQW analysis of ONS Census data. See: SQW (2013), 'UK Broadband Impact Study'.
[68] Department for Transport National travel survey 2017
[69] For example: English Partnerships (2008), 'Additionality Guide' https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/191511/Additionality_Guide_0.pdf; and BIS (2009), 'Research to improve the assessment of additionality' http://webarchive.nationalarchives.gov.uk/20121106103730/http://www.bis.gov.uk/assets/biscore/economics-and-statistics/docs/09-1302-bis-occasional-paper-01
[70] Ibid.
[71] ONS Regional GVA (balanced estimate) and ONS Annual Survey of Hours and Earnings

GVA per hour was estimated at £33 in 2016 (and in 2016 prices). Only private sector workers have been included as SQW argued that any time saved by public sector employees would lead to improved public services rather an increase in GVA. Acknowledging this, private sector workers represented around 83% of all jobs in 2016 based on ONS Labour Force Survey data.

Labour force participation - disabled people and carers

83. Similarly, the UK Broadband Impact Study identified that "the ability to work from home, using improved levels of connectivity, also reduces the barriers to employment for certain parts of the working age population"[72]. In particular, they identified carers who would otherwise be economically inactive looking after the home or family, and disabled people who would otherwise potentially find it difficult to find suitable work environments.

84. Like above, the model estimates the proportion of disabled people and carers who are unemployed/economically inactive, want a job and are able to work from home as a function (i.e. curve) of internet speed use[73] [74]. There is an assumption that new entrants to the labour market can sustain work. Displacement, which here can include other interventions to support disabled people and carers into work, has been estimated by SQW using the same approach as that described previously to be 40%[75].

85. To convert this into a monetary value, the number of people entering the labour market because of improved connectivity is multiplied with the average GVA per worker. Disabled people are assumed to work full time, while carers are assumed to work part time. The latest estimate of GVA per worker is £55,100 for full-time workers and £18,100 for part-time workers in 2016 (and in 2016 prices)[76].

Wellbeing

86. As noted earlier, the UK Broadband Impact Study reported that higher internet speeds can lead to an improved sense of wellbeing. This is in line with other studies that showed a higher subjectively felt sense of wellbeing because of: communicating with friends and family; using social media and online communication tools[77]; reducing the need to travel to work[78]; and a general feeling of empowerment[79]. However, while most studies

[72] Ibid.
[73] SQW analysis of ONS Annual Population Survey data and estimates produced by Jones, M (2010), 'Disability, education and training', Economics and Labour Market Review, 4, 4 https://www.researchonline.org.uk/sds/search/download.do;jsessionid=DECBBBECE480F0935A63389F1C8A8FAE?ref=A27862. See: SQW (2013), 'UK Broadband Impact Study'.
[74] The Superfast Broadband Programme evaluation (pending publication) sets out a different approach to measuring this benefit by looking at the impact on local (long-term) unemployment and out of work benefits. However, this has not been used here given the fact that the evaluation looks at the impact on both residential and commercial premises.
[75] Ibid.
[76] ONS Regional GVA (balanced estimates) and ONS Labour Force Survey
[77] See: Townsend, L, Wallace, C & Fairhurst, G (2015), 'Stuck out here': the critical role of Broadband for remote rural places', Scottish Geographical Journal, 131, 3-4 http://dx.doi.org/10.1080/14702541.2014.978807; Kraut, R & Burke, M (2015), 'Internet use and psychological well-being', Communications of the ACM, 58, 12 https://cacm.acm.org/magazines/2015/12/194633-internet-use-and-psychological-well-being/fulltext; and Valkenburg, P & Peter, J (2007), 'Internet communication and its relation to well-being', Media Psychology, 9, 1 https://doi.org/10.1080/15213260709336802
[78] Deloitte (2013), 'Benefits of high-speed broadband for Australian Households' https://www2.deloitte.com/content/dam/Deloitte/au/Documents/finance/deloitte-au-fas-benefitshighspeed-broadband-v2-240914.pdf
[79] Ashmore, F, Farrington, J & Skerratt, S (2015), 'Superfast Broadband and Rural Community Resilience', Scottish Geographical Journal, 131, 3-4 https://doi.org/10.1080/14702541.2014.978808

have shown the impact of the internet on wellbeing as being positive, some suggest that the impact could be negative[80] or non-existent[81].

87. Acknowledging the above, the UK Broadband Impact Study benefit model did not quantify or monetise the potential impact on wellbeing at the time. However, more recently, the evaluation of the Superfast Broadband Programme did attempt this in line with HM Treasury Green Book guidance[82]. It suggested that the wellbeing improvement to households with a superfast connection - an average of those taking up a superfast service and those that do not - was £222 per year excluding any impact associated with household incomes. The evaluation noted "this benefit [is expected] to increase over time as consumer demand for superfast broadband increases".

88. This wellbeing benefit has been included in the New Builds model. While it could be argued that an increase in wellbeing could capture some of the benefits of being able to work remotely or entering the labour market - and therefore includes an element of double counting - it also captures wider wellbeing benefits of being able to access online entertainment, communicate with friends and family and shopping online for instance. The risk of double counting is also minimised given that the wellbeing value from the Superfast Broadband Programme excludes the wellbeing effect associated with household incomes (i.e. an increase in wages). Nonetheless, as there is nothing to compare this wellbeing value with, especially given the relatively early stage of including wellbeing in cost benefit analysis, this benefit is only included as part of sensitivity. It has also only been applied to households with a FTTC or FTTP connection to illustrate those with at least a superfast connection compared with an ADSL line. Whilst it is possible that the wellbeing gains last more than a year, we have also only counted it once (in the year of connection).

Spillover effects

89. By ensuring that all new builds have access to good internet connectivity, it can help bring good connectivity to other nearby premises as well. This is because it reduces the cost of deployment. For example, in an area where it would otherwise be uneconomic to deploy a network, new build connectivity brings the network closer potentially reducing the cost. Or sunk costs like civil works could be shared across a larger number of premises further reducing the cost per premise. This is similar to the rationale behind the public sector anchor tenancy and public sector building upgrade projects that are a part of the Local Full Fibre Network (LFFN) Programme[83].

90. Evidence from CityFibre, and a part of the LFFN business case illustrated the potential impact of these spillover effects. The CityFibre network in Edinburgh includes 324 public sector sites which are in close proximity to around 7,000 businesses within 250 metres and 100,000 homes. The deployment cost per premise passed for a new entrant was estimated to have fallen from £550 - £600 to around £400 per premise passed.

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[80] Kraut, R et al (2002), 'Internet paradox revisited', Social Issues, 58, 1 https://spssi.onlinelibrary.wiley.com/doi/10.1111/1540-4560.00248

[81] Huang, C (2010), 'Internet use and psychological well-being: a meta-analysis', Cyberpsychology, Behaviour and Social Networking, 13, 3 https://doi.org/10.1089/cyber.2009.0217

[82] Pending publication

[83] DCMS (2017), 'Local Full Fibre Networks Challenge Fund' https://www.gov.uk/government/publications/local-full-fibre-networks-challenge-fund

91. Similarly, an assessment for the LFFN benefit model suggested a 125% commercial input from public sector anchor tenancy funding.

92. A similar impact could be expected for this New Build policy, but the extent is uncertain and therefore included as part of sensitivity. We have applied a spillover effect of 25% (based on the 125% assumption in the LFFN benefit model) to the value of total benefits in this analysis. However, this multiplier effect is not robust and the spillover values should be used with caution.

Willingness to accept lower internet speeds

93. In specific reference to the connectivity certificate policy option, there could be a benefit around the willingness to accept lower internet speeds. This is a holistic measure of overall consumer utility (including increased labour force participation and teleworking), so is another way of measuring this benefit instead of the above approaches.

94. More specifically, the willingness to accept lower speeds is a reflection of the expected outcome of this policy option where prices for premises with poor connectivity will fall as a result of lower demand. While a developer may respond by improving the connectivity (to maintain the price), others would be willing to accept a lower price. By removing the information asymmetry, the homebuyer in a sense is willing to accept lower internet speeds. The value of this can be estimated by the attributable fall in house prices.

95. Knight Frank estimated that 32% of house buyers would research an area's internet connectivity before purchasing a property[84]. However, a further 21% said that internet connectivity had no bearing on their decision, implying that 47% would consider, but do not actively investigate broadband speeds. Consequently, it is this group who are likely to be impacted by this policy option. Another study by Rightmove and broadbandchoices in 2012 suggested that one in ten homebuyers have rejected properties because of poor connectivity[85]. Consequently, it could be plausible that around 5% (47% x 10%) of properties with poor connectivity might not sell without an upgrade and the remaining 42% (47% x 90%) might sell, but at a lower price, which could be synonymous with a willingness to accept measure.

96. Research by Imperial College London and the London School of Economics estimated the impact of internet speeds on house prices between 1995 and 2010[86]. They estimated that there was a significant and positive relationship, though with diminishing returns to speed. An upgrade in speed from 8 Mbps to 24 Mbps was associated with a 1% increase in house prices. They did not look at speeds higher than 24 Mbps as the technology was not yet available. However, given the diminishing returns to speed, it could be assumed to only be slight.

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[84] Knight Frank (2016), 'Prime country review', winter 2016 https://content.knightfrank.com/research/570/documents/en/winter-2016-4251.pdf

[85] The Telegraph (2012), 'Fast broadband more important to house buyers than parking', 28 September https://www.telegraph.co.uk/finance/property/news/9570756/Fast-broadband-more-important-to-house-buyers-than-parking.html

[86] Ahlfedt, G, Koutroumpis, P & Valletti, T (2014), 'Speed 2.0: evaluating access to universal digital highways', SERC Discussion Paper 161 http://www.spatialeconomics.ac.uk/textonly/serc/publications/download/sercdp0161.pdf

97. The inverse of the 1% increase in house prices can be applied to those developments which would remain on a copper connection (equivalent to less than 24 Mbps). The average house price for new builds using Land Registry and ONS data[87] was estimated at £245,045 across the UK in January 2016. Taking 1% of this (£245) can give an indication as to the monetary value of the willingness to accept.

98. As noted previously, this method is another way of valuing overall consumer utility instead of valuing labour force participation, teleworking and wellbeing individually. Consequently to avoid double counting, this benefit does not feature in the economic appraisal.

Non-monetised benefits

99. The UK Broadband Impact Study surmised that "beyond its economic impacts, broadband has, of course, become an integral part of modern life, affecting various aspects of our day-to-day activities as individuals, families and communities"[88]. This is supported by similar findings by the Superfast Broadband Programme evaluation and a report by Regeneris looking at the economic impact of full fibre infrastructure[89] among others. Many are social benefits which are difficult to measure and value, take some time to materialise and depend on the take up of the service. Nonetheless, they should be considered alongside the quantitative cost benefit analysis.

Reduction in travel

100. A number of sources highlight the benefits for many (especially those in rural or remote areas) through a reduction in the need to travel. Examples given include areas such as e-government, for example; filing taxes and conducting other business with local and national governments[90], online shopping and employment[91]. The rise of teleworking gives rise to economic benefits as described above, and it also has social benefits related to reduced travelling.

101. The benefits from avoiding travel can potentially be measured in two ways – firstly through the monetary savings that can be made by not travelling (e.g. on petrol, parking, other costs), and secondly through being able to use the time that would have been spent travelling on leisure, or another purpose entirely. Ashmore, Farrington and Skerratt (2015) note that the ability to get banking and other shopping activities organised online meant

[87] Land Registry (2018), 'UK house price index' https://www.gov.uk/government/collections/uk-house-price-index-reports#2018?utm_medium=GOV.UK&utm_source=govuk&utm_campaign=Open_data&utm_image=Image_infographic&utm_content=UK_HPI_Press_Release
[88] Ibid.
[89] Regeneris (2018), 'The economic impact of full fibre infrastructure in 100 UK towns and cities' https://www.cityfibre.com/wp-content/uploads/2018/03/The-Economic-Impact-of-Full-Fibre-Infrastructure-in-100-UK-Towns-and-Cities-12.03.18.pdf
[90] Van de Wee, M., S. Verbrugge, B Sadowski, M. Driesse & M. Pickavet (2015), 'Identifying and quantifying the indirect benefits of broadband networks for e-government and e-business: a bottom-up approach', Telecommunications Policy, 39, 3-4, pg.176-191 http://www.sciencedirect.com/science/article/pii/S030859611300205X
[91] Philip, L, Cottrill, C, Farrington, J, Williams, F & Ashmore, F (2017), 'The digital divide: patterns, policy and scenarios for connecting the 'final few' in rural communities across Great Britain', Journal of Rural Studies, pg.1-13 https://www.sciencedirect.com/science/article/pii/S0743016716306799

that the participants they spoke to were afforded "greater control over how they planned their physical shopping excursions"[92].

Access to education

102. The internet has become increasingly central to education but children with unreliable internet at home are unable to access resources in the same way as other classmates. For instance, in reference to Glow - an online platform used by schools as a teaching resource - a parent of a child said that her daughter "can't get onto all of it…she sits there for hours and waits for it and that's pretty sad"[93].

103. Improved broadband is seen as making the provision of education and remote training more successful. Citing the increasing availability of the option to gain formal qualifications entirely remotely through the use of video conferencing for lectures and tutorials, Meador (2016) notes that the provision of superfast broadband to those areas in Dumfries and Galloway currently without it would allow residents to participate in formal and informal distance education[94]. This could raise educational attainment in an area of Scotland where the proportion with tertiary education is lower than the national (Scottish) average.

Access to health and social services

104. There is a large potential for remote services to improve health and social services. Telemedicine applications that enable remote screening, diagnosis, treatment and monitoring allow people to receive quality care in the communities in which they work and live.

105. There are challenges associated with fully realising the potential of telemedicine benefits. More vulnerable people who might benefit most from telemedicine may be least likely to have interest in using the internet or taking up better broadband should it become available. Additionally, a literature review from 2013 notes that this sort of benefit relies on local health services being structured to provide telemedicine, which was not the case at that time, and seems unlikely to be the case now[95]. However, in recent years remote GP services accessed through video-conferencing have started to reach the mainstream market.

Consumer access benefits

106. Another similar benefit relates to savings more generally through increased availability of online shopping. This operates at both ends; consumers will be better able to use online shopping platforms to shop around and find cheaper goods and services,

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[92] Ashmore, F, Farrington, J & Skerratt, S (2015), 'Superfast broadband and rural community resillience: examining the rural need for speed' https://www.tandfonline.com/doi/full/10.1080/14702541.2014.978808

[93] Townsend, L., C. Wallace & G. Fairhurst (2015), '"Stuck out here": the critical role of broadband for remote rural places', Scottish Geographical Journal, 131, 3-4, pg.171-180 http://dx.doi.org/10.1080/14702541.2014.978807

[94] Meador, E (2016), 'Superfast broadband in Scotland: implications for Dumfries and Galloway' https://www.researchgate.net/profile/John_Meador/publication/308163239_Policy_Briefing_10_Superfast_Broadband_in_Scotland_Implications_for_Dumfries_and_Galloway/links/57dbad6808ae5292a376bd14.pdf

[95] SQW (2013), 'UK broadband impact study' https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/85961/UK_Broadband_Impact_Study_-_Literature_Review_-_Final_-_February_2013.pdf

saving money that can be used elsewhere, while rural-based businesses may be able to offer more competitive prices through a reduction in the business costs of physical isolation[96].

107. More broadly, those without good quality broadband are unable to reliably access some online services that others take for granted, as demonstrated by the example of Glow, the online teaching resource given above. The UK Government assumes 'digital by default' in the provision of public services. Currently all public services can be accessed with a 2Mbps download speed, but should the bandwidth requirements of government websites increase (in line with the general growth in the size of websites), then faster broadband may become necessary for universal reliable access to public services. A number of articles cite a longer-term concern that the withdrawal of commercial and public organisations from physical locations to being solely available online will be damaging to non-users of the internet, with the suggestion that an inability to access online services may "generate a new dimension of social exclusion that transcends conventional 'causes' of disadvantage such as low income"[97]. A report by Deloitte from 2013 outlines that "there is some evidence that these greater impacts [of good quality broadband] are where households face difficult circumstances, such as needing to find employment, move residence or where additional education is of significant benefit"[98].

Access to employment

108. The previously published literature review from 2013 found that[99]:

> *"The use of broadband internet at home may also play a role in opening up job opportunities for people who would otherwise find it difficult to participate in the labour market. In a recent survey of over 1,000 working age people not currently employed, a study for the Australian Government found that 76% of people with family or caring commitments, and 70% of people with a disability would take up a teleworking employment opportunity, if it was available (Colmar Brunton Research and Deloitte Access Economics 2012). These groups indicated a preference to work from home the majority of the week, but still have some connectedness to the office to overcome issues of isolation."*

Community resilience

109. A number of academic sources use the framework of 'enhancing resilience' as a measure of the impacts of better broadband. In the literature this operates mostly within a rural context, where community resilience is highlighted as a particular issue. Ashmore, Farrington & Skerratt (2015) describe resilience as[100]:

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[96] Philip, L, Cottrill, C, Farrington, J, Williams, F & Ashmore, F (2017), 'The digital divide: patterns, policy and scenarios for connecting the 'final few' in rural communities across Great Britain', Journal of Rural Studies, pg.1-13 https://www.sciencedirect.com/science/article/pii/S0743016716306799

[97] Ibid.

[98] Deloitte Access Economics (2013), 'Benefits of high-speed broadband for Australian Households' https://www2.deloitte.com/content/dam/Deloitte/au/Documents/finance/deloitte-au-fas-benefits-highspeed-broadband-v2-240914.pdf

[99] Ibid.

[100] Ibid.

"Social–ecological resilience builds upon this understanding to represent the ability of a community to withstand shocks due to external, ecological factors (Adger 2000). In relation to rural areas, shocks, or changes, can include depopulation, a loss of, or a disinclination to develop, public services for small populations and demographic ageing (see Delfmann et al. 2014), which require individuals and communities to be able to adapt and adopt new practices (i.e. be resilient) to address such changes to their community structure and livelihood."

110. Recent papers define a framework for assessing the impact of better broadband on individual and community resilience. Heesen, Farrington & Skerratt (2013)[101] identify the impact on technological engagement (for instance through improving unreliable internet connections), the ability to live and work in a rural setting (the use of superfast in maintaining a rural life), and the capability for the local community to act together as key parts of community resilience that could be affected by a Universal Service Obligation.

Environmental impacts

111. The UK Broadband Impact Report identified three routes to environmental saving as a result of improved broadband: the effect of reduced commuting as teleworking becomes more viable, the fall in business travel due to similar reasons, and the reduction in energy consumption as cloud storage becomes more viable[102]. Environmental benefits are not included in the quantified benefits below.

Productivity gains from home businesses

112. Home businesses can also benefit from having improved broadband. For example, it can lead to more productive and efficient ways of working and enabling access to larger markets. This includes taking advantage of cloud services, having an online presence on websites and social media, interacting with suppliers and customers, and offering e-commerce[103]. It is also a similar argument used in the UK Broadband Impact Study for all businesses[104]. However, quantifying this impact is difficult as there is no reliable information describing the number of home businesses (though some estimates suggest that there were approximately 2.7 million home businesses in the UK in 2017[105]) or what the likely magnitude of impact could be.

Optimism bias and multipliers

113. An optimism bias of 44% has been applied to the costs associated with the various policy options. This is based on the suggested upper bound optimism bias for standard civil engineering projects included in HM Treasury Green Book guidance. However, this

[101] Heesen, F, Farrington, J & Skerratt, S (2013), 'Analysing the role of superfast broadband in enhancing rural community resilience' http://aura.abdn.ac.uk/bitstream/handle/2164/4002/FHeesen_ESRS_Analysing_sfbb_in_enhancing_rural_community_resilience_ShortPaper_ESRS2013.pdf?sequence=1
[102] Ibid.
[103] SBA (2010), 'Impact of broadband speeds and price on small business' https://www.sba.gov/sites/default/files/rs373tot_0.pdf
[104] Ibid.
[105] Vonage (2018), 'Unlocking the UK's home business potential' http://www.homebusiness100.co.uk/wp-content/uploads/2017/09/StepUps-Report-FINAL-DIGITAL.pdf

could be judged to be overly pessimistic for several reasons. Firstly, the technology and installation processes are already proven reducing some uncertainty. Secondly, the costs used in the New Builds model are based on actual past experience of delivery. Thirdly, these costs are also generally higher than other benchmarks, suggesting that they have the potential to be lower. Altogether, we have later tested the analysis using different levels of bias.

114. The optimism bias has only been applied to the costs. While the costs are relatively uncertain at this stage (though, based on the actual cost of delivery using BDUK approximations - see above), there is more certainty around the impact and value of benefits. For example, the benefits used in the New Builds model are based on the established UK Broadband Impact Study model developed by the consultants SQW. The benefits have also been of focus in other research like the Superfast Broadband Programme evaluation. That said, the benefits (and costs) are still subjected to sensitivity analysis later.

115. Type II multipliers that illustrate the induced effects of this intervention has not been included. While the new builds policy will have a direct effect on developers, operators and households, as well as an indirect effect when there is a wider impact on the supply chain, induced effects that arise when employees of the developer and operator make household purchases are difficult to fully attribute to the intervention and are therefore excluded.

Summary of costs and benefits

116. This section summarises the costs and benefits identified above for the five policy options. A starting point is to illustrate the impact the policy options have on the actual number of new builds by connectivity. Table G provides this breakdown over 15 years using the assumption that 215,000 new homes will be built each year of which 43,000 (or 20%) would be within developments of less than 30 units. This is the equivalent to 3.2 million and 645,000 premises respectively over 15 years.

Table G: Technology of new build premises over 15 years

	Option 1	**Option 2**	**Option 3**	**Option 4**	**Option 5**
	Do nothing	100% FTTP coverage	Partial FTTP coverage (£3,000 cap)	100% FTTC coverage	Connectivity certificate
Number of new builds	3,225,000				
Of which: 1-29 sites	645,000				
Connectivity					
ADSL	42,300	0	3,500	0	40,400
FTTC	222,900	0	9,400	265,100	222,900
FTTP	379,900	645,000	632,100	379,900	381,700
Total	**645,000**	**645,000**	**645,000**	**645,000**	**645,000**

Source: New Builds model using Ofcom Connected Nations data

117. The costs can essentially be estimated by multiplying the unit costs of installing a connection with the number of new builds. This is done on a per technology and per decile basis. The costs also includes an optimism bias of 44% which, as outlined previously, is likely to be overly pessimistic. Using a 15 year appraisal period, we have discounted values using a rate of 3.5%.

118. The benefits are estimated using the approach outlined in the previous section. Given that the evidence supporting some benefits is more robust than others, we have separated them out. The more robust benefits includes the labour force participation of carers and disabled people and increased productivity from teleworkers. The less robust benefits also includes wellbeing and spillover effects. Like above, the benefits have been analysed over a 15 year period and discounted using a 3.5% rate. There are also a number of non-quantified benefits that should be considered alongside these monetised ones.

119. Table H summarises the social costs and benefits and presents the net present value and benefit cost ratio relative to the do nothing scenario. However, it should be considered against the fact that: the optimism bias is high (using the upper bound of Green Book suggestions even though it is likely to be less than this); the unit costs are relatively high in comparison with other benchmarks; and there are several non-quantified benefits that need considering as well. Acknowledging this, most policy options are expected to have a negative net impact when only looking at the main benefits - the only exception is option 3 which is partial FTTP under a cost cap. If the less robust benefits are also included then the net present value turns positive for most options (except connectivity certificate) with option 3 still being the preferred option.

Table H: Social cost benefit analysis over 15 years relative to do nothing, constant 2016 prices, £ millions

	Option 2	**Option 3**	**Option 4**	**Option 5**
	100% FTTP coverage	Partial FTTP coverage (£3,000 cap)	100% FTTC coverage	Connectivity certificate
Costs				
Base costs	£0.0	£0.0	£0.0	£0.0
Upgrade costs	£138.7	£96.7	£14.5	£1.7
Familiarisation costs	£0.4	£0.4	£0.4	£0.4
Certificate costs	..	..	..	£9.7
Optimism bias at 44%	£61.0	£42.7	£6.5	£5.2
Total - undiscounted	£199.7	£139.9	£21.4	£17.0
Total - discounted	**£163.2**	**£114.9**	**£17.2**	**£13.5**

Benefits				
Labour force participation: carers	£41.9	£39.6	£2.0	£0.3
Labour force participation: disabled	£47.4	£44.9	£2.3	£0.4
Increased productivity	£105.2	£96.9	£5.8	£1.0
Subtotal - undiscounted	£194.5	£181.4	£10.0	£1.7
Subtotal - discounted at 3.5%	**£137.4**	**£128.0**	**£7.0**	**£1.2**
Wellbeing	£9.4	£8.6	£9.4	£0.0
Spillover effects at 125%	£51.0	£47.5	£4.8	£0.4
Total - undiscounted	£254.9	£237.5	£24.2	£2.2
Total - discounted	**£181.0**	**£168.5**	**£18.1**	**£1.5**
Summary				
Net present value	-£25.8	+£13.1	-£10.2	-£12.3
Benefit cost ratio	0.84	1.11	0.41	0.09
Summary with less robust evidence				
Net present value	+£17.9	+£53.6	+£0.9	-£12.0
Benefit cost ratio	1.11	1.47	1.05	0.11

Source: New Builds model using Ofcom Connected Nations and BDUK data

120. The impact on businesses only is shown in Table I. While the costs are expected to be incurred entirely by businesses (whether this is developers or telecoms operators), the vast majority of the benefits will be for consumers. The few exceptions are the increased productivity from teleworkers and the spillover benefits which can impact both residential and commercial premises but this cannot be separated out. Therefore, the benefits to businesses only currently includes teleworkers productivity. While acknowledging that not all the benefits are included, and also the high optimism bias and relatively high unit costs noted above, the net present value for businesses is negative across all policy options.

Table I: Business NPV over 15 years relative to do nothing, constant 2016 prices, £ millions

	Option 2	**Option 3**	**Option 4**	**Option 5**
	100% FTTP coverage	Partial FTTP coverage (£3,000 cap)	100% FTTC coverage	Connectivity certificate
Costs				
Total (inc. optimism) -	£199.7	£139.9	£21.4	£17.0

undiscounted				
Total (inc. optimism) - discounted	**£163.2**	**£114.9**	**£17.2**	**£13.5**
Benefits				
Increased productivity	£105.2	£96.9	£5.8	£1.0
Total - undiscounted	£105.2	£96.9	£5.8	£1.0
Total - discounted	**£74.1**	**£68.2**	**£4.0**	**£0.7**
Summary				
Net present value	-£89.0	-£46.7	-£13.1	-£12.8

Source: New Builds model using Ofcom Connected Nations and BDUK data

121. Finally, the estimated annual net direct cost to businesses (EANDCB) is based on the total discounted cost (including optimism bias) shown above. However, this also includes a high optimism bias and relatively high unit costs figures meaning it is likely to be overly pessimistic. The total cost is divided by the annuity rate of 11.9 associated with the 15 year appraisal period and the discount rate of 3.5%. Overall, the EANDCB is expected to be greater than £5 million per annum across all policy options.

Table J: Estimated annual net direct cost to businesses (EANDCB), constant 2016 prices, £ millions

	Option 1	**Option 2**	**Option 3**	**Option 4**	**Option 5**
	Do nothing	100% FTTP coverage	Partial FTTP coverage (£3,000 cap)	100% FTTC coverage	Connectivity certificate
EANDCB	£71.7	£85.3	£81.3	£73.1	£72.8
Relative to do nothing	-	£13.7	£9.6	£1.4	£1.1

Source: New Builds model using Ofcom Connected Nations and BDUK data

122. Based on the above, the preferred option is option 3 - partial FTTP coverage under a cost cap. This option delivers the largest positive net present value and suggests £111 in benefits for every £100 in cost or, when also including the less robust benefits, this rises to £147 in benefits for every £100 in cost. It is also against the backdrop that these net present values and benefit cost ratios are likely to be underestimates because of the high optimism bias, relatively high unit costs and the fact that not all benefits have been included. For example, using the lower Frontier Economics cost estimates raises the BCR above two for this preferred option (see Table P). Subsequently, these assumptions are later tested as part of sensitivity analysis.

Small and Micro Business Assessment (SaMBA)

123. The recommended policy is designed to deliver a Gigabit capable connection to new residential properties. The recommended policy option (connecting all NBDs subject to a cost cap) will affect small and large house builders in the same way, in that they may have to contribute to the deployment of digital infrastructure on their developments. We have not identified any small or micro telecommunications operators that would fall in scope of this policy.

124. Principally we believe that any additional costs that fall to developers can be passed on. This would apply regardless of the size of the developer. We also understand there are existing programmes that could mitigate these potential costs and that other mitigating factors can be taken into account when assessing the impact on SaMBs. Also, later we show that the impact in terms of number of homes built by smaller developers (i.e. those in scope) is small. With these points in mind, our assessment against the advised considerations is as follows:

Table K: SaMBA considerations

Factor	Consideration
Full exemption	We do not believe a full exemption is compatible with achieving the aim of improving connections to new build homes. SaMBs produce a materially significant amount of homes per year (as demonstrated below); if they were exempted and built homes with poorer connections then they would potentially be disadvantaged by this policy, i.e. their homes may be less attractive to buyers. Consequently, this would be a counterproductive use of an exemption.
Partial exemption	We also believe a partial exemption would not achieve the aim of improving connections to new build homes. We have not identified any specific requirements within the proposals from which we would be able to exempt SaMBs. We do not believe any exemption is compatible with achieving a significant portion of the intended benefits.
Extended transition period	We do not believe an extended transition period for SaMBs is compatible with achieving a large part of the intended benefits. We will ensure that a sufficient transition period is in place for all developers and that there is sufficient time for a well-supported process of familiarisation and transition.
Temporary exemption	We do not believe a temporary exemption would benefit SaMBs, or consumers, or wider aims.
Different requirements by firms size	We do not believe different requirements by firm size would be an appropriate mitigation consideration. In fact, different requirements would add an additional layer of administration that would potentially prove confusing.
Information	We do believe an information pack (designed for all companies) with a specific focus on smaller firms would be a viable consideration. We will explore what any information pack could look like during consultation.
Financial aid	Financial aid to smaller firms already exists and we are keen to explore whether extant programmes would be viable to be used to deliver digital

	connections. Further, to this we will explore what other digital connectivity programmes are on the horizon and whether they could be used. Finally, we will explore whether specific funds could be made available to aid smaller developers.
Opt-in and voluntary solutions	We have considered and discounted non-regulatory solutions in our impact assessment. Principally because we believe that legislation will provide the best solution. For 'softer' approaches to work (i.e. be taken up) they often require a legal basis - this negates the positives of a non-regulatory solution. (For example, Energy Performance Certificates are a legal requirement, which are comparable to a 'connectivity certificate').

125. Anecdotally we have been told that in the main, larger developers are more likely to liaise with Openreach to discuss connection requirements in good time[106]. Further, larger developers are increasingly more likely to request FTTP connections. This points to a possible information failure on behalf of smaller developers - this being the case we should not exempt smaller developers from this intervention. By providing more information to smaller developers we could encourage better uptake of Gigabit capable connections. Exempting in totality could lead to more smaller developers building homes with poor connections - in comparison to larger developers - this would be counterproductive as poorly connected homes are less attractive to consumers.

126. To give an illustration of the number of SaMBs that might be affected by this policy, we need a definition in the context of new build construction. Small businesses are usually defined as having less than 50 employees and micro less than 10. Using ONS UK Business - Activity, size and location data, there were approximately 42,400 enterprises in SIC 41.20/2 Construction of domestic buildings sector in 2017. Of this, almost all (99%) were small and micro businesses. This proportion remains the same even if SIC 41.1 Development of buildings (both residential and commercial) was also included. Consequently, excluding SaMBs from this policy would dramatically reduce the relevance and impact.

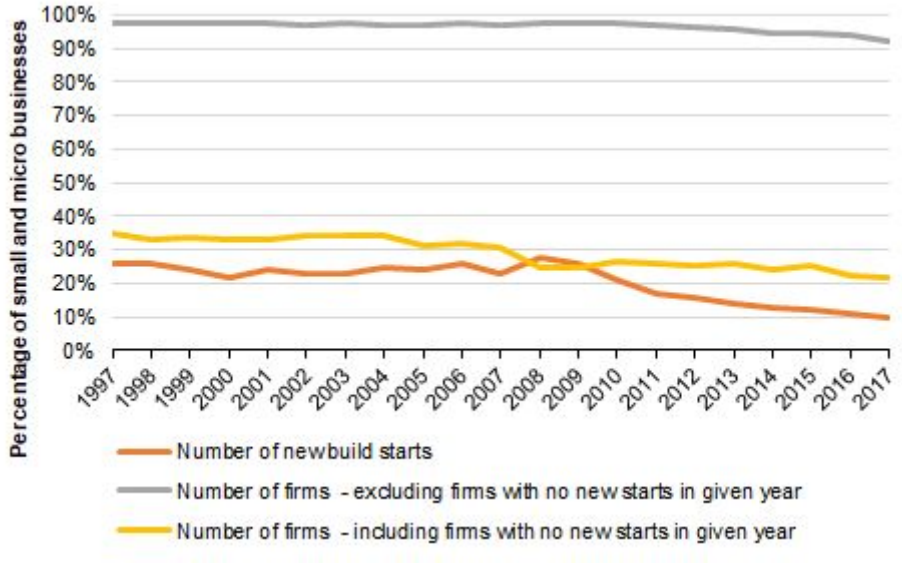
127. Headcount is not a metric that the building and development industry use to gauge size. Because of contracting (and subcontracting) employee headcount is not a useful tool to examine developer size. Looking at SaMBs in terms of headcount does not necessarily bear any resemblance to the amount of new homes built. For example, the relatively few large construction firms (~18) are responsible for a large proportion of housing completions (see Figure 7). Therefore, an alternative approach is to use the industry standard definition of small businesses - which includes micro enterprises - which are those that produce less than 100 new homes per year[107].

128. The National House Building Council (NHBC) publishes statistics that show the proportion of new housing starts by size of builder, which here is measured in terms of new home starts per annum[108]. It suggests that around 10% of new home starts were by small builders in 2017, i.e. those that built less than 100 homes per year. The NHBC also

[106] Openreach suggest a period of nine months for planning purposes.
[107] Home Builders Federation (2017), 'Reversing the decline of small housebuilders', https://www.hbf.co.uk/documents/6879/HBF_SME_Report_2017_Web.pdf
[108] NHBC (2018), 'Housing market report', issue 206, April 2018, https://www.catesbyestates.co.uk/uploads/files/HM%20Report%20April%202018.pdf

publishes the number of businesses by size of builder and indicated that around 92% of all construction firms (around 1,740 enterprises) were small excluding firms with zero new starts. So, while most builders are SaMBs, they produce a fraction of new homes. It should be noted that the NHBC does not cover all construction activity, though they represent around 80% of the industry so it is still a reasonable representation.

Figure 7: Percentage of new build starts and firms by small and micro businesses



Source: NHBC (2018), 'Housing market report'

129. The NHBC data can be sense checked with the Homes Builder Federation (HBF). Assuming new build construction of 215,000 per annum and 10% of construction is by SaMBs, then output could be 21,500 per annum. Given the NHBC also estimates that there were 1,740 SaMBs in total, plus 20% for the rest of the industry not covered by NHBC, this suggests an average of around ten new builds per SaMB each year. This is in line with the HBF that reports small businesses produce eight new build homes per year[109].

130. The potential impact on SaMBs can be estimated by multiplying the average upgrade cost with the number of new builds per SaMB. (Note that only developments with 1-29 units are of interest which is around 20% of all new build premises.) Assuming that the proportion of new builds by connection type in the baseline (see Table C) is the same for SaMBs as it is for all builders, then the average cost faced by SaMBs could be between £3,900 and £4,700 each per annum depending on the policy option. This is likely to be an overestimate, however, as the unit costs used in the New Builds model is generally higher than other benchmarks and the optimism bias is likely to be overly pessimistic. This cost is also likely to be shared with telecoms operators as well.

[109] NHBC (2018), 'Housing market report', issue 206, April 2018, https://www.catesbyestates.co.uk/uploads/files/HM%20Report%20April%202018.pdf

Table L: Estimated annual impact on small and micro businesses, constant 2016 prices

	Option 1	Option 2	Option 3	Option 4	Option 5
	Do nothing	100% FTTP coverage	Partial FTTP coverage (£3,000 cap)	100% FTTC coverage	Connectivity certificate
Number of SaMB	2,100				
New build construction per annum	215,000				
Of which: 1-29 unit per development (20%)	44,000				
Of which: by SaMB (at 10%)	4,300				
Connectivity (in Year 1)					
ADSL	300	0	<100	0	300
FTTC	2,100	0	100	2,400	2,100
FTTP	1,900	4,300	4,200	1,900	1,900
Total cost (in Year 1) - including feasibility costs*, certificate costs and optimism bias (44%)					
Total cost	£8.1m	£9.8m	£9.4m	£8.3m	£8.2m
Cost per SaMB	£3,900	£4,700	£4,500	£3,000	£3,900
Cost per SaMB relative to do nothing	..	£800	£600	£100	£0

*This has been estimated using the same assumptions described in paragraph 73 and assuming a SaMB has 49 employees in total which is a pessimistic assumption. It applies to all options except do nothing.
Source: New Builds modelling using Ofcom Connected Nations and BDUK data

131. It is plausible that the percentage of new builds by SaMBs on developments with 1-29 units is larger than for all developments. That is, small and micro businesses could build proportionally more smaller sized developments. Table M shows the average cost faced by a SaMBs per annum if this share was different.

Table M: Sensitivity analysis of the estimated annual impact on small and micro businesses, constant 2016 prices

Share of new builds on developments with 1-29 units	Option 1	Option 2	Option 3	Option 4	Option 5
	Do nothing	100% FTTP coverage	Partial FTTP coverage (£3,000 cap)	100% FTTC coverage	Connectivity certificate
10% (base case)	**£3,900**	**£4,700**	**£4,500**	**£4,000**	**£3,900**
20%	£7,800	£9,400	£9,000	£8,000	£7,800
30%	£11,700	£14,200	£13,500	£12,000	£11,800

Source: New Builds modelling using Ofcom Connected Nations and BDUK data

132. On the telecoms operators side, most exceed the SaMB definition of less than 50 employees. For instance, even some of the smaller (compared to Openreach and Virgin Media) operators installing full fibre like Gigaclear[110], CityFibre[111] and Hyperoptic[112] have more than 100 employees and over 300 in some cases.

Mitigating costs

133. There are a number of ways smaller developers could mitigate any additional costs incurred. Beyond the measures available we have identified below, we are keen to explore other ways in which any financial impact on smaller developers could be minimised. We welcome further information and evidence from stakeholders in the consultation that accompanies this impact assessment.

134. **Investment** - **Home Building Fund**. The Government's £3 billion Home Building Fund is designed to be a flexible source of loan funding open to small developers and house builders. Infrastructure projects that lead to the development of new housing are in scope. Developments must be in England[113]. A case study shows how the fund can be utilised to provide investment for infrastructure[114]. The Home Building Fund is available to draw down on up to 31 March 2021 and the minimum loan size is £250,000. Although only a limited number of developers would be able to use this fund we believe there may be other similar investment options and would be interested to hear from relevant stakeholders during the consultation. We are working with other departments to understand if the fund will be extended.

135. **Passing on costs**. There is also the possibility that smaller developers can pass on additional costs to consumers. The NHBC reports[115] that:

> *"Small house builders and developers are not generally concerned about competition from the larger, volume house builders. Their interest is in building a local reputation for developing smaller sites, typically those that would not be viable for high-volume operations. They are keen to promote individual, bespoke new home environments and carry this philosophy through into their building, differentiating their homes with individual features and special materials, finishes and appliances. Their target buyer is someone who wants a more distinctive product, is prepared to pay a premium for it and may be less inclined to live on a very large development."*

[110] Gigaclear (2018), 'Annual report and accounts 2016'
https://www.gigaclear.com/wp-content/uploads/2016-Annual-Report-Gigaclear-Plc-FINAL-Companies-House.pdf
[111] CityFibre (2018), 'Audited full-year results for the year ending 31 December 2017'
https://irpages2.equitystory.com/websites/rns_news/English/1100/news-tool---rns---eqs-group.html?article=27370120&company=city
[112] Hyperoptic (2018), 'Report and financial statement: year ended 31 December 2017'
https://beta.companieshouse.gov.uk/company/07222543/filing-history
[113] We will work with the devolved administrations to identify if similar funds are available to be used.
[114] Homes Community Agency (2016), 'Westward UK Ltd - French Fields, St Helens'
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/559041/Westward__UK__Ltd_-_French_Fields__St_Helen_s__Merseyside.pdf
[115] NHBC (2017), 'Small house builders and developers'
https://www.nhbcfoundation.org/wp-content/uploads/2017/04/NF76_WEB.pdf

136. This principle of differentiating through quality of product could be applied to digital connectivity. It appears smaller developers recognise a requirement to provide high quality, sometimes bespoke, homes. It follows then that slightly increased costs to provide Gigabit capable connections is something that smaller developers' clients may prioritise and be willing to pay for.

137. **Information sharing and education**. Openreach have told us that they are trying to liaise with smaller developers and inform them of choices available when connecting developments. We will explore what connectivity choice information would be useful to smaller developers and, if appropriate, create information packs in association with stakeholders to help smaller developers deliver the best digital connections to their homes.

138. **Operators to absorb more costs when deploying to small developers**. The cost cap used by operators could be raised if the development they are deploying to was built by a small developer. An example metric to be used could be how many homes the housebuilder had built in the last year. If a developer had built eight or less homes in the past year then they would be classified as a small or micro developer (broadly in line with the average number of homes built by SaMBs discussed above) - this would mean that the operator cost cap would rise, for example from £850 to £1,500 per premise.

Distributional analysis

140. The new builds policy is likely to have three main distributional impacts: the effect on first time buyers, disabled people and urban and rural areas. In all cases, we expect to use the consultation to identify other groups that might be affected by this policy and to estimate the likely impact.

First time buyers

141. We have outlined the possibility that the cost to install or upgrade telecoms connections could be passed on to consumers through higher house prices. While this could be a reflection of cost mitigation on the behalf of businesses, it could also reflect that consumers are willing to pay for good internet connections (see paragraph 136). In any case, the increase in house prices could mean that some house buyers may struggle to pay this. This is likely to disproportionally affect first time buyers compared to 'second steppers' as they do not benefit from any existing housing assets that benefit from appreciation.

142. Data from the English Housing Survey can be used to give an idea as to the potential distributional impact of the new builds policy. This reported that there were 653,000 first time buyers across England in 2015-16[116]. This was the equivalent of around 5% of all owner occupiers. Around 15% of first time buyers belonged to a minority ethnic group and 9% reported at least one individual in the household as having a disability or long term illness.

[116] DCLG (2017), 'English Housing Survey', first time buyers, 2015-16 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/626887/First_Time_Buyers_report.pdf

143. Separately, the ONS estimated that first time buyers across England and Wales spent around 4.3 times their annual gross income on purchasing a house in 2017[117]. The first time purchase affordability ratios were higher in the South East (including London) and lowest in Wales and some northern areas of England. Furthermore, prospective first time buyers could expect to pay 13 times their workplace-based annual earnings on a property in London in 2017, compared with 5.5 times in the North East.

144. The average house price for new builds in the UK was approximately £245,000 in January 2016 (and has since increased to £285,100 in March 2018). Therefore, even if the whole cost of installing a connection (£1,700 for FTTP on average) was passed on to consumers through higher prices, this represents a small percentage of the house price (0.7%). Moreover, studies generally suggest price elasticity of demand for housing to be around -0.5 and -0.8[118] which implies that the 0.7% increase in price is associated with a small 0.4% to 0.6% fall in demand.

145. It also assumes that developers are able to pass the costs on to housing. However, new houses are subject to being sold at market rate, meaning they are competing with existing homes which are not subject to the regulation. This may deter home builders from increasing prices to cover costs.

Disabled people

146. Improved broadband connections will help disabled people enter the labour market through the prospects of teleworking. The employment rate for disabled people aged 16-64 is statistically lower than for non-disabled people across the UK[119]; in 2017, the employment rate was 52.5% for disabled people[120] compared with 80.4% for non-disabled people[121]. Instead, disabled people were more likely to be unemployed. There were approximately 397,400 unemployed disabled people aged 16-64 who want and are looking for a job in the UK in 2017, giving an unemployment rate of 8.5%. That compared with an unemployment rate of 3.8% for non-disabled people. Consequently, this new builds policy has the potential to reduce these inequalities.

147. In comparison with the do nothing scenario, the (gross) number of disabled people that enter employment can be up to 165 over 15 years (for option 2: 100% FTTP coverage). Displacement - which refers to the policy also having a reduction in the number of employed disabled people elsewhere - was estimated at 40% by SQW[122]. So, even after accounting for this, the policy is expected to have a positive, albeit small, effect on the number of employed disabled people overall.

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[117] ONS (2018), 'First time buyer housing affordability in England and Wales, 2017' https://www.ons.gov.uk/peoplepopulationandcommunity/housing/articles/firsttimebuyerhousingaffordabilityinenglandandwales/2017

[118] Malpezzi, S & Wachter, S (2012), 'Housing demand', International Encyclopedia of Housing and Home

[119] ONS Annual Population Survey, year ending December 2017

[120] People reporting having an Equality Act core and/or work-limiting disability.

[121] Excluding unknowns

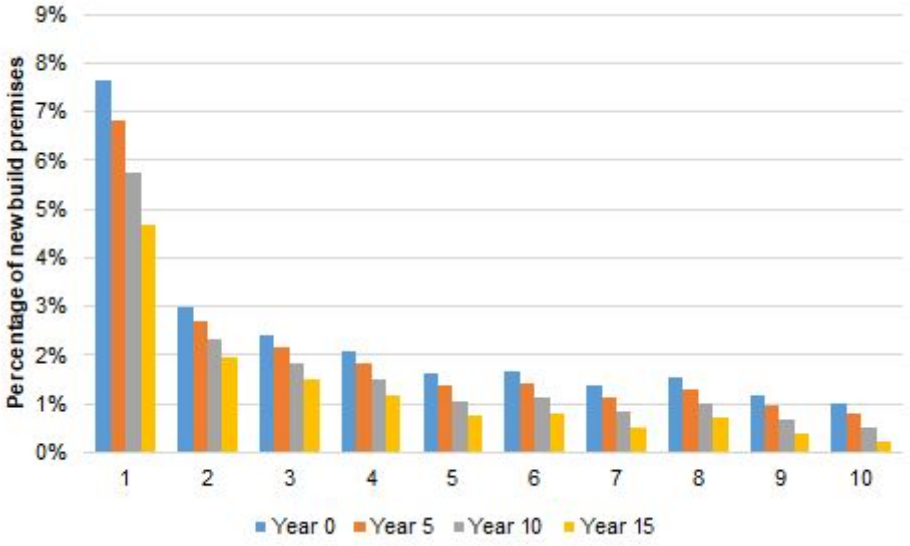
[122] SQW (2013), 'UK Broadband Impact Study' ttps://www.gov.uk/government/uploads/system/uploads/attachment_data/file/85961/UK_Broadband_Impact_Study_-_Literature_Review_-_Final_-_February_2013.pdf

Rural and urban areas

148. The New Builds model has been developed in such a way that the analysis can be broken down into decile groups based on housing density and local authority. Due to the use of confidential data, we have aggregated the local authority breakdowns to NUTS1[123] regions. As is expected, the cost of installing a connection is generally higher in low density areas and lower in high density areas.

149. For policy option 3, where there is a cost cap on the deployment of FTTP, approximately 3% of all new build premises would potentially have deployment costs above the £3,000 threshold (with this decreasing over time given the rise in FTTP rollout in the baseline). This varies by geography, however. For example, 8% of premises in the lowest decile exceed the cost cap compared with 1% in the highest decile (Figure 8). Similarly, by NUTS1 region, 6% of new build premises in Northern Ireland could exceed the cost cap compared with 1% in London (Figure 9).

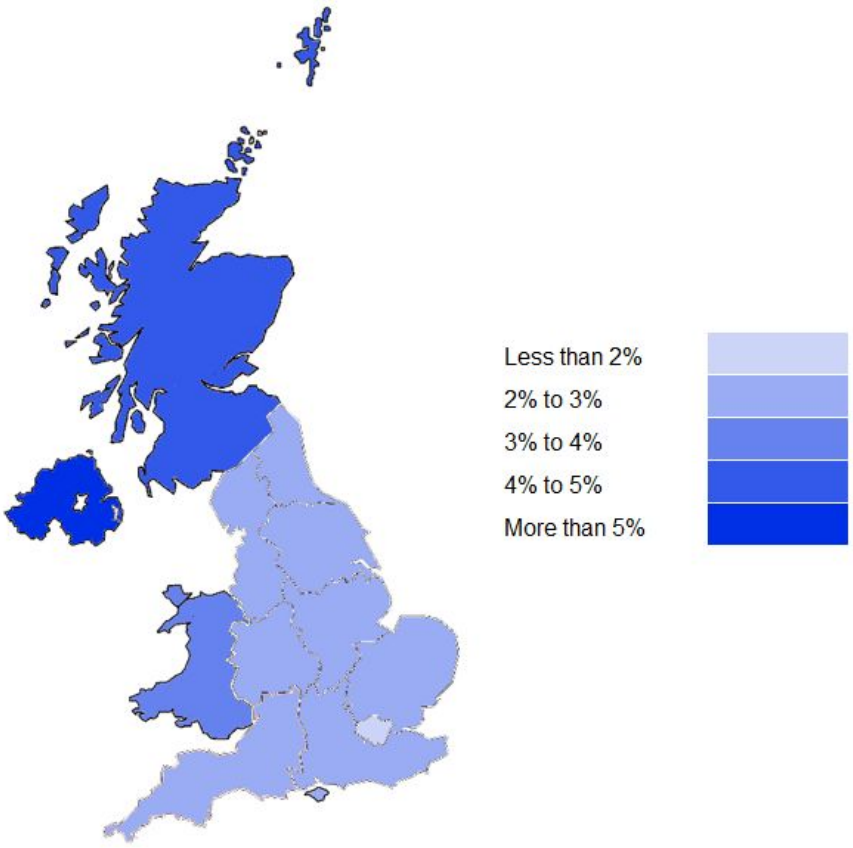
Figure 8: Percentage of new builds that could exceed the £3,000 cost cap in option 3 by density decile



Source: New Builds model using Ofcom Connected Nations and BDUK data

[123] Nomenclature of Territorial Units for Statistics (NUTS) are standard definitions of geographical areas used in statistics in Europe. The NUTS1 regions for the UK include: North East, North West, Yorkshire & Humber, East Midlands, West Midlands, South East, South West, Wales, Scotland and Northern Ireland.

Figure 9: Percentage of new builds that could exceed the £3,000 cost cap in option 3 by NUTS 1 region



Source: New Builds model using Ofcom Connected Nations and BDUK data

150. The higher deployment costs for rural and remote areas, as well as areas with challenging geographies, is widely known. For example, the FTIR noted that these factors "increase the costs of deployment and reduce returns from fewer premises... [and] means the market is unlikely to reach them"[124]. The Review will adopt an 'outside in' approach to try and reach these areas which could involve using wireless and fixed technologies. We plan for the proposed new builds policy to be able to work with other programmes - potentially including 'outside in'. In practice this would mean developments that fell within 'outside in' areas (for example very rural developments) could benefit from operator and developer contributions.

151. Given the complexity of this issue, we will continue to consult with other stakeholders including the devolved administrations, MHCLG and DEFRA on this as part of the consultation.

Sensitivity analysis

152. This section looks at the sensitivity of the cost benefit analysis by adjusting some of the key assumptions. Of which, the main assumptions are around the level of house building per annum, the cost to install/upgrade connectivity, the optimism bias and the rate

[124] DCMS (2018), 'Future Telecoms Infrastructure Review' https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/727889/Future_Telecoms_Infrastructure_Review.pdf

of take up. For policy option 3, there is also a key assumption around the level of the cost threshold. The optimism bias and assumed costs are shown to have the biggest impact on the costs benefit analysis.

Different levels of house building

153. In the main analysis, we have assumed that there will be 215,000 new homes built each year. This is in line with the estimate of house building (including conversions and changes in use) from MHCLG, Scottish Government, Welsh Government and Northern Ireland's Department of Finance for 2016-17. However, there are a range of alternative estimates as shown in Table N. For example, NHBC reported that their members completed 147,000 new homes across the UK in 2016-17 and, given they represent around 80% of all house building activity, can be scaled up to 176,000[125]. Similarly, the Government has a housing target of 300,000 homes per year across England by the mid-2020s[126].

Table N: Estimates of new additional dwellings in 2016-17

	England		UK	
	Starts	Completions	Starts	Completions
MHCLG: Housing supply	..	183,750	..	214,000
MHCLG: House building	163,000	147,930	..	..
NHCB (+20%)	163,260	153,370	186,950	176,440
Government target (by mid-2020s)	..	300,000	..	..

Source: MHCLG; Scottish Government; Welsh Government; NI Department of Finance,; NHBC (2018), 'Housing market report'

154. Table O shows the impact on the cost benefit analysis if these alternative house building figures are used. While the net present value is impacted, the benefit cost ratio remains unchanged suggesting the benefits and costs are largely scaled depending on the number of new homes built[127].

Table O: Sensitivity analysis of different house building levels (all benefits and relative to do nothing)

New homes per annum	Option 2	Option 3	Option 4	Option 5
	100% FTTP coverage	Partial FTTP coverage (£3,000 cap)	100% FTTC coverage	Connectivity certificate
Social net present value, £ millions				
150,000	+£12.3	+£37.3	+£0.5	-£8.5

[125] NHBC (2018), 'Housing market report', issue 206, April 2018, https://www.catesbyestates.co.uk/uploads/files/HM%20Report%20April%202018.pdf
[126] MHCLG (2018), 'New housing agency to boost housebuilding' https://www.gov.uk/government/news/new-housing-agency-to-boost-housebuilding
[127] The benefits and costs are perfectly scaled to the number of new homes built when familiarisation costs - which is linked to the number of employees in the sector rather than the number of new homes built - are excluded.

215,000 (base case)	**+£17.9**	**+£53.6**	**+£0.9**	**-£12.0**
300,000	+£25.1	+£75.1	+£1.5	-£16.5
Benefit cost ratio				
150,000	1.11	1.46	1.04	0.11
215,000 (base case)	**1.11**	**1.47**	**1.05**	**0.11**
300,000	1.11	1.47	1.06	0.11

Source: New Build modelling using Ofcom Connected Nations and BDUK data

Different cost estimates

155. Comparisons between the modelled cost estimates and those from other studies suggest that, while they are in line with the range for the various geotypes, they are often higher than the average figures (Table D). Consequently, the net present values and benefit cost ratios are likely to be understated. We can test this by doing sensitivity analysis using the cost benchmarks instead.

156. Given that the Frontier Economics and Tactis and Prism estimates are based on geotypes (such as a 'high cost' area) and the New Builds model is based on density deciles, it is not straightforward to apply the benchmarks into the model. This has been overcome by assuming the relative difference between a density decile and the average (i.e. density area one is 20% higher than the average) is the same when using the benchmark averages. This does mean that the geographical peculiarities of the benchmarks have been lost, however.

157. Acknowledging this, Table P shows the impact of using these lower industry benchmarks, though this should also be read in the context that the optimism bias is still relatively high and not all benefits have been counted. Overall, using these lower benchmarks improves the benefit cost ratio to a point well above one for all options except for the connectivity certificates.

Table P: Sensitivity analysis of different cost estimates (all benefits and relative to do nothing)

Cost benchmark	**Option 2**	**Option 3**	**Option 4**	**Option 5**
	100% FTTP coverage	Partial FTTP coverage (£3,000 cap)	100% FTTC coverage	Connectivity certificate
Social net present value, £ millions				
New Builds model	**+£17.9**	**+£53.6**	**+£0.9**	**-£12.0**
Tactis and Prism	+£42.4	+£73.2	+£10.3	-£11.5
Frontier Economics	+£73.0	+£95.7	+£10.8	-£11.2
Benefit cost ratio				
New Builds model	**1.11**	**1.47**	**1.05**	**0.11**

Tactis and Prism	1.31	1.77	2.33	0.12
Frontier Economics	1.68	2.32	2.48	0.12

Source: New Build modelling using Ofcom Connected Nations and BDUK data; Tactis and Prism (2017), 'A cost analysis of the UK's digital communications infrastructure options 2017-2050'; Frontier Economics (2018), 'Future Telecoms Infrastructure Review'

158. The cost figures can be further tested by looking at what would happen if costs are higher than those currently used in the New Builds model. This can be tested by adjusting certain assumptions within the model itself. Principally, there are two areas where adjustments to the assumptions can be made: how the distance between a premise and nearest cabinet/exchange is calculated; and whether the modelled cost profile is adjusted or not.

159. For the distance, the model currently assumes that a premise will be connected to the nearest cabinet or exchange and this can vary between premises in a development (i.e. sum). However, an alternative assumption is that all premises in a development will be connected to the same cabinet or exchange, and so the distance used is the maximum length (i.e. max). This generally has the effect of producing higher cost estimates as the maximum distance is usually longer than the sum distance. As can be seen from Table Q, this assumption can have a large impact on the cost benefit analysis.

160. Deployment costs are usually higher in rural areas and lower in urban areas. The New Builds model adjusts the cost profile to reflect this using a linear trend, however an option is to leave the cost profile unchanged. Table Q shows that by adjusting the cost trend it reduces the costs slightly, but not by much in relative terms.

161. Overall, even with these higher cost estimates, option 3 remains the preferred option. However, like above, these figures should be considered carefully as it does not include all benefits and the optimism used is considered high.

Table Q: Sensitivity analysis of different cost assumptions (all benefits relative to the do nothing)

Distance from premise to nearest cabinet / exchange	**Adjust cost profile by decile**	**Option 2**	**Option 3**	**Option 4**	**Option 5**
		100% FTTP coverage	Partial FTTP coverage (£3,000 cap)	100% FTTC coverage	Connectivity certificate
Social net present value, £ millions					
Sum	None	+£35.4	+£65.5	-£1.3	-£11.9
Sum (base case)	**Linear**	**+£17.9**	**+£53.6**	**+£0.9**	**-£12.0**
Maximum	None	-£1,327.3	-£123	+£3.7	-£24.9
Maximum	Linear	-£1,314.5	-£137.1	-£2.6	-£22.3
Benefit cost ratio					

Sum	None	1.24	1.62	0.93	0.11
Sum (base case)	**Linear**	**1.11**	**1.47**	**1.05**	**0.11**
Maximum	None	0.12	0.44	1.26	0.06
Maximum	Linear	0.14	0.41	0.87	0.06

Source: New Build modelling using Ofcom Connected Nations and BDUK data

Optimism bias

162. The optimism bias used in the main analysis is 44%, which is based on the upper bound of standard civil engineering projects within the HM Treasury Green Book[128]. However, the costs involved in this policy are relatively known. For example, the process for installing full fibre connections is proven and in use today. Similarly, the input costs to the New Builds model are based on BDUK approximations of the cost of delivery by different suppliers in different areas. Given this, the optimism bias could reasonably be lower than this upper bound.

163. Table R shows the impact on the cost benefit analysis for different optimism biases ranging from 3% (lower bound) to 44% (upper bound). This suggests that an optimism bias of around 20% would generally be sufficient to turn the net present value positive.

Table R: Sensitivity analysis of different optimism bias (all benefits relative to do nothing)

Optimism bias	**Option 2**	**Option 3**	**Option 4**	**Option 5**
	100% FTTP coverage	Partial FTTP coverage	100% FTTC coverage	Connectivity certificate
Social net present value, £ millions				
3%	+£64.3	+£86.3	+£5.8	-£8.1
10%	+£56.4	+£80.8	+£5.0	-£8.8
20%	+£45.0	+£72.8	+£3.8	-£9.7
30%	+£33.7	+£64.8	+£2.6	-£10.7
44% (base case)	**+£17.9**	**+£53.6**	**+£0.9**	**-£12.0**
Benefit cost ratio				
3%	1.55	2.05	1.47	0.16
10%	1.45	1.92	1.38	0.15
20%	1.33	1.76	1.26	0.13
30%	1.23	1.62	1.17	0.12
44% (base case)	**1.11**	**1.47**	**1.05**	**0.11**

[128] HM Treasury (2018), 'The Green Book' https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/685903/The_Green_Book.pdf

Source: New Build modelling using Ofcom Connected Nations and BDUK data

Take up rate

164. While premises may be connected to the internet using superfast or ultrafast connections, it does not necessarily mean that households have bought broadband packages with these speeds. In the main analysis, it was assumed that households would initially start with their baseline speed, but gradually upgrade their package to reach the highest speed possible with their connection. It was assumed that it would take five years to get to 100% take up (an absolute increase of 20% in take up per annum).

165. Take up could be slower or faster than what was assumed in the main analysis. In this sensitivity, we examine if take up requires three years to reach 100% (an absolute increase of 33% in take up per annum) or if it requires ten years (an absolute increase of 10% per annum). When assuming take up will be faster, it logically raises the net present value; whereas when assuming take up will be slower, it lowers the net present value.

Table S: Sensitivity analysis of different take up rates (all benefits and relative to do nothing)

Time to reach 100% take up	**Option 2**	**Option 3**	**Option 4**	**Option 5**
	100% FTTP coverage	Partial FTTP coverage	100% FTTC coverage	Connectivity certificate
Social net present value, £ millions				
3 years	+£24.8	+£60.3	+£1.4	-£11.9
5 years (base case)	**+£17.9**	**+£53.6**	**+£0.9**	**-£12.0**
10 years	+£4.3	+£40.5	-£0.2	-£12.2
Benefit cost ratio				
3 years	1.15	1.53	1.08	0.12
5 years (base case)	**1.11**	**1.47**	**1.05**	**0.11**
10 years	1.03	1.35	0.99	0.10

Source: New Build modelling using Ofcom Connected Nations and BDUK data

Cost threshold (option 3)

166. Policy option 3 looks at FTTP coverage for new builds under a cost cap. The analysis so far has focussed on a cost threshold of £3,000 which is largely in line with other interventions such as the Universal Service Obligation (£3,400 threshold for connections with at least 10 Mbps) and the Gigabit Voucher Scheme (£3,000 for businesses and £500 for residents applying as part of a group). Sensitivity analysis can therefore be used to show the impact of different cost caps.

Table T: Sensitivity analysis of cost threshold for Option 3 (all benefits and relative to do nothing)

Cost cap	Percentage of premises excluded by cap (in Year 1)	Social net present value, £ millions	Benefit cost ratio
£1,000	15%	+£60.0	1.89
£2,000	7%	+£55.0	1.57
£3,000 (base case)	**3%**	**+£53.6**	**1.47**
£4,000	2%	+£48.7	1.39
£5,000	1%	+£44.2	1.34
£10,000	0%	+£35.5	1.25

Source: New Build modelling using Ofcom Connected Nations and BDUK data

167. This suggests that a change in the cost cap can have a significantly affect the net present value or benefit cost ratio, and it can also have an impact on the percentage of premises excluded from the intervention. We will further examine what the cost cap should be during the consultation, though we illustrate a suggested costs model in the summary.

Risks to the policy

168. There are risks to the proposed new builds policy, both on the upside and downside. This includes:

- **Potential cost efficiencies**. The New Build model does not account for any cost efficiencies with delivering connectivity. It could be the case that factors such as 'dig once' where infrastructure can be delivered at the same time can reduce installation costs. Similarly, the underlying cost inputs to the model are based on 'upgrade' costs only, so there could be some further cost efficiencies as it would be 'first fit'. We will use the consultation to gauge the prospect of these cost efficiencies and introduce them as part of sensitivity to the economic appraisal.

- **Potential for telecoms operators to overestimate cost**. Depending on the policy option chosen, it is likely that telecoms operators would need to estimate the cost of connection prior to installation. There could be an incentive for the operator to over (or under) estimate the cost. For example, estimating the cost of installation above the cost threshold so that premises are excluded. Or to shift the cost burden more on to developers if costs are being shared above a threshold for the operators. These issues to some extent relate to the information asymmetry that developers face in understanding the cost of connection. Consequently, potential solutions could take on board lessons learnt from the Superfast Broadband Programme where elements of clawback and risk sharing were a part of the tendering process.

- **Effect on residential construction**. The new builds policy could be argued to potentially affect the rate of residential construction. For example, any extra

administrative burden to install FTTP could slow the build process. However, as noted previously, we expect this policy to be largely time-neutral to developers and the analysis above suggests the extra cost is relatively small. Consequently, we do not judge this to be a substantial risk. The Oliver Letwin Independent Build-Out Review is looking at build out rates and investigating why they have been consistently below target. The prelim report[129] states that the main factor for targets not being met is “absorption rates”. The absorption rate is the rate at which a house supplier can release newly constructed properties onto the market without materially disturbing the housing price market. The report states this is the main factor in build out rates being below forecast. The preliminary report alludes to this being caused by an over concentration of market power; often seen by large developers with sizeable plots of land being able to control how quickly they bring new properties onto the market. A potential solution would be splitting large plots into smaller parcels to encourage competition. The second stage of the report will continue the exploration of the problem. The second stage will also include an investigation of how the build out rate is affected by the speed of utility deployment. This may include more insight into whether mandating FTTP would affect build out rates, though from the analysis conducted so far we do not believe that either time or costs could have such an impact so as to slow build out rates.

Monitoring and evaluation

169. As part of this policy, a Post Implementation Review (PIR) will be conducted five years after implementation. Some of the research questions that we propose in order to assess impact include:

- Has the policy been successful in deploying fibre to new build developments?
- Is the rationale for intervention still valid? For instance, whether the information failures that exist between telecoms operators, developers, house buyers and consumers remain.
- Did the spillover effects occur and to what extent? This is particularly important given the effect of these spillovers in this impact assessment.
- Business impacts - what were the overall impacts on business?
- Direct and indirect impacts - did the assumed impacts occur and were there others that were not identified both direct and indirect?
- Small and micro businesses - Did the approach taken to mitigate the impact on small businesses work? What was the eventual impact of the policy on small developers?
- Assessment of compliance and enforcement - Did stakeholders comply, if not, how did Government respond to ensure adherence to the policy?
- Market structure impacts - was there any impact on the market structures of developers and network providers?

[129] Letwin, O (2018), ‘Build out review letter’ https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/689430/Build_Out_Review_letter_to_Cx_and_Housing_SoS.pdf

170. A counterfactual will be needed to answer some of these questions to ascertain the additional impact of the policy. One potential idea at this stage is comparing the rollout speed for similar areas with and without a new build development to test the spillover effects (i.e. propensity score matching). Another potential idea is phasing the introduction of the policy, though this depends on the implementation of the policy and the policy option chosen.

171. To successfully answer these questions, we propose monitoring the following (provisional) key indicators though the list is not exhaustive. The consultation phase may also identify alternative indicators and methods of data collection.

- Number of housing completions
- Type of connectivity for new builds
- Number of premises with fibre connections
- Take up of fibre connections for new builds and nearby premises

Summary

172. In summary, the preferred option is to recommend that Gigabit capable connections are made available to all new build homes subject to a cost cap of £3,000. We will use the consultation period and subsequently, the responses to the consultation, to continue to refine the proposal.

The key elements of the policy design are:

- We believe Local Authorities should be empowered to prevent poorly connected developments being built - we will investigate the detail of this principle through consultation.

- We have suggested a tiered cost cap per premise - this would be able to be aggregated across the development. In theory, this means that developments would meet the cost criteria based solely on costs. However we recognise there could be other useful metrics to use instead of a cost cap. For example; number of premises in a development. We will ask for views from industry on how best to design a metric for identifying developments that are in scope. This can be simply described as: the cost aggregation vs. number of premises decision.

- We will use the consultation process to refine the cost cap thresholds. We will also investigate whether this policy would benefit from having a dedicated fund from Government to deliver connectivity to the most isolated (and therefore expensive) developments.

- We firmly believe that competition should be encouraged at the wholesale and retail level. We have suggested that developers must request a quote from a minimum of to network operators in order to ensure there is competition in this market.

- As well as competition, we believe there should be choice for the consumer. This means we will investigate whether it is feasible to mandate that new developments should be connected to networks that will allow a minimum of two Internet Service Providers (ISPs) to serve residents.

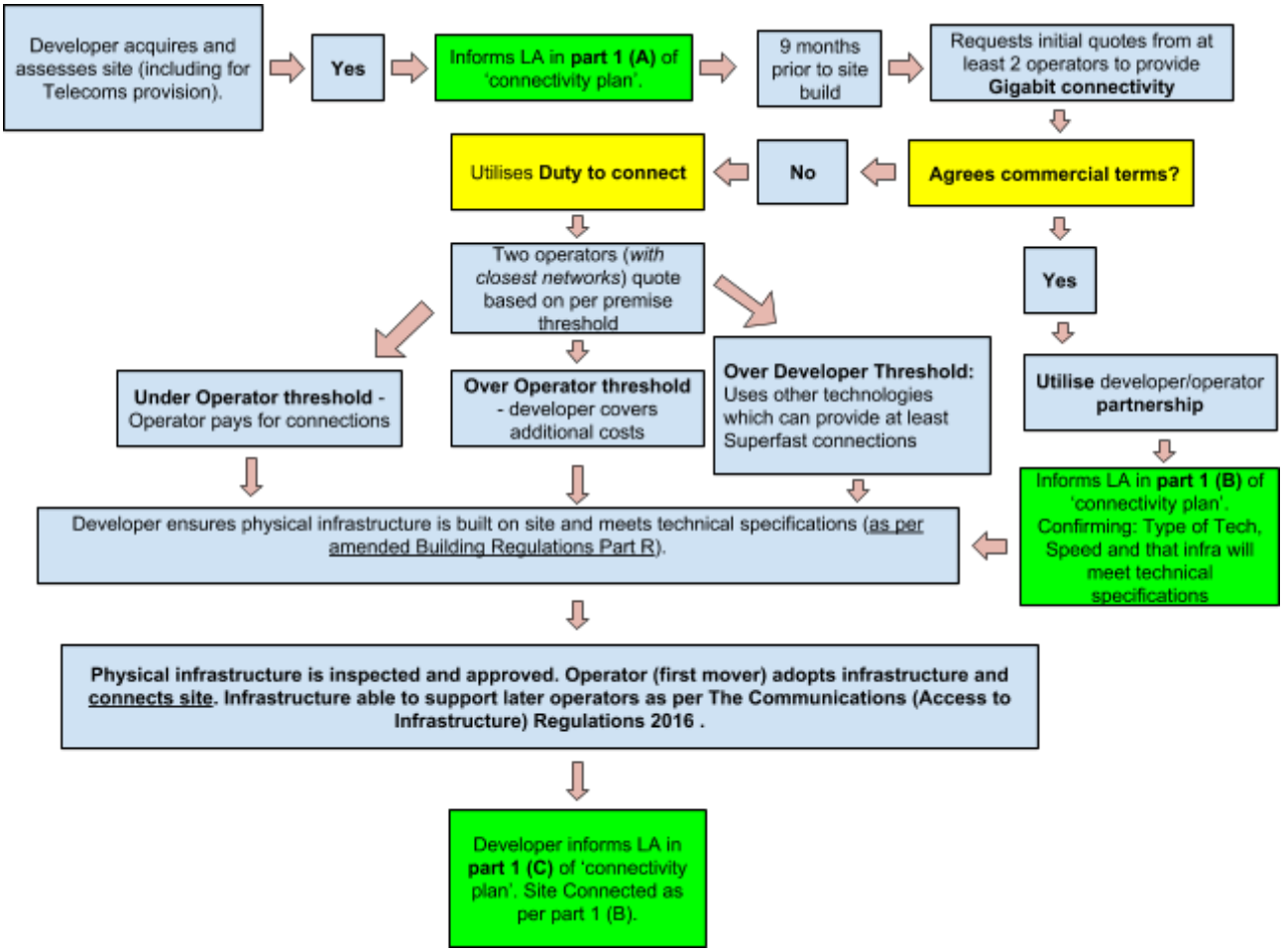
- This policy would require a new piece of primary legislation and potentially an amendment to Building Regulations Part R. The amendment to Building Regulations would be designed to ensure that physical infrastructure designed to carry Gigabit capable networks is built in to the development. We welcome views from industry on this subject, particularly the technical specifications that would be required (ducting etc).

We believe that this policy option balances the needs of new homeowners with those of developers and operators and brings digital connections in line with traditional utilities,

thereby recognising the critical importance of high quality, future proof connectivity in our daily lives in our digital future.

173. The proposed policy design is shown by Figure 10 below.

Figure 10: Proposed policy design



174. The analysis has shown that all options considered are better than doing nothing and that options which mandate Gigabit capable (FTTP) connections are best overall. Of this, the FTTP cost cap option (option 3) has been selected as it is the most deliverable and has the best NPV/BCR overall.

175. **Deliverability**. The cost cap option scored highest on the long list appraisal and throughout further research appears to be the most deliverable option as it best meets the objectives by:

- Mandating a Gigabit capable connection to new build homes;
- Has a built-in cost cap so as not to overly burden industry;
- Will help to grow Gigabit capable networks;
- Will be enforceable by enshrining in law; and
- Is shown to have the best NPV and BCR of the options considered.

176. **NPV/BCR**. While acknowledging that the economic appraisal uses unit cost estimates that are higher than the benchmarks, a high optimism bias that is likely to be overly pessimistic and does not include several non-quantifiable benefits, the initial analysis has shown that policy option 3 would deliver the best Net Present Value at +£53.6 million and the best Benefit Cost Ratio at 1.47 when including all the monetised benefits.

177. This reform will be likely to necessitate primary and secondary legislation. We will continue to refine our legislative options during consultation and present a recommended approach in the final impact assessment.

178. Once the policy has completed its Parliamentary passage, we would seek to implement the following high level implementation plan. This will be further refined as transitional and other arrangements are further developed.

- Month 0: Parliamentary passage of primary and secondary legislation.

- Following Parliamentary passage: Royal Assent, commencement of primary and secondary legislation.

- On or before legislation coming into force: Guidance developed and communicated to developers, telecoms network operator and their advisors.

- On legislation coming into force or specified period thereafter (proposed, liable to change post consultation): Developers required to present connection plan to LA's. Designated operators liable to be obliged to provide a duty to connect service to developers. Developers required to gain approval of works undertaken in respect of amendments to Building Regulations Part R. LA's able to prevent developments going ahead if no provision for Gigabit connections are made by developer.

Royal Assent plus 3 years: Review of legislation

Following implementation, we will undertake the requisite post-implementation review (PIR).

Annex 1 - Long list of options.

Policy options long list appraisal - using Critical Success Factors (CSF)							
Ser.	**Option**	**Strategic fit and meets business needs**	**Potential VfM (all stakeholders)**	**Supplier capacity and capability**	**Potential affordability (all stakeholders)**	**Potential achieveability**	**Score: Red = -1 Amber = 0 Green = 1**
1	**Do nothing.**	This option does not meet strategic aims. By doing nothing Government would be in danger of ignoring the valid concerns of new homeowners who are not able to access quality internet connections.	Although developers, operators and HMG would not incur any costs under a 'do nothing' scenario consumers would be affected. From a consumer perspective VfM is best achieved by buying a new home which is connected to a high quality connection. Retrospectively connecting developments is expensive, this cost initially falls to operators but would be passed to consumers. Developers are likely to achieve a certain degree of VfM initially (by utilising cheaper technologies) however, in the longer term they could find it difficult to sell poorly connected homes.	This status quo option would see no impact on supplier capacity and capability. [There is an argument that a lack of Government intervention could negatively affect operators. It is likely that operators expect some form of intevention in order for Government targets to be met - no intervention, resulting in a 'do nothing' approach - could underestimate the ability of operators to deploy Gigabit capable networks].	Similar to VfM for consumers - retrospective installations are more expensive. For developers and operators this is an affordable option as there would be no change to their current approaches.	Easily achievable.	1
2	**Mandate Gigabit-ready physical infrastructure for all NBD.**	There is a relatively strong case for this policy fitting strategically - encouraging, as it does, the roll-out of Gigabit capable networks. However there is a crucial flaw in that it does not provide a complete solution. Homes and developments may be Gigabit or fibre ready but with no legislation ensuring those areas are connected to a network residents could, in some cases, remain unconnected.	Strong case for VfM being achieved with this policy. In the main Fibre deployments are not much more expensive than copper ones. In the long run the higher Capex associated with fibre deployments can be balanced against a lower Opex.	In this case the supplier would be the developer. The developer would provide all the necessary physical infrastructure to support a fibre connection to the home. Developers (or their contractors) would have both the capacity and capability of doing this.	With this option the costs would fall solely to the developer. We do not believe that costs would be unaffordable for developers. Although this would potentially allow operators to deploy infrastructure cheaper this would not be guaranteed. Although developers would be able to offer a 'fibre ready' package to consumers they could not offer guaranteed connections this could make it more difficult for developers to pass on costs.	This option could be achieved through an amendment to Building Regulations (or similar) across the four nations in addition to new primary legislation.	1

3	**Mandate Gigabit capable connections for all NBD within a cost cap.**	This option meets the strategic intent of this particular policy objective; to ensure NBD residents get high quality, reliable and future proof connections, but also meets wider Government ambitions to; build fibre spines in over a hundred towns and cities by 2022, and to provide Gigaspeed connections to as many homes as possible. The addition of a cost cap is designed to meet business needs and make it affordable for the key stakeholders affected by this policy proposal.	Early analysis suggests that there are monetarised and non-monetarised benefits derived from this approach, both for the resident and the wider community and the UK more widely.	This option would mandate connections to new build developments with both developers and operators being obliged to connect homes. Both operators and developers have the capacity to provide these connections and additional costs accrued could be passed to original landowners, retail providers, or end consumers. There could be a small number of developments where operators are unable to connect (even if within cost cap).	With this option costs would be shared primarily between operators and developers. A third funding stream provided by government for particularly difficult to connect developments (for example rural sites) will be explored. Insert costs.	This option could be achieved through an amendment to Building Regulations (or similar) across the four nations in addition to new primary legislation.	3
4	**Mandate Gigabit capable connections for all NBD.**	This option meets the strategic aim of this particular policy objective; to ensure NBD residents get high quality, reliable and future proof connections, but also meets wider Government ambitions to; build fibre spines in over a hundred towns and cities by 2022, and to provide Gigaspeed connections to as many homes as possible	Early analysis suggests that there are monetarised and non-monetarised benefits derived from this approach, both for the resident and the wider community and the UK more widely. This policy however does not use a cost cap - therefore both operators and developers are less likely to achieve VfM.	As this option would be for all NBDs there is likely to be a significant impact upon the capability and capacity of operators.	Developers would be the group most affected by this policy. With no cost cap in place very small developments would be likely to become very expensive.	This option could be achieved through an amendment to Building Regulations (or similar) across the four nations in addition to new primary legislation.	1
5	**Mandate superfast (>24Mbp/s) connectivity for all NBD.**	This option partially meets the strategic aim. It would ensure new homes are able to access a good connection. As a potential policy it is limited as it does not grasp the opportunity to deploy future-proof digital infrastructure when building works are taking place. i.e. copper lines would be deployed to new homes which would potentially need to be replaced by fibre	Early analysis suggests that there are monetarised and non-monetarised benefits derived from this approach, both for the resident and the wider community and the UK more widely. This policy however does not use a cost cap - therefore both operators and developers are less likely to achieve VfM. This policy also supports	As this option would be for all NBDs there is likely to be a significant impact upon the capability and capacity of operators.	Developers would be the group most affected by this policy. With no cost cap in place very small developments would be likely to become very expensive. Although in general it is cheaper to deploy copper in capex terms mandating a superfast connection would still have a significant cost impact as very remote developments would be likely to have a disproportionate impact on affordability.	This option could be achieved through new primary legislation.	0

		ones in the near future. It also fails to grow fibre networks which is a broader HMG aim to drive economic growth.	deployment of copper-based technologies - these networks would need to be updated in the future, reducing the VfM that could be realised by residents, the wider community and the UK. There would be little effect in developers and at this stage it is difficult to assess the impact on operators.				
6	**Penalise (through fines) developers who build homes with 'no or slow' connectivity**	This option only partially meets strategic aims. Without a principle piece of legislation that mandates developers to provide high quality connections any penalisation system would be flawed. If this policy was accompanied by legislation that mandated connections then the aim could potentially be achieved. We believe there are issues with holding one party responsible (developers). If only developers were responsible for the connectivity of new homes this is unlikely to encourage good behaviour by developers. Further any regime which is based around penalties does not necessarily create the right conditions for a collaborative approach to delivering good connections.	It is difficult to assess any VfM for this potential policy. Although it is possible benefits to the public could outweigh any costs to developers it does appear unfair that only developers would be liable to face fines for poor connections. Any fines could potentially be used to cover the costs of the policy. VfM is probably best achieved by spreading costs between all stakeholders.	In this case the supplier would be the operator - with the developer responsible for ensuring the connection is of a specified quality. In most cases operators would have the capability to supply, in those cases when they cannot connect a development developers could be liable to face fines.	The key concern with this policy idea is that smaller developers (who struggle to compete against larger companies with better access to finance) could face fines. Costs to operators would not be raised in this scenario.	Key issue for achievability is that a fine based system would not be viable in isolation. There would need to be a legal obligation on developers to provide connections in order for fines to be levied. This being the case it would be more useful for any legal obligation to be shared between developers and operators.	-3

7	**Introduce a Government endorsed and ratified 'Gigabit-Ready Certification Mark'.**	This option would enable buyers of new properties to understand the level of connectivity they would get in their new home - similar to the Energy Performance Certificate (EPC). It partially meets the strategic aims - consumers would be better informed but crucially the certificate would only show what levels of connectivity the home actually has. If poor, then consumers may not buy the house, this would then nudge developers to ensure connections in new developments are high quality. There is no guarantee that developers would take this action. Further, even if they were to, it could take some time for developers to respond to a better informed consumers expectations.	Initial assessments indicate that introducing a certificate system would be amongst the cheaper policy options explored. The benefits could be significant relative to costs to implement, however these benefits could take some time to accrue - leaving a period where some home buyers continue to experience poor connections. As provisionally designed costs would fall to operators. In the longer term consumers could experience greater VfM when buying a new home as the policy could nudge developers in to ensuring better connections are in place.	On initial assessment we have no indication that the production of a certificate would be beyond the capability or capacity of operators.	The certificate would be the responsibility of operators to produce, we assess that the additional costs would be affordable. If the policy intention were to be realised then changes to the market could have an effect on; the ability of developers to provide Gigabit-capable connections; the ability of developers to sell homes with poor connections and the ability of consumers to buy homes with good connections.	A key concern with this policy idea is that for the certificate to be best utilised it would need to be a legal obligation. In order to do this primary legislation would be required, in our view a primary legislative option could be better used by a policy option that delivers infrastructure as opposed to encouraging its deployment. If the certificate was to be voluntary (with the associated risk of lack of take up such an approach brings) then it would be relatively easy to achieve.	1

8	**Legislate for all housebuilders to clearly show connectivity levels (technology and likely speed) on their websites.**	This option partially meets strategic aims. Currently there is a lack of information on house builders websites regarding access to broadband connections, there is often a great deal of information about schools, leisure facilities and transport links. As consumers value connectivity so highly we have briefly explored whether developers should be obligated to show what type and speed of connection is available at their sites. This option would be similar to the certificate option (7.) although the responsibility on informing consumers would fall to developers and not operators. We believe this option could encourage developers to consider how well they are facilitating the digital connections to their sites as well as giving consumers important information prior to purchasing a home. This option would not encourage the deployment of Gigabit capable networks.	This option would cost little and if successful could bring significant rewards. Similarly to the certificate however it could take some time for the policy to impact on developer behaviour, this would mean a proportion of new homes could continue to be built with no or slow connectivity.	On initial assessment we have no indication that sharing connection information would be beyond the capability or capacity of developers.	Short term costs to developers would be negligible, however if developers were unable to sell poorly connected homes and/or they upgraded connections to homes costs could rise. Consumers could see a rise in house prices with high quality connections. There would be little cost impact on operators.	To ensure that without qualification developers show connectivity levels on their websites it would be necessary to legislate. This would potentially be achievable on a voluntary basis, however for this kind of approach to work developers would have to be meeting a legal obligation. There are legislative options which are likely to offer a better solution to the problem.	0

Annex 2: Modelling approach

1. This annex discusses the modelling approach taken in this impact assessment. It does so at a high level to illustrate the quality of the input data, as well as the issues and mitigating actions to overcome them.

2. The New Builds model is primarily based on Ofcom Connected Nations data. More information about the Connected Nations data can be found in the Connected Nations Data Analysis report[130]. Ofcom provided DCMS with a copy of the Connected Nations data that only included records that are new to the database. This is based on the assumption that new records are newly built premises, though it could also include existing premises that had been recorded for the first time. This dataset included fields such as: unique property reference number, address, lifecycle stage of record, Basic Land and Property Unit (BLPU) information, date the property unit was added, highest download speed and type of technology served. We removed records that related to non-residential premises and were inhabitable; and in instances where there is more technology available, we assumed the highest speed option would be used.

3. We grouped new builds into 10 geotypes (deciles)[131] based on the density of housing in that area to simplify the modelling. Furthermore, we used a clustering algorithm (nearest neighbour using the DBSCAN function) to identify residential premises that are likely to be within the same new build development. We assume that a new build premise is part of a development if it is within 50 metres of another new build premise. We tested this assumption by also looking at the impact of 25 metres, but the number and size of developments were broadly similar in all instances.

4. We also randomly checked the results of the clustering algorithm with satellite images of the same location using Google Maps. In some instances, it appeared that some premises were part of a development but were not captured by the clustering analysis. There are two possible explanations for this:

- The distance between premises is too large, but this in reality reflects things such as space for roads, open spaces or gardens; and

- A development is completed (and, consequently, premises are connected) within phases. It is possible that the snapshot of the Ofcom data we received only captured one development phase.

[130] Ofcom (2017), 'Connected Nations 2017, data analysis' https://www.ofcom.org.uk/__data/assets/pdf_file/0016/108511/connected-nations-2017.pdf
[131] Decile group 1 is the least dense area; group 10 is the most dense area.

Figure 12: New Builds model clustering

a) Model clustering

Note: green circles represent a premise that was part of a development with 1-2 units, yellow is a premise that was part of a development with 5-9 units and black refers to uninhabitable premises.

b) Google Maps (potential development site shown by yellow box)

Source: New Builds model; Google Maps

5. This can also explain why the proportion of new build developments by size within the New Builds model is different to benchmarks from industry (see Table C in the main body). We corrected for this by superimposing the benchmarks from industry to the underlying Ofcom data. That is, while keeping the spatial and telecoms technology distributions the same, the size of developments have been adjusted.

6. The New Builds model is also capable of estimating the likely cost of installing a particular telecoms technology to each premise. This builds on previous work by DCMS for the Superfast Broadband Programme and the Local Full Fibre Network. It does so in several steps; for each technology type:

- The model identifies the nearest telecoms exchange or cabinet that a new build could feasibly connect to and, consequently, assumes that there will be spare capacity for the new build.

- The distance is multiplied with the unit cost to install a connection, and added to the cost of all other structures and infrastructure (usually on a per home basis) that may be required based on our understanding of the installation process. We assume that the installation would be done in isolation, but it could be joined up with other infrastructure work such as utilities that could lead to efficiency savings.

- The total cost of installation is averaged within each geotype.

7. A key input to the model is the cost information. BDUK provided us with approximations of the cost of delivery experienced by different suppliers across different areas. This is separated into costs occurred during planning, during connecting the cabinet to the exchange and during connecting the premise to the cabinet.

8. The New Builds model can adjust certain assumptions to provide a range of cost estimates which we later use as part of sensitivity testing. This includes:

- The model makes an assumption about the distance between a premise to nearest cabinet and/or exchange. This can be estimated for each individual premise (sum) or collectively for each development (maximum). The distances tends to be larger when using the development assumption as a premise could be connected to a cabinet/exchange that is far away even if one is closer. In our main scenario, we have opted to use the **premise (sum) distances**.

- The BDUK cost approximations can be summarised using either a mean or median. In our main scenario, we have opted to use the **median costs**. This is because the mean can be affected by developments with extreme high costs (i.e. outliers).

- Deployment costs are usually higher in rural areas and lower in urban areas. The cost profile within the New Builds model can be adjusted to reflect this using a linear trend. In our main scenario, we have opted to use **adjust the cost profile using a linear trend**.

9. Overall, comparing the total cost of installation by technology type and by geotype with other benchmarks (see Table F) suggests the modelled cost estimates are broadly similar.