SOCIO–ECONOMIC BENEFITS OF HIGH SPEED BROADBAND
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Note on the Socio-Economic Benefits of High-Speed Broadband

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0 Executive Summary

ICT and broadband are key drivers to enhance socio-economic development policy in Europe. All businesses, services and citizens must be able to benefit from high speed, next generation broadband infrastructure in order to ensure Europe’s competitiveness in the global economy. Availability of top class connectivity, by means of fibre networks, together with the right set of digital skills in the workforce is predicted to have an impact on total factor productivity of the European economy (i.e. improving the way capital and labour are employed in the economy) and result in higher GDP growth.

This concept note reviews the current literature on the benefits of high speed broadband for society, together with the main experiences and policy insights available today. A number of studies have investigated why Europe is not reaping the benefits it should from ICT. This note focuses on connectivity, having in mind that this is only part of the answer and that demand-side policies have to complement supply side ones. However, connectivity is still central to our policy action: the note explores why the traditional investment model implicit in the current regulatory framework is not necessarily in line with the interest of society.

A key underpinning argument is that not all benefits of high-speed broadband can be monetised and that passive broadband infrastructure can be seen as a public good and often meets natural monopoly conditions outside urban areas. This is at odds with the principle of infrastructure-based competition that is meant to be beneficial in all areas, regardless of density. The outcome that has been generated is that urban areas enjoy choice between two or three infrastructure networks, while large part of rural areas have no NGA infrastructure at all. When the business case is limited or infrastructure duplication is not viable, private operators usually have lower incentive to invest in fibre broadband infrastructure.

Therefore, public intervention (policy and/or funding) is necessary to meet future bandwidth needs and to ensure that society at large can reap the benefits of the digital economy. There are three layers of welfare that can be associated to high speed broadband deployment, and which constitute the backbone of this note:

1. **The socio-economic benefits can be monetised and internalised**: by efficient for-profit market operators. In this case citizens are willing to pay for high speed broadband an amount that covers the cost of capital of a market player. The market player has a clear business case to deploy high speed broadband, can cover its cost of capital and make a profit. This is typically what happens in urban areas, given the strong economies of density that drive broadband networks.

2. **The socio-economic benefits can be monetised, but not internalised**: this happens often because the benefits accrue to a different actor than the network operator. As an example a high speed broadband network may enable saving to the national health system through the availability of eHealth services, but these savings would not be reflected in the cash flow of the network operator, which does not have a business case to build the network. A public policy action (often through subsidies) may be envisaged after a Cost Benefit Analysis or a similar technique shows the case for intervention.

3. **The socio-economic benefits cannot be monetised nor internalised**: this happens because some assets cannot be monetised or measured through traditional instruments like GDP. This includes aspects like well-being quality of life, but also the possibility of new applications arising in the future as policy makers empowers content creators. The only manner to capture these benefits is to have broadband as a public good.
The benefits from reaching these targets are direct employment benefits stemming from the construction of broadband, which are easy to monetise, but also indirect and induced benefits such as e-government, e-health and e-education. Some of the main methods to capture the socio-economic benefits of high-speed broadband are mentioned, with special emphasis on cost-benefit analysis.

Results of recent studies show a positive effect of high-speed broadband on GDP, employment, consumers, businesses and many more. The socio-economic impact of high speed broadband is big, and will most likely be even bigger than estimated. We therefore conclude that this principle should drive the policy agenda of the European Commission, with specific regards to the Digital Single Market strategy and the upcoming review of the regulatory framework. The market-based principle can deliver in most areas, but is not a panacea and our policy should have an answer for those areas where the social return cannot be guaranteed by private sector operators' investment.
1 Introduction

Digital is at the heart of the Juncker Commission policy action, with high-speed broadband infrastructure as the number 1 item on the list. As already identified in the Political Guidelines of the Juncker Commission, in order to achieve the overall objective to make better use of the opportunities offered by the digital technologies, a more ambitious reform of telecoms rules is needed, addressing inter alia the need to overcome fragmentation in telecom regulation implementation and in the management of radio waves. Socio-economic development is a key driver – albeit an implicit one – of regulation. The guide to high-speed broadband investment\(^1\) states that "To ensure that Europe remains competitive in the global economy, it is important that the underlying communication infrastructure be upgraded or replaced so that all citizens, businesses and public services may benefit from the development of new digital applications and services". These actors are the ultimate beneficiary parts of our regulatory activities.

Although Electronic Communication Network (ECN) operators (mainly telecom operators) contribute to the achievement of these social objectives, their contribution is not always sufficient to achieve the ultimate socio-economic development goals that the European Commission has set\(^2\). The targets of the Digital Agenda for Europe (DAE) are 100% coverage of the EU with broadband of 30 Mbps in 2020 and 50% subscription in the EU to broadband of 100 Mbps or higher. The latest Digital Agenda Scoreboard shows that Next Generation Access (NGA) fixed-line technologies (at least 30 Mbps) covered 62% of the European population at the end of 2013. The take-up objective of 100 Mbps remains marginal at 3% of the homes. In order to reach this take-up target, at least 75% - 80% of the population will have to be covered with 100 Mbps technologies. Recent studies have shown that these targets might even not suffice for the future needs of the European society beyond 2020.\(^6\) The targets are therefore currently being reviewed by DG CONNECT. In the meantime, political action aiming to achieve the current targets should avoid that groups without digital access are left behind and miss out on opportunities in life and work. In order to achieve this, services that rely on robust and reliable networks are needed and superfast fibre-based broadband is the only solution. Areas showing market failure are the most straightforward examples of areas where the absence of a business case is not aligned with a strong socio-economic case to intervene and avoid a digital divide condition.\(^3\) This is certainly the case in the current phase of progressive transition migration from copper-based to fibre-based networks\(^4\).

The aim of this concept note is to explain why private sector operators are not always in the position of contributing to the Commission’s targets, proposing alternative ways to meet these targets in case this misalignment of interest occurs. There are three layers of welfare that can be associated to high speed broadband deployment, and which constitute the backbone of this note:

1. **The socio-economic benefits can be monetised and internalised:** by efficient for-profit market operators. In this case citizens are willing to pay for high speed broadband an amount that covers the cost of capital of a market player. The market player has a clear business case to deploy high speed broadband, can cover its cost of capital and make a profit. This is


\(^{3}\)http://www.sciencedirect.com/science/article/pii/S0143622814000782

\(^{4}\)“While until recently fixed networks could be created using existing copper infrastructure, bandwidth demand from users and providers is quickly reaching the point where a new generation of digital communication infrastructure will be needed. Optical fibre which supports a wide range of fixed and wireless technologies, should be brought closer and closer to the end user, for example.” (source: bb investment guidelines)
typically what happens in urban areas, given the strong economies of density that drive broadband networks.

2. **The socio-economic benefits can be monetised, but not internalised:** this happens often because the benefits accrue to a different actor than the network operator. As an example a high speed broadband network may enable saving to the national health system through the availability of eHealth services, but these savings would not be reflected in the cash flow of the network operator, which does not have a business case to build the network. A public policy action (often through subsidies) may be envisaged after a Cost Benefit Analysis or a similar technique shows the case for intervention.

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The last two points in the list can be captured through the concept of socio-economic return of investment which we introduce in chapter three.

The rest of the note is organised as follows: Chapter 2 will deal with point 1 and explain why private operators might not be interested in investing in high-speed broadband and therefore do not capture the full socio-economic benefit for society. The chapter will also briefly describe the available high-speed broadband technologies and accompanying speeds, as well as the possibilities of business models for broadband investment. Chapter 3 will deal with points 2 and 3 and continue with the socio-economic benefits that cannot be internalised by private operators but will result in more employment and GDP. However, even indicators such as GDP cannot capture the full benefit of high-speed broadband for society, which will be elaborated on in Chapter 3 as well. As a result, we will introduce the concept of public good in chapter 4 and conclude that socio-economic development should be a central element of the Commission broadband policy in general and of the next review of the telecom framework in particular.

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**Reducing inequality through digital innovation: the Young Foundation**

The Young Foundation stresses the importance of digital social innovation (i.e. the use of digital technology to enable new or more effective solutions to social problems or needs) in order to reduce inequality. Emphasized are the many digital innovations that are or have been developed to connect, mobilise and empower people, communities, organizations and sectors to help them shape their environments, solve problems and improve lives; "digital tools are providing different ways for organisations and institutions to deliver services and create solutions to both new and age-old problems faced by the public, private and voluntary sectors."

However, in order to support the digital tools at hand, a superfast broadband infrastructure is needed. The standard broadband available (mostly still in the form of copper) does not meet the needs of many social entrepreneurs, citizens and new social ventures, either because of speeds or location.

The Young Foundation concludes that a shared understanding of digital social innovation is needed, where interaction between sectors is key. High-speed broadband is a must in order to enable new and more effective solutions to social problems and needs.

2 Can Private Operators Capture the Full Socio-Economic Benefit of network roll-out?

This chapter explains how private telecom operators act rationally when taking investment decisions and will show why they cannot capture the full socio-economic benefits associated with network roll-out. Private telecom operators (incumbents and alternative operators) account for most of the investment carried out in Europe for the upgrade of network infrastructure to deliver high speed broadband. Municipal networks and community-led initiatives are still the exception more than the rule in several European countries.

When deciding whether an investment has to be carried out or not private telecom operators are obviously driven by return on investment considerations (typically a net present value (NPV) > 0 at a discount rate \( r \) over a certain duration \( t \)) and would perform a cost/benefit analysis before undertaking an investment. The discount rate that makes the NPV of future cash flows equal to zero is the Internal Rate of Return (IRR). In a for-profit environment the return on the investment must be higher than the cost of capital (WACC, Weighted Average Costs of Capital) to take place.

In areas where the business case conditions mentioned above are not met, a rational private operator will not intervene without subsidies or other sorts of state support (tax rebates etc.). This is because when operators look at the internal rate of return (IRR), a project can show a negative financial net present value. However, it is important to note that, when only looking at the internal rate of return (IRR), positive externalities for society and environment are not taken into account; if these externalities are significant enough, the economic rate of return (ERR) might actually be higher than the IRR and therefore make the investment worthwhile from a societal perspective. Hence, the investment may generate a positive welfare change (a positive economic net present value (ENPV)) for the communities that will be affected by that deployment project. The cost benefit analysis guidelines\(^5\) by the European Commission state that, in this case, the project will need support to make it viable and is worthy of receiving this support because of the benefits it will deliver to society.

Of course, no network operators are exactly the same. Whereas there is little interest from large operators to go into rural areas with FTTH, it has been shown that fibre investment in rural areas can be profitable for local private operators, or community-led initiatives, which have a longer horizon for getting a return on their investment.

2.1 Broadband Definitions and technologies

A broadband connection is a channel over which digital data services such as Internet and digital TV can be delivered. The types of services that can be delivered depend on the speed of the broadband connection. There are three layers to a broadband network: a passive infrastructure (e.g. cable, fibre), an access layer (e.g. routers, switches, peering centres) and services.

There are different kinds of broadband connections: dial-up connections, first generation broadband connections, and next generation networks (NGN). The targets of the European Commission focus on NGN broadband connections, with a speed range between 30 to 100 Mbps (or higher). As previously stated, the need for speed is growing and soon these targets might not be high enough. In this note, the focus is therefore on the passive infrastructure of high speed NGN broadband connections, fibre in particular, which entail connections with speeds above 100 Mbps. Passive infrastructure is the most critical bottleneck in the process of upgrading and deploying next generation networks, since it takes

the longest to generate a return on investment. Although deployment of fibre in the local access loop initially costs more than upgrading the current networks, it offers much greater revenue potential over a longer period and has lower running expenses. Further explanation on this can be found in section 2.2.

Dial-up connections and first generation broadband connections are not capable of reaching the required speeds. Dial-up connections are provided via phone lines and usually go up to 128 kb/s. First generation broadband connections are the most common in Europe today and can be achieved using telephone lines, coaxial cables, satellite dishes or wireless connections. These connections are asymmetric: the download speed is often a few Mbps while the upload speed is below 1 Mbps.

Fibre to the premises (FTTH/B) provides symmetrical bandwidth, which results in low operating costs and high access, provided by no other technology. The symmetrical bandwidth results in low energy use to run the network and creates opportunities to develop and exploit many new types of services and applications. For further information on the need for faster broadband infrastructures, we refer to the broadband note on the Need for Speed.

Existing FTTx solutions are however only provisional. Forzati and Mattson in their 2011 study for Acreo provide a clear overview of why the best solution for the future is to invest in fibre.

Figure 1 - Source: Forzati & Mattson (2011)

Many operators and stakeholders in the telecom sector agree to this statement as fibre is a technology that is future proof, it is easy to upgrade and provides virtually unlimited capacity, as depicted in figure 1. The pace of replacing copper is instead more debated (incremental solution of copper upgrades or one-off investment in all-fibre network).

Buneman and Fourman explain that private investment in rural areas is often lacking, and that the copper connections in these areas will never reach the 30 Mbps download speed, because of too long copper lines. It is however possible to reach the targets in these areas by connecting rural households to fibre. This can be done at relatively low costs, provided they have access to backhaul. The reason for this is that in rural areas civil engineering costs are often lower as there are fewer obstacles to deployment, infrastructure is locally owned, communities can adapt more quickly and people are resourceful.

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6 http://www.ftthcouncil.eu/documents/Publications/Primer_UpdateMay2014_FINAL.pdf
7 In comparison to copper, fibre is more reliable and can carry a signal over long distances with minimal degradation – 60 km or more in installed networks, while the signal in copper starts to degrade after just a few hundred meters. Furthermore, there is no interference between fibres, and the signal inside each strand is far more secure from outside detection.
8 ARES No.
9 https://docs.google.com/document/d/1L7W46JvkpgB3nrt5ge31LuDyIUjWtL11R3f4mVi5_A/pub
2.2 The economics of market structure today

2.2.1 Private Investment Models

Depending on what roles the different market actors take on, different business models arise. The possible roles a market actor can take are: physical infrastructure provider (PIP), network provider (NP) and service provider (SP). A business model is referred to as a **vertically integrated model** when one market actor takes on all three roles. This is the case with all large telecom operators.

Regulations can demand the opening up of network access to competitors, either at the passive or active layer. This means that the network owner designs the network to deliver its own services and gives access to its competitors in forms compatible with the network design. This is than a **vertically integrated model with unbundling** (either at the physical layer (LLU) or at the active layer (bitstream access)).

When all the roles are separated, we speak of an **open network model**. In this case, the infrastructure is available to all market participants under equal conditions. Three open network business models can be identified:

- Passive-layer open model (PLOM)
- Active-layer open model (ALOM)
- Three-layer open model (3LOM)

The above can be illustrated as follows:
A passive infrastructure-only network: Axione

After the French government in 2005 adopted a law enabling local authorities to build, finance and operate broadband infrastructures where private operators were not investing, the company Axione started in 2006 serving big local authorities. The company became a leader in the French market serving 10% of the population through 15 contracts (600 million EUR CAPEX). Because of Axione Networks, 2.4 million people are connected to broadband. According to Axione, their work tackles the digital divide by providing high-speed internet to middle-schools and university dorms, by providing hospitals with high-speed data sharing systems and videoconferencing capabilities, improves safety with alert notifications in the event of an industrial catastrophe and provides possibilities for telecommuting and office workplace sharing. Axione infrastructures try to create a competitive environment, resulting in an increase from one incumbent operator in 2004 to 30 internet service providers in the Limousin region in 2013. This competition resulted in a decrease of prices for both companies and the general public. This results in a purchasing power increase of more than 31 million EUR a year for businesses and end-users. Other socio-economic benefits from Axione Infrastructure are the creation of 800 jobs a year in the infrastructure industry as well as in the IT/telecom industry apart from the creation of new businesses. In the future, starting from 2015, Axione plans to develop high-speed broadband infrastructure (FTTH) through shared networks in rural areas in France.

Source: presentation Axione Jan 2015

2.2.2 Natural monopolies

Today in Europe a vertically integrated former monopolist (designated as holding a Significant Market Power by ex-ante regulation provisions) typically competes in the market with a number of access seekers plus, in some cases, with alternative operators which have rolled-out infrastructure of their own (following the so-called "Ladder of Investment" principle). Infrastructure competition is also granted by the presence of cable providers, although their footprint varies greatly across and within EU Member States.11

We are not going to express any opinion for areas where a private-sector led business case exists and infrastructure competition takes place; the investment model is very important for areas where this is not the case. In these areas, there is no room for infrastructure competition and the conditions of a natural monopoly on passive infrastructure are often met (typically ever-decreasing LRAC (long Run Average Cost)).

A natural monopoly exists when a single supplier is the most efficient market structure. A single firm can produce a given level of output at a lower cost than multiple firms. If efficiency was required, natural monopolies would make losses but, via state support, the profit motive will no longer dominate (losses can be compensated). In the case of a natural monopoly, cost decreases with increases in production. Had there been competition in this case, diseconomies of scale would emerge. In this case, LRAC decline for all outputs, no matter how large the market is. The LRAC curve intersects with the demand curve at the point of falling or minimum average total costs (ATC).

11 For more detailed analysis of the socio-economic benefits of the different business models, we refer to the framework review study on access, which is part of the "review studies" to be launched in parallel in the context of the Regulatory Fitness (REFIT) exercise on the evaluation of the current regulatory framework.
In figure 4, the industry demand does not support multiple firms. If a firm invests and operates at ATC2, the firms with ATC1 are out of business.

If public money has to be catered to projects in economically unviable areas, then the public sector acquires an interest in pushing towards socio-economic objectives rather than profit. Business models should be chosen in consequence.

**Towards social impact: the Broadway Example**

Broadway Partners recently published a social impact report with the aim to transform the communications infrastructure of the UK. They claim that it is not because of a lack of demand but because of weak anti-trust regulation and an over-dominant incumbent that there exists a lack of incentive to invest in fibre in the UK. Because of lack of competitive threat, the incumbent protects the value of its copper network and its cash flows, framing the political debate in the direction of incremental upgrade rather than wholesale renewal of infrastructure.

Broadway's primary purpose is to ensure that the economic and personal welfare benefits of the Internet are available to all members of society, regardless of physical location or socio-economic status. They emphasize the fact that broadband should be regarded as a basic right, along with health services and education. But also in the UK a clear digital divide exists.

Broadway will start to deliver NGA network capability to those parts of the UK that are beyond the incumbent's upgrade programme. Broadway will work as a catalyst, working through industrial partners and will use several business models of which the preferred approach is the PPP/co-investment model.

The estimated socio-economic impact of Broadway's approach is similar to that covered in this note. However, to gain a better insight in the different business models used to stimulate high-speed broadband investment in Europe and their socio-economic benefits, more research on this front is needed.
2.3 How to Measure the Benefit that cannot be Monetised

The ROI-based business model is driven by profit and is acceptable for a private sector operator, but it fails to capture the full return for society as a whole and cannot be internalised by private sector telecom operators. However, public authorities have to act in the interest of society as a whole and should therefore be able to clearly define where private sector operators cannot intervene and provide an alternative strategy for these areas.

This is currently done by the National Regulatory Authorities on a periodic basis through a survey aimed at identifying the areas where operators are willing/able to invest. The results of this exercise have been of different quality according to the competitive pressure in the Member State surveyed.

The risk is that in countries with little infrastructure competition the operators might refrain to invest in profitable areas and wait for the state-support schemes to arrive. A more coherent application of CBA guidelines is needed when giving grants under the European Structural and Investment Funds (at the moment discount rates chosen for NPV calculation may vary greatly across and within MS).

To ascertain whether intervention in a given area is justified (no crowding-out) and proportional, a number of methods exist.

In the CBA guidelines, the European Commission proposes cost benefit analysis as a tool to judge the economic advantages or disadvantages of an investment decision by assessing the costs and benefits in order to assess the welfare change attributable to it. A CBA must include an economical and financial analysis and risk assessment. The rationale behind CBA is that investment decisions are sometimes taken on the basis of profit motivations and price mechanisms, which could lead to socially undesirable outcomes. In order to measure the project's contribution to social welfare, the input, output and external effects of an investment project should be valued at their social opportunity cost.

CBA follows a microeconomic approach with a long-term perspective. It provides monetary value to positive (benefits) and negative (costs) welfare effects of a project. These values are discounted and then totalled to calculate a net total benefit.

Costs and benefits occurring at different times must be discounted. Social discount rate (SDR) is used to reflect a social view of how future benefits and costs are to be valued against present ones. The SDR affects the weight attributed to future benefits and costs. After the use of the appropriate discount rate, it is possible to calculate the project economic performance using the indicators' economic net present value (ENPV), economic rate of return (ERR) and benefit/cost ratio (B/C ratio). The concept of ERR is very important as it factors in components that cannot be internalised by the private sector operator through the IRR. This is the first step towards the socio-economic return on investment which we will deal with in the next section.

A financial analysis must be included in the CBA to compute a project's financial performance indicators; financial net present value (FNPV) and financial rate of return (FRR). For public investments to be financed by EU funds, the FRR on the investment is expected to be lower than the applied discount rate and the revenues generated will therefore not cover the costs. These investments however, are high on national capital, which means that the project performance from the public entities in the member states' perspective is positive. Finally, a risk assessment must be included in the CBA to deal with the uncertainty that permeates investment projects.
### 2.4 Public Investment Models

There are four types of public investment models for broadband development. The choice of model is a decision based on the budgetary and socio-economic context of the area, the ambitions of the public authority (PA) and the development goals for the region. These four investment models for broadband development are:

1. **Direct Investment: The Publicly Run Municipal Network Model**
   
The public authority builds a broadband network in the municipality, county or region. A company or dedicated division typically needs to be established. The public authority keeps ownership of the network and runs operations and maintenance. A PPP can also be used. This model is very common in the Nordic countries. An example of a successful implementation of this model is Stockholm\(^2\), where since the rollout in 1994, a profit of 1.6 bn. SEK was demonstrated. Further information on this can be found in section 3.4.

2. **Indirect Investment: The Privately Run Municipal Network Model**
   
The public authority procures the building and operation of a broadband network in the municipality, county or region to a private actor. The contracted private firm generally builds an open, operator-neutral network over which competing services can deliver services to all end-users. The contracted firm commits the investment and takes all the revenues as well as the business risks for the whole contract period. It is relatively common in continental Europe, e.g. in the county of Nièvre in France.

3. **Support of Community-Led Initiatives: The Community Broadband Model**
   
Broadband investment is done as a private initiative by local residents, in a "bottom-up" approach. These projects have generally been very successful in driving the take-up rate among the end-users and in building financially sustainable cases. Competition varies. The role of the public authority is to provide support if and where needed (e.g. co-financing, advising, regulation). This can be found in the Nordic countries, the Netherlands and parts of the UK.

4. **The Operator Subsidy Model** (a.k.a. gap-funding)
   
The Public Authority decides not to become directly involved with broadband deployment in the region, limiting itself to subsidising one market actor to upgrade its own infrastructure. The Public Authority funds the gap between what is commercially viable and the coverage that the public authority aims to achieve. Funding is offered as a grant to one or more private operators to deliver the desired outcome. This models is widespread in a number of European countries using Structural Funds, it is the less engaging for PAs but has not delivered an optimal outcome in a number of cases.

One of the questions the public authority will need to answer in choosing an investment model is: "Given the socio-economic conditions on the ground, what level of competition is required to facilitate penetration of high quality and affordable services?" For instance, contexts characterized by the inability to use or to afford ICT may slow down penetration of broadband and consequently also penetration of ICT. The investment model adopted in a project can also significantly influence future investment.
3 Towards a Social Return on Investment: which Socio-Economic Effects cannot be internalised?

If some positive externalities cannot be captured by for-profit entities, how can we justify public action? In this section we introduce the notion of Social Return on Investment (SROI). There are several definition of SROI: according to the general Wikipedia definition it is "a principles-based method for measuring extra-financial value (i.e., environmental and social value not currently reflected in conventional financial accounts) relative to resources invested. It can be used by any entity to evaluate impact on stakeholders, identify ways to improve performance, and enhance the performance of investments". We will explore the methods for estimating it and describe the socio-economic benefits that cannot be internalised by private operators but will result in more employment and GDP.

Finally, we will describe intangible assets that even indicators such as GDP cannot capture when assessing the full benefit of high-speed broadband for society as a whole.

In addition to CBA there are multiple other approaches to estimate the economic impact of broadband, ranging from econometric techniques to qualitative micro-level case studies. Analysys Mason and Tech4iError! Bookmark not defined. point out three methodological approaches that are ostly used in analysing the potential impact of high-speed broadband in Europe.

In sum, the choice of analytical technique is driven by the availability of data and the type of effect to be analysed. Van der Wee and colleagues stress that top-down methods only evaluate the overall effect using aggregated macro-economic data. They suggest a bottom-up approach to capture the indirect effects of broadband, which has the advantage of a clearer link between results and individual effects, more detailed results and the possibility of forecasting27.

The other techniques most commonly in use are:

- Firstly, input-output analysis is mostly used in studies to estimate job creation from broadband deployment. The analyses are used to investigate the interrelationship between economic sectors at a certain point in time and normally make use of multipliers. Input-output analyses are robust in estimating short-term direct and indirect effects but do not measure dynamic processes. The impact of network construction may be over- or underestimated.

- Secondly, regression analysis can be used for estimating the relationship between one or more explanatory (or independent) variables and a dependent variable. Studies usually use change in employment or GDP as the dependent variable. Sufficient data needs to be available to develop the analysis, which is often lacking.

- Thirdly, consumer surplus studies are used to estimate consumer surplus benefits arising from broadband deployment and adoption. Consumer surplus is the difference between the total amount that consumers are willing and able to pay for a good or a service and the total amount that they actually do pay. Consistency of data is essential when undertaking consumer surplus calculations.
3.1 The GDP paradox

It can be argued that the above mentioned econometric techniques do not suffice in measuring the socio-economic impact of broadband. The main indicator of welfare that is used is GDP and for over half a century now, a paradox has existed on whether this indicator is a satisfactory measure of (social) welfare.\textsuperscript{12} A few of the criticisms are the fact that GDP does not capture: benefits, social costs, basic needs, happiness, (in)equality, and many more factors.

Alternative indicators of social welfare that succeed in repairing the list of shortcomings of GDP have yet to be found. GDP has a large impact on both private and public decisions and can therefore not be left out of this note. We do however not deny that GDP represents a serious information failure and suffers from many shortcomings.

3.2 Intangible assets

A key question in the field of socioeconomics is how to transform an intangible input or asset into a financial value or asset. In a network, participants use tangible and intangible assets and convert them into more negotiable forms of value that can be delivered through a transaction. "The value of the deliverables received is realized by participants when they convert them into gains or improvements in tangible or intangible assets."\textsuperscript{13}

In terms of intangible assets, Verna Allee\textsuperscript{13} suggests the use of a value network analysis to explore the creation of value through intangible assets, consisting of an exchange analysis, impact analysis and value creation analysis. Using this analysis one maps the overall pattern of exchanges and value creation in the system as a whole, with the amount of impact each value input has and one looks at the best way to create, extend and leverage value.

Real options theory explains how high-speed broadband deployment can provide valuable future benefits that are not captured by traditional expected net present value (NPV) theory. NPV theory calculates future cash flows of an investment project based on today's expectations of future information, where option valuation allows for the flexibility of making decisions in the future. It takes into account the uncertainty of future cash flows, the irreversible investment at time $T$ and the flexibility of investment timing. Option pricing will therefore always result in greater values than NPV theory. In the case of high-speed broadband deployment, the costs of deployment might result in a low NPV, while according to real options theory this value is higher when taking into account e.g. the benefits of the services provided over the broadband infrastructure in the long run.

The above suggests that when calculating the benefits of high-speed broadband, we need to take into account the value of future options which cannot be monetised at the moment of calculation and that can result from empowering citizens and businesses.

\textsuperscript{12}http://www.sciencedirect.com/science/article/pii/S0167487008001141
\textsuperscript{13}http://www.vernaallee.com/images/vaa-vnaandvalueconversionjit.pdf
3.3 Effects on Growth and Jobs

This section focuses on the different types of socio-economic effects that can be generated by universal availability of broadband connectivity. The study on the socio-economic impact of bandwidth and published by our services in 2013 has carried out an extensive literature review and identified several spill-over channels to areas such as education, crime, household income, well-being and so forth. Although most of this literature focused on first generation broadband, we strongly believe that the same dynamic applies to NGN, due to the development of bandwidth-hungry applications.

The study has also tried to obtain a quantitative estimate of what achieving the broadband targets for 2020 may mean in terms of jobs and GDP. This was done by reviewing research that estimated job creation and GDP growth from broadband deployment using input-output models. The authors emphasize that these studies usually use robust national data tables, however differences arise because of different time periods studied or different assumptions made.

Six of the reviewed studies estimated job creation from broadband deployment, estimating that each one billion EUR spent on broadband deployment will on average create 9320 jobs. Broadband construction has an effect at three levels: direct employment (network construction); indirect job creation (incremental employment generated by businesses selling to those that are directly involved in network construction); and induced job creation (additional employment induced by household spending based on the income earned from the direct and indirect effects).

According to the study, generating one direct job in network construction could change the total employment in the study area between 1.38 and 1.83 jobs from direct and indirect linkages and between 1.92 and 3.60 jobs from direct, indirect and induced linkages.

The Fibre to the Home Council Europe further mentions that a 25 million EUR investment in information and communications technology (including smart grid and broadband) would create or retain 700,000 jobs, of which 360,000 would be small business jobs.

Raul Katz and Stephan Suter note that there is no linear relationship between broadband and job creation; they find instead an inverted U-curve. This implicates that the impact of broadband on employment only becomes significant after a certain level of broadband penetration. Katz and Suter explain this by stating that broadband will be adopted first by those who get the greatest benefit from it, while later adopters will realize less benefit. The strength of the relationship in this case is highest once the technology has achieved a critical mass but before it reaches saturation. This critical mass is generally associated with levels of penetration of industrialized countries, leading to increasing returns on growth. An implication of this U-curve is that, beyond a certain penetration level, the effect of broadband on employment will tend to lose strength. The productivity gains will then result in a reduction of employment due to capital-labour substitution and achieving critical mass could therefore accelerate labour displacement as a result of outsourcing. The boundaries of this “window of opportunity” between the critical mass and saturation point have not yet been identified.

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14http://www.ntia.doc.gov/legacy/broadbandgrants/comments/1EA7.pdf
Examples of activities that are likely to be important in service industries are use of broadband at home to connect to business offices or to telecommute. Broadband also provides possibilities for a quick introduction of new applications and services. Possible reasons for this positive effect of broadband for the manufacturing sector are e.g. better supply chain management and productivity gains.

Katz and Suter state three types of impact of broadband on employment can be identified:

- **Acceleration of innovation** resulting from the introduction of new applications and services (with the consequent creation of employment).

- **Improvement of productivity** as a result of the adoption of more efficient business processes enabled by broadband, where it was found that companies adopting broadband-based processes also improved their employees’ labour productivity on average by 5% in manufacturing and by 10% in services.

- The possibility of **attracting employment from other regions** as a result of the ability to process information and provide services remotely. It is possible that the lower indirect effects of European economies compared to US economies stems from this. Furthermore, because many European countries are relatively small and have several adjacent neighbours with common land boundaries, it could be the case that neighbouring countries are involved in meeting direct or indirect demand. The parameters (member state borders) adopted within which to calculate impacts could therefore have a significant effect on indirect effects.

These three effects act simultaneously, resulting in contradictory positive and negative impacts on employment. Katz and Suter suggest the negative effect is compensated by an increase in the rate of innovation and services, resulting in the creation of new jobs. Again important is the notion of ‘critical mass’ research that suggests that the impact of broadband on employment only becomes significant once the adoption of the platform achieves high penetration levels.

Below an indication is given of the nature of jobs created under three scenarios; no intervention, moderate intervention and major intervention. Under all three scenarios direct and indirect jobs comprise about one third of the total jobs created.
A large number of studies conclude that broadband has a significant and positive impact on economic growth (measured through GDP). Results can be found in the table below.

<table>
<thead>
<tr>
<th>Country</th>
<th>Study</th>
<th>Data</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA</td>
<td>Crandall et al. (2007)</td>
<td>48 States of USA for the period 2003–2005</td>
<td>Not statistically significant results</td>
</tr>
<tr>
<td></td>
<td>Thompson and Garbacz (2009)</td>
<td>46 US States during the period 2001–2005</td>
<td>A 10% increase in broadband penetration is associated with 3.6% increase in efficiency</td>
</tr>
<tr>
<td>OECD</td>
<td>Czernich et al. (2009)</td>
<td>25 OECD countries between 1996 and 2007</td>
<td>The adoption of broadband raises per-capita GDP growth by 1.9–2.5 percentage points</td>
</tr>
<tr>
<td></td>
<td>Koutroumpis (2009)</td>
<td>22 OECD countries for the period 2002–2007</td>
<td>An increase in broadband penetration of 10% yields 0.25% increase in economic growth</td>
</tr>
<tr>
<td>High-income economies</td>
<td>Qiang et al. (2009)</td>
<td>A high-income subset of 120 countries, for 1990–2002</td>
<td>10% broadband penetration yields an additional 1.21 percentage points of GDP growth</td>
</tr>
<tr>
<td>Low- and middle-income economies</td>
<td>Qiang et al. (2009)</td>
<td>The remaining low and middle income subset of the 120 countries</td>
<td>10% broadband penetration yields an additional 1.38 percentage points in economic growth</td>
</tr>
</tbody>
</table>

The positive impact on GDP is related to improvements in productivity. Examples of productivity gains are growth of the information work force and adoption of ICT services. In the case of productivity growth an inverted U-shape is also present, therefore a threshold has to be passed and the eco-system has to be developed enough to result in an impact of broadband development.
More recently a study for DG ECFIN by Lorenzani and Varga\textsuperscript{15} has tried to model and quantify the impacts of product market reforms for telecom: interestingly enough the main gains in terms of additional GDP would come from demand-side reforms rather than supply-side ones. Examples of this are the impact on GDP of reinforcement of the integration of the Digital Single Market and e-business models (1.9% in the long run) and enhancement of professional e-skills (0.4% in the long run).

A 2014 study by Econstor\textsuperscript{16} showed a positive relationship between broadband speed and GDP, with greater effects for countries with lower income.

Figure 7 – The relationship between (average) speed and GDP per capita in OECD countries (Q4 2012)

3.4 Effects on Consumers

The socio-economic benefits for consumers originate from multiple fields. Ultra-fast broadband over FTTH is much more than just doing the same things faster. Some services work much better over FTTH, while others simply won't work at all without it. A study by Richard Hayes\textsuperscript{17} on the benefits of broadband makes the distinction between home entertainment and communication, e-health, e-education, e-government, smart grid benefits, transport, teleworking and cloud computing\textsuperscript{18}.

- **E-health** is an important benefit for consumers. Fibre makes it possible to home-monitor patients or the elderly, but also provides the opportunity to better provide health information to the public and training and support by health professionals, especially in rural areas. Healthcare demands ultra-high quality of service and reliability and these services can therefore only exist where there is fibre deployment\textsuperscript{19}. Because fibre access networks have lower latency, there is no noticeable delay in exchanging information. This is important for applications that depend on real-time communication and high-resolution images, such as remote medical diagnostics and surgery.\textsuperscript{6}

\textsuperscript{16}http://www.econstor.eu/bitstream/10419/101415/1/795234465.pdf
\textsuperscript{18}For more detailed information on why ultrafast broadband is needed for these applications, we refer to the note on the Need for Speed by the EC.
\textsuperscript{19}A study was recently carried out for European Commission (2014) on use of commercial mobile networks and equipment for "mission-critical" high-speed broadband communications including savings through mobile emergency medical support. It demonstrates that the value of life saved by prompter intervention of emergency services would easily outweigh costs. The study is available at: http://ec.europa.eu/information_society/newsroom/image/smart_2013_0016_final_report_8211.pdf
- **E-education** can reduce the need to travel to class and research and courses can be done more remotely.

- **E-government** options are information and resource provision for citizens, transactions between government and citizens (e.g. applying for licences and paying for tickets) as well as the exchange of specifications, data and images with businesses. This may be more cost effective under faster broadband. The result is possibly a decrease in the offline demand with greater residential broadband availability.

- In the home, broadband enables home entertainment and other **home-based services** such as home security, utility monitoring and control and home automation. It becomes possible to introduce new applications and services, e.g. e-health, telemedicine, internet search, e-commerce, online education and social networking. For security applications, FTTH is necessary to ensure quality-of-service and reliability.

- **Smart grid** is a way of achieving digital control over balancing electricity supply, demand and transmission capability. This is driven by collection of information about customer loads and distributed energy resources via smart meters. The smart grid demands reliability and physical security and existing broadband networks are often poorly capable of processing the steady stream of data that is created.

- Furthermore, faster broadband can be used to improve **transport** via improvements in household and business trip planning and congestion avoidance from receiving more detailed and more frequent traffic information. Centralised traffic monitoring and management by roads authorities may also benefit from backhaul and other fixed line improvements.

- **Teleworking** results in reduced travel time, stress and travel costs for the consumer. Indirect benefits are reduced congestion and environmental impact because of reduced travel.

- Finally, via **cloud computing**, consumers can access all of their documents and data from any device with internet access.

The following figure depicts the capabilities needed for different services.

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20 Some studies already show that benefits and cost-savings by national health systems from telemedicine/e-health alone could already be monetised and could exceed in a few years the level of CAPEX needed for new infrastructure rollout. An example for Australia is the study "Telemedicine in the context of the National Broadband Network, available at: http://www.nicta.com.au/content/uploads/2015/02/TelehealthNBN.pdf"
A study commissioned by the FTTH council in 2014 on the differences in broadband attitudes and usage between FTTH/B users and DSL users showed that the superior quality of FTTH/B over DSL is perceived and valued by FTTH/B users. In less mature markets this perceived quality is lower. Furthermore, FTTH/B users want higher performance (an opportunity for upsell revenue increase) and are more interested in new service concepts. Pent-up demand from DSL users who cannot migrate to fibre improves the business model of outward fibre deployment, since the main barrier to upgrade is the availability of better service. Finally, it is shown that differences in behaviour are driven by FTTH/B adoption and are not a result of power users choosing FTTH/B.  

"Subscribers to FTTH have higher satisfaction rates with their service providers than other broadband users. Other factors that contribute to this are the fact that the rare failures can be diagnosed remotely using technology that can pinpoint the exact location of the fault, and can be repaired quickly, often even before the end customers becomes aware of service disruption. The optical cable also does not impose physical restrictions on the speed that can be achieved – unlike copper telephone cables and regardless of the number of users or distance from the cabinet.”

The broadband series emphasizes that consumer surplus (the amount of utility that consumers gain from purchasing a product for a price that is less than what they would be willing to pay) is enhanced because of high speed broadband development. Drivers of willingness to pay are; the enhanced access to information, entertainment, health and public services and saving in transportation. Robson emphasizes the possible under- or over-estimation of the impact of broadband speed on future innovations and the value of new applications, services and products by customers and producers. This may lead to estimates of willingness to pay not correctly and fully reflecting the relevant benefits.

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22 http://www.ftthconference.eu/conference/conference-programme
Finally, Rohman and Bohlin\(^\text{25}\) have shown that household income improves because of high speed broadband connections. The fibre to the home council Europe emphasizes that the number of domestic appliances with internet connectivity is ever increasing and in order to be able to provide next-generation services that are always on, such as home security systems or smart meters, bandwidth availability must increase. Fibre networks are the only networks that can provide this.\(^\text{6}\)

**The aging continent: The Silver Economy**

Because of ageing, 1 in 3 Europeans will be over 65 years old in 2060. If we don't change our systems for health and social care we will not have the money and the people to guarantee a good and healthy life for all. Reinvention of our health and social care is needed. Innovative new ICT products and services can help us deliver better and cheaper care for all. Ageing in good health allows us to work for more years, learn new things and prepare our homes for living independently for the many years to come. Europe has what it takes to benefit from its ageing population. A host of SMEs and startups are developing, as well as new ICT products such as care robots, health mobile applications and integrated therapeutic solutions by big pharma companies. The silver economy offers new highly skilled tech jobs but also the opportunity for low qualified population to reskill.

Solutions do not need to be expensive. In the Netherlands, the town of Nuenen, which has one of the world's highest FTTH densities, has linked its elderly population over high-speed networks to create a video-based platform of community exchange, which reduces loneliness.\(^\text{6}\)

In order to become a leader in the silver economy, it is important to invest in fiber infrastructure. Only with sufficient broadband speed will Europe be able to benefit from its ageing population.


**Socio-economic benefits in rural areas: Berkshire 2014**

Adroit Economics and the Community Broadband Network (CBN)\(^\text{26}\) performed a study on the economic and social impact of broadband in Berkshire county in the UK. Benefits for white, grey and black areas were reported.

**Economic Benefits**

Over the next 5 to 7 years, Berkshire will generate an additional 1.2 billion gross value added (GVA) because of optimization of advanced ICTs by businesses. This equates to 17,000 jobs. 2,300 of these will come from uplift in white areas in the county. West Berkshire, with the largest white areas, accounts for the most significant ICT-driven GVA uplift and associated jobs. When broadband speeds are quadrupled and there is a 10% additional penetration in white areas, this will generate an additional 150 million GVA over the next 2 years.

**Social Benefits:**

At this point in time, there are over 140,000 people and 44,000 households in Berkshire that are digitally excluded. Benefits stemming from access to the internet are significant: students would

\[^{25}\text{https://www.econstor.eu/dspace/bitstream/10419/88531/1/774543450.pdf}\]

\[^{26}\text{Berkshire: http://www.superfastberkshire.org.uk/CHtPHandler.ashx?id=29612&p=0}\]
achieve better GCSE results (and associated increased lifetime earnings), the unemployed would find new jobs more easily (and associated increased lifetime earnings), there would be household savings from shopping online, which also would save the public sector 25 million pa in transaction costs. Furthermore, there would be 120,000 less visits to the general practitioner per year, resulting in cost savings to the National Health Service because of increased access to on-line health information.

3.5 Effects on Businesses

Business use of high speed broadband allows for many advantages, especially in firm efficiency. Examples of more efficient business processes are marketing, inventory optimization and streamlining of supply chains\(^\text{23}\). Other advantages are high definition video conferencing and cloud computing\(^\text{17}\) as well as new forms of commerce and financial intermediation. Besides advantages for production processes, high-speed broadband connection also allows for teleworking, which reduces not only travel time but also expenses on office rent, travel reimbursement and operational savings (lightning, electricity, cleaning staff, etc.). Furthermore, it has been shown that high speed broadband leads to a reduction of excess inventories and business revenue growth. Growth was especially seen in service industries, but in manufacturing as well\(^\text{23}\).

Robust networks are necessary; the networks must be ultra-reliable for business use. The fibre to the home council Europe emphasizes that for small businesses, the use of internet business services is correlated with competitiveness. Starting a home-based business requires FTTH as well.

Finally, the new media industry is expanding and needs fibre. It is forecasted that the entire global gaming business will produce more than $100 billion in 2017. Note that the average age of players in the US is 30, and 45% of them are female. FTTH is not only preferred by gamers but is also vital for the future of television and today copper networks simply cannot accommodate the growing bandwidth demand in the media sector.\(^6\)

Van der Wee and colleagues\(^\text{27}\) used a bottom-up approach to quantify the benefits of FTTH in comparison with xDSL for e-business and e-government in the cities Eindhoven and Ghent. They concluded that there is a clear advantage for FTTH for e-business, while for e-government there was limited additional value of FTTH. According to van der Wee et al., savings in travel and operational savings have the most effect. More efficient use of ICT by centralizing ICT infrastructure could also provide larger savings for business and authorities and should be kept in mind when evaluating investment in fibre infrastructure.

In sum, the indirect benefits of fibre are significant and would provide large businesses and local authorities additional incentives to stimulate investment in broadband networks.

![Figure 8 - source: Van der Wee et al (2013)](image)

\(^{27}\) VanderWee et al: http://dx.doi.org/10.1016/j.telpol.2013.12.006i
3.6 Effect on economic development and Innovation

According to the broadband series\textsuperscript{23}, broadband contributes to economic growth through (1) more efficiency in business processes, (2) acceleration of innovation by introducing new consumer applications and services (e.g. new forms of commerce and financial intermediation) and (3) more efficient functional deployment of enterprises by maximizing their reach to labour pools, access to raw materials, and consumers (e.g. outsourcing of services, virtual call centres).

A regional initiative: \textit{Nièvre Numérique}

In December 2014, Nièvre Numérique conducted a survey to collect a number of indicators to measure the socio-economic impact of the introduction of Smart Work Centers (SWC): demographic indicators (i.e. total population of the region and age-structure composition of the population), commuting, digital growth, environmental impact and cultural, social and sport life. SWCs are business spaces that allow for interaction and collaboration and provide high-level ICT infrastructure and capabilities. SWCs offer a support infrastructure providing managerial, administrative, technical and social support services. Case studies on France, Denmark, the UK and the Netherlands showed positive effects on businesses, where the SWC functioned as a business hub when local and external businesses, employees, entrepreneurs or freelancers were attracted to it. This led to the exchange of experiences and competence, resulting in a business creation effect. In Lormes, France, the SWC additionally resulted in an increase in the number of events organized per week with hundreds of people attending as well as local investment and more people being active in associations.

A regional initiative: \textit{The Noord-Brabant case}\textsuperscript{28}

In the Netherlands, there have been multiple regional initiatives aimed at implementing FTTH networks in different municipalities. In June 2013, the provincial council of the province Noord-Brabant in the Netherlands decided to invest €55 million on improving the broadband infrastructure in the province. A better broadband infrastructure should improve health, the leisure economy, rural economic development, agrifood and mobility in the province of Noord-Brabant. These areas are considered vital for the local economy of the province.

The municipality Nuenen became the first city in Noord Brabant to implement FTTH and because of being a black area this was highly risky and uncertain. Individual meetings with key individuals in the community were set up to develop social assistance. To reach high penetration and reduce demand uncertainty, the network was deployed in the entire community. In the first year the project was already highly successful with a penetration rate of 97%. The development of the FTTH network would not have been possible without government subsidies. The case of Nuenen provided incentives for other broadband initiatives in the Netherlands. Private companies used the business model of Nuenen as a benchmark to roll out FTTH networks in other regions of the Netherlands. Involvement of the municipality in these networks varies from direct initiation to passive participant.

There is limited evidence that the network was mostly utilized for acquisition of health information, educational information, and for information useful for finding a new job. About 30% of the users increased their social capital by making new contacts with people.

\textsuperscript{23}http://www.efx.nl/media/project_downloads/Ivision_2010.pdf

\textsuperscript{28}http://micropol-interreg.eu/IMG/pdf/MICROPOL_SROI_Study_2014.pdf
3.7 Other effects on society

When comparing the studies on broadband deployment effects in Europe and the USA, it appears that European economies have lower indirect effects than the US economy. Analysys Mason and Tech4i2 suggest this could be due to a leakage of money (arising from broadband deployment) to countries beyond the boundaries of those being studied. The parameters used for the studies can have a significant effect on the indirect effects measured. The effect of investment in high-speed broadband deployment may therefore actually be greater than is suggested.

Forzati and Mattson analysed the fibre investment model of the city of Stockholm, and its effect on the different stakeholders and society. The company Stokab invested in an open, neutral-fibre network for everyone, and the study finds these investments to have generated significant economic benefits for society, enterprises and citizens. The socio-economic return on Stokab investment in passive infrastructure is estimated to be over 16 billion SEK, as shown in the figure below.

![Figure 9 - source: Forzati & Mattson (2013)](image)

The socio-economic return was calculated as the sum of increased property value, revenues for the municipal housing companies, added value for tenants, increased employment, Stokab's return, saving for local governments' ICT costs and increased economic activity in the supplier industry. Notable is that Stokab only owns and operates the passive infrastructure and leaves active network operation and service provisioning to the market in an intensive competition environment.

Preliminary follow up results by Forzati and Mattson show that there is a correlation between FTTH/B and entrepreneurship, where a 10 percent higher fibre penetration is correlated with an average creation of 13 extra companies per 100,000 inhabitants. Furthermore, a correlation is observed between fibre and driven distances. A 10 percent higher fibre penetration results in an average 130,000 less kilometres driven a year, per capita. It has yet to be analysed how these numbers vary between rural and urban areas. Finally, yearly net savings in the delivery of home care because of digital services can reach 4 million EUR in sparse rural municipalities (pop 8,000; 2 inh/km²) and 68 million EUR in a large city (pop 500,000).

An overview of the main benefits of high speed broadband mentioned in this note, are depicted in the figure below.
4 Towards broadband as a public good?

Well-known examples of public goods are street lighting, law and order and defence. A common misunderstanding is the fact that public goods are only provided by the state. This need not to be the case, some public goods may be supplied by the private sector. Furthermore, there are different levels of public goods, ranging from a pure public good to a pure private good.

Public goods exhibit two key characteristics: they are non-excludable and non-rival in consumption. Which means it is impossible to prohibit access to a good once it is provided and that it is either impossible or extremely costly to exclude people. Non-rivalry means that the consumption of one person does not affect the quantity available for consumption by others. In the case of a pure public good the marginal cost of supplying to an additional user is zero.

High-speed broadband shares characteristics of a public good, in the sense that the cost of provision is often high and while the value to society exceeds the cost, the individual consumer does not place sufficient value on the good for it to be provided by the private sector. The Digital Agenda targets are aiming for policy that ensures no individual is excluded from broadband consumption, and the focus on net neutrality should ensure that the consumption of connectivity does not impact the quality of the open internet. This would ensure broadband that is non-rival and non-excludable.

However, despite these inherent features of high speed broadband, the deployment of NGA has largely been confined to the realm of for-profit operators, which have been largely upgrading network in urban areas or where directly threatened by infrastructure competition (mainly cable). Most rural areas in Europe are unlikely to be covered by for-profit operators, but the classification of broadband as a public good has been left at the margins of the political debate.

The Smart Working Centres of Nièvre Numérique mentioned above are an example of high-speed broadband as a public good, with clear benefits for society. Public Hot Spots also show the development towards broadband as a public good.

Certainly, one of the key issues for a future policy of the EC is to balance the competition related and public-goods related aspects in defining the specific aspects of our broadband policy. From a public goods perspective, there are concerns with respect to expected increasing demand for bandwidth which creates, in turn, markets for new broadband services. This is the only way to capture the intangible assets like well-being and quality of life and to capture the value of future real options of growth that arise from empowering citizens. These considerations are probably of utmost importance and go clearly in the direction of having broadband clearly linked to a public good status in the policy debate.

The qualification of broadband as a public good will have certain consequences with regard to existing European and national policies. As an example incorporating high speed broadband into the Universal Service Obligation would mean redefining the role and financial commitment of public authorities in Europe. As USO was conceived for giving the service to a marginal part of the population (typically the last 5%), this concept is still not applicable to high speed broadband. However, the expansion of the universal service definition and the inclusion of broadband in the scope of USO may become a necessity, if the ambitious aims of the DAE are to be achieved (Nucciarelli et al., 2014). Different theses exist on this point.
However, USO is not the only tool at the disposal of the EC, should broadband start being considered as a public good. The re-vamping of National Broadband Plan and an investment-friendly regulatory framework (avoiding over-build, binding mapping) could create the necessary environment for deployment. Funding is also of capital importance; not only for grants, but also in terms of equity and debt support that can be guaranteed by the Juncker Plan to small broadband projects, provided aggregation vehicle exist. But for all this to happen the Commission should launch a clear message that it considers broadband a public good for all Europeans' consumption and not only a private sector-business.

5 Conclusions

High speed broadband has a positive impact on more elements of society than captured by the traditional return on investment considerations. This note has emphasized the importance of fibre deployment in order to meet the need for speed in the future. Benefits described by the studies, and reinforced by the observations, case studies and anecdotal evidence, include; the potential for higher revenues and lower costs for businesses and consumers alike (due to higher productivity and efficiency) and access to information and markets which are no longer restricted geographically. The studies describe in detail the features of broadband networks as a basic infrastructure, bringing network and scale effects to programmes of public interest (e.g. e-health and e-education) as well as broadband as an enabler of private sector innovation and a necessary element of disruptive offers (e.g. supporting business efficiency (cloud) or entertainment).

Authors agree on the socio-economic benefits of next generation networks; i.e. broadband deployment not only has a direct stimulation effect on job creation and GDP, but also provides for indirect benefits from connectivity, which exceed the financial costs. Most broadband projects have a positive economic rate of return, with key areas of benefits for consumers, businesses and government. However, private operators alone are not able to capture this full socio-economic benefit.

As demonstrated by the effect on employment, socio-economic benefits of broadband may not appear in a linear way. Some of them will only appear and become visible once penetration and use reaches a given level. This feature is also typical for infrastructure investment, in which initially use drives construction of networks and subsequently the availability of infrastructure encourages adoption of services, which in turn increases use, leading to a peak in monetisable even and non-monetisable benefits in a self-reinforcing cycle.

Policy should avoid groups without digital access being left behind because of a lack of private sector operators to invest in passive broadband infrastructure. The benefits that society can reap from an ubiquitous broadband connectivity outweigh the cost of construction. Hence, it makes economic sense, from a public policy perspective to intervene and build these networks in areas where the market will not deliver and avoid to replace the market in other areas. The incoming strategy on the Single Digital Market as well as the review of the regulatory framework, compulsory infrastructure mapping and the state aid policy we pursue will be of fundamental importance in this respect.

Currently available studies reinforce the need for public intervention to reinforce and complement private sector investment in broadband. None of them, however, covers all EU countries and all aspects of socio-economic benefits, and in most cases the extrapolation potential may be limited. This note informs us about the scope of a new study that is needed. An important point is the fact that while most authors agree on the necessity of connectivity for mass adoption, there are still
uncertainties on this inverted U-curve, where the point of critical mass and saturation and therefore the window of opportunity of broadband are unknown. Furthermore, because innovation on broadband happens fast, part of the literature reviewed in this note is already outdated. Apart from that, most studies are geographically limited and use limited data, which makes it difficult to draw European conclusions.

Further study of the socioeconomic benefits of high-speed broadband is necessary; it is recommended that broadband policy is accompanied by the observation of socio-economic benefits as they develop.