Horizon 2020

Project title: Network Infrastructure as Commons

Deliverable D2.1: The Multiple Aspects of Politics of Sustainability in Community Networks: Definitions, Challenges, and Countermeasures

Deliverable number: D2.1

Version 1.0

Co-Funded by the Horizon 2020 programme of the European Union
Grant Number 688768

Project Acronym: netCommons
Project Full Title: Network Infrastructure as Commons.
Call: H2020-ICT-2015
Topic: ICT-10-2015
Type of Action: RIA
Grant Number: 688768
Project URL: http://netcommons.eu

Editors:	Prof Christian Fuchs, Dr Maria Michalis, Dr Dimitris Boucas - University of Westminster: Westminster Institute for Advanced Studies
Deliverable nature:	Report (R)
Dissemination level:	Public (PU)
Contractual Delivery Date:	June 30, 2016
Actual Delivery Date :	July 3rd, 2016
Number of pages:	136
Keywords:	sustainability, information technology, information society, broadband policy, community networks
Authors:	Christian Fuchs, University of Westminster Maria Michalis, University of Westminster Dimitris Boucas, University of Westminster
With comments and peer reviews by:	Merkouris Karaliopoulos, Athens University of Economics and Business Panayotis Antoniadis, Nethood

Executive Summary

This deliverable discusses the politics of sustainability in general, in the information society, and in respect to community networks.

The first chapter (written by Christian Fuchs) studies theoretical foundations of sustainability. It gives an overview of what sustainability is and traces the history of the concept (section 1.1). It then relates the concept to information technology and the information society (section 1.2). It identifies ecological, economic, political, and cultural dimensions of (un)sustainable information technology. Finally, the chapter uses the preceding discussion and discusses in section 1.3 (un)sustainability in the context of community networks. The chapter provides checklists that support asking sustainability questions.

The second chapter (written by Maria Michalis) assesses the EU approach towards telecommunications liberalisation. It identifies two main eras: the initial era of the copper network (section 2.1) and the current era of the transition to NGAs (section 2.2). It examines the key characteristics of each period, before proceeding to present data about the structure of the broadband markets in the EU (section 2.3). There follows an examination of the role of municipality and community networks within the EU's liberalisation approach (section 2.4). Finally, the chapter ends with some remarks about the current perception of community networks in the EU policy framework, their potential and pitfalls.

Contents

1 Theorising Sustainability in the Information Society

The task of this chapter is to outline theoretical foundations of how we can understand sustainability in the information society and how sustainability and unsustainability are related to information technology and digital networks such as the Internet. Section 1.1 discusses the theoretical concept of sustainability; section 1.2 focuses on sustainability in the information society; and section 1.3 relates the topic of sustainability to community networks.

1.1 The Sustainability Concept

1.1.1 The Environmental Understanding of Sustainability

The United Nations World Commission on Environment and Development (WCED) in the years 1983-1987 conducted an investigation of possible solutions to the environmental crisis. Gro Harlem Brundtland, who then was Norway's prime minister, chaired the Commission that in 1987 published its report "Our Common Future" (WCED 1987). What became also known as the Brundtland Report provided the most widely adopted and cited definition of sustainable development.

The WCED defined the task of the report the following way:

- "to propose long-term environmental strategies for achieving sustainable development by the year 2000 and beyond";
- "to recommend ways concern for the environment may be translated into greater co-operation among developing countries and between countries at different stages of economical and social development and lead to the achievement of common and mutually supportive objectives that take account of the interrelationships between people, resources, environment, and development";
- "to consider ways and means by which the international community can deal more effectively with environment concerns";
- "to help define shared perceptions of long-term environmental issues and the appropriate efforts needed to deal successfully with the problems of protecting and enhancing the environment, a long term agenda for action during the coming decades, and aspirational goals for the world community" (World Commission on Environment and Development (WCED) 1987, 5).

So there was a fourfold goal: (a) to identify strategies for solving the environmental crisis, (b) to find ways of global co-operation for realising these strategies, and (c) to cast the environmental crisis as a global problem that (d) requires a long-term agenda.

The Report had a clear focus on global environmental problems such as deforestation, declining biodiversity, global warming and the greenhouse effect, the depletion of the ozone layer, the

depletion of non-renewable natural resources, nuclear and other industrial catastrophes (Chernobyl 1986, Bhopal 1984), food insecurity, air and water pollution, etc. It was published one year after the Chernobyl nuclear accident: "During the time we met as a Commission, tragedies such as the African famines, the leak at the pesticides factory at Bhopal, India, and the nuclear disaster at Chernobyl, USSR appeared to justify the grave predictions about the human future that were becoming commonplace during the mid-1980s" (World Commission on Environment and Development (WCED) 1987, 8).

The Brundtland Report gave the following definition of sustainable development:

> "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It contains within it two key concepts:
>
> · the concept of 'needs', in particular the essential needs of the world's poor, to which overriding priority should be given; and
>
> · the idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and future needs.

Thus the goals of economic and social development must be defined in terms of sustainability in all countries – developed or developing, market-oriented or centrally planned" (World Commission on Environment and Development (WCED) 1987, 41).

Sustainability is the basic survival capacity of humans in society. It means an institutional, social, economic, political, environmental, technological and cultural design of society that allows future generations to survive and to satisfy basic human needs for all. The Report was primarily concerned with the relationship of nature and society, i.e. the environmental crisis. It ascertained that given the complex and global nature of this problem, multidimensional solutions at the international level were required:

"[S]ustainable development is not a fixed state of harmony, but rather a process of change in which the exploitation of resources, the direction of investments, the orientation of technological development, and institutional change are made consistent with future as well as present needs. […] The concept of sustainable development provides a framework for the integration of environmental policies and development strategies – the term 'development' being used here in its broadest sense. The word is often taken to refer to the processes of economic and social change in the Third World. But the integration of environment and development is required in all countries, rich and poor. The pursuit of sustainable development requires changes in the domestic and international policies of every nation" (World Commission on Environment and Development (WCED) 1987, 17, 38).

The identified scope of global problems was centred on the nature-society relationship, whereas the solution was seen as having to be multidimensional. Other global problems – such as global conflicts, wars and violence, right-wing and religious extremism, precarious living and working conditions, the continued existence of slavery; social, income and wealth inequalities; illiteracy and educational inequalities, gender inequalities, racism and xenophobia, displacement and forced

migration, human rights violations, etc. – only played a subordinated role in the Report.

The Report's somewhat limited understanding of society's problems also becomes evident in its definition of human needs (World Commission on Environment and Development (WCED) 1987, 49-50). It mentions livelihood (employment), energy, housing, water supply, sanitation, and health care as the basic human needs that development needs to ensure. Needs that are missing in this list are cultural ones (such as education, communication possibilities for ensuring communication and social relations, recognition by others), political ones (the participation in collective decision-making [democracy], the guarantee of and realisation of human rights) and social ones (the protection from poverty, the social security of a population that has an increasing average age via publicly provided insurance, pension and care systems).

"The most basic of all needs is for a livelihood: that is, employment" (World Commission on Environment and Development (WCED) 1987, 49). The Brundtland Report here reduces human needs to employment, i.e. wage-labour, which is the main organisation of labour in modern societies. One should, however, see that there are societies, in which traditional forms of labour that cannot be classified as wage-labour prevail, and that wage-labour is just one possible means to achieve the end of general wealth, i.e. the production of use-values that can satisfy the basic human needs of all. The Brundtland Report fetishises wage-labour as a need in-itself and overlooks that it is rather a means to an end in modern societies. In 2015, only half of the world's economically active population were wage and salaried employees, whereas the other half was working on its own account, in households or families:

"Today, wage and salaried employment accounts for only about half of global employment and covers as few as 20 per cent of workers in regions such as sub-Saharan Africa and South Asia. […] In addition, within the pool of wage and salaried workers, new dynamics are emerging. Fewer than 45 per cent of wage and salaried workers are employed on a full-time, permanent basis and even that share appears to be declining. This means that nearly six out of ten wage and salaried workers worldwide are in either part-time or temporary forms of wage and salaried employment. Women are disproportionately represented among those in temporary and part-time forms of wage and salaried employment" (International Labour Organisation 2015, 13).

1.1.2 Unsustainability and Socio-Economic Stratification

The Brundtland Report mentioned that unsustainable development posed problems in both "market-oriented" and "centrally planned" societies (World Commission on Environment and Development (WCED) 1987, 41), which indicates that both market and state-command versions of industrialism can have very negative environmental impacts. But the Report nowhere mentions how unsustainability is related to patterns of socio-economic stratification or what in sociological analysis is also termed class. Class is not an issue in the Brundtland Report and many other sustainability reports and studies (Deutz 2014). Although Western economies and the Soviet and Chinese versions of state command economies certainly had differences, they also shared the feature of being class societies: In Western societies, an elite controls wealth and ownership of resources, from which everyday people are excluded. In the Soviet and Chinese model, a group of party bureaucrats, who enjoyed social privileges inaccessible to everyday people, controlled the

economy and politics. Both models of society share the feature that the mass of everyday people produces use-values that they do not directly control in terms of ownership and decision-making.

In economically stratified societies, those who are rich in terms of the amounts of the wealth, income and power they control, are likely to be less affected by unsustainability because a) resource inequality is itself a form of unsustainable development: Sustainability not just means that a social system can reproduce itself, but does so in a fair and just way. Wealth and abundance on one side and poverty and lack on the other side are an expression of a fundamental social mismatch in society. And b), those controlling significant amounts of money, influence, reputation and social relations can more easily escape unsustainable living conditions by changing their places, contexts and forms of work and life in the case of risks and crises. Unsustainability is class-structured and tends to affect those with the least power in society most drastically.

The disregard of economic stratification was certainly a tendency that strongly shaped the analysis of society in the 1980s. A prototypical example is the work of the popular German sociologist Ulrich Beck, who in 1986 published his most well-known book *Risikogesellschaft: Auf dem Weg in eine andere Moderne* (released in English in 1992 as *Risk Society: Towards a New Modernity*). Beck argued that

> "the topic of inequality disappeared almost completely from the agenda of daily life, of politics, and of scholarship. […] It is surprising, however, how much inequality has lost significance as an issue during the past two decades. […] But if public and political discussion is taken as an accurate indication of the actual developments one could easily be led to the conclusion that in the Western countries, especially Germany, we have moved beyond class society. The notion of a class society remains useful only as an image of the past. It only stays alive because there is not yet any suitable alternative" (Beck 1992, 91). The "hierarchical model of social classes and stratification has increasingly been subverted. It no longer corresponds to reality" (Beck 1992, 91-92).

Individualisation, education, mobility, and competition would have brought about an individualised, self-reflexive risk society. "Race, skin color, gender, ethnicity, age, homosexuality, physical disabilities" (Beck 1992, 101) would have become more important than class. In the risk society, "risks, risk perception and risk management in all sectors of society become a new source of conflict and social formation" (Beck 1992, 99).

Beck defines the risk-society in the following manner:

"At the center lie the risks and consequences of modernization, which are revealed as irreversible threats to the life of plants, animals, and human beings. Unlike the factory-related or occupational hazards of the nineteenth and the first half of the twentieth centuries, these can no longer be limited to certain localities or groups, but rather exhibit a tendency to globalization which spans production *and* reproduction as much as national borders, and in this sense brings into being *supra*-national and *non*-class-specific *global hazards* with a new type of social and political dynamism. […] Components of a traditionality inherent in industrialism are inscribed in varied ways within the architecture of industrial society – in the patterns of 'classes', 'nuclear family', 'professional work', or

in the understanding of 'science', 'progress', 'democracy' – and their foundations begin to crumble and disintegrate in the reflexivity of modernization. Strange as it might sound, the epochal irritations aroused by this are all results not of the crisis but of the success of modernization" (Beck 1992, 13-14).

I want to discuss some example cases in order to show that it is inappropriate to neglect class in social analysis. According to estimations, the world's richest 10% in 2014 owned 87% of the global wealth, the richest 1% 48.2%, and the bottom half less than 1% (Credit Suisse Research Institute (CSRI) 2014, 11). In 2014, 69.8% of the world's population owned a wealth of less than US$ 10,000 and 0.7% more than US$ 1 million (Credit Suisse Research Institute (CSRI) 2014, 23-24). In 2015, the share of those owning less than US$ 10,000 increased to 71.0% and the share of those having more than US$ 1 million remained constant (Credit Suisse Research Institute (CSRI) 2015, 104). The worldwide Gini coefficient (a measure of inequality) was 0.915, which is a very high level (Credit Suisse Research Institute (CSRI) 2015, 104). The same study also found that the financial crisis and austerity measures resulted in an increase of wealth inequality: In the years 2007-2014, "wealth inequality rose in 35 countries and fell in only 11" (Credit Suisse Research Institute (CSRI) 2014, 32). For example, the share of the richest decile increased in China from 56.1% in 2007 to 64.0% in 2014, from 65.3% to 73.3% in Egypt, from 72.3% to 74.0% in India, from 75.4% to 84.8% in Russia, from 52.0% to 54.0% in the UK, from 52.0% to 55.6% in Spain, from 48.6% to 56.1% in Greece, from 56.0% to 58.3% in Ireland, from 69.0% to 71.7% in South Africa, from 47.9% to 51.5% in Italy, from 62.6% to 67.5% in Denmark, from 51.1% to 53.1% in France (Credit Suisse Research Institute (CSRI) 2014, 33: Table 2).

The labour share is the share of wages in the global GDP. Karabarbounis and Neiman (2014) created a model that analyses the development of the labour share in 59 (developing and developed) countries from 1975 until 2012. They found "a 5 percentage point decline in the share of global corporate gross value added paid to labor over the past 35 years" (61). "Of the 59 countries with at least 15 years of data between 1975 and 2012, 42 exhibited downward trends in their labor shares" (62). "From a level of roughly 64%, the global corporate labor share has [in the period from 1975 until 2012] exhibited a relatively steady downward trend, reaching about 59% at the end of the sample" (69). The share of the world's 2,000 largest corporations revenues' in the world GDP increased from 50.8% in 2004 to 51.4% in 2014 (Fuchs 2015).

Thomas Piketty (2014) in his study *Capital in the Twenty-First Century* documents high levels of global inequality:

> "Global inequality of wealth in the early 2010s appears to be comparable in magnitude to that observed in Europe in 1900–1910. The top thousandth seems to own nearly 20 percent of total global wealth today, the top centile about 50 percent, and the top decile somewhere between 80 and 90 percent. The bottom half of the global wealth distribution undoubtedly owns that less than 5 percent of total global wealth.
>
> Concretely, the wealthiest 0.1 percent of people on the planet, some 4.5 million out of an adult population of 4.5 billion, apparently possess fortunes on the order of 10 million euros on average, or nearly 200 times average global wealth of 60,000 euros per adult, amounting in

> aggregate to nearly 20 percent of total global wealth. The wealthiest 1 percent – 45 million people out of 4.5 billion – have about 3 million euros a piece on average (broadly speaking, this group consists of those individuals whose personal fortunes exceed 1 million euros). This is about 50 times the size of the average global fortune, or 50 percent of total global wealth in aggregate" (Piketty 2014, 438).

Morris Triventi (2013) analysed data on educational achievement from 11 European countries. "Individuals with more educated parents have the highest likelihood of graduating from the best institutions, and differences with individuals with less educated parents are significant in all the countries except Germany. […] parental education is strongly associated with the probability of attaining different types of qualifications in tertiary education. In particular, students from culturally advantaged families have a higher probability of graduating from the best educational paths in terms of quality and future occupational outcomes" (Triventi 2013, 495, 499).

Barro and Lee (2013) provide data for 146 states that shows that the share of the combined population in these countries, who have completed tertiary education, has increased from 1.1% in 1950 to 7.8% in 2010. There are, however, significant inequalities between developed and developing countries: Whereas the share was 17.9% in developed countries (N=24), it was only 5.7% in developing countries (N=2010), which indicates that wealth differences play a role in possibilities for educational attainment.

Bukodi and Goldthorpe (2013) analysed how parents' occupational groups, occupational status, and education influence the educational attainment of children born in 1946, 1958 and 1970. Children of "parents in Classes 6 and 7 [semi-routine and routine workers], which can be equated with the working class, tend to do worst" (Bukodi and Goldthorpe 2013, 1030). Parental occupational groups, occupational status and education "all have independent effects on children's educational attainment" (1030). "We find that level of family income does itself have an independent—positive – effect on children's educational attainment" (1030). "[L]ittle change is evident in the tendency for children from relatively disadvantaged class backgrounds to be less ready than children from more advantaged backgrounds to take a given standard of secondary school performance as a basis for seeking tertiary level qualifications" (1036). It is a consistent pattern that children from households, where the parents have low income, low skills and low educational attainments are more unlikely to attain a university degree than those who come from more privileged backgrounds.

Mike Savage (2015) studied class in 21st century British society. He takes a Bourdieuian approach in class analysis that distinguishes between economic capital (wealth, income), cultural capital (tastes, interests, cultural activities), and social capital (social networks, relations, friendships, group memberships) and use this approach for discerning seven classes. The elite members have accumulated high levels of all three forms of capital, whereas those belonging to the precariat have low levels. The other five classes are intermediate strata.

One focus of the study was higher education. Although "attending university is no longer unthinkable for disadvantaged young people, as it was in the nineteenth century" (224), going to university "is strongly related to class" (226): Whereas 56% of the elite were university graduates,

only 3% of the precariat held academic degrees (229; see also: Savage et al. 2013). "The expansion of higher education has not led to greater equality of access to universities; yet there is a tightening association between graduate status and membership of the most advantaged groups in British society" (Savage 2015, 229). In Cambridge, "more than half of the University of Cambridge's graduates are in the elite", whereas "just one-eight" of the graduates at the former polytechnic Anglia Ruskin University have an elite background (238). Three quarters of the 100 biggest British companies' CEOs attended public schools such as Eton, Harrow, Westminster or Winchester and around 50% studied at Oxford or Cambridge (Hartmann 2010, 298-299).

Another dimension of analysis in Savage's study was generational class mobility:

> "51 per cent of those in our elite class had parents who were in class 1 (senior managerial and professional) compared to only 11 per cent who had parents who were in the precariat. This is a remarkable difference, with over twelve times as many of the elite coming from the most advantaged backgrounds compared to the precariat. Only 11 per cent of the elite have climbed from the valley floor compared to the majority, who, because of their starting point high up on the mountain, have had to do little or no climbing at all. At the other extreme, the picture is reversed: 65 per cent of the precariat remain where they grew up, on the valley floor (their parents having been in semi-skilled or routine employment). And we can see that only 4 per cent of the precariat come from senior managerial or traditional professional backgrounds: there is not much mobility going from top to bottom of British society either. Few of those on the mountain tops, or even the valley sides, move down. It is actually rather difficult to fall all the way down the mountain slopes!" (Savage 2015, 193).

The ND-GAIN Vulnerability Index measures countries' vulnerability to climate change by considering six aspects, namely how climate change affects ecological resources that support livelihood, food provision, public health, human habitat, costal and energy infrastructure, and fresh water supplies. Figure 1 shows the climate change vulnerability of the world's countries in 2014. 38 of the 50 most vulnerable countries are located in Africa. Most highly vulnerable countries are poor and have low human development. Two of the countries most at risk of climate change, Sudan and Eritrea, were in 2015 ranked on position 167 and 186 out of 188 countries in the inequality-adjusted Human Development Index (United Nations 2015) [1]. Whereas Africa in contrast to the two largest carbon dioxide-emitting countries China (25%) and the USA (16%), as a whole produces only around 4% of global carbon dioxide emissions, it is the part of the world that is most at risk of climate change's negative impacts.

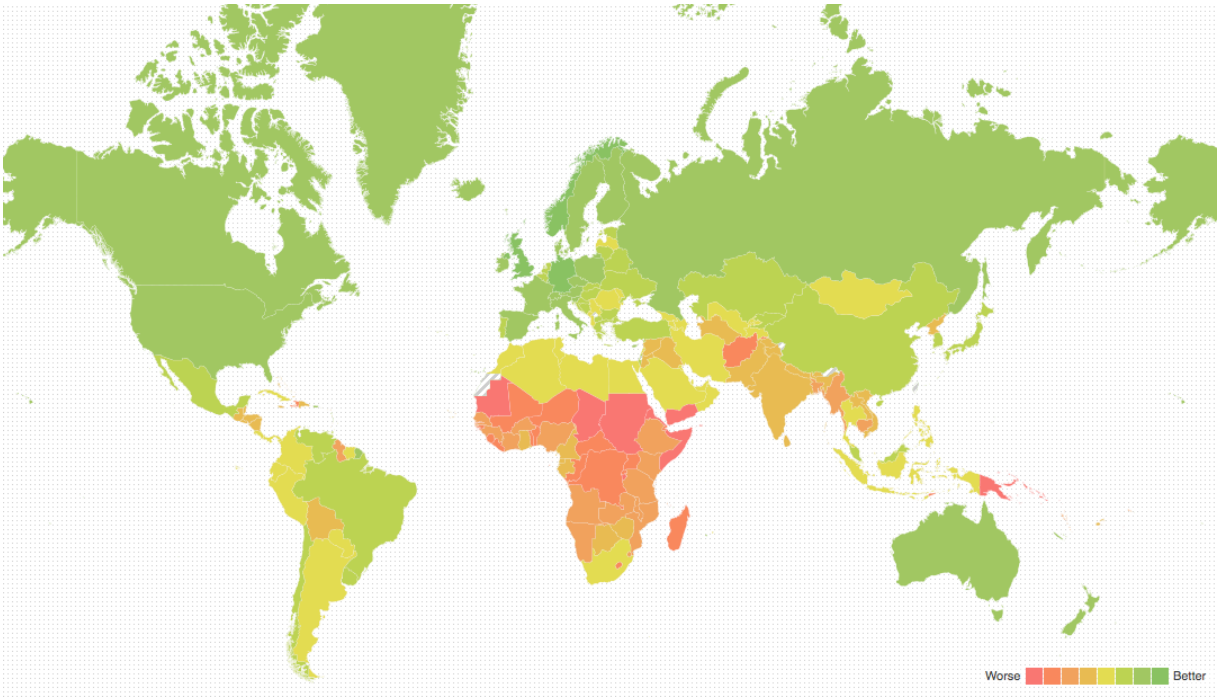

Figure 1: Vulnerability to climate change in 2014 (data source: http://index.gain.org)

In 2015, 10 of the world's largest 100 companies were oil and gas producers (data sources: Forbes 2000, 2015 list): Exxon Mobil (#7), PetroChina (#8), Royal Dutch Shell (#13), Chevron (#16), Sinopec (#24), Gazprom (#27), Total (#35), BP (#41), Rosneft (#59), ConocoPhillips (#89). In addition, there were 9 companies producing cars, trucks and airplanes in the top 100: Toyota (#11), VW (#14), Daimler (#26), BMW (#45), Honda (#63), General Motors (#64), Ford (#69), Boeing (#72), Nissan (#96). These data indicate that the mobility industry that generates vast amounts of carbon dioxide is one of the world's most profitable industries. The global environmental crisis has been created and sustained by profitable businesses.

Naomi Klein argues in this context in her book *This Changes Everything: Capitalism vs. The Climate*: "The fossil fuel companies have known for decades that their core product was warming the planet, and yet they have not only failed to adapt to that reality, they have actively blocked progress at every turn. Meanwhile, oil and gas companies remain some of the most profitable corporations in history, with the top five oil companies pulling in $900 billion in profits from 2001 to 2010. […] These companies are rich, quite simply, because they have dumped the cost of cleaning up their mess onto regular people around the world. It is this situation that, most fundamentally, needs to change." (Klein 2015, 110-111).

Waste is another environmental problem that disproportionally affects the poor. "Waste, including highly toxic industrial waste, is frequently exported to poor countries for disposal or supposed recycling. Beginning in the 1970s, African countries – such as Nigeria, Ghana, and Ivory Coast – have been prime recipients of the industrial and sewage wastes of developed countries" (Magdoff and Foster 2011, 86). In 2014, 41.8 million tonnes of e-waste were produced in the world (Baldé 2015). In 2015, it was 43.8 million tonnes (24). Whereas in Africa the e-waste generated per person was just 1.7 kg, it was 12.2 kg in the Americas and 15.6 kg in Europe (25). Africa is hardly a

source, but the world's largest dumping ground for e-waste. "Africa, particularly the western Africa, becomes the dumping destination for e-waste from various regions of the world. […] Illegal import of e-waste or used electronics from all over the world is a major source of e-waste in countries like Ghana and Nigeria. […] The recycling activities of e-waste in Africa are usually carried out on an informal basis, often involving open burning in unmonitored dumpsites or landfills. This rudimentary recycling has caused substantial damage to the health of scavengers and local environment" (Baldé 2015).

The examples of climate change and waste show that "inequalities in power tend to be reflected in the inequitable distribution of environmental harms and ecological burdens" (Gandy 2013, 223).

The unequal distribution of the world's income has in the past forty years significantly increased globally. Wealth inequality has increased. Children from elite and upper class families that control large amounts of economic, cultural and social capital are more likely to obtain a university degree and attend elite universities. There are much fewer university graduates in poor than in rich countries. Children with parents belonging to the elite are very likely to themselves be part of the elite, whereas working class children are unlikely to attain such a status in society. The world's poor are most hit by the negative impacts of global environmental problems such as pollution and climate change, whereas transnational corporations are turning environmental devastation into profit by fostering carbon dioxide emissions and polluting nature as a negative externality. These are just some examples that indicate that inequalities form a crucial factor in the advancement of unsustainability. It therefore does not seem so feasible to assume, as the Brundtland Report and some sociologists like Ulrich Beck do, that economic stratification does not matter in contemporary society.

Frederic Jameson (1991) characterized postmodernism as the cultural logic of late capitalism: "The last few years have been marked by an inverted millenarianism in which premonitions of the future, catastrophic or redemptive, have been replaced by senses of the end of this or that (the end of ideology, art, or social class; the 'crisis' of Leninism, social democracy, or the welfare state, etc., etc.); taken together, all of these perhaps constitute what is increasingly called postmodernism. The case for its existence depends on the hypothesis of some radical break or coupure, generally traced back to the end of the 1950s or the early 1960s" (Jameson 1991, 1).

Often postmodern claims involve the assumption that computerisation has brought about a radically new post-industrial society that goes beyond class structuration. The assumption of such claims is that the information society is not economically stratified. This work tried to illustrate with some examples the continued importance of social stratification in the 21st century. If it is true that we live in society with global inequalities, then postmodernism has problematic asusmptions.

The mass of everyday people produces the goods that sustain the existence of humans and society and the social relations that enable, govern and reproduce everyday life in society. But it is just an elite that controls and accumulates vast amounts of money (economic capital), decision-power (political capital), influence and reputation (cultural capital). Modern society's logic of accumulation creates a structure, in which the mass of the producers of (economic, political,

cultural) capital are poor by not being able to control the structures they create and that enable society's reproduction. Inequalities are built into the logic of accumulation on which modern society is built.

1.1.3 The Emergence of a Multidimensional Concept of Sustainability

In 1992, the UN Conference on Environment and Development ("Earth Summit") took place in Rio de Janeiro, Brazil, where for the first time heads of state from all over the world gathered to discuss problems of sustainability. At the Earth Summit, all participating countries agreed to the Rio Declaration on Environment and Development that put forward 27 principles for the future that supposedly can help to achieve sustainable development. The Declaration starts with the principle that "human beings are at the centre of concerns for sustainable development. They are entitled to a healthy and productive life in harmony with nature" (United Nations Conference on Environment & Development (UNCED) 1992b, principle 1).

The understanding of sustainability advanced by the Brundtland Report is present in the Rio Declaration's principle 3: "The right to development must be fulfilled so as to equitably meet developmental and environmental needs of present and future generations" (United Nations Conference on Environment & Development (UNCED) 1992b, principle 2). Although the Rio Declaration covers a wide range of issues such as the environment, poverty, demography, the economy, gender, youth, indigenous people, or peace, its primary focus is still the natural environment, which becomes evident by the fact that it contains the keywords "environment" and "environmental" 40 times and the keywords "society" and "societies" just twice.

The Agenda 21 document (United Nations Conference on Environment & Development (UNCED) 1992a) is the action plan implemented for achieving the goals of the Rio Declaration. It strives to reconcile the two requirements of a high quality environment and a healthy economy for all people of the world. All national governments represented at the Earth Summit committed themselves to the principles of action contained in the Agenda 21 document. At the Earth Summit, the participants also agreed to the formation of the UN Commission on Sustainable Development as an international environmental organisation that monitors the progress towards achieving the Agenda 21's objectives.

In 2002, the World Summit on Sustainable Development (WSSD) conference was held in Johannesburg with the intention of conducting a review ten years after the 1992 Rio Earth Summit. The outcomes include a Plan of Implementation and the Johannesburg Declaration on Sustainable Development. The Plan of Implementation designed a means for acting on the topics discussed at the Earth Summit such as poverty eradication, production and consumption issues, and health concerns. The Johannesburg Declaration comprises 36 principles and emphasises the current issues facing the world community, the significance of multilateralism, and practical implementation strategies. Whereas the Earth Summit focused on the environmental issues of sustainability, the WSSD conference more effectively integrated economic and equity issues into the discussion. The Johannesburg Declaration identifies a number of challenges that humanity faces in creating a sustainable world:

> "11. We recognize that poverty eradication, changing consumption and production patterns and protecting and managing the natural resource base for economic and social development are overarching objectives of and essential requirements for sustainable development.
>
> 12. The deep fault line that divides human society between the rich and the poor and the ever-increasing gap between the developed and developing worlds pose a major threat to global prosperity, security and stability.
>
> 13. The global environment continues to suffer. Loss of biodiversity continues, fish stocks continue to be depleted, desertification claims more and more fertile land, the adverse effects of climate change are already evident, natural disasters are more frequent and more devastating, and developing countries more vulnerable, and air, water and marine pollution continue to rob millions of a decent life.
>
> 14. Globalization has added a new dimension to these challenges. The rapid integration of markets, mobility of capital and significant increases in investment flows around the world have opened new challenges and opportunities for the pursuit of sustainable development. But the benefits and costs of globalization are unevenly distributed, with developing countries facing special difficulties in meeting this challenge" (World Summit on Sustainable Development (WSSD) 2002).

The Declaration argues that decisions are needed "to speedily increase access to such basic requirements as clean water, sanitation, adequate shelter, energy, health care, food security and the protection of biodiversity. At the same time, we will work together to help one another gain access to financial resources, benefit from the opening of markets, ensure capacity-building, use modern technology to bring about development and make sure that there is technology transfer, human resource development, education and training to banish underdevelopment forever" (World Summit on Sustainable Development (WSSD) 2002, principle 18). It reaffirms the pledge to "place particular focus on, and give priority attention to, the fight against the worldwide conditions that pose severe threats to the sustainable development of our people, which include: chronic hunger; malnutrition; foreign occupation; armed conflict; illicit drug problems; organized crime; corruption; natural disasters; illicit arms trafficking; trafficking in persons; terrorism; intolerance and incitement to racial, ethnic, religious and other hatreds; xenophobia; and endemic, communicable and chronic diseases, in particular HIV/AIDS, malaria and tuberculosis" (World Summit on Sustainable Development (WSSD) 2002, principle 19).

In the discourse on sustainability, there has been a shift from a focus on ecological issues towards the inclusion of broader societal issues. "Sustainability discourse shifted from an emphasis on pollution and availability of natural resources to […] more complex and integrated frameworks" (Quental, Lourenço, and da Silva 2011). The "triangle of sustainability" introduced by the World Bank has been important in shifting the sustainability discussion from purely ecological aspects towards more integrative concepts. Ismail Serageldin, then vice-president of the World Bank, identified an economic, a social, and an ecological dimension of sustainability. "It is not surprising that these concerns reflect the three sides of what I have called the 'triangle of sustainability' – its economic, social, and ecological dimensions" (Serageldin 1995, 17). By 2002, it had become common to identify an ecological, an economic, a social, and an institutional dimension of

sustainability (as e.g. the EU and the UN do):

> "At the time of Rio, sustainable development was mainly about protecting nature, but now, in the wake of Johannesburg, it is first and foremost about protecting people. For nobody can close his or her eyes in front of what can be called the 21st century challenge, namely how best to extend hospitality to twice the number of people on the globe, in light of a rapidly deteriorating biosphere? Indeed, the historical pattern of scarcity, which had left its imprint to economic development and continues to shape it, today is outdated. While in the old days the world appeared full of nature, but void of people, today the world is void of nature, but full of people. The satisfaction of needs and wants is not constrained so much by the paucity of hands and brains, but by the scarcity of resources and living systems. Nature is now more of a limiting factor than money, given that development is more and more restricted not by the number of fishing boats, but by the decreasing numbers of fish; not by the power of pumps, but by the depletion of aquifers; not by the number of chainsaws but by the disappearance of primary forests (Heinrich Böll Foundation 2002)

The understanding of sustainability as multidimensional challenge is also evident in the Johannesburg Declaration: It speaks of three "interdependent and mutually reinforcing pillars of sustainable development – economic development, social development and environmental protection – at the local, national, regional and global levels" (World Summit on Sustainable Development (WSSD) 2002, principle 5).

10 years after Johannesburg and 20 years after Rio, the Rio+20 Conference took place in Rio de Janeiro in June 2012. The outcome document *The Future We Want* foregrounds the importance of the three pillars of sustainability that the Johannesburg Conference stressed. It therefore calls for "an economically, socially and environmentally sustainable future for our planet and for present and future generations" (United Nations Conference on Sustainable Development (UNCSD) 2012, principle 1). It accentuates the importance of institutions that foster these three pillars of sustainable development: "We underscore the importance of the sustainable development which responds coherently and effectively to current and future challenges and efficiently bridges gaps in the implementation of the sustainable development agenda. The institutional framework for sustainable development should integrate the three dimensions of sustainable development in a balanced manner and enhance implementation by, inter alia, strengthening coherence and coordination, avoiding duplication of efforts and reviewing progress in implementing sustainable development" (United Nations Conference on Sustainable Development (UNCSD) 2012, 75).

As a follow-up to Rio+20, the *2030 Agenda for Sustainable Development* (United Nations 2015) contains 17 goals:

> "Goal 1: End poverty in all its forms everywhere.
>
> Goal 2: End hunger, achieve food security and improved nutrition and promote sustainable agriculture.
>
> Goal 3: Ensure healthy lives and promote well-being for all at all ages.
>
> Goal 4: Ensure inclusive and equitable quality education and promote lifelong learning

opportunities for all.

Goal 5: Achieve gender equality and empower all women and girls.

Goal 6: Ensure availability and sustainable management of water and sanitation for all.

Goal 7: Ensure access to affordable, reliable, sustainable and modern energy for all.

Goal 8: Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.

Goal 9: Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation.

Goal 10: Reduce inequality within and among countries.

Goal 11: Make cities and human settlements inclusive, safe, resilient and sustainable.

Goal 12: Ensure sustainable consumption and production patterns.

Goal 13: Take urgent action to combat climate change and its impacts.

Goal 14: Conserve and sustainably use the oceans, seas and marine resources for sustainable development.

Goal 15: Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss.

Goal 16: Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels.

Goal 17: Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Development" (United Nations 2015, 14).

Figure 2: The UN 2030 Agenda for Sustainable Developments' 17 Goals (source: https://sustainabledevelopment.un.org)

Figure 2 visualises these 17 goals. There is certainly a multidimensional understanding of sustainability as social, environmental and economic underlying these objectives. But there are two

problems that are characteristic for all the mentioned policy documents:

1) Communication and culture are not mentioned as realms of sustainability (except for education),

2) Economic problems such as socio-economic inequality and crisis are not really discussed. This is particularly striking in the 2012 and 2015 documents because they were written in the course of the global economic crisis that started in 2008.

These declarations express the need of economic sustainability, a term that has no straightforward meaning. It would be a meaningful general term if conceived as the satisfaction of basic human needs for all humans on the planet in ways that guarantee equality and the protection of the environment. But the understanding of economic sustainability tends to be much focused on GDP growth, which mainly means the growth of private businesses' profits. The Rio+20 outcome document speaks of the need for "sustained economic growth" (United Nations Conference on Sustainable Development (UNCSD) 2012, 2) and "sustained, inclusive and equitable economic growth" (United Nations Conference on Sustainable Development (UNCSD) 2012, 19). Similar formulations can be found in the *2030 Agenda for Sustainable Development*: "We envisage a world in which every country enjoys sustained, inclusive and sustainable economic growth and decent work for all. […] Sustained, inclusive and sustainable economic growth is essential for prosperity. This will only be possible if wealth is shared and income inequality is addressed. […] Sustain per capita economic growth in accordance with national circumstances and, in particular, at least 7 per cent gross domestic product growth per annum in the least developed countries" (United Nations 2015, 4, 8, 19).

The GDP is a peculiar variable that lumps together labour costs, the costs for new means of production, and profits, i.e. labour and capital. The growth of GDP is no guarantee at all for socio-economic equality because profits can grow faster than labour income, which, as we saw earlier, has been an important tendency since the 1970s. "[M]ost people have not benefited from the growth of GDP as quality of life has become separated from economic growth" (Giddings, Hopwood, and O'brien 2002). Should "progress be purely a growth-only (economic) phenomenon and be measured mainly in GDP terms; should we not rather be treating economy as a means and target to achieve what we term 'good society' as our end goal?" (Khan 2015, 69). Stiglitz, Sen and Fitoussi (2009) argue that the GDP is of limited use for measuring social progress and that it is "an inadequate metric to gauge well-being over time" (8). Measuring well-being by the GDP could for example "send the aberrant message that a natural catastrophe is a blessing for the economy, because of the additional economic activity generated by repairs" (265). "If inequality increases enough relative to the increase in average […] GDP, most people can be worse off even though average income is increasing" (8). They call for a shift of emphasis "*from measuring economic production to measuring people's well-being"* (12) in policymaking and research in the context of sustainability.

The netCommons project is part of the CAPS (Collective Awareness Platforms for Sustainability and Social Innovation) research initiative. The issue of going beyond GDP as measurement of progress plays also a role in CAPS. So for example the Web-COSI project (Web Communities for Statistics for Social Innovation) focused on how "to improve people's engagement with statistics

beyond GDP" (http://www.webcosi.eu/about/).

We saw that the mobility industry that is based on non-renewable energy resources and produces large amounts of carbon dioxide is among the most profitable industries. Approaches calling for GDP growth without seeing the limits of this approach is somewhat short-sighted. They are often dualistic in character, formulating multiple goals, but not looking if some of them may stand in contradition to each other.

The sustainability concept just like the notion of the network society sounds immensely positive and allows diverse groups that have opposing interests to project their political goals into it. “Who in his or her right mind would be against ‘sustainability’?” (O’Connor 1994).

1.1.4 Towards a Dialectical Understanding of Sustainability

The three dimensions of sustainability seem to have been relatively arbitrary chosen. They are not underpinned by a theory of society. “While the use of the term ‘sustainability’ has become almost inflationary in both science and society, the work on theories of sustainable development has received much less attention” (Enders and Remig 2014, 1). (Giddings, Hopwood, and O’brien 2002) argue that the three dimension model sees the economy, society and nature as autonomous and encourages “a technical fix approach to sustainable development issues” (189), focuses on parts instead of the whole (190). They instead of the three-ring model suggest a nested model of sustainability.

In figure 3, models 1 (M1) and 2 (M2) visualise the two models of sustainability that Giddings, Hopwood and O’Brien discern. One can argue for a third model (M3) that is a further development of M2. It besides the economy also foregrounds the political and the cultural system as parts of society and is based on a dialectic of nature/society and a dialectic of the economy/the non-economic (the political and the cultural). In model M3, society is made up of the economy, politics and culture and these 3 interacting realms of society are grounded in nature, with which society interacts.

The third model is a dialectical model. Chapter 1 in this work often uses the notion of the dialectic (for a more detailed discussion, see: Fuchs 2014; Fuchs 2011, chapter 2.4). What do we mean if we speak of a dialectic? A dialectic is a contradictory relationship between two entities. They simultaneously are identical and different. They require and exclude each other. Dialectical logic challenges classical binary and reductionist thought. It questions the reduction of the world to just one dimension. It is, however, not just relational and multidimensional, but also sees the world as being in flux and development. Development potentialities emerge out of poles that contradict each other. At a certain level of organisation, everything constantly develops. There are, however, also more continuous processes that only change at specific critical points. Dialectical development includes situations of crisis and change and the emergence of novelty at such critical points. In society, there are two basic forms of the dialectic: One has to do with the very basic conditions and the basic development of society. So for example there is a social dialectic between human beings: In order to exist, humans have to communicate with each other. They are different individuals, but can only inform themselves by mutual symbolic interaction. The second form of societal dialectic

has to do with power relations. In a power dialectic, we find conflicting interests and conflicting structures.

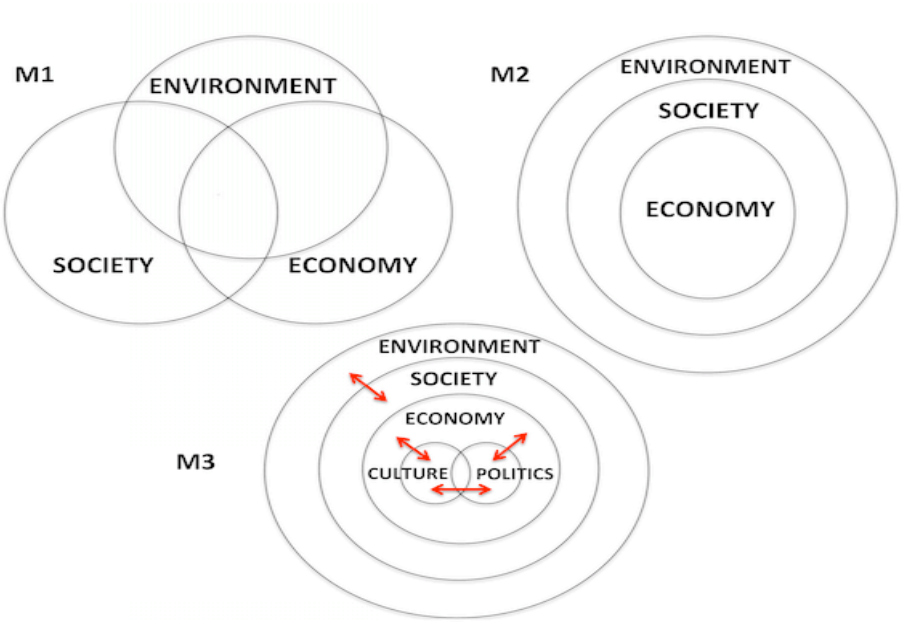

Figure 3: 3 models of sustainability

A distinction of three subsystems of society (economy, polity, culture) can be found in several widely adopted social theories: Giddens (1984, 28-34) distinguishes between economic institutions, political institutions and symbolic orders/modes of discourse as the three types of institutions in society. Bourdieu (1986) speaks of economic, political and cultural capital as the three types of structures in society. Habermas (1985) differentiates between the lifeworld, the economic system and the political system. Daniel Bell (1976) discerns between society's social structure (economy, technology, occupational system), polity and culture.

These social theories have different theory backgrounds and implications for society. They do however broadly share a distinction between economy, politics and culture as the three main domains of society (Fuchs 2007; Fuchs 2011): The economy is the realm of society, where humans enter a metabolism with nature so that work organises nature and culture in such a way that use-values that satisfy human needs emerge. Given that it is the economy, where the man-nature relationship is established and that the ecological system is closely linked to the economy, one could treat the ecological system as part of the economy. But the circumstance that society is part of nature, but at the same time a sublation of nature, allows giving specific analytical attention to the ecological system as part of society. Nature is larger than society and there are vast parts of it that are unknown to humans. But the part of nature that stands in a metabolism with humans is part of society. Nature is at the same time part and no-part of society. The political system is the realm of society, where humans deliberate on or struggle about the distribution of decision power in society. Culture is the realm of the recreation of the human body and mind in such ways that meanings, identities and values emerge and are renegotiated in everyday life. It includes aspects of society

such as the mass media, science, education, the arts, ethics, health care and medicine, sports, entertainment, and personal relations.

Society is an interconnection of social systems. In a social system, humans enter into social relations, in which they make meaning of each other and in their practices produce and reproduce specific social structures that enable and constrain individual thought, individual action, and further social practices that again produce and reproduce social structures, and so on ad infinitum. A social system is a dialectic of social practices and social structures (Fuchs 2003a; Fuchs 2003b). (Marx 1844) described society's dialectic when writing that "just as society itself produces man as man, so is society produced by him". Communication plays a very basic role in social systems: It is the means, by which humans relate to each other symbolically (either in linguistic and non-linguistic ways) and establish and produce social relations. A social system exists as long as the structure-agency dialectic is organised regularly via communication in time and space. Without communication and the social dialectic there can be no social system. A social system therefore ceases to exist when its dynamic comes to an end. Figure 4 illustrates society's social dialectic.

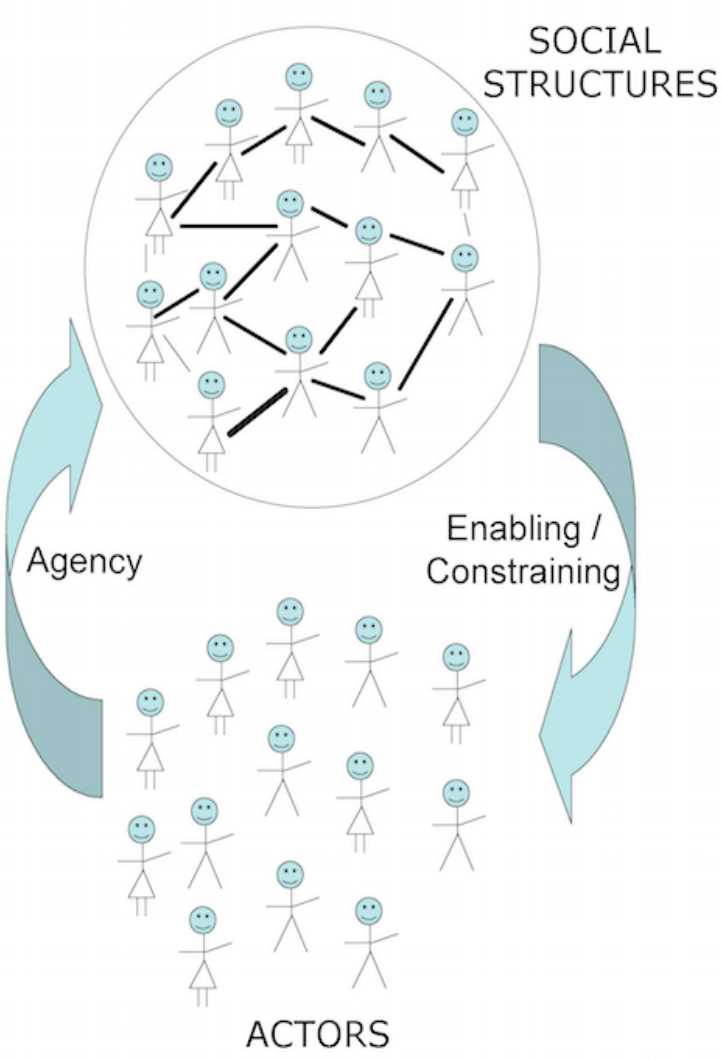

Figure 4: The dialectic of structure and agency in society (source: Fuchs 2007, 52)

All social systems have an economic, a political and a cultural dimension: Humans in all social systems use resources, take decisions, and produce meanings. Depending on the social system and the social role that humans have in it, one of these dimensions can be primary, which allows us to distinguish between economic, political and cultural social systems. So for example in modern society, companies and markets belong to the economic systems; states, parliaments, political parties and protest movements to the political system; universities, religions, libraries, museums, the mass media, hospitals, leisure clubs and families to the cultural system. The economic, the political and the cultural system are society's subsystems. Each of these three systems consists of the networks of interaction between all humans and between all social systems that orient their communication and their social dialectic primarily on the (re)production of specific social structures. Table 1 and figure 5 provide an overview of this distinction.

Society's subsystems are distinct, but not autonomous. They interact with each other. Politics and culture have in modern society their own economies: There are particular workers, who as their profession and in order to economically survive engage in the production of political and cultural structures. They are, however, not the only actors. There is also a multitude of voluntary activities. The political and cultural system are grounded in work that produces specific political and cultural use-values, but they at the same time go beyond these systems because political decisions and cultural meanings take effect all over society. A basic premise of a cultural materialist approach in social theory is therefore that the economic and the non-economic are identical and non-identical at the same time (Fuchs 2015b, chapters 2 and 3).

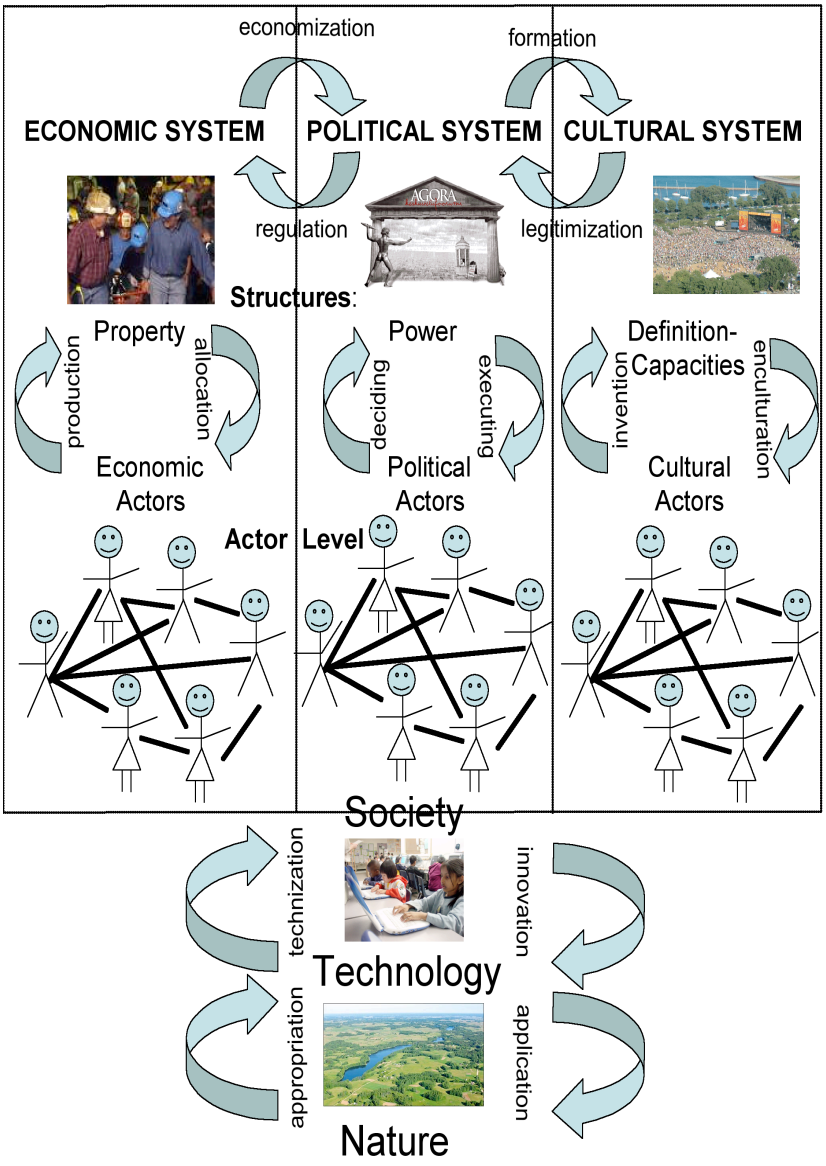

Figure 5: Society as a dialectic of dynamically reproducing subsystems (source: Fuchs 2007, 52)

Dimension	**Social structures**	**Definition**	**Social structures in modern society**
Nature	Natural structures: Natural resources	Physical matter that is extracted in labour processes from nature and that is changed by human activities.	Natural resources as the physical body of commodities
Society: Economy	Economic structures: Property	Use-values are created by human work, distributed and consumed in order to satisfy humans needs	Commodities and capital that objectify specific average amounts of human labour and

			take on the exchange-value form when being traded as commodities on markets
Society: Political system	Political structures: Decision-power	Collective decisions that define basic rules of behaviour in society	Laws and policies that regulate social conflicts in specific ways
Society: Cultural system	Cultural structures: Definitions, meanings	Collective definitions of reality that give meaning to social systems and provide identities to human actors.	Knowledge, worldviews and ideologies that provide meaning to modern society's antagonisms and provide status and reputation to humans.

Table 1: Structures in society

Table 1 provides not only an overview of natural and social structures in general, but also shows the forms they take on in modern society. Modern society is a societal formation that is based on the accumulation of economic, political and cultural capital. In modernity, society's basic structures take on the form of capital that is accumulated. Modern society is in a general sense a society that is based on the logic of accumulation. In modern society, natural resources are the physical body of commodities, economic property is organised as commodities and capital, collective decisions take on the form of laws and policies, collective definitions and meanings are worldviews, knowledge and ideologies that provide status and reputation.

Sustainability is an inherently ethical concept (Ziegler and Ott 2011, 56) that poses the question: What is a good society? Sustainability asks the long-term question about how present and future generations can lead a good life in society. Table 2 provides an overview of the dimensions of sustainability and a check-list of questions that can be asked when determining the sustainable or unsustainable character of social systems.

Dimension	**Dimension of sustainability**	**Question**	**Dimension of unsustainability**	**Question**
Nature	Environmental sustainability: Biodiversity	To which degree are natural resources protected and preserved so that the survival of nature and society is guaranteed? To which degree is there an equitable distribution of environmental	Environmental unsustainability: Environmental pollution, degradation and depletion	To which degree are natural resources depleted and polluted so that the survival of nature and society is threatened? To which degree is there an unequal and inequitable distribution of environmental harms and benefits to certain groups and places?

		harms and benefits to certain groups and places?		
Society: Economy	Economic sustainability: Wealth for all	To which degree are economic relations organised in a way that allows the production of wealth for all and a fair distribution of wealth?	Economic unsustainability: Poverty, inequality, economic crisis	To which degree are economic relations organised in a manner that does not guarantee satisfaction of the needs of all humans (poverty), that results in unfair distribution of need satisfaction (inequality) or the irreproducibility of the economy (economic crisis) ?
Society: Political system	Political sustainability: Participation and peace	To which degree does the political system enable humans to participate in collective decision-making? To which degree does the political system guarantee the peaceful existence and interaction of and within societies and the guarantee of basic rights?	Political unsustainability: Dictatorship and war	To which degree is the political system ruled by an elite that excludes the population from participation in collective decision-making? To which degree does the political system foster violence and the violation of basic rights and warfare?
Society: Cultural system	Cultural sustainability: Recognition	To which degree does culture enable the development of the human mind, the recognition of identities in society, and the reproduction of the human body?	Cultural unsustainability: Disrespect and malrecognition	To which degree does culture limit the development of the human mind, the recognition of identities and the reproduction of the human body?

Table 2: Dimensions of un/sustainability

This typology of un/sustainability is grounded in social theory. It suggests not just three dimensions of sustainability (environmental, economic, social), but distinguishes between environmental, economic, political and cultural un/sustainability. The latter three constitute the societal dimension

of un/sustainability of the communication between humans. The first aspect is the natural dimension in the interaction between society and nature. Sustainability has to do with the good life for all and the satisfaction of human needs for all.

Human needs are not fixed over time, but change historically with the development of society. Human needs today are different than for example 500 years ago. So for example today the Internet, a global communication system, exists as a still relatively novel form for the organisation of communication. It poses both opportunities and risks for society's organisation of the environment, the economy, politics and culture (Fuchs 2007). Discussions about sustainability cannot ignore that Internet communication has become just like electricity supply, water supply, sewage systems, health care, and education systems a basic utility. Communications as utility form a basic human need today. The information society has developed both the communication and cultural capacities in society. It is therefore disturbing that discussions, policy agendas and declarations have thus far not adequately taken communications and culture into account (see Parodi 2015).

The definition of cultural sustainability in table 2 is based on an understanding of culture as the system of the reproduction of the human mind and body. The human mind can only develop if humans' identities and personalities are recognised in society and by others; if there are institutions that nourish human skills; if their ideas are taken serious, acknowledged and recognised; and if there are no large status and reputational inequalities. That the human body can reproduce itself means that there should be adequate amounts of leisure available to all that allows recreation and that health system protects humans from illnesses and helps them in the case of sickness. Cultural sustainability therefore has to do with the role of education, science, health care, personal and family life, arts and culture, leisure, entertainment, sports, the mass media, morality, and belief systems in society.

One should note that the typology of sustainability in table 2 does not define economic sustainability in terms of GDP growth and monetary profitability of companies. It takes a critical perspective on economic sustainability that considers that it is labour and not capital that produces human wealth. The structures of modern society are distinct in that specific groups tend to accumulate economic, political and cultural capital and to exclude others from wealth, participation and recognition. Unsustainability arises in modern society to the extent that the particular interests of elites become the governing principles of social systems and society's subsystems.

Productive forces turn into destructive forces in the metabolism of nature and society to the degree that they deplete and destroy natural resources. There are complex relations between class structures in society and environmental unsustainability. We have for example discussed that the poor tend to be most affected by environmental degradation that poses a threat to their lives.

Based on these foundations, we can next discuss the concept of sustainability in relation to information technology's role in society.

1.2 Information Technology and Sustainability in the Information Society

1.2.1 What is Technology?

The term technology has its roots in the Greek term techné [τέχνη] (Williams 1985, 315; Reydon 2012; Feenberg 2006), which means the knowledge, art and craft of making something. "Originally the term referred to a carpenter's craft-knowledge of how to make objects from wood […], but later it was extended to include all sorts of craftsmanship, such as the ship's captain's *techne* of piloting a ship, the musician's *techne* of playing a particular kind of instrument, the farmer's *techne* of working the land, the stateman's *techne* of governing a state or *polis*, or the physician's *techne* of healing patients" (Reydon 2012). Technology as techné was considered in subjective terms oriented on humans skills, capacities and knowledge to create something in purposeful manner and thereby change the world.

Aristotle distinguishes between physis/nature and poiesis as two domains of existence. Physis is the natural world, in which things are their own causes, whereas poiesis means that humans actively change the world and are the cause of change.

> "Some things are due to nature; for others there are other causes. Of the former sort are animals and their parts, plants, and simple bodies like earth, fire, air, and water – for we say that these and things like them are due to nature. All these things plainly differ from things which are not constituted naturally: each has in itself a source of change and staying unchanged, whether in respect of place, or growth and decay, or alteration. […] in some cases, such as that of a house or anything else made by 30 human hands, the source is in something else and external, whilst in others the source is in the thing, but not in the thing of itself, i.e. when the thing comes to be a cause to itself by virtue of concurrence" (Aristotle 1992, 23).

Aristotle (2004, §1139b) discerns five forms of knowledge: skill (techné), scientific knowledge (episteme), practical wisdom (phronesis), wisdom (wisdom), intellect (nous). He writes about techné:

"Every skill is to do with coming into being, and the exercise of the skill lies in considering how something that is capable of either being or not being, and the first principle of which is in the producer and not the product, may come into being; for skill is not concerned with things that are or come into being by necessity, or with things that are by nature (since they have their first principle within themselves). […] Skill, then, as we have said, is a productive state involving true reason; and its contrary, lack of skill, is a productive state involving false reason. Both are concerned with what can be otherwise" (Aristotle 2004), §1139b).

With the rise of modern large-scale industry and machinery, the dominant meaning of the category of technology shifted towards a more objective understanding. Technology has become to be understood as thing, system, machines, tools, artefacts, hardware that apply the results of science for controlling nature (see: Dusek 2006, chapter 2; Li-Hua 2009; Williams 1985, 315).

Georg Lukács (1971, 131) argues that with the rise of the modern economy, "human relations (viewed as the objects of social activity) assume increasingly the objective forms of the abstract elements of the conceptual systems of natural science and of the abstract substrata of the laws of nature". The economy thereby became "transformed into an abstract and mathematically orientated system of formal 'laws'" (105) that is governed by "the abstract, quantitative mode of calculability" (93). Technology in such a system is a machine that is used for controlling and instrumentalising human activities expended in time for partial interests such as corporations' monetary profits and commodity production, bureaucratic power, possessive individualism, or consumerism. Alfred Sohn-Rethel (1978) argues that this instrumental understanding of knowledge and technology goes back to the division of labour between manual and mental labour in class societies. The "logic of the market and of mechanistic thinking is a logic of intellectual labour divided from manual labour" (Sohn-Rethel 1978, 73). For Sohn-Rethel, the logic of mechanistic, quantifying, mathematical reasoning is not something that emerged with the existence of modern society, but is as much older. He argues that it goes as far back as ancient Greek slavery that instituted a division between manual labour performed by slaves and the mental labour of philosophers, politicians and scientists. "It is Greek philosophy which constitutes the first historical manifestations of the separation of head and hand in this particular mode" (66). For Sohn-Rethel, this division of head and hand is accompanied by a particular role of exchange in the economy that bases production and distribution of goods and services on the logic of measurement: A specific quantity of one good is exchanged for the quantity of another one (x commodity A = y commodity B). The division of labour would therefore in the realm of thinking and logic be accompanied by quantifying reason and in the realm of the economy by exchange-value.

Aristotle's distinction between theoria (philosophy), praxis (action), and poiesis (production) is characteristic for this division. It is a division of society into the realms of ideas, politics and the economy. The latter is the realm of slaves, the first two are realms of citizens. "Aristotle distinguished three ways of life (b'xo'i) which men might choose in freedom, that is, in full independence of the necessities of life and the relationships they originated. This prerequisite of freedom ruled out all ways of life chiefly devoted to keeping one's self alive – not only labor, which was the way of life of the slave, who was coerced by the necessity to stay alive and by the rule of his master, but also the working life of the free craftsman and the acquisitive life of the merchant. In short, it excluded everybody who involuntarily or voluntarily, for his whole life or temporarily, had lost the free disposition of his movements and activities" (Arendt 1958, 12).

So for Aristotle, labour is not a universal form of production in society, but a sphere in a class society, in which citizens own slaves as property and have the right to exploit them. Aristotle asks in the first book of his *Politics* whether there are humans who are slaves by nature. His answer is that the soul rules the master and the body the natural slave:

"it is in a living creature, as we say, that it is first possible to discern the rule both of master and of statesman: the soul rules the body with the sway of a master, the intelligence the appetites with constitutional or royal rule; and in these examples it is manifest that it is natural and expedient for the body to be governed by the soul and for the emotional part to be governed by the intellect, the

part possessing reason, whereas for the two parties to be on an equal footing or in the contrary positions is harmful in all cases. Again, the same holds good between man and the other animals: tame animals are superior in their nature to wild animals, yet for all the former it is advantageous to be ruled by man, since this gives them security. Also, as between the sexes, the male is by nature superior and the female inferior, the male ruler and the female subject. And the same must also necessarily apply in the case of mankind generally therefore all men that differ as widely as the soul does from the body and the human being from the lower animal (and this is the condition of those whose function is the use of the body and from whom this is the best that is forthcoming) – these are by nature slaves, for whom to be governed by this kind of authority is advantageous, inasmuch as it is advantageous to the subject things already mentioned. For he is by nature a slave who is capable of belonging to another (and that is why he does so belong), and who participates in reason so far as to apprehend it but not to possess it; for the animals other than man are subservient not to reason, by apprehending it, but to feelings. And also the usefulness of slaves diverges little from that of animals; bodily service for the necessities of life is forthcoming from both, from slaves and from domestic animals alike. The intention of nature therefore is to make the bodies also of freemen and of slaves different – the latter strong for necessary service, the former erect and unserviceable for such occupations, but serviceable for life of citizenship (and that again divides into the employments of war and those of peace)" (Aristotle 1932, book I, chapter 2, §§11-14).

Aristotle here makes a dualistic separation between body and mind that he naturalises in order to justify a division between mental and manual activities in society. He says that slaves and women are lower classes of humans. Comparable to animals, they would be ruled by the body, drives, and feeling, whereas citizens would be rational and reasonable. Aristotle infers the necessity of class rule from nature, so he sees nature determining society. Such an onto-epistemological naturalisation is an ideology because society is always historical and man-made. Ancient Greek class rule had to be ideologically justified by arguments that naturalise slavery. Overall, this discussion confirms Sohn-Rethel's assumption that already in ancient Greece, class divisions instituted a separation of mental and manual labour and a gap between abstract conceptual knowledge and practical knowledge.

In a general understanding, technology is neither knowledge nor a thing, but a process, in which humans make use of their skills, knowledge and capacities and of objects in order to change the world in an intentional and purposeful manner. In modern society, technology is no longer a human-controlled means for human-defined ends. Means and ends are reversed: Humanity is not an end-in-itself, but humans have become means and instruments for dominant groups' partial interests. Technology is in this context an instrument for domination. Capital, including technology as its means of production, is a subject that dominates labour. Technology is in such a system not a means to humane ends, but rather servers a specific instrumental aim, namely capital accumulation, and as part of this end turns humans into objects.

The instrumental character of technology is not inherent in technology as such or in society in general, but rather has to do with how partial interests shape technology and society. Technology is not neutral and value-free, but embedded into power structures, contradictions and struggles that

shape its invention, design, application and use. This also means that technologies can be re-designed, re-invented, changed, re-purposed, abolished, etc. Humans can consciously change society and technology. Putting technologies to humane and democratic use requires shaping society, invention, design, application and use by humane and democratic values. It requires a political struggle for alternative technological and alternative frameworks that benefit all humans.

Given that technology is always a medium for achieving purposeful human activities, we cannot assume that technology is a subsystem or autonomous realm of society. Wherever there are human activities, there are also technologies. There are technologies that humans use for transforming nature into resources used in the economy, political technologies of how humans govern society in particular (e.g. despotic, democratic, populist, etc.) ways, cultural technologies for the definition of identities, etc. Information and communication technologies are means that humans use for creating, disseminating and consuming information about the world. The computer and networked computer systems are particular technologies that other than traditional media (radio, television, the newspaper, etc.) do not just allow the consumption of information, but also its production, co-production and dissemination. The networked computer allows the convergence of the production, dissemination and consumption of information in one tool. You need different tools for producing and listening to a radio or television broadcast, traditional broadcast production, circulation and consumption technologies diverge. The networked computer allows their convergence. The computer is also a convergent technology of information, communication and co-operation that is used in all realms of society. It is just like language or the telephone a communication technology and just like the newspaper, the radio, the television or the cinema an information technology. But in addition to an information consumption technology, the computer is like a typewriter, a studio or a film set also a means for producing information. And more than this, it allows not just one person to produce information, but as networked technology allows computer-supported co-operative work, i.e. the co-production of information.

Given that technology is not independent from society, we cannot speak of the sustainability of technology just in technological terms, but need to connect this topic to society. A computer-controlled atom bomb is a particular political technology used for threatening actual or potential enemies. Its existence has to do with political power relations in the world. Defining technological sustainability immanently would mean that the atom bomb would be sustainable if it works error-free, has comprehensive usability, can be controlled with the help of a user-friendly, secure and stable computer interface, etc. The problem of such an understanding is, however, that the computer-controlled atom bomb is inherently political and conflicts with the goal of a peaceful global society. It is politically unsustainable.

Such immanent definitions of technological sustainability that stay in the realm of technology without considering society often take on ideological forms. (Mulder, Ferrer, and van Lente 2011) argue in this context in the book *What is Sustainable Technology?*:

> "Sometimes the claim that a technology is sustainable is made in order to make the technology acceptable in the political process. This can especially be seen in the case of nuclear energy production, where the claims of sustainability refer to the absence of CO2

> emissions. In the case of biofuels, claims of sustainability have led to a 'fuel or food' debate showing that sustainability has counteracting articulations. […] Technologically, there are often much more challenging options to work on than just improving existing designs. These options change not only a single part of a machine, but the machine as a whole, or even the whole system in which it functions. […] Technologically, there are often much more challenging options to work on than just improving existing designs. These options change not only a single part of a machine, but the machine as a whole, or even the whole system in which it functions" (Mulder, Ferrer, and van Lente 2011, 3, 5).

A critical approach to sustainability therefore has to define sustainability of information technology and other technologies not independently from society, but in the context of the dialectic of technology and society. Technology is not sustainable as such, but can only be sustainable in the context of particular technological designs based on particular societal frameworks:

> "What is this thing called 'sustainable technology'? Clearly, the concept refers to the big challenges that global developments pose to engineers, policy-makers and civil society at large. These challenges are often located in the domains of social, economic and ecological concerns. […] Thus, sustainability, it appears, is not an end in itself. There is no such thing as an inherently sustainable technology. This might seem a frustrating answer but we have to get used to the fact that technologies can only be judged as part of a social process rather than as simply products. […] For any specific technology, there is no set of design characteristics that would make it sustainable. Rather, sustainability of a technology can only be determined through a socio-political process, as the process has to deal with various human capabilities and preferences. Engineers may be uncomfortable with this truth, but we do, both individually and collectively, have to humbly learn to live with it" (Mulder, Ferrer, and van Lente 2011, 236, 242).

Computer technology cannot simply be made sustainable by changing chips, cables, variables, codes, or algorithms. Sustainable computing is not a technological matter because computing is embedded into environmental, economic, political and cultural contexts of design, production and use. It is therefore necessary to discuss the topic of computing and sustainability in the context of the information society. Making computing sustainable requires shaping technology and society in an integrated manner.

Such an understanding of technology is underlying the philosopher Ivan Illich's (1973) book *Tools for Conviviality*. He argues that it is dangerous to base society on what is technologically possible and not what is politically and ethically feasible. Illich argues that both society and technology need to be re-designed in an integrated manner. He therefore speaks of convivial tools in a convivial society. "Such a society, in which modern technologies serve politically interrelated individuals rather than managers, I will call 'convivial'. […] I have chosen 'convivial' as a technical term to designate a modern society of responsibly limited tools" (Illich 1973, 12). We cannot assume that technological developments are automatically societally responsible. Sustainability and technology development should be seen as two interlinked social and political tasks.

Illich gives the example of the development of modern medicine. "The year 1913 marks a

watershed in the history of modern medicine. Around that year a patient began to have more than a fifty-fifty chance that a graduate of a medical school would provide him with a specifically effective treatment" (Illich 1973, 14). Scientific progress helped to increase the average life duration significantly. Illich describes how medical progress turned against itself and created negative consequences. This includes that humans live longer, but "in unhealthy cities and in sickening jobs" (Illich 1973, 15), unequal access to medical services, a focus on treating only symptoms and not also the causes of illnesses, the development of a medical bureaucracy that many patients consider to be inhumane, the emergence of new diseases, etc. These negative consequences would have constituted a second watershed that would have become evident in the 1950s. Other dimensions of modern society, such as education, transportation, social work, or civil engineering, would also have undergone the dilemma of the two watersheds. "At first, new knowledge is applied to the solution of a clearly stated problem and scientific measuring sticks are applied to account for the new efficiency. But at a second point, the progress demonstrated in a previous achievement is used as a rationale for the exploitation of society as a whole in the service of a value which is determined and constantly revised by an element of society, by one of its self-certifying professional élites" (Illich 1973, 20). So for Illich the problem is that technological innovations have the danger to blind people for potential negative consequences. Their all too optimistic adoption can backfire and result in unforeseen consequences. In an argument comparable to Illich's, Horkheimer and Adorno (2002) argue that enlightenment reason can turn negatively against itself and have dangerous consequences. This is what they call the dialectic of the enlightenment. The implication of the problems that technologies can entail is to take an approach that tries to actively limit negatively consequences by designing society and technology in human-centred ways. Such designs do not think primarily about what is "good for institutions" (Illich 1973, 25), but what is good for all humans.

1.2.2 Four Approaches to Understanding Sustainability in the Information Society

Discussions about the un/sustainability of information technology's role in society have especially emerged since the 1st World Summit on the Information Society that was held in two phases in 2003 and 2005.

We can classify information society policy discourses according to how they relate the domains of the ecology and the economy to the realms of politics and culture. According to the information philosopher Wolfgang Hofkirchner (2013), there are four ways of how the relationship of two categories C1 and C2 can be explained: reductionism, projectivism, disjunctivism/dualism, and dialectical integrativism. Reductionism causally reduces the relation C1-C2 to C1. Projectivism projects causality into C2. Dualistic thought argues that C1 and C2 have independent causalities. A dialectical approach sees C1 and C2 as at the same time relatively autonomous and mutually constituting each other. In a dialectic, C1 and C2 are identical and non-identical at the same time. Other publications have based on Hofkirchner's typology elaborated and applied a distinction of four information society policy discourses (Fuchs 2010b; Verdegem and Fuchs 2013).

Type of approach	Description
Reductionism	Ecology, economy, or technology are considered as the driving forces of a sustainable information society.
Projectivism	Politics and/or culture are seen as the determinant forces of a sustainable information society.
Dualism	Multiple dimensions and goals of a sustainable information society are identified, but not causally related to each other.
Dialectic	Multiple dialectically interrelated dimensions and goals of a sustainable information society are identified, existing contradictions of these dimensions are analysed, and changes are seen as integral, interdependent, and systemic.

Table 3: Approaches on sustainability and information society policies (based on: Fuchs 2010b)

Reductionist approaches see ecological or technological or economic developments (such as GDP investment in information technology and the information economy) as the sole driving forces of the un/sustainable information society. Projectionist approaches see the political and/or cultural system as the determining forces of un/sustainability in the information age. Dualistic approaches define multiple goals and dimensions of a(n) un/sustainable information society, but do not consider if these goals are compatible and if and how they are causally linked. Dialectical approaches see the various dimensions and goals of un/sustainability in the information society as interdependent, mutually causally linked, and only relatively autonomous.

1.2.2.1 Projectionist Understandings of Sustainability in the Information Society

Projectivism is an approach that can hardly be found in ICT policy discourses on sustainability because the notion of sustainability originates in the environmental realm and this kind of discourse tends to be associated with industry interests. Therefore either the ecological or the economic or both dimensions normally tend to play a role. Theoretically ICT sustainability could of course be conceived in purely political or cultural terms with a pure focus on either digital democracy or fostering online understanding.

1.2.2.2 Reductionist Understandings of Sustainability in the Information Society

Hilty and Ruddy (2010) reject multidimensional definitions of sustainability in general and in the ICT context in particular because they argue that nature is the most fundamental dimension of human survival. They say that "multidimensionality mitigates the radical nature of SD" (Hilty and Ruddy 2010, 11). They define the central concern of sustainable development as the "sustainability dilemma", i.e. "the physical impossibility of extending the present consumption patterns of the industrialized countries to all parts of the world without putting a great burden on future generations" (Hilty and Ruddy 2010, 10).

"We conclude from this section that, assuming a natural science view of human

> consumption, there is no meaningful way of assigning the sustainability dilemma to one of more aspects or 'dimensions' of SD. As a consequence, there is no meaningful interpretation of terms such as 'ecological sustainability', 'environmental sustainability', 'economic sustainability', 'social sustainability' or 'cultural sustainability' as long as 'sustainability' refers to SD. It is impossible to segment the normative component of the SD concept into these dimensions because the sustainability dilemma must be solved in any case, irrespective of the specific focus of a given discourse. From this point of view, there is only one way to solve the sustainability dilemma: reducing the per-capita material input into the economic system, e.g. to 6 metric tons per year for non-renewable materials including fossil fuels" ((Hilty and Ruddy 2010, 11-12).

The emergence of ICTs and the Internet has not dematerialized the economy. The depletion of non-renewable natural resources and the massive emission of carbon dioxide continue. The ecological catastrophe is certainly an important challenge in the information society. But assume that we had solved this problem, then other ways of destroying humanity could nonetheless still persist, especially politically and ideologically motivated wars and spirals of violence that in escalation could result in the large-scale use of nuclear, chemical and biological weapons that could wipe out humanity. Also economic crises have the potential to render the lives of many people precarious and can lead to political crises and in the last instance also to wars.

Hilty and Ruddy create the impression that the environmental crisis is the only problem that needs to be solved in the information age. Their approach is a form of **environmental reductionism**. We can also not exclude the possibility that it may indeed be possible to universalise today's per capita quantity of physical consumption to all humans if it is at the same time possible to make a large-scale qualitative shift to green energy and renewable resource use. Given that there is more than one dimension that threatens the existence of humanity and the attainability of a good society, a one-dimensional use of the category of the sustainable information society is not feasible.

The European Union in 2010 introduced its new information society policy called *A Digital Agenda for Europe*, in which it formulates a policy strategy and goals it wants to reach until 2020 (European Commission 2010). "*The overall aim of the Digital Agenda is to deliver sustainable economic and social benefits from a digital single market based on fast and ultra fast internet and interoperable applications*" (European Commission 2010, 3). The notion of sustainability is here used as both meaning a) the continuous growth of profits and the GDP as well b) the continuous guarantee of social cohesion. There is no consideration that there may be an antagonism between on the one side the focus on companies' profits and on the other side increasing social inequalities The overall aim formulated in the Digital Agenda tends to be strongly focused on the economy and technology: It sees economic and social sustainability as a result of the development of the Internet and a market-oriented digital economy.

The EU expresses its view that the Internet in Europe is not developed enough, not fast enough and that the uptake is not widely enough:

> "More needs to be done to ensure the roll-out and take-up of broadband for all, at increasing speeds, through both fixed and wireless technologies, and to facilitate

> investment in the new very fast open and competitive internet networks that will be the arteries of a future economy. Our action needs to be focused on providing the right incentives to stimulate private investment, complemented by carefully targeted public investments, without re-monopolising our networks, as well as improving spectrum allocation" (European Commission 2010, 6).

One of the keywords of the EU for creating sustainability is the focus on a "vibrant digital single market" (7) for Internet services, digital content and "telecom services" (7), which includes Internet access and infrastructure. "*We need very fast Internet for the economy to grow strongly and to create jobs and prosperity, and to ensure citizens can access the content and services they want.* The future economy will be a network-based knowledge economy with the internet at its centre. Europe needs widely available and competitively-priced fast and ultra fast internet access. The Europe 2020 Strategy has underlined the importance of broadband deployment to promote social inclusion and competitiveness in the EU" (18-19). The EU has the objective to achieve "broadband for all" (26) and wants to specifically foster the deployment of Next Generation Access (NGA) networks (20), which are Internet networks that have a download speed of more than 24 Mbit/s. The EU strategy in this respect is to "encourage market investment in open and competitive networks" (20).

The EU overall fosters a market approach to digital society. It sees businesses as the key to providing Internet access and services and sees the Internet economy as the source of the growth of economic profitability and the creation of wealth and social inclusion.

The EU considers regions that have a per capita GDP lower than 75% of the EU average as being less developed. In the years 2014-2020, this includes all of Bulgaria, Estonia, Latvia, Lithuania, Romania, Slovakia, Slovenia as well as parts of Croatia, the Czech Republic, Greece, Hungary, Poland, Portugal, South Italy, Spain, and the UK (Cornwall, West Wales). Figure 5 visualises these regions and shows that they are especially located in Europe's South and East, which is an indication of uneven development in Europe. Table 4 shows that in the EU, less developed regions, sparsely populated areas, poor households and individuals with low education have significantly lower use of the Internet and computers than the average EU citizen.

	Individuals regularly (at least once a week) using the Internet, 2015	**Households with Internet access, 2015**	**Households with broadband access, 2015**	**Households owning a computer, 2015**	**Share of individuals who have never used the Internet, 2015**
EU28	76%, 2010: 65%	83%	80%	82%	16%
Less developed regions	2013: 59% total EU28 (2013): 72%	2013: 68%, total EU28 (2013): 79%	2013: 66%, total EU28 (2013): 76%	2013: 70%, total EU28 (2013): 80%	2013: 31%, total EU28 (2013): 20%
ICT professionals	92%				3%
Manual workers	72%				17%
Low education	55%				36%
Individuals in poorest households (lowest quartile)	48%	62%	59%	62%	31%
Individuals in richest households (upper quartile)	81%	97%	95%	97%	5%
Households in sparsely populated areas (< 100 inhabitants/km2)			73%	77%	23%

Table 4: Internet and computer use statistics for the EU (data source: Eurostat)

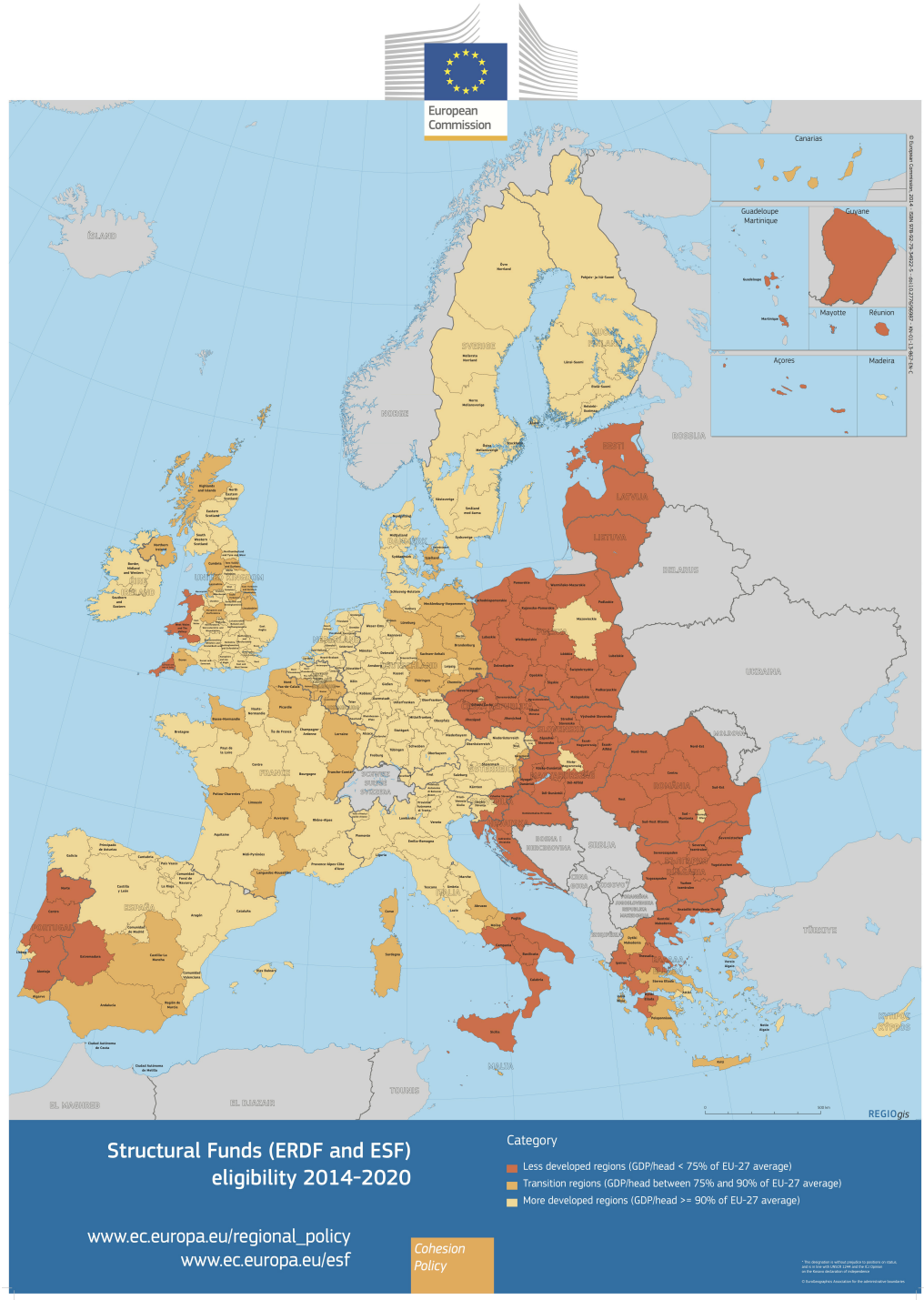

Figure 6: Less developed regions in Europe, 2014-2020 (in orange, source: European Union - http://ec.europa.eu/regional_policy)

Figures 7, 8 and 9 visualise the geographical access to the Internet in Europe. They indicate that there is less Internet use in less developed regions. Tables 5 and 6 show the regions in Europe that in 2015 had the largest share of citizens who had never used a computer and the lowest use of broadband Internet. They again indicate that it is regions in the South and East of Europe that have the lowest computer and Internet use.

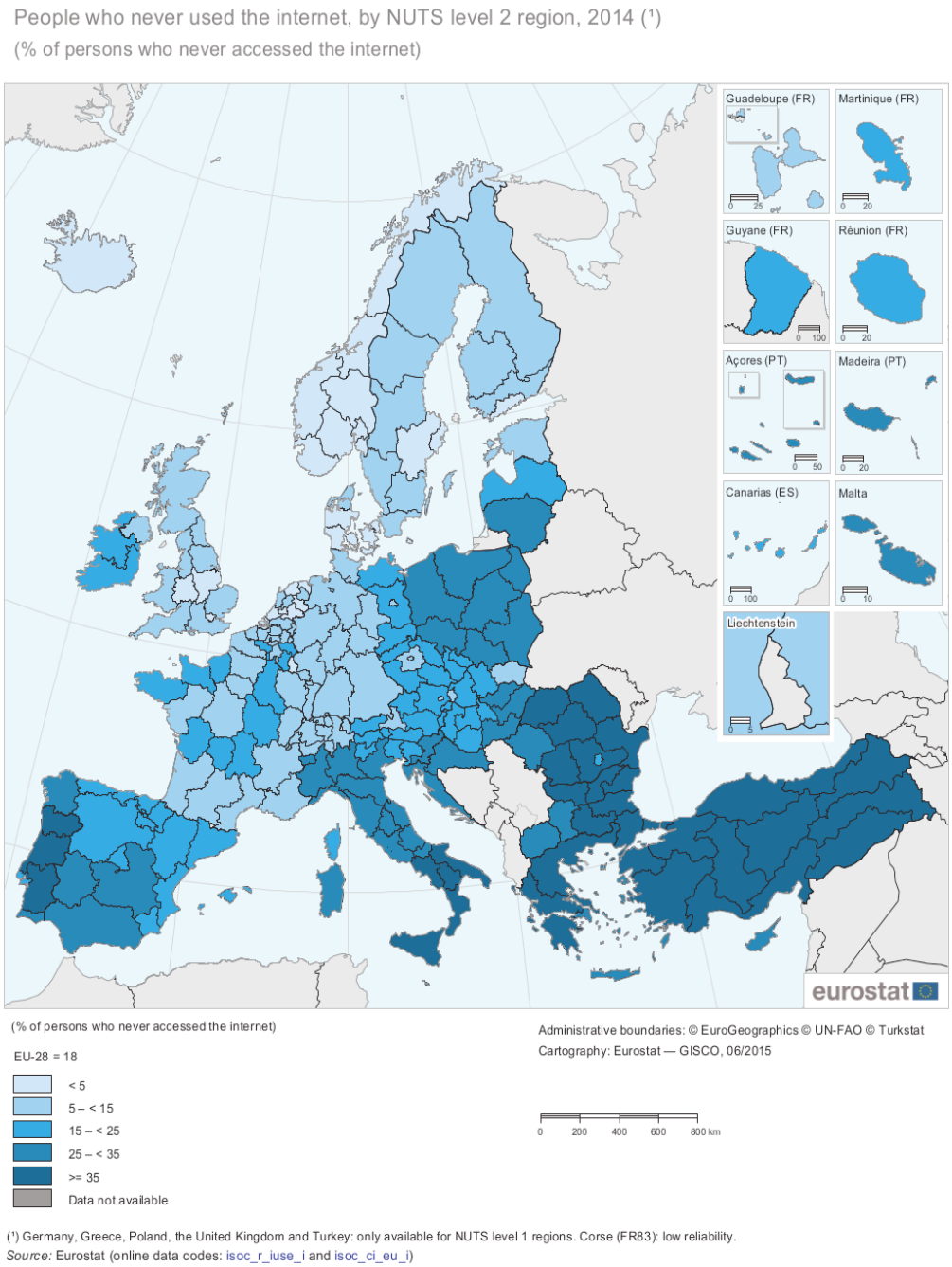

Figure 7: Share of Europeans who have never used the Internet, 2014 (source: Eurostat)

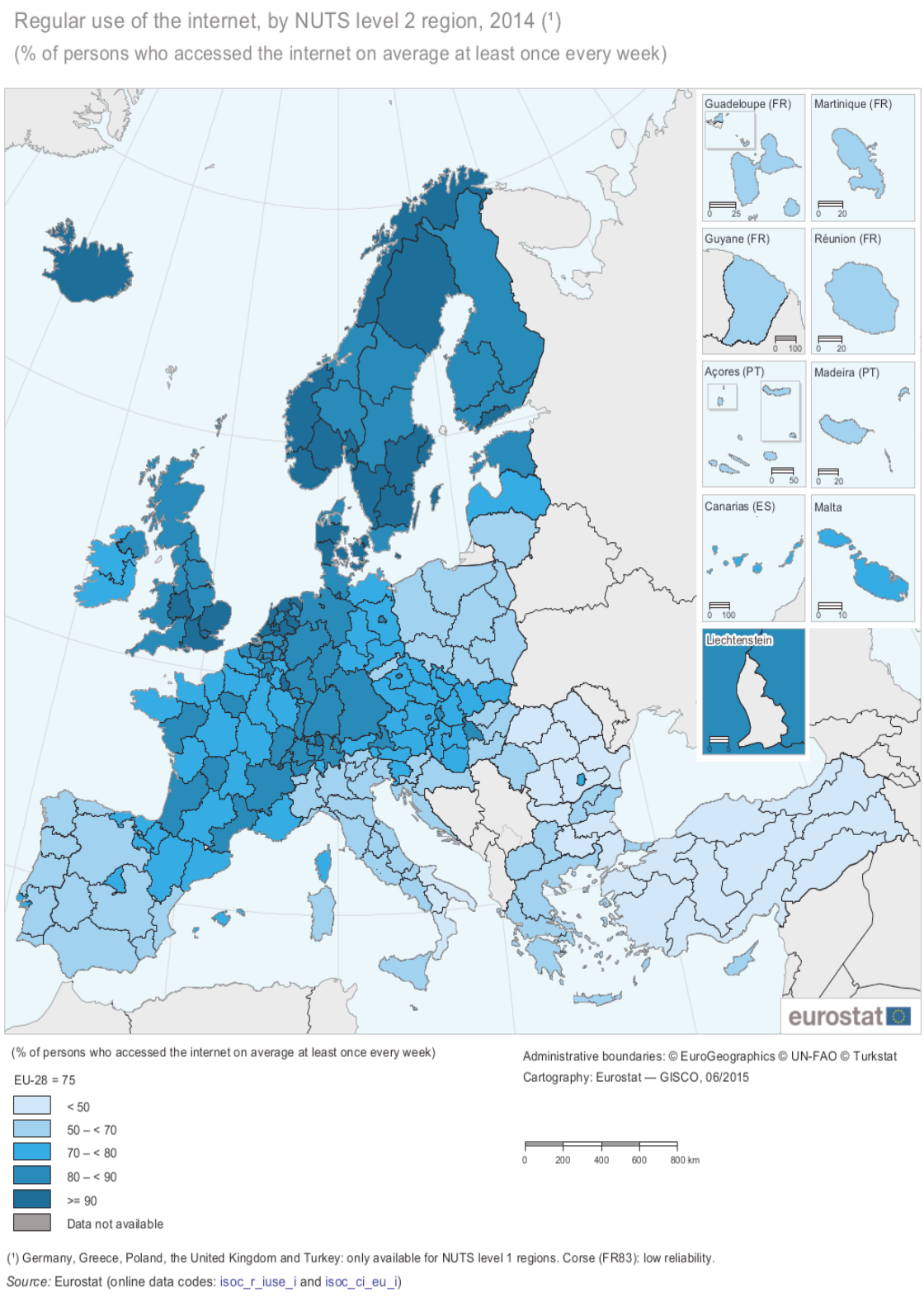

Figure 8: Share of Europeans who regularly used the Internet in 2014 (source: Eurostat)

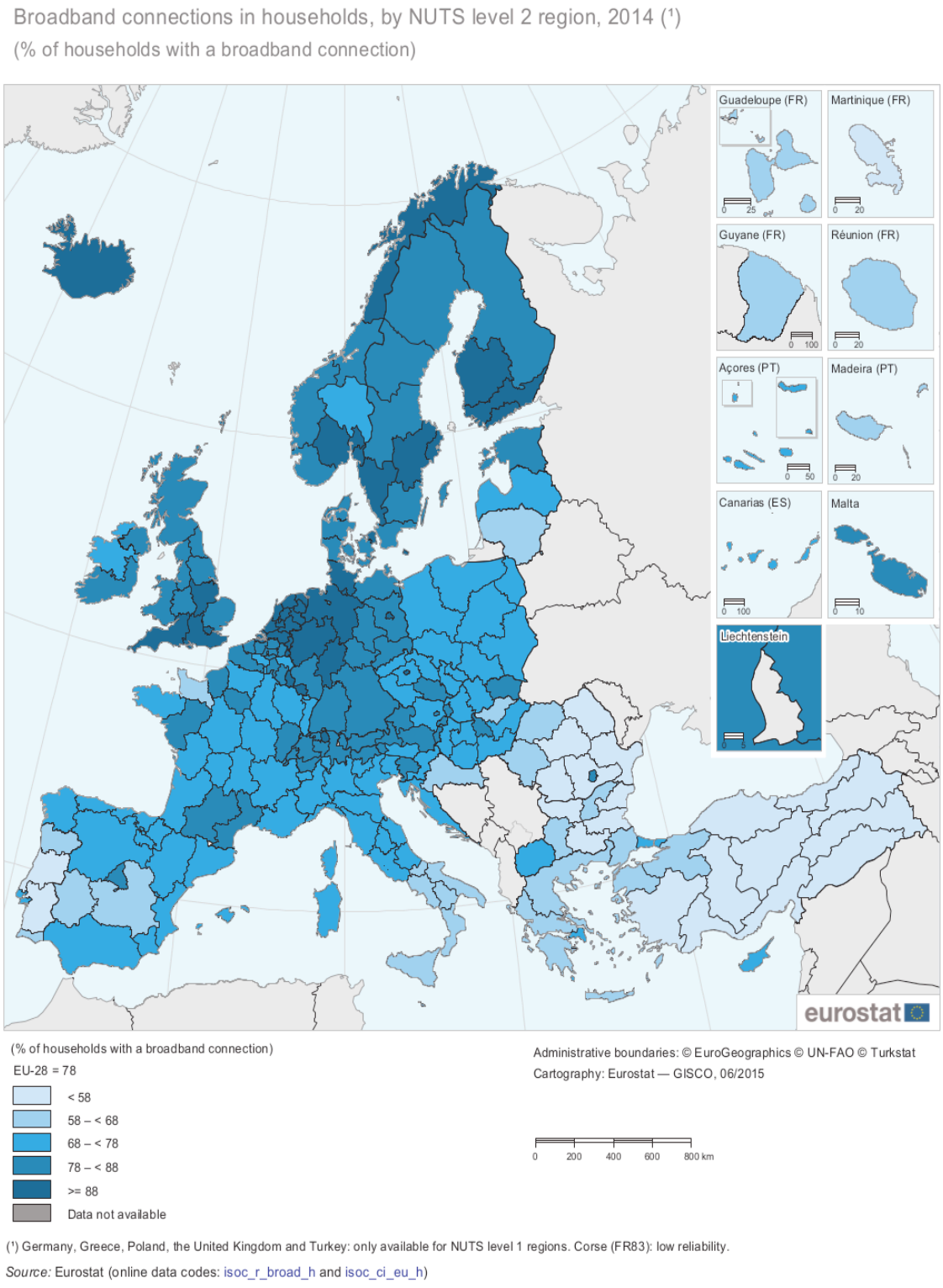

Figure 9: Share of European households that had broadband connections in 2014 (source: Eurostat)

Region	%
Severozapaden, Bulgaria	45%
North and South Bulgaria	55%
Severoiztochen, Bulgaria	56%
Yuzhen tsentralen, Bulgaria	56%
Corsica, France	57%
Macroregiunea, Romania	57%
Nord-Est, Romania	57%
Sud-Est, Romania	57%
Severen tsentralen, Bulgaria	58%
Yugoiztochen, Bulgaria	58%
Central Greece	59%

Table 5: Regions in the EU, where in 2015 less than 60% of households had broadband access at home (data source: Eurostat)

Region	%
Severozapaden, Bulgaria	49%
Campania, Italy	42%
Apulia, Italy	42%
Sud, Romania	40%
Molise, Italy	40%
Sicily, Italy	40%

Table 6: Regions in the EU, where in 2015 40% or more have never used a computer (data source: Eurostat)

Given the existence of a digital divide between poor citizens and regions on the one side and rich citizens and regions on the other side, the question arises if an approach that is very much focused on fostering private ownership and for-profit operation of Internet networks is suited for overcoming such divides. For-profit means that operators charge for network access. Access is organised as a commodity. Given income inequality, those on lower income are less likely to be able to afford the same level and speed of access than those who are better off.

The EU predominantly follows a market approach in the creation of fast broadband networks. In 2014, the EU announced the European Fund for Strategic Investments (EFSI), a plan of investing 315 billion Euros into broadband infrastructure, transport, education, research and innovation in the years 2015-2017 as a combination of public funding and private investment[2]. Around 80% comes from private investors, the rest from the European Investment Bank and the European Investment Fund (European Commission 2016a).

> "Since the global economic and financial crisis, the EU has been suffering from low levels of investment. Collective and coordinated efforts at European level are needed to put Europe on the path of economic recovery. The Investment Plan for Europe adopted in November 2014 as the first major initiative of the Juncker Commission has the potential to bring

> investments back in line with its historical trends. Via the EFSI, the European Investment Bank is able to respond quickly to financing needs in areas where alternative sources of financing are scarce or unavailable. The Bank's presence often provides reassurance to other financiers to provide co-financing. The EFSI projects need to be economically and technically viable, consistent with Union policies, provide additionality (i.e. they could not be realized without the backing of the EU guarantee), and maximise the mobilisation of private sector capital" (European Commission 2016a)

The President of the European Commission Jean-Claude Juncker commented: "We need to pursue fiscal responsibility and keep public finances sustainable. We also need to restore investment levels to overcome the crisis, to kick-start growth and sustain it. […] We have to […] stimulate private capital. We cannot spend money we do not have. So this is an offer to the private sector where the money is […] to join the efforts we are developing"[3].

The discussion shows that there is a policy regime in Europe that tends to be predominantly focused on fostering Internet infrastructure and access as commodity. There is not just unequal access to the Internet in Europe, but also large market concentration in the broadband market. Since 2012, over 60 billion Euros were spent on mergers and acquisitions of telecommunications operators in the EU (European Commission 2015). In 8 of 28 EU countries, the incumbent controls more than 50% of all broadband subscribers (ibid.): Luxembourg, Cyprus, Austria, Denmark, Estonia, Latvia, Croatia, and Lithuania. For all of Europe, incumbents control 41% of the subscribers (ibid.). Table 7 provides an overview of the dominant market player's share in broadband subscription for all European countries.

Country	Share	HHI >
Luxembourg	69%	4761
Cyprus	64%	4096
Austria	58%	3364
Denmark	58%	3364
Estonia	58%	3364
Latvia	58%	3364
Croatia	53%	2809
Lithuania	51%	2601
Malta	49%	2401
Portugal	48%	2304
Italy	48%	2304
Spain	45%	2025
Belgium	44%	1936
Hungary	44%	1936
Greece	43%	1849
Germany	42%	1764
Netherlands	41%	1681
France	39%	1521
Sweden	39%	1521
Ireland	37%	1369
Slovenia	35%	1225
Slovakia	34%	1156

UK	32%	1024
Poland	32%	1024
Czech Republic	29%	841
Romania	27%	729
Bulgaria	23%	529
Average in EU	44%	HHI > 2106

Table 7: Market share of the incumbent in fixed line broadband subscriptions and minimum level of the Herfindahl-Hirschman-Index, data for 2015, data source: European Commission 2015

The Herfindahl-Hirschman-Index is a measure of market concentration. It is calculated the following way:

$$HHI_j = \sum_{i=1}^{f} S_{ij}^2$$

f = number of firms participating in an industry, S_{ij} = each firm i's market share in the industry j.

HHI < 1000: low market concentration,

1000 < HHI < 1800: moderate market concentration,

HHI > 1800: high market concentration (E. Noam 2009)

The calculations of the Herfindahl-Hirschman-Index (HHI) in table 7 show minimum levels. We can infer from them that in at least 15 of 27 EU countries, for which data is available, the broadband market was highly concentrated in 2015. The average EU HHI in the broadband market is at least 2106, which is also a very high level.

Mobile broadband has a relatively small share of the broadband market: In 2014, only 8.3% of the homes in the EU used mobile Internet connections for accessing the Internet (European Commission 2015). Table 8 shows that the average minimum HHI for the mobile communications market in 25 EU countries in the year 2014 was 1753. Given that this is a minimum value based on the market share of only the incumbent, we can assume that the actual value is higher than 1800 and that therefore also the European mobile communications market is highly concentrated.

Country	**%**	**HHI >**
Cyprus	66%	4338
Luxembourg	55%	2973
Slovenia	48%	2345
Portugal	47%	2246
Croatia	46%	2146

Hungary	45%	2049
Malta	44%	1968
Romania	44%	1933
Lithuania	43%	1815
Austria	42%	1776
Latvia	42%	1769
Slovakia	42%	1734
Estonia	41%	1665
Finland	40%	1587
Czech Republic	39%	1556
Denmark	39%	1524
Ireland	38%	1439
Bulgaria	37%	1369
Germany	37%	1369
Sweden	36%	1299
France	33%	1106
Spain	32%	1025
Italy	32%	996
UK	30%	900
Poland	30%	888
EU	41%	1753

Table 8: Market share of the incumbent in mobile network subscriptions and minimum level of the Herfindahl-Hirschman-Index, data for 2014, data source: Eurostat (Digital Agenda Key Indicators), UK and Germany: Ofcom (2015)[data for other European countries was not available]

Given that the development of the Internet market has resulted in high broadband market concentration, the question arises if it is wise to further foster the market model in building new infrastructure or if alternative models are needed.

The EU's strategy to try to stimulate private investments into Internet infrastructure can easily enforce further market concentration: Investments into communications infrastructure is very expensive because it involves the digging of trenches and the laying of fibre cables and ducts. Only companies with lots of capital can undertake such investments. Given a high concentration of communications markets as in Europe, the most likely investors into new communications infrastructure are the incumbent players, which strengthens their market advantages, makes it more likely that they also dominate the new markets, which then reinforces capital concentration.

Fostering private investments with the help of public aid in an overall highly concentrated economic realm such as communications tends to reinforce concentration. We can therefore speak of a vicious cycle of capital concentration in the communications infrastructure market. Furthermore, communications corporations such as Verizon, Vodafone, EE, O2[4], Hutchison, Tele Columbus, Tele2, and Telecom Italia[5] seem to have avoided paying taxes in Europe. The argument that private investment is needed because public finances are under strain seems to overlook that public funding could certainly be increased if tax avoidance structures could be overcome and large corporations be made accountable.

Such processes constitute together a *vicious cycle of concentration* that operates in the

communications market and other markets (see figure 10): A specific form of policies and ideology foster the commodification of services, society's resources, infrastructures and services (Harvey 2005). The result is the emergence of markets. Markets in general have a tendency to concentrate and form oligopolistic and monopolistic structures. Communications markets are affected by concentration in a particular way: Investment into network infrastructures and new technologies are expensive, which fosters concentration. Advertising-funded media tend to attract advertisers if they attract large numbers of viewers, readers, listeners and users, which fosters the concentration of advertising via an advertising-audience share-spiral (Furhoff 1973). Selling media content is a high-risk business, in which survival is difficult. All of these mechanisms foster concentration of communications markets. A focus on commodity logic also fosters a tendency for corporate tax avoidance that together with concentration tendencies strengthens the power of corporations. Building, maintaining and operating communications infrastructure is expensive. Given market concentration, especially existing incumbent operators tend to be able to afford necessary investments so that there is a tendency that dominant market actors tend also to control new communications infrastructures. Corporate tax avoidance not just strengthens the financial power of corporations, but also puts pressure on public finances to further foster specific policy agendas. Increasing corporate power fosters the tendency that corporations are enabled to threaten state institutions to withdraw or outsource their capital, which may result in unemployment. The competition state competes with other states for attracting capital and so tends to foster ever more commodification, privatisation, and market liberalisation. The outcome is a vicious cycle of concentration, in which neoliberal policy and ideology, markets, market concentration and corporate power are reinforced.

Overall the example of broadband markets in Europe's confirms the analysis that the EU's digital society agenda is based on an economic reductionism that fosters relatively pure market logic an the realm of digital media and sees at as primary force for sustainability.

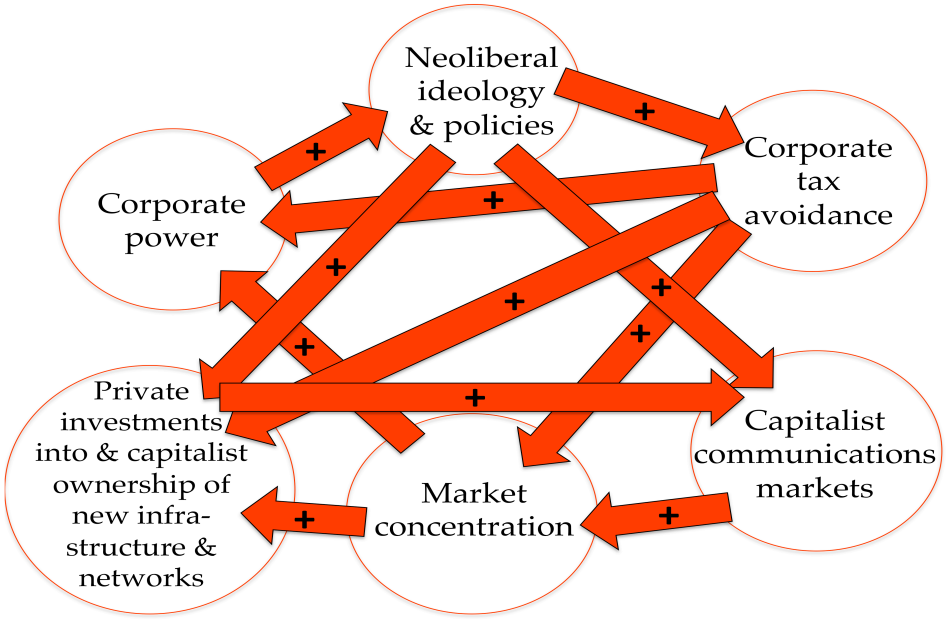

Figure 10: The vicious cycle of concentration

1.2.2.3 Dualistic Understandings of Sustainability in the Information Society

A **third type of information society policy discourse** is **dualistic** in character. The World Summit of the Information Society was a summit organised by the United Nations. It took place in two phases with one event 2003 in Geneva and another one 2005 in Tunis. WSIS formulated the vision of promoting "sustainable development and improving […] quality of life" in the information society (World Summit on the Information Society 2003, §1).

WSIS identified potentials of ICTs to eradicate hunger and poverty and foster education, gender equality, health care, environmental sustainability, peace, prosperity, freedom, democracy, human understanding, cultural diversity, and human rights (World Summit on the Information Society 2003, §§2, 3, 51). It argues that GDP growth and social equality can be advanced at the same time through ICTs: "Under favourable conditions, these technologies can be a powerful instrument, increasing productivity, generating economic growth, job creation and employability and improving the quality of life of all. They can also promote dialogue among people, nations and civilizations" (World Summit on the Information Society 2003, §9). "A well-developed information and communication network infrastructure and applications […] can accelerate the social and economic progress of countries, and the well-being of all individuals, communities and peoples" (World Summit on the Information Society 2003, §22).

WSIS' logic of argumentation is dualistic because it assumes that through ICT development both economic growth and social equality can be achieved at the same time. ICT development is seen as a realm of investment, both in developed and developing countries: WSIS promoted ICT and Internet development in developing countries through the support of foreign direct investment and

the transfer of technology (World Summit on the Information Society 2003, §40; see also World Summit on the Information Society 2005, §§54+90b). It encouraged "private-sector participation" (World Summit on the Information Society 2005, §13) and identified a "powerful commercial basis for ICT infrastructural investment" in developing countries (World Summit on the Information Society 2005, §14). It wanted to "promote and foster entrepreneurship" in the realm of ICTs in developing countries (World Summit on the Information Society 2005, §90b) and spoke of "sustainable private-sector investment in infrastructure" (World Summit on the Information Society 2005, §20). We can here find a peculiar understanding of sustainability as "private-sector investment in infrastructure". Sustainability is here not related to the common good that benefits all, but to the growth of the profits of private companies that own Internet infrastructure. In a comparative passage, WSIS called for "adequate and sustainable investments in ICT infrastructure and services" (World Summit on the Information Society 2005, §8).

In contrast to WSIS, the winners of the Noble Prize in Economics Joseph Stiglitz (winner in 2001) and Amartya Sen (winner in 1998) argue that economic growth is no guarantee for social sustainability. Stiglitz, Sen, and Fitoussi (2009, 8) write that the GDP is of limited use for measuring social progress and that it is "an inadequate metric to gauge well-being over time". Measuring well-being by the GDP could for example "send the aberrant message that a natural catastrophe is a blessing for the economy, because of the additional economic activity generated by repairs" (265). "If inequality increases enough relative to the increase in average […] GDP, most people can be worse off even though average income is increasing" (8). They call for a shift in emphasis *"from measuring economic production to measuring people's well-being"* (12) in policymaking and research in the context of sustainability.

The WSIS meetings in 2003 and 2005 were based on a policy agenda that advances a dualistic agenda that sees social sustainability and growth of profits as achievable by private control and development of ICT infrastructure. Since the rise of a form a politics that advanced privatisation, the commodification of common goods and public services, market liberalisation, and the deregulation of social policies, inequality understood as the distribution of income between labour and capital and between the rich and the poor, resource inequality, and inequality of health and death has increased. "The gap between corporate executive pay and average workers' pay is now much wider than in pre-modern times. […] Another angle from which to view the new economic distance is the current world distribution of wealth. In March 2008, before the bubble burst, *Forbes* magazine listed 1,125 of the world's billionaires. Together, they owned $4.4 trillion. That was almost the entire national income of 128 million Japanese or a third of the income of 302 million Americans" (Therborn 2012, 583, 584).

WSIS propagated a so-called "multi-stakeholder approach" that in Internet governance fosters the co-operation of "governments, the private sector, civil society and other stakeholders, including the international financial institutions" (World Summit on the Information Society 2003, §60; see also (World Summit on the Information Society 2005, §§29, 34, 80, 83, 97, 98). Such formulations create the impression that these actors possess equal shares of power in the world. Transnational corporations have significant shares of money, reputation and influence and may therefore be more

capable of being more heard in policy debates and policy formulations than civil society actors. It is therefore not a surprise that in contrast to the official "multi-stakeholder" documents published by WSIS in 2003 and 2005 that have a corporate-friendly character, the 2003 Civil Society Declaration to the World Summit on the Information Society formulated a different vision. It said that "full participation in information and communication societies requires us to reject at a fundamental level, the solely profit-motivated and market-propelled promotion of ICTs for development. Conscious and purposeful actions need to be taken in order to ensure that new ICTs are not deployed to further perpetuate existing negative trends of economic globalisation and market monopolisation" (WSIS Civil Society Plenary 2005, 7).

WSIS saw public service investment and provision of Internet access only feasible in poor regions: "We recognize that public finance plays a crucial role in providing ICT access and services to rural areas and disadvantaged populations including those in Small Island Developing States and Landlocked Developing Countries" (World Summit on the Information Society 2005, §21). It did not consider that communications markets tend to result in high economic concentration, which also means a high concentration of power and private wealth. Public service infrastructure in a world of high inequality and concentrated ownership may therefore be a feasible alternative not just for developing regions. The argument that the public should only step in where private investors cannot easily make profits overlooks that the market also fails in other areas, where transnational corporations make large profits and such accumulation results in market concentration.

Ten years after the WSIS, the WSIS+10 High Level Event conducted a progress review (Geneva, 10-13 June 2014) and published outcome documents. The approach has 10 years later not changed and remains dualist: ICTs are "cross-cutting enablers for achieving the three pillars of sustainable development" (WSIS+10 High-Level Event 2014, 10). WSIS+10 recognises some problems such as the gender digital divide, the lack of youth empowerment, the lack of Internet access in the least developed countries, that the voluntary digital solidarity fund does not work, e-waste, or privacy issues resulting from mass surveillance. But overall it is just like the WSIS outcome documents in 2003 and 2005 over-confident that the market is the right way to social and economic progress.

The WSIS agenda is still dualist: "ICTs should be fully recognized as tools empowering people, and providing economic growth" (12). "To attract private investment, competition and adequate market liberalization policies to develop the infrastructure, financing, and new business models need to be studied and deployed, taking into account national circumstances" (WSIS+10 High-Level Event 2014, 36). "We recognize the critical importance of private sector investment in information and communications technology infrastructure, content and services, and we encourage Governments to create legal and regulatory frameworks conducive to increased investment and innovation" (United Nations General Assembly 2015, §38).

WSIS simply ignores certain important issues that concern the development of the information society and show the latter's contradictions: concentrated wealth, precarious labour (especially in the younger generation), computerisation- and automation-induced unemployment, the crisis of the economy, profit/wage-inequality, income and wealth inequality, the concentration of ownership in the communications industries, unpaid and precarious digital and crowdsourced labour,

communications corporations' tax avoidance, etc.

In 2015, there were 241 information companies among the world's 2,000 largest transnational companies[6]. Together they had combined profits of US$ 537.3 billion (data source: Forbes 2000, 2015 list). These profits exceeded the combined GDP of the world's 33 least developing countries (US$ 474.0 billion) and the combined GDP of the world's 74 smallest economies (GDP of US$ 536.2 billion) (data source: UNHDR 2015, World Bank Data [GDP I market prices in current US$])). Table 9 shows the world's 10 most profitable transnational information corporations in the year 2015.

#	**Forbes Rank**	**Company**	**Industry**	**Profits 2015 (billion US$)**
1	40	Vodafone	Telecommunications	77.4
2	12	Apple	Computer Hardware	44.500
3	18	Samsung Electronics	Semiconductors	21.9
4	25	Microsoft	Software & Programming	20.7
5	20	China Mobile	Telecommunications	17.7
6	39	Google	Computer Services	13.700
7	44	IBM	Computer Services	12.000
8	67	Intel	Semiconductors	11.7
9	88	Oracle	Software & Programming	10.8
10	22	Verizon	Telecommunications	9.6
				Total: US$ 240.0 bn

Table 9: The world's most profitable transnational information corporations in the year 2015 (data source: Forbes 2000, 2015 list)

The combined profits of the world's 10 largest transnational information corporations (US$ 240.0 billion) are larger than the combined GDP of the world's 16 least developed countries (US$ 229.2 billion) and larger than the combined GDP of the world's 54 smallest economies (US$ 234.2 billion) (data source: UNHDR 2015, World Bank Data [GDP at market prices in current US$]). Vodafone was in 2015 the world's most profitable transnational information corporation. Its profits amounted to US$ 77.4 billion). Vodafone's profits were larger than the individual economic performance of 114 of the world's countries (data source: World Bank Data, GDP at market prices in current US$ for 2015), including populous countries such as Ethiopia (100 million inhabitants), the Democratic Republic of Congo (75 mn), Tanzania (52 mn), Kenya (45 mn), Uganda (38 mn) (data source: World Bank Statistics, year 2014). Vodafone, a British telecommunications company that uses "a Luxembourg entity to reduce tax bills", according to reports paid no corporation tax in 2014/2015[7].

These data show the power of transnational information corporations. They are very profitable companies. Their individual economic power is often larger than the one of entire countries. Their profitability is often further increased by tax avoidance. At the same time, there is large inequality between profits and wages. Dualistic thought formulates the goal of corporate profitability together

with a wish list of social equality goals and ignores the actual contradiction between the first and the second.

1.2.2.4 A Dialectical Understanding of Sustainability in the Information Society

A **dialectical perspective on the information society** sees unsustainable development as the result of contradictions in society that are mediated by information technology and result in destruction and inequalities. Table 10 gives an overview of the dimensions of un/sustainable ICTs and an un/sustainable information society.

Dimension	**Dimension of sustainability**	**Question**	**Dimension of unsustainability**	**Question**
Nature	Environmental sustainability of ICTs: Biodiversity (Questions concerning eWaste and the energy consumption of ICTs)	To which degree does ICT use respect the protection and preservation of natural resources so that the survival of nature and society is guaranteed? To which degree is there an equitable distribution of ICTs' environmental harms and benefits to certain groups and places?	Environmental unsustainability of ICTs: Contradiction between nature and society (environmental pollution, degradation and depletion)	To which degree does ICT use result in the depletion of non-renewable natural resources, the consumption of non-renewable energy resources, the production of non-recyclable (e-)waste, and in pollution? To which degree is there an unequal and inequitable distribution of ICTs' environmental harms and benefits to certain groups and places?
Society: Economy	Economic sustainability of ICTs: Wealth for all (Questions concerning power, monopolies, labour, access, affordability, and resource availability in the digital media industry)	To which degree is a social system that produces, uses or provides access to ICTs organised in a way that fosters wealth for all and a fair distribution of wealth?	Economic unsustainability of ICTs: Contradiction between digital capital and digital labour (poverty, inequality, economic crisis)	To which degree is a social system that produces, uses or provides access to ICTs organised in a manner that does not guarantee the satisfaction of the needs of all humans (poverty), that results in unfair distribution of need satisfaction (inequality) or the irreproducibility of the economy (economic crisis)?
Society: Political system	Political sustainability of ICTs: Participation and peace (Questions about eParticipation, eDemocracy, cyberwar, online privacy, digital surveillance)	To which degree does the social organisation underlying the production or use of ICTs enable humans to participate in collective decision-making? To which degree does the use of ICTs guarantee the peaceful existence and	Political unsustainability of ICTs: Contradiction between the rulers and the ruled (dictatorship and war)	To which degree is the social organisation underlying the production or use of ICTs ruled by an elite that excludes others from participation in collective decision-making? To which degree does the use of ICTs foster violence, the violation of basic rights and warfare?

		interaction of societies and the guarantee of basic rights?		
Society: Cultural system	Digital cultural sustainability: Recognition (Questions about online community and eLearning)	To which degree does digital culture enable the development of the human mind, the recognition of identities in society, and the reproduction of the human body?	Digital cultural unsustainability: Contradiction between the cultural elite and everyday people (disrespect and malrecognition)	To which degree does digital culture limit mental development and production, the recognition of identities and the reproduction of the human body?

Table 10: A dialectical view of the un/sustainability of ICTs and the information society

The basic assumption, on which a dialectical concept of un/sustainable ICTs in an un/sustainable information society is based, is that unsustainability means that there are contradictory interests in the production and/or use of digital media technologies, such as for example a contradiction between nature and society (environmental unsustainability), digital elites and digital producers (economic unsustainability), the rulers and the ruled (political unsustainability), or a cultural elite and everyday people (cultural unsustainability).

The dimensions of sustainability do not exist independently, but are interdependent, i.e. a lack of a certain dimension eventually will have negative influences on other dimensions, whereas enrichment of one dimension will provide a positive potential for the enrichment of other dimensions. So for example people who live in poverty are more likely to not show much interest in political participation. Another example is that an unsustainable ecosystem advances an unsustainable society and vice versa: If man pollutes nature and depletes non-renewable natural resources, i.e. if he creates an unhealthy environment, the problems such as poverty, war, totalitarianism, extremism, violence, crime, etc. are more likely to occur. The other way round a society that is shaken by poverty, war, a lack of democracy and plurality, etc. is more likely to pollute and deplete nature. So sustainability should be conceived as being based on dialectics of ecological preservation, human-centred technology, economic equity, political participation, and cultural recognition. These dimensions are held together by the logic of co-operation, i.e. the notion that systems should be designed in ways that allow all involved actors to benefit. Co-operation is the unifying and binding force of a participatory, co-operative, sustainable information society. The logic of co-operation dialectically integrates the various dimensions of sustainability.

The WSIS Civil Society Plenary (2005) argues that in the WSIS process, civil society interests were not adequately taken into account (for a critique of WSIS see also Servaes and Carpentier 2006). "Internet access, for everybody and everywhere, especially among disadvantaged populations and in rural areas, must be considered as a global public good. […] The WSIS documents also mostly focus on market-based solutions and commercial use. Yet the Internet, satellite, cable and broadcast systems all utilize public resources, such as airwaves and orbital paths. These should be managed in the public interest as publicly owned assets through transparent and

accountable regulatory frameworks to enable the equitable allocation of resources and infrastructure among a plurality of media including community media" (WSIS Civil Society Plenary 2005, 4, 12).

In its own declaration – that is very different from the official dualistic WSIS outcome documents –, the WSIS Civil Society Plenary (2003) argues for an information society that is based on 34 inclusive principles. Among them are the promotion of free software and the establishment of a public domain of global knowledge that challenges intellectual property. The focus is on public goods and redistribution. The Plenary stresses that distributive justice is needed and that economic resources should not simply be produced within economic growth models, but need to be redistributed: "We aspire to build information and communication societies where development is framed by fundamental human rights and oriented to achieving a more equitable distribution of resources, leading to the elimination of poverty in a way that is non-exploitative and environmentally sustainable" (WSIS Civil Society Plenary 2003, 3).

Given a dialectical framework of un/sustainability in the information society, we can next approach the question what un/sustainability means in the context of community networks

1.3 The Un/Sustainability of Internet Access and Community Networks

In academic literature, both the terms wireless community networks and community networks are in use. Some of these networks, such as Guifi, are not purely wireless, but also use optical fibre. Including wireless in the terminology is therefore limiting. The minimal definition of a community network that we can give is that it is an IP-based computer network that is operated by a community as a common good (see Baig et al. 2015; Baig, Freitag, and Navarro 2015; Maccari 2013; Maccari and Cigno 2015). Community networks can be closed or open: They are either only accessible to a specific community and then form a closed commons or provide "bandwidth resources free of charge to the general public" as an open commons (Damsgaard, Parikh, and Rao 2006, 106).

Douglas Schuler (1996, 25) argues that community networks are not necessarily computer-based because any community is a network of social relations between communicating humans. Michael Gurstein (2007, 59-60) defines a community network as "a locally based, locally driven communication and information system designed to enhance community and enrich lives".

The development of communication systems is often a story of conflicting power interests. "The history of communication technologies is populated with such conflicts between centralization and decentralization" (De Filippi and Tréguer 2015). Questions of centralisation and decentralisation are questions about who controls economic, political and cultural power in communication systems. In addition, power also concerns the relationship between society and nature. A multidimensional analysis of power therefore also matters when studying community networks.

There are environmental (1.3.1), economic (1.3.2), political (1.3.3) and cultural (1.3.4) aspects of the sustainability and unsustainability of community networks. These aspects will be discussed subsequently.

1.3.1 Environmental Aspects of Network Access

According to estimations, around 50 million tonnes of e-waste are generated per year and predictions are that within four years there will be further growth by 33%[8]. This amount of e-waste is around 7 kg per person in the world. Data on electronic waste in Europe is incomplete. The recycling rate of e-waste has ranged in 2010 between 11.0% in Malta and 64.9% in Sweden (data source: Eurostat). The total waste from electrical and electronic equipment has increased in the EU28 countries from 14 million tonnes in 2004 to 18 million tonnes in 2010 (ibid.). In 2012, the amount was 16 million tonnes. Given the recycling rates, it becomes evident that millions of tonnes of non-recyclable electronic waste are discarded every year in the European Union. The total hazardous waste generated in 2012 in the EU28 countries in the manufacture of computer, electronic and optical products, electrical equipment, motor vehicles and other transport equipment amounted to 2.0 million tonnes in 2010 and 2.4 million tonnes in 2012 (ibid.).

"It is estimated that the total amount of e-waste generated in 2014 was 41.8 million metric tonnes (Mt). It is forecasted to increase to 50 Mt of e-waste in 2018. This e-waste is comprised of 1.0 Mt of lamps, 6.3 Mt of screens, 3.0 Mt of small IT (such as mobile phones, pocket calculators, personal computers, printers, etc.)" (Baldé 2015). The worldwide e-waste generated per capita is forecast to increase from a figure of 5.0 kg in 2010 to 6.7 kg in 2018 (Baldé 2015).

Up to 45% of the total e-waste is treated informally and illegally (Rucevska et al. 2015). "Key destinations for large-scale shipments of hazardous wastes, such as electrical and electronic equipment, include Africa and Asia. In West Africa, a significant recipient is Ghana and Nigeria, but high volumes also go to, but not limited to Cote D'Ivoire, and the Republic of the Congo. South Asia and Southeast Asia also appear to be major regional destinations, including, but not limited to, China, Hong Kong, Pakistan, India, Bangladesh, and Vietnam" (Rucevska et al. 2015, 8).

e-waste recycling is a profitable business. The goal is to extract precious metals such as gold, silver, etc. The problem, however, is that electronic goods contain hazardous materials such as arsenic, mercury, cadmium, bromides, etc., which can easily poison e-waste workers and the soil. "E-waste recycling is flourishing in many parts of the world. South Asia and Southeast Asia appear to be major regional destinations, including, but not limited to, China, Hong Kong, India, Pakistan and Vietnam. In West Africa, common, but not limited destinations are Ghana, Nigeria, and Benin among others" (Rucevska et al. 2015, 38). Estimates are that between 250 000 and 1.3 million tonnes of e-waste are shipped out of the EU per year, mainly to Africa and Asia, where they are dumped and threaten the health and environment of local populations. Comparable estimations have been made for the USA.

The average lifespan of a mobile phone is just 18 months[9] and of a laptop 2 years[10]. Planned obsolescence and lifestyle branding, as part of which computers, tablets and mobile phones are presented as a way of life, enforce the generation of ever more e-waste (Maxwell and Miller 2012; Lewis 2014). ICT companies such as Apple are at the heart of the computer age's ecological problems. The large-scale production and use of green ICTs that are re-useable and have flexibly exchangeable components are not in sight. The vast amount of e-waste and its negative impacts on the environment makes the information society ecologically unsustainable.

eReuse is an EU project that focuses on "open-source tools, procedures, open data, and services organised as a common-pool resource (CPR) to reach the circular economy of electronics through promoting reuse and ensuring traceability until recycling" of ICTs (https://www.ereuse.org).

The production and consumption of energy can be measured in tonnes of oil equivalent (toe). One toe is the "energy released by burning one tonne of crude oil. It is approximately 42 gigajoules"[11]. In 2014, the worldwide production of energy was 13.8 billion toe and worldwide consumption 13.7 billion toe[12]. In 2000, these values were 10.0 billion toe for both production and consumption. So the increase of world energy production and consumption was almost 40% in 15 years. Energy production and consumption as such is not a problem as long as it does not harm the environment. One problem is that in the same time, the emission of carbon dioxide increased from 22.8 Mega tonnes in 2000 to 31.2 Mega tonnes in 2014. The world's main energy and electricity sources are oil, gas and coal. Wind and solar energy made up 4.0% of electricity production in 2014.

In 2012, the world energy generation was 21.53 trillion kilowatt hours (kWh) and the world energy consumption 19.71 trillion kWh[13]. Table 11 shows the share of various energy sources in world energy production for the year 2012. Nuclear energy tends to be considered as a renewable energy source. However, the nuclear power plant disasters in Chernobyl and Fukushima have shown how dangerous this energy form is for humans and nature. The share of relatively clean, renewable energy types (hydroelectric, geothermal, wind, solar, tidal, wave, biomass and waste energy) in world energy production was therefore 21.7% in 2012.

Energy type	Share
Nuclear energy	10.9%
Hydroelectric energy	16.8%
Geothermal energy	0.3%
Wind energy	2.4%
Solar, Tidal and wave power	0.4%
Biomass and waste energy	1.8%
Fossil fuels	67.3%

Table 11: Share of energy sources in world energy generation, year 2012, data source: Data source: International Energy Statistics, https://www.eia.gov, accessed on March 6, 2015.

How much energy does the Internet consume? Running the global Internet "consumed 1,815 TWh of electricity in 2012. This corresponds to 8% of global electricity production in the same year (22,740 TWh)" (De Decker 2015b). By 2017, "the electricity use of the internet will rise to between 2,547 TWh (expected growth scenario) and 3,422 TWh (worst case scenario)" (De Decker 2015b). Given the fact that the majority of the world's energy consumption is based on fossil fuels and nuclear energy, the Internet's growing energy consumption certainly contributes to environmental risks.

Why is there a tendency that the Internet's energy use increases?

"Importantly, the increasing energy consumption of the internet is not so much due to a growing amount of people using the network, as one would assume. Rather, it's caused by a growing energy

consumption per internet user. The network's data traffic rises much faster than the number of internet users (45% versus 6-7% annually). There's two main reasons for this. The first is the evolution towards portable computing devices and wireless internet access. The second is the increasing bit rate of the accessed content, mainly caused by the digitalization of TV and the popularity of video streaming […] A wired connection (DSL, cable, fibre) is the most energy efficient method to access the network. Wireless access through WiFi increases the energy use, but only slightly. However, if wireless access is made through a cellular network tower, energy use soars. Wireless traffic through 3G uses 15 times more energy than WiFi, while 4G consumes 23 times more. […] Engineers are already preparing the future launch of 5G, which will be faster than 4G but also use more energy. […] The concept of the 'internet of things' foresees that in the future all devices could be connected to the internet, a trend that's already happening" (De Decker 2015b).

De Decker (2015a) argues that long distance Wi-Fi that uses point-to-point antennas for establishing connections of up to several hundred kilometres consume relative low amounts of energy. "Long range WiFi also has low operational costs due to low power requirements. A typical mast installation consisting of two long distance links and one or two wireless cards for local distribution consumes around 30 watts. In several low-tech networks, nodes are entirely powered by solar panels and batteries".

Baliga et al. (2011) analysed the energy consumption of seven different wired (DSL, PON, FTTN, PtP, HFC) and wireless (WiMAX, UMTS) Internet access network types. "At access rates greater than 10 Mb/s, wired access technologies are significantly more energy-efficient than wireless access technologies. […] Wireless technologies will continue to consume at least 10 times more power than wired technologies when providing comparable access rates and traffic volumes. PON will continue to be the most energy-efficient access technology. […] Passive optical networks and point-to-point optical networks are the most energy-efficient access solutions at high access rates" (Baliga et al. 2011, 75-76).

If wireless networks consume indeed much more energy than wired ones, then a world of wireless community networks promises to be more energy-intensive than one of wired Internet access. Community networks do, however, not have to be predominantly wireless, but can to a certain degree also rely on optical fibre cables. Energy production and consumption as such is not necessarily an environmental problem. Nuclear power and fossil fuels are the dominant unclean electricity sources. If community networks want to be environmentally sustainable, then they should strive to base their electricity consumption on wind, solar, tidal, wave and geothermal power.

Wireless communications are part of the rise of mobile communication. The typical user nowadays not just has one computer or laptop, but accesses the Internet from different places for significant times of the day with various devices such as a computer, a laptop, a tablet and a mobile phone. All of these devices consume energy and given the short average lifespan also contribute to the production of e-waste and its toxic effects on humans and nature.

The nodes of the Guifi community network use cheap wireless routing devices such as Ubiquity or MikroTik (Vega et al. 2012). The community networks FunkFeuer and Ninux tend to use devices such as the TP-Link TL-wr841nd or Ubiquiti nanostations (Maccari and Cigno 2015). Freifunk in

Germany recommends the use of routers like TP-Link TL-WR842ND, TP-Link TL-WDR3600, TP-Link TL-WDR4300, Ubiquiti NanoStation M2 & Loco, Ubiquiti NanoStation M5 & Loco, Ubiquiti NanoBridge M5, TP-Link CPE210/510[14]. Such routers consume energy and it is a technical task that one tries to minimise their energy efficiency. Another question is, however, how long such routers are used and if they are re-useable and updateable. If not, then there is a risk that they end up as e-waste in developing countries, pollute the environment and poison e-waste workers.

There is no comprehensive and reliable data available on the average lifespan of wireless routers. We also do not have data on how many routers end up as e-waste per year. Routers are classified as small IT e-waste together with other devices such as mice, keyboards, external drives, printers, mobile phones, desktop PCs, and game consoles (Baldé 2015). We know that in 2014, 3.0 Million tons of small IT e-waste was generated globally and that in 2016 35% more e-waste was produced than in 2010 (Baldé 2015). It is therefore likely that also the volume of routers cast away as e-waste has increased.

1.3.2 Economic Aspects of Network Access

Discussing the economic dimension of the Internet brings up the question what kind of economic resource it is. Some observers have argued that the Internet is an **infrastructure**. Brett M. Frischmann (2012, xiv) defines an infrastructure as a resource that to some extent is non-rivalrous in consumption and is an input into the production of goods and services. Infrastructures include transportation systems, communications (telecommunications, postal system, Internet), governance systems and public services (schools, hospitals, courts, parliaments, etc.) (Frischmann 2012, 4, 61).

Frischmann (2012, 67) distinguishes between private, public and social infrastructures, which shows that such resources can be owned by corporations, the state and civil society-communities. Private ownership is often associated with the accumulation of profits, which can make payments the access criterion to infrastructure. Richer individuals and groups thereby have an advantageous access. The Internet is a communications infrastructure: As in any communications network, there are so-called network effects (Frischmann 2012, 214): The more users are connected to the network, the better quality for the single user it has because it has a wider reach. The Internet is a resource that is an input into a wide range of production processes in the economy, politics, culture, social life, everyday life, education, welfare, creativity, arts, science, health care, etc.

The term community comes from the Latin word “communis” that means that something is shared or common (Williams 1985, 75-76). So the question arises what is shared and in common to which degree in community networks. The common in a weak sense means that a resource that is owned individually or by a group is shared in a larger community. The common in a strong sense means that a resource is collectively owned, which means that there are benefits for the entire community and there is common decision-making about the use of this resource (common management, self-management, common governance). In computer networks, the common can refer to the technological infrastructure, the rules governing communication in the network, and the structure of collective feeling (Fuchs 2007, section 9.2). This means that there are economic, political and cultural levels of community networks. The common can extend to one or several of these levels and can be developed to a rather strong or rather weak degree (see figure 11).

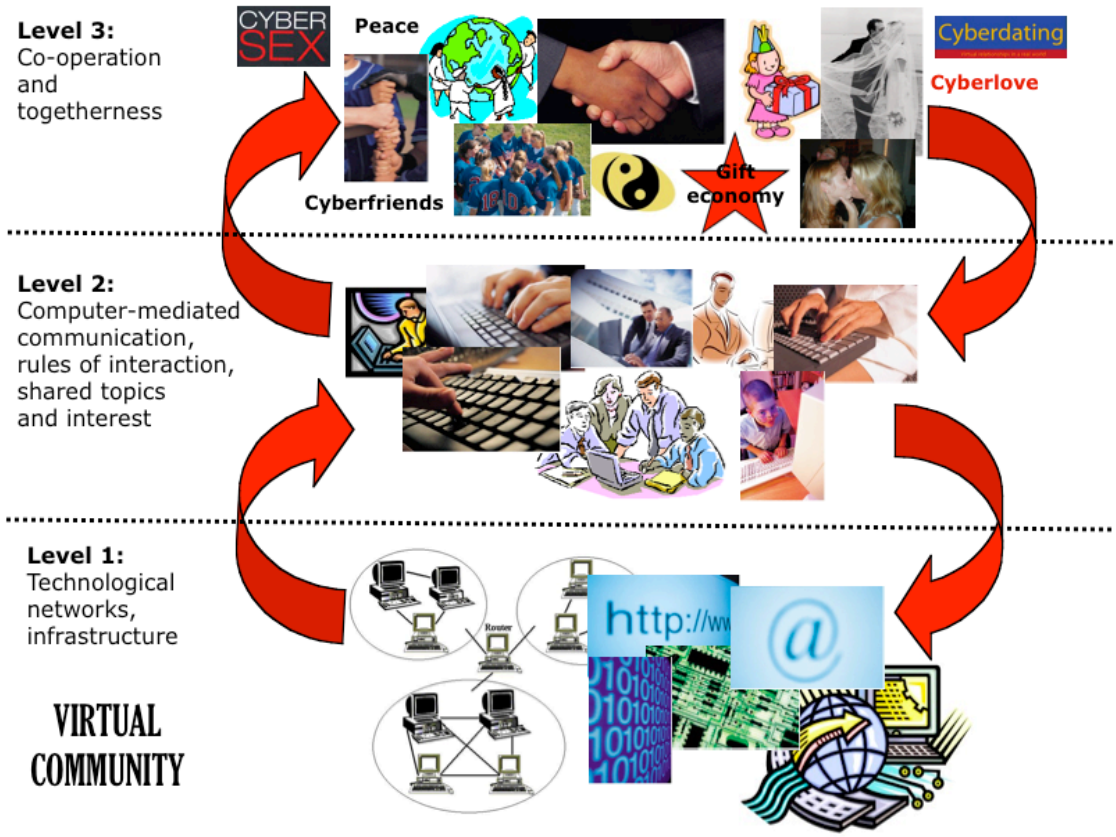

Figure 11: Three levels of community networks

The **economic theory of goods** has influenced a specific understanding of the commons as common-pool resource. Hess and Ostrom (2003) use the theory of goods in order to discern four types of economic goods. They discern if it is easy or difficult to exclude others from access to a resource (exclusion) and if more consumption of a resource subtracts from the benefits others can have (subtractability; also called rivalrousness of consumption). Figure 12 shows the theory of goods' standard classification.

		SUBTRACTABILITY	
		Low	*High*
EXCLUSION	*Difficult*	**Public goods** Useful knowledge Sunsets	**Common-pool resources** Libraries Irrigation systems
	Easy	**Toll or club goods** Journal subscriptions Day-care centers	**Private goods** Personal computers Doughnuts

Figure 12: Types of goods in the economic theory of goods (source: Hess and Ostrom 2011, 9)

Information is in this theory a public good that has low subtractability and low exclusivity. Communications networks are in contrast common-pool resources that have high subtractability and low exclusivity. Damsgaard, Parikh, and Rao (2006) stress that community networks can be faced

by the problem of “overgrazing” like on a meadow with too many grazing cows. “Overgrazing” a community network means that too many users or devices consume bandwidth so that the network slows down or is shut down.

Hess and Ostrom (2003, 120) stress that common-pool resources “may be owned by national, regional, or local governments, by communal groups, by private individuals or corporations, or used as open-access resources by whomever can gain access”. One issue of such a distinction between common property and common-pool resources is that it is confusing and also allows to use the term of the common for all forms of ownership. A basic question is if there is just common access to a resource or also common ownership and control. The latter also involves the collective right of community members to define the organisation and use of the resource. In the case of a community network that involves shared use, in which the network parts are privately owned, the problem that arises is that the private owners can at any time withdraw their infrastructure, which harms all others. Owners of large parts of the network therefore have a particularly high degree of network power. In a true network commons, the entire infrastructure is collectively owned and managed, not just used in a shared manner.

The concept of the common-pool resource can also distract from possible power asymmetries. By building a physical, social, digital or legal fence around a good that according to the theory of goods is public or a commons-pool resource, the natural features of these resources can be limited so that others can be excluded from access. In such cases, it also does not make sense to speak of a common or public good. If something is common or no does not so much depend on natural characteristics than on the social relations and power relations into which it is embedded. Some argue that the typology of goods that Ostrom and others use neglects power relations. The economic theory of goods that distinguishes between public, common, private and toll goods based on the criteria of (non-)rivalrousness and (non-)excludability, could also be considered as being functionalist: It characterises goods based on their functional features in the economy and thereby abstracts from the social and power relations into which these goods are embedded and in which they are produced. Ownership and production structures are thereby obscured. Because Ostrom won the 2009 Nobel Prize in Economic Sciences, her notion of the commons has become quite hegemonic. This hegemony has somehow focused public attention on Ostrom's concept and neglected that there is a diversity of the meaning of the notion of the commons. There are also understandings that are quite different from the one given by Ostrom.

David Harvey (2011) has a somewhat different understanding of the commons than Ostrom. argues that open access commons are not always beneficial and that state authority can be required for protecting the commons. If knowledge an author created is for example available online for completely free re-use, then companies can gather such and other knowledge and sell it. In such cases, limiting the openness of the commons by for example a Creative Commons licence that only allows re-use for non-commercial purpose, can provide some counter-power. Harvey (2011, 105) argues that the commons should be seen as something that “is continuously being produced”. “The central conclusion is that the collective labouring that is now productive of value must ground collective, not individual, property rights” (Harvey 2011, 105) so that the means of production are

held in common. The Internet infrastructure is a specific means of production that enables, produces and reproduces communication and social relations. Without communication, the Internet is dead and useless. It comes only alive through human activity. If those who produce a resource should also own the means of production as a matter of democracy and fairness, then any communications infrastructure should be owned and controlled as common property.

The theory of goods often justifies markets by saying that they are the most efficient and effective ways of managing congestion of what this theory characterises as common goods. The problem, however, is that thereby inequality can be introduced: Those who have more money are privileged. Money as access criterion is inherently discriminatory. If we think for example of an open Wi-Fi that is at times very popular, then giving access only to those who are willing to pay the highest sum, is inherently discriminatory. The first come-first served principle can help avoid network congestions (Frischmann 2012, 145): If too many users have logged in so that there is a risk that the networks slows down so much that it becomes practically unusable, then potential additional users have to wait until others log out. The Internet is, however, not really depleted or congested if more people use it: The more users are connected, the larger the communication space, which makes the quality of the network better. This phenomenon is called network effect. If more users, however, transmit more information, then higher transmission speed is required in order not to slow down the network. The Internet has evolved so that the point of congestion could be ever more offset, allowing more users to transmit more data. But congestion is nonetheless a problem because bandwidth is not unlimited. This fact is also shown by net neutrality debates, i.e. the phenomenon that certain Internet Service Providers want to slow down Internet transmission for certain users transmitting specific type of data.

Hardin (1968) argues with the example of a "pasture open to all" that "[f]reedom in a commons brings ruin to all" (1244). He calls this phenomenon the tragedy of the commons. Applied to an open Wi-Fi this means that one would have to expect that it becomes overcrowded with users and thereby slows so much down that it becomes unusable. Carol M. Rose (1986) challenged Hardin's tragedy of the commons by what she terms the comedy of the commons: She argues that there are goods that are so plenteous that they do not become depleted, such as oceans, beaches or the air. "We might even think that properties devoted to such noncommercial uses as recreation or speech could achieve their highest value when they are accessible to the public at large. […] In a sense, this is the reverse of the 'tragedy of the commons': it is a 'comedy of the commons', as is so felicitously expressed in the phrase, 'the more the merrier'" (Rose 1986, 723, 768). In respect to Wi-Fi, the comedy of the commons means that network effects make communications networks the better, the more potential users there are.

Frischmann (2012) therefore argues that the Internet is an impure public good because it is partially (non-)rival: "Many partially (non)rival resources are *sometimes* nonrivalrously consumed and *sometimes* rivalrously consumed, depending on the number of users and available capacity at a particular time. Highways, in real space and cyberspace, offer excellent illustrations. During off-peak hours (imagine traffic at 2 a.m.), consumption of these resources is often nonrivalrous. […] At some point (e.g., rush hour), nonrivalrous consumption turns rivalrous and congestion problems

arise" (Frischmann 2012, 31).

The Internet is a complex, multi-level system consisting of physical network infrastructure, standards and protocols, software applications, content, and social uses (see table 12). To argue that the Internet is a certain functional good underestimates the different characteristics of hardware, software, information and human social networks that make up the Internet. It also masks the social relations of ownership, decision-making and use.

Level	**What is this level about?**	**Examples**	**Political economy**		
5: Social systems of use	Social systems of users that have a presence on the Internet and whose online communication persists in time by making use of specific platforms	Website and social media presence of a fan club, political party, protest group, company, university, group of friends, etc.	C: private	C: public	C: common
			P: private	P: public	P: common
			E: private	E: public	E: common
4: Data	Information stored on and transmitted via the Internet	An e-mail message, a Facebook image, a Google search query, a tweet, a Skype conversation	C: private	C: public	C: common
			P: private	P: public	P: common
			E: private	E: public	E: common
3: Applications, platforms	Software for the production, transmission and use of data on the Internet	Thunderbird, Facebook, Google, Twitter, Skype, etc.	C: private	C: public	C: common
			P: private	P: public	P: common
			E: private	E: public	E: common
2: Protocols	Standards for data transmission	TCP/IP, DNS, IMAP, POP, SMTP, FTP, HTTP, HTTPS, TLS/SSL, etc.	C: private	C: public	C: common
			P: private	P: public	P: common
			E: private	E: public	E: common

1: Physical infrastructure	Hardware that makes up the network	Cables, wireless networks, backbones, routers, switches, servers	C: private	C: public	C: common
			P: private	P: public	P: common
			E: private	E: public	E: common

Table 12: A model of the Internet's levels and their political economy (E: economy, P: politics, C: culture)

Each level of the Internet has its own economy, politics and culture. There are resources that form an economy, decision-making mechanisms, and a culture of everyday communication. The distinction between private, public and common goods in a critical theory of society other than in the theory of goods refers to the power relations between human beings. If there is control by private owners, then we speak of a private good. In the case of public control, which involves some role of the state, we speak of a public good. And in the case of community control, we speak of a common good.

Think for example of data and communication in a group of political activists present on Facebook and YouTube: They generate a number of effective political meme images and videos that hold a Creative Commons licence. So the user-generated data is a common good. Facebook and YouTube, however, hold the private right to analyse this data and insert advertisements into it on their platforms, which is a form of private control, from which others are excluded. So such data on Facebook and YouTube is a hybrid good. Let us assume it is a democratic community, so the decision what licence uploaded data holds, is taken in common. This means we have to do with a political commons at the data-level. The culture of communication about how to produce and use data can be more inclusive or exclusive. If the users respect each other's views and strive to make each other's voices heard, then we can speak of a commons culture that is based on the principle of unity in diversity. The model in table 12 is more complex than the one in figure 11: Figure 11 only covers common control and excludes private and public control. Furthermore table 11's levels 1-4 are in figure 11 summarised into one technological level, whereas the social system level (level 5 in table 12) is broken up into the two level of rules and everyday culture.

Yochai Benkler has an alternative understanding of the commons. He does not provide a strong critique of Ostrom's concept of the commons, but remarks that based on her work, "a more narrowly defined literature developed" (Benkler 2006, 480). Benkler argues for "an entirely different theory of the commons" (Benkler 2013, 1510). He defines commons the following way: "Commons are an alternative form of institutional space, where human agents can act free of the particular constraints required for markets, and where they have some degree of confidence that the resources they need for their plans will be available to them. Both freedom of action and security of resource availability are achieved in very different patterns than they are in property-based markets" (Benkler 2006, 144). Benkler (2006, 61-62) distinguishes four types of commons based on two criteria: 1) The first criterion is whether there is open access to the commons or access only for a

defined community. 2) The second criterion is whether access and use of the commons is legally regulated or unregulated.

Kostakis and Bauwens (2014) provide an understanding of the commons that is related to the one by Benkler. They argue that the Commons are a "social process" (39) that involves resources, a community that creates use-values, and rules so that they constitute "a paradigm of a pragmatic new societal vision beyond the dominant capitalist system" (38). For Kostakis and Bauwens, the Commons are opposed to private property (40). Commons-based peer production "is not driven by the for-profit orientation that defines market projects, as peer projects have a for-benefit orientation creating use value for their communities" (53).

Benkler's understanding of the commons is ownership-based and therefore contrary to Ostrom takes social relations and power relations into account. He discerns commons from public resources and private property. The commons are "radically decentralized, collaborative, and nonproprietary; based on sharing resources and outputs among widely distributed, loosely connected individuals who cooperate with each other without relying on either market signals or managerial commands. This is what I call 'commons-based peer production'" (Benkler 2006, 60). "The salient characteristic of commons, as opposed to property, is that no single person has exclusive control over the use and disposition of any particular resource in the commons" (Benkler 2006, 61).

Benkler (1999) argues that communications policy has a choice between regulation that treats humans as consumers of commercial communications commodities or as peer users and producers of a sustainable commons. "These choices occur at all levels of the information environment: the physical infrastructure layer – wires, cable, radio frequency spectrum – the logical infrastructure layer – software = and the content layer" (Benkler 1999, 562). Commercial communications would result in economic concentration, ubiquitous commerce, and homogeneous contents (576). Benkler (2006, 395) describes a conflict between private property ("enclosure") and commons ("openness") at the Internet's physical, logical and content layers.

Open Wi-Fi would form an "open-access-spectrum commons" (Benkler 2013, 1510). For Benkler (2006, 395), both open wireless community networks and municipal broadband initiatives are opposed to the enclosure of the spectrum and the Internet by private property. Benkler speaks of network effects as "cooperation gain" (Benkler 2006, 88): The co-operation of wireless access devices in a mesh network would result in improved quality.

Benkler (2002) compares wireless communications based on a spectrum property market to open wireless networks that use a spectrum commons. Open wireless networks are based on end use devices, are an ad hoc infrastructure, scalable, both mobile and fixed (Benkler 2002, 37). Benkler argues that open wireless networks, in which nobody owns parts of the spectrum, tend to more rapidly increase the capacity of users to communicate information wirelessly, are more cost-effective, more advance technological innovations, adapt better to changing consumer preferences, and tend to be more robust and technically secure. These are technological and economic advantages.

Elsewhere, Benkler (2003) argues that common communications resources enhance freedom from

"the constraints imposed by the requirements of markets" and have "democratic advantages" (8). "Building a core common infrastructure is a necessary precondition to allow us to transition away from a society of passive consumers buying what a small number of commercial producers are selling. It will allow us to develop into a society in which all can speak to all, and in which anyone can become an active participant in political, social, and cultural discourse" (Benkler 2003, 9).

Benkler (2006, 152) sees wireless commons also as a challenge to the "near-monopolistic structure" of Internet access. In the USA, the Clinton administration would have brought about the spectrum's privatisation by introducing spectrum auctions (ibid.). "96 percent of homes and small offices get their broadband access either from their incumbent cable operator or their incumbent local telephone carrier" (240). Building wireless commons would be supported by the fact that the required hardware would be relatively cheap (153, 240).

Benkler sees a broad range of advantages of wireless commons (and other commons). There are technical, economic, and democratic advantages. Wireless commons can also challenge communications monopolies. Benkler (2006) is not in principle opposed to private property. He rather argues that private property and the common can peacefully co-exist and be complementary: "Each institutional framework – property and commons – allows for a certain freedom of action and a certain degree of predictability of access to resources. Their complementary coexistence and relative salience as institutional frameworks for action determine the relative reach of the market and the domain of nonmarket action, both individual and social, in the resources they govern and the activities that depend on access to those resources" (24). "Understanding the opportunities social production presents for businesses begins to outline how a stable social production system can coexist and develop a mutually reinforcing relationship with market-based organizations that adapt to and adopt, instead of fight, them" (123).

The history of markets is a history of concentration and monopoly tendencies. Imagine that a non-profit, privacy-enhancing, commons-based search engine challenges Google's monopoly power. Would Google simply accept the reduction of its profits? Or wouldn't it rather try to find strategies to outcompete the non-commercial competitor? Communications and Internet access are particularly highly concentrated markets. Is it likely that in an area where a non-profit freely accessible Wi-Fi network challenges the market power of an incumbent Internet Service Provider (ISP), the latter will simply watch and peacefully co-exist?

Benkler discusses himself the reactions of communications corporations to non-commercial alternatives:

> "The incumbent broadband providers have not taken kindly to the municipal assault on their monopoly (or oligopoly) profits. When the city of Abilene, Texas, tried to offer municipal broadband service in the late-1990s, Southwestern Bell (SBC) persuaded the Texas legislature to pass a law that prohibited local governments from providing high-speed Internet access. […] Bristol, Virginia, had to fight off similar efforts to prohibit its plans through state law before it was able to roll out its network. […] After Philadelphia rolled out its wireless plan, it was not long before the Pennsylvania legislature passed a similar law prohibiting

> municipalities from offering broadband. While Philadelphia's plan itself was grandfathered, future expansion from a series of wireless 'hot spots' in open area to a genuine municipal network will likely be challenged under the new state law"[15] (Benkler 2006, 405-406).

The question is if different forms of ownership can peacefully co-exist or not.

Vincent Mosco argues that in the contemporary world of the Internet and cloud computing, we should think back to the 1950s, when there were discussions about whether computing is a utility.

> "At that time, people who were familiar with utilities that provided roads, water, and electricity wondered whether there was need for a public or regulated utility for computer communication. Was not information as essential a resource as roads, water, and power? With widespread agreement that it was both a resource and essential, some concluded that a handful of centralized computer facilities strategically located around the world and connected by telecommunications networks to keyboards and screens would satisfy the world's need for information. Today, there are far more than a handful of large data centers worldwide, but the principle of the utility is inscribed in cloud computing systems to the point that interest is returning to this venerable idea. Questions are also emerging about whether computer utilities should be government enterprises, or at least publicly regulated even if they remain commercial enterprises" (Mosco 2015, 6).

We can say that the Internet as communications networks is just like transportation, water supply, power supply, the education system, the sewage system, the health care system, a clean and healthy natural environment, cultural institutions, housing, food, the political system a public interest infrastructure that is in the common interest of all: All humans need these infrastructures in order to lead a decent life. Turning infrastructures into a commodity operated by for-profit companies increases inequality in society. Those on lower incomes and with little wealth will tend to find it more difficult to access infrastructures or will only get access to second-class infrastructures than the class of the wealthy. It is therefore a matter of justice and equality that infrastructures are treated as public or common goods and not as commodities controlled by for-profit companies.

The US Government's Broadband Opportunity Council in 2015 released a report, in which it says: "Broadband has steadily shifted from an optional amenity to a core utility for households, businesses and community institutions. Today, broadband is taking place alongside water, sewer and electricity as essential infrastructure for communities" (Broadband Opportunity Council 2015, 12). If broadband is an infrastructure and utility, then not just adequate regulation is needed, but then this is also a reason to not let it be governed by the market, but to explore opportunities for community control and public funding.

The Internet first started as a military network (ARPANET). It was later turned into a scientific and higher education-oriented network controlled by the National Science Foundation (NSF). In its early phase, the Internet was government-funded. The NSF started thinking about privatising the Internet's infrastructure in 1990 (Greenstein 2015). Bids were launched in 1993. In 1995, the NSFNET was shutdown and the Internet's backbone was privatised. PSINet, UUNET and IBM's Advanced Network Services (ANS) emerged as three private Internet service provision companies

competing for the ownership of the Internet backbone. ANS refused to interconnect its Internet transmission services with other networks and hoped to thereby gain monopoly control (Greenstein 2015, 76-82).

Internet backbones are long-distance data routes. The world's largest Internet backbone owners include companies such as Telefonica (Spain), AT&T (USA), Hurricane Electric (USA), Telecom Italia (Italy), Zayo Group (USA), Tata Communications (India), Orange (France), Level 3 Communications (USA), Deutsche Telekom (Germany), Global Telecom & Technology (USA, Italy), NTT (Japan), XO Communication s (USA), TeliaSonera (Sweden, Finland), Verizon (USA), CenturyLink (USA), Cogent Communications (USA)[16], and Sprint Corporation (USA)[17]. These are so-called tier 1 networks: They own so much Internet backbone infrastructure that they do not have to make peering agreements with other networks. They rather rent out their own backbone to smaller ISPs[18]. Large for-profit corporations control the Internet's infrastructure.

PSINet and UUNET created the Commercial Internet eXchange (CIX) in 1991. CIX was an interconnection serviced funded by all participating firms. "Each member of CIX paid a flat fee to support the cost of the equipment and maintenance, and each agreed *not* to charge each other on the basis of the volume of traffic they delivered" (Greenstein 2015, 80). Today, the data exchange between networks is established by Internet Exchange Points (IXPs). Measured in average data throughput, the world's largest IXPs are the DE-CIX (Deutscher Commercial Internet Exchange) in Frankfurt, the AMS-IX (Amsterdam Internet Exchange), and the LINX (London Internet Exchange) [19]. IXPs are typically non-profit organisations with commercial Internet Service Providers (ISPs) as their members. Their principle goes back to the CIX: All ISPs want to benefit from network effects: The more users one can reach, the better the network. They therefore have a commercial incentive to be connected to other networks: The larger the Internet's reach, the more users they are likely to attract and the larger their profits promise to be. One can say that Internet Exchanges are a commons for capital: It is a commonly owned infrastructure that serves the interests of capital.

The Internet's domain name system (DNS) was privatised in 1992. The private company Network Solutions controlled the DNS. In 1995, it started to charge for the registration of domain names. In 1998, the Internet Corporation for Assigned Names and Numbers (ICANN) was created. It is responsible for the Internet's global DNS and top-level domains. Also the domain name service is a business.

A problem of the argument that community networks benefit areas in which commercial providers cannot make a profit so that the market fails is that market failure not only occurs in serving communications services to remote and sparsely populated regions. The market tends itself to lead to market failure. In communications markets this becomes evident by the fact that they tend to be highly concentrated, i.e. competition leads to oligopoly or monopoly. Community networks can therefore be a general mechanism to challenge economic concentration of communications markets.

Sadowski and others (2014) studied Dutch broadband co-operatives, in which large numbers of local community members joined and paid membership fees in order to set up fibre networks. In a survey of such members of broadband co-operative (N=481), Sadowski found that the motivation to support the co-operative was not just the lack of other providers, but also the associated individual

technical support, the idea to pluralise the communications market, the hope for the availability of specific advanced services via the co-operative, the creation of local identity, and the promotion of the co-operative idea. These results provide indications that alternatives to market-oriented communications providers have the potential to be accepted for a variety of reasons also in situations when they compete against privately owned providers because citizens tend to appreciate co-operatives not simply for obtaining economic advantages, but also for political and cultural reasons.

Douglas Schuler (1996, 230) argued in his study of early computer-mediated community networks that when "the community owns the community network, it naturally will reflect these shared values and concerns, promoting creative and useful interaction within the community". He does not understand community networks as shared computer networks that can be privately, publicly or commonly owned, but rather sees them as inherently non-profit projects owned by a community.

The question is how one should understand sustainability in respect to community networks. An economic reductionist understanding would be to think about how to make economic profit by creating such networks. Such a position, however, would neglect that the for-profit logic can easily come into contradiction with social issues that concern justice, fairness, equality and democracy. There are indications that community networks tend to be receptive for a different understanding of sustainability. It is certainly important to think about the economic issue of how the necessary resources can be guaranteed and maintained in a community network. But this does imply the necessity of for-profit logic. Stoll (2005) studied the introduction of Wi-Fi in a remote, poor village in the Ecuadorian rainforest El Chaco. He shows that that the people in El Chaco asked: "How can the Internet help us in our schools, in our local government, in the small and medium enterprises, in the ecology, the health services and tourism? How can we make it sustainable not only in a financial but also in a technical, social, cultural and political sense?" (Stoll 2005, 192). The question is if community networks have the potential to "sustain entirely novel communication paradigms that not only break the Telco and Internet Service Providers (ISP) oligopoly in communications" (Lo Cigno and Maccari 2014, 49).

Non-commercial community networks committed to the idea of providing gratis or cheap access as a matter of freedom and democracy, face the problem how to sustain the service and how to survive if there is competition with commercial providers, who may be able to provide faster and more stable access. Alison Powell and Leslie Shade (2006) discuss this problem in the Canadian context with the example of the Montreal-based community network Île Sans Fil (ISF):

"Like all volunteer-based groups, ISF must worry about long-term sustainability. The organization is worried that over time their core volunteers will eventually be unable to take on the responsibilities of deploying and servicing a larger number of hotspots. This issue is even more pronounced for a group which aims to provide a specific telecommunications service like free public wireless Internet when technological developments make it likely that cities like Montreal will soon be covered with ubiquitous wireless Internet signals" (Powell and Shade 2006, 399).

The problem such projects can face is that under market conditions, municipalities and governments tend to use taxpayers' money for attracting for-profit businesses or for-profit private/public

partnerships and that co-operation of non-profits with for-profits may require the first one to either commodify access or usage, i.e. to introduce access fees or advertising. In all of these cases, the autonomy and freedom of non-commercial projects is undermined. Alternative, non-commercial, non-profit media and technology projects in general face existential threats in a market environment (Fuchs 2010a, Sandoval and Fuchs 2010). They often lack labour-power, resources, money, influence, attention, and broad participation. Nico Carpentier (2008, 250) argues in this context that like "most alternative media", many "community Wi-Fi organizations remain vulnerable, dependent on a limited number of volunteers". One community Wi-Fi activist remarked in this context: "If I disappear, the network will disappear" (Carpentier 2008, 250). The danger is that resource precarity renders community networks a "secondary Internet" (Sandvig 2004, 596) that always remains marginal and cannot challenge the power of incumbents.

Policies designed to favour large transnational telecommunications corporations are a problem that community networks often face. This concerns for example the roll-out of new infrastructure, the management and control of spectrum, complex registration processes, high registration fees, and general ignorance of the peculiarities of community networks, survival threats by copyright and surveillance legislation, etc. (De Filippi and Tréguer, Félix 2015)

Schuler (1996) in his study of early computer-mediated community networks devotes a chapter (chapter 10) to the question how community networks can survive. He explicitly uses the term sustainability in this context. He however thereby not just means economic survival, but also survival of what he considers to be community networks' six core values of conviviality, co-operative education, strong democracy, health and well-being, economic equity, information and communication. He argues that for-profit organisations are ill-suited to sustain community networks because the profit motive contradicts "social, ethical or environmental concerns" and because corporations do not like to be criticised and therefore tend to censor free speech and alternative voices (355). Schuler stresses the potentials of non-profit communities and community/public co-operation:

"The community network (as previously mentioned) must meet three requirements: (1) principles that address core values, (2) open policies, and (3) open processes. A for-profit concern is likely – even obligated – to put profits above the community. A government concern may be overly controlling, exclusive, closed, or patronizing. A nonprofit may also be exclusive and self-serving, while being unable to obtain the necessary resources and skills to run a community network effectively. A nonprofit community network that abides by the three requirements, with adequate government funding and independence from government control, may be the best hope for a sustained, useful community network" (Schuler 1996, 356-357).

Schuler discusses as funding options support by direct users or indirect users. The first includes donations, payment for certain services, membership fees, and support by participating organisations. The second entails support by foundations and public funding. Schuler (1996, 370-371) also mentions advertising, but at the same time sees the problem that it is likely to change or even destroy the community character. It results in what Howard Rheingold (2000, 389) called the "commodification of community".

Tapia, Powell, and Ortiz (2009) argue that ISF managed to survive in a market-oriented communications environment because it was able to create a hybrid public/community model, in which a municipality and civil society co-operate and so provide a “better alternative” (368) to privately owned for-profit networks. The authors suggest that public/commons hybrid networks can be economically sustainable and require that we “think of broadband as a utility and a public service” (369). They stress that grants are needed for funding “broadband deployment for both municipal and citizen groups” (370).

Municipal and community networks have good potentials to help overcoming digital divides. Forlano et al. (2011, 22-23) argue that "[d]igital inclusion has been the impetus behind many municipal and community wireless projects". A survey conducted among 22 community networks shows that overcoming the material access digital divide by providing affordable gratis Internet connectivity is an important motivation for running such projects (Dimogerontakis et al. 2016, Maccari and Cigno 2015). One can, however, not always assume that poor local communities in developing countries consider Internet access as a primary need and in some cases they may for various reasons be sceptical, including the suspicion of imperialism that technology is offered to them in order to create economic dependence on the West.

A frequently heard argument is that an advantage of community networks is that this model can provide Internet access in rural and other areas, in which deploying infrastructure is not viable for commercial providers. Community networks certainly have a potential for lowering the digital divide by providing access to underserved areas. In cases, where community networks are, however, significantly slower than commercial networks, a new digital bandwidth divide is created and poor regions then only have a second class Internet. Slower networks cannot run the same kind of services than faster ones. Community networks should certainly strive to offer high-speed networks.

Another problem is that in urban areas there is a tendency that wireless community networks are predominantly used by young, educated and affluent citizens and do not appeal to the poor (Oliver, Zuidweg, and Batikas 2010). Oliver, Zuidweg, and Batikas (2010) show that the Guifi community network in Catalonia has helped to reduce the geographical digital divide in Catalonia by increasing the Internet access rate in Osona-county.

Whereas free software as all knowledge only needs to be developed once in order for one version to exist that can be shared with others, hardware infrastructure has considerable maintenance and renewal costs (Medosch 2015), which makes it more difficult to provide gratis access. Nonetheless creating access to wireless Internet networks tends to be relatively inexpensive (Apostol, Antoniadis, and Banerjee 2008; Bar and Galperin 2004): Wi-Fi uses an industry-wide standard (IEEE 802.11), unlicensed spectrum, and relatively cheap equipment. In a wireless mesh network, not all, but only some nodes need to be connected to a fixed lined Internet connection. Problems may arise when this architecture is significantly slower and much more unreliable than competing commercial Wi-Fi networks. In many countries, there are legal limits on the unlicensed use of the channels in the 5 GHz band-spectrum that tends to be less congested than the 2.4 GHz-spectrum. This circumstance puts additional pressures on non-commercial community networks in areas

where they have to compete with commercial providers.

Free software guru Stallman (2001) argues that the freedom of free software is that "the users have the freedom to run, copy, distribute, study, change and improve the software. Thus, 'free software' is a matter of liberty, not price. To understand the concept, you should think of 'free' as in 'free speech', not as in 'free beer'. We sometimes call it 'libre software' to show we do not mean it is gratis". Such an understanding of freedom also underlies in the realm of community networks the Guifi Network's licence (FONN Compact: Compact for a Free, Open & Neutral Network): "You have the freedom to use the network for any purpose as long as you don't harm the operation of the network itself, the rights of other users, or the principles of neutrality that allow contents and services to flow without deliberate interference"[20].

Medosch (2015) takes a different position and argues for understanding freedom as gratis use. He says that the economic crisis and the precarity it has created should make us see that "[f]ree or at least cheap telecommunications is an important issue of our times". Freedom should also be an issue of being "cheaper and fairer" (Medosch 2015). We can add that providing gratis access to a common resource is a matter of equality that guarantees that certain basic goods and services are available to all.

In 2013, there were reports that the Federal Communications Commission under its then-Chairman Julius Genachowski planned to free up frequencies that enable free public Wi-Fi (Super Wi-Fi) that uses lower frequencies located between the ones that television channels use (so-called white spaces). Jeremy Rifkin (2014, 180-181) interprets this development very optimistically and sees the future of the Internet as one of gratis access for anyone everywhere: "In the near future, everyone will be able to share Earth's abundant free air waves, communicating with each other for nearly free, just as well will share the abundant free energy of the sun, wind, and geothermal heat. […] The use of open wireless connections over a free Wi-Fi network is likely going to become the norm in the years to come, not only in America, but virtually everywhere".

But there are strong economic interests that may well be able to impede such future developments because communications corporations fear their profits could be reduced: In the USA, Republicans and companies such as AT&T, Intel, Qualcomm, T-Mobile, and Verizon criticised the free Wi-Fi model with the argument that licensing the airwaves to corporations who then rent it out to customers would be a better approach and warned that free Wi-Fi could harm Internet businesses[21]. In August 2015, the FCC adopted rules that allow the unlicensed use of certain channels in the 600 MHz band for Wi-Fi communication[22]. But it also planned a Broadcast Incentive Auction for 2016, in which TV stations are offered to sell the use rights of channels in the 600 MHz band-spectrum so that wireless operators can bid for the use[23]. So the decision that the FCC actually took is to free up parts of the 600 MHz band for unlicensed use and to auction other parts to corporations.

1.3.3 Political Aspects of Network Access

Medosch (2015) argues that "free networks contribute to the democratisation of technology" because users are involved in the establishment and maintenance of technology. Antoniadis and

Apostol (2014) write that community networks can make a contribution to fostering participatory democracy by advancing the right to the ownership of the urban commons, by which they mean "commonly held property, and use, stewardship and management in common of the available and produced resources". The urban commons also include the communications commons. A survey conducted among 22 community networks shows that decision-making tends to be participatory and transparent in such community networks (Dimogerontakis et al. 2016).

Edward Snowden has revealed the existence of global Internet surveillance programmes that have been driven by the collaboration of the US security agency NSA and American communications companies: In June 2013, Edward Snowden revealed with the help of the *Guardian* the existence of large-scale Internet and communications surveillance systems such as Prism, XKeyscore, and Tempora. According to the leaked documents, the National Security Agency (NSA), a US secret service, in the PRISM programme obtained direct access to user data from seven online/ICT companies: AOL, Apple, Facebook, Google, Microsoft, Paltalk, Skype, Yahoo![24].

The Powerpoint slides that Edward Snowden leaked refer to data collection "directly from the servers of these U.S. Service Providers"[25]. Snowden also revealed the existence of a surveillance system called XKeyScore that the NSA can use for reading e-mails, tracking web browsing and users' browsing histories, monitoring social media activity, online searches, online chat, phone calls, and online contact networks, and follow the screens of individual computers. According to the leaked documents, XKeyScore can search both meta-data and content data[26].

The documents that Snowden leaked also showed that the Government Communications Headquarter (GCHQ), a British intelligence agency, monitored and collected communication phone and Internet data from fibre optic cables and shared such data with the NSA[27]. According to the leak, the GCHQ for example stores phone calls, e-mails, Facebook postings, and the history of users' website access for up to 30 days and analyses these data[28] (ibid.). Further documents indicated that in co-ordination with the GCHQ also intelligence services in Germany (Bundesnachrichtendienst BND), France (*Direction Générale de la Sécurité Extérieure* DGSE), Spain (Centro Nacional de Inteligencia, CNI), and Sweden (Försvarets radioanstalt FRA) developed similar capacities[29].

It has become evident that Internet surveillance, privacy violations, and lack of adequate data protection have resulted in major threats to democracy. Internet surveillance is a threat to political-democratic sustainability. Thus far no adequate responses of how to effectively tackle Internet surveillance's threats and to strengthen the Internet's democratic sustainability have been undertaken.

Surveillance after Snowden has on the one hand increased the interest in wireless community networks (Antoniadis and Apostol 2014; Lo Cigno and Maccari 2014; Medosch 2015) because decentralised networks promise more security against the surveillance-industrial complex. At the same time there have been countries such as Germany, where complex legal battles have occurred about the question whether a wireless community network can be made legally liable for the illegal use of a network for terrorism, crime, copyright infringement, child pornography, etc. (Medosch 2015). Wireless community networks face a contradiction between privacy-enhanced openness and

surveillance. Empirical research shows that privacy may not automatically be larger in wireless community networks than other networks if the majority of the traffic is transported over some key nodes (Maccari and Cigno 2015). The network architecture and routing method therefore play a key role in the question of privacy and security in community networks.

A survey among 22 community networks showed that such projects tend to be concerned about protecting users' privacy (Dimogerontakis et al. 2016). Depending on national legislation concerning user identification, data retention and surveillance, there can be more or less complications for community networks because implementing such measures is expensive (ibid.) and may violate privacy. Wireless community networks tend to use the frequency bands of 2.4 GHz and 5 GHz that are mostly seen as open spectrum, for whose use one does not need a licence. The regulation of spectrum use and the right to build and use outdoor antennas can, however, create legal, administrative and financial problems for community networks (ibid.).

The "resistance of mesh networks to surveillance and repression should not be over-hyped, as it is sometimes the case in media reports. 'Devices operating in any wireless network—including mesh networks—use a radio transmitter that can always be located by triangulation', notes a member of Freifunk (Mr. Juergen Neumann, pers.comm., 26 March, 2014). Besides, even with highly distributed networks, traffic can always be monitored. [...] Thus, in spite of their benefits, in no way can local community networks replace proper encryption techniques" (De Filippi and Tréguer, Félix 2015).

In respect to the political shutdown of the Internet in authoritarian regimes, community networks are "means to communicate independently from the central command of governments and traditional operators. They enable citizen to organize (politically or otherwise) even in the eventuality that the established powers activate the so-called 'kill-switch' and shut down communications networks in a given area" (De Filippi and Tréguer, Félix 2015).

The potential that community networks and decentralised peer-to-peer systems for network access and the storage, production, communication, distribution and consumption of information have for guaranteeing anonymity, privacy, security and data, poses at the same time also a problem in a political system that is obsessed with the idea that surveillance can prevent terrorism and crime. There is the danger that given such circumstances, decentralised IT systems that allow anonymity will be outlawed. If access, storage and processing are distributed, then it is legally difficult to argue that the participating peers are liable for certain infringements because one cannot assign intention and awareness to them (De Rosnay 2015; Giovanella 2015; Musiani 2014).

De Rosnay (2015) argues that the problem is that the Western legal system is based on liberal individualism. She identifies the "need for cultural change away from the neoliberal paradigm" so that the law is distributed and recognises "community rights and duties and collective persons as opposed to individual persons" (De Rosnay 2015). The question is if in the case of illegal use, the individual user, the ISP or the community network should and could be held accountable (Giovanella 2015). Giovanella (2015) argues that it is unlikely that community networks can be held accountable by European law, except if they are organised as associations. She acknowledges the problem of applying "old legal schemes to […] new technology" (Giovanella 2015, 67) and

argues that potential solutions are to hold the networks liable and/or to introduce user identification systems. Some community networks, such as Guifi, are already organised as non-profit foundations. The difficulty is that the question arises if a foundation should legally be held accountable for network use that is beyond their control. It could limit liability by prohibiting illegal use of the network by issuing terms of use.

Let us, however, assume that Daesh-terrorists use such a community network for organising terrorist attacks. If the individual user cannot be identified, then the legal authorities and the police may either try to shut the network down or to hold it legally accountable. This can then bias the network towards introducing a surveillance system that may infringe users' privacy and freedom of speech. Another possibility is that the network introduces a user identification system. But of course fake names and addresses could be used. Only identification by an ID or a credit card could guarantee personal identification. The first option, however, can be quite inconvenient because verification can be time- and resource-intensive. Using credit cards for user identification can bias a network towards charging for access, which may undermine the idea of free and open network access. In a society that is obsessed with monitoring users, it is difficult to run free and open communications networks.

In the ideal case, we could overcome the idea that communications surveillance is a solution to crime and terrorism and instead focus on fighting the social causes of these phenomena. As long as such politics is not in place, community networks are confronted with the danger that the surveillance ideology may lead legal and policing authorities to consider outlawing or criminalising them. They therefore have to think about how to position themselves towards the political contradiction between privacy-enhancing, free, open community networks and the surveillance ideology. The antagonism between privacy and the surveillance ideology also shows that community networks have necessarily to be political if they care about freedom and democracy.

1.3.4 Cultural Aspects of Network Access

A survey conducted among 22 community networks shows that providing local education and training in technical skills is an important activity of such projects (Dimogerontakis et al. 2016) (Dimogerontakis et al. 2016). Wireless communities have opportunities for users to engage in participatory learning about "the structure and the functioning of the Internet" (Medosch 2015).

Community networks are not just technical networks, but allow creating neighbourhood communities (Apostol, Antoniadis, and Banerjee 2008). Powell (2008) distinguishes between geek publics and community publics in community networks. The first are a community that is brought together through creating and discussing community networks, whereas the second is brought together through local discussions using a community network. Powell found in a study of community networks in Canada that they tended to primarily create geek publics – "social club[s] for geeks" (1078). Everyday users were "not necessarily interested in using technology as a means of creating social links" (1081), but in gratis Wi-Fi access.

Sandvig (2004) concludes in a case study of Wi-Fi co-operatives that the studied cases were communities of technical experts (geek communities) that were difficult to join for outsiders. These

communities therefore remained marginal. "Overall, the Wi-Fi co-ops examined here are inward-looking: they emulate Douglas's 'cult of the boy operator' in radio before 1920 more than they provide an outward-looking CN that builds its own internal community through an explicit mission of helping those outside the group that are disadvantaged. […] Indeed, co-ops are in some cases so expert that this makes it impossible to imagine their success as a populist movement" (Sandvig 2004, 596).

In Alison Powell's research, the geek publics were strong communities organised around joint activities and communication, and the community publics were weak communities organised around sharing access to the same network as a gratis resource. One may be disappointed that in this case no strong social user communities developed, but one should not downplay the importance of the fact that users are interested in gratis Internet access, which means that they consider Internet infrastructure as a common good that should be available to everyone everywhere cheap or free of charge. The public these users envision is one of public or common ownership of the Internet infrastructure. That they all use a specific network is a potential for the creation of cultural communities, but it is no automatism and not an absolute necessity.

Tapia, Powell, and Ortiz (2009) discuss the example of the community network Île Sans Fil (ISF) in Montreal that managed via a public/community partnership to develop from a geek public into a more outward-looking community. The example shows that it is also not an automatism and a necessity that community networks are "alternative ghettos" of tech-savvy experts, from which everyday citizens feel excluded. In the end, it is an organisational question to which degree community networks are able to reach out to and engage the general public.

Schuler (1996) in his study of early computer-mediated community networks such as the Seattle Community Network or the Cleveland Free-Net argues that conviviality is a key characteristic of such networks. It means the "fostering of a shared culture" that helps "organize people into a community that is infused with identity, purpose, and love" (13). Community action would be a foundation for supporting and inclusive communities, co-operative learning and education, a strong democracy, health and well-being, economic equity, and participative, affordable/free, trustworthy information (11-16). Conviviality "suggests that people derive strength and meaning through living together […] – working, playing, eating, communicating, and *being* together" (35).

1.3.5 (Un-)Sustainability and Community Networks

We have discussed four dimensions of sustainable and unsustainable development of Internet access and how they affect community networks. Table 13 provides a checklist that based on the previous discussion identifies key issues that should be considered when thinking about how sustainable development of a community network can best be achieved. It identifies ecological, economic, political and cultural sustainability issues.

Dimension	**(Un-)Sustainability issue**	**Sustainability questions**
Nature	Energy use	To which extent does the community network rely on relatively environmental-friendly energy sources (wind energy, solar power, tidal power, wave power, geothermal energy, biomass and waste energy)? To which extent does the network rely on suppliers of such energy forms? What is the share of the total energy consumed per year by the network that is based on relatively clean power sources?
Nature	e-waste	What is the average lifespan of different hardware types used in the community network? Can measures be taken for ensuring the long-term re-use and update of hardware? If hardware devices have to be replaced, is it possible to recycle the old ones? How? If hardware devices have to be trashed, is it possible to do so in a way that does not threaten humans and nature? How? If hardware devices have to be trashed, is it possible to do so in a way that avoids the creation of e-waste that is shipped to developing countries where it poses threats to e-waste workers, humans and nature? How? If old hardware devices that a network no longer uses are donated to other networks, can it be ensured that this does not result in a two-tier Internet access structure, in which poorer communities have slower Internet access than others?
Economy	Monopoly power and corporate concentration	How strongly concentrated is the Internet access market in a specific region, country and the world? What share of users and financial resources (revenue, capital assets, profits) does the incumbent Internet service provider have in a specific region, country and the world? Does the operation of the community network help to challenge the financial and market power of dominant Internet service providers and to advance a plural economy? How? What are the dangers and what happens when a community network suddenly faces competition by a private for-profit Internet service provider?
Economy	Survival and resources	Does the community network manage to survive economically, i.e. to afford the necessary hardware and labour-power necessary for running the network? How does it do that? What are its financial sources? Can the community network ensure that it has enough resources, supporters, workers, volunteers, and users? Can the risk be avoided that the community network is a “secondary Internet” that is marginal, slower and less attractive than other services? How? What strategies can be used for avoiding marginalization and resource precarity? Are there possibilities for the community network to obtain

		public or municipal funding or to co-operate with municipalities, public institutions or the state in providing access?
Economy	Economic democracy	Is the community network collectively controlled by its members as a common good? How can the community network best ensure that it is a not-for-profit project? Are those, who work professionally for the maintenance of the network, fairly remunerated for their labour so that they can lead decent lives? To what extents does the network rely on community control, municipal control, or private control? What are potential dangers of collaboration with or inclusion of private for-profit companies? How can they be avoided?
Economy	Tragedy and comedy of the commons	Is the network large enough to attract significant numbers of users so that this community can have mutual benefits from network effects? How can possible congestion and slowdown of the network best be avoided if it is very popular?
Economy	Network wealth for all	How can the community network provide gratis/cheap/affordable network and Internet access for all? Can it help to lower the digital divide? How? How can the community network help to avoid a two-tier Internet with slower Internet access for some and faster for others? How can the community network avoid the commodification of a) access (i.e. using access fees) and b) users?
Politics	Participation	How is the community network governed? How does it decide on which rules, standards, licences, etc. are adopted? Does the community network allow and encourage the participation of community members in governance processes? How? Are there clear mechanisms for conflict resolution and for proceedings in the case of the violation of community rules?
Politics	Privacy-enhancement and protection from surveillance	How can a community network best be designed and governed so that the privacy of users is guaranteed, it is technically secure, and protects users from corporate and state surveillance? How can privacy-enhancing and privacy-friendly community networks best face the threat that in a culture of law-and-order politics and a surveillance society, in which governments believe that surveillance is a way of preventing crime and terrorism, they are outlawed? How can they best challenge the argument that they provide a safe harbour for the communication of criminals and terrorists? How does the community network deal with actual crime occurring in its network? How can it best minimise the occurrence of crime?

Culture	Conviviality, learning and community engagement	Does the community network provide mechanisms for learning, education, training, communication, conversations, community engagement, strong democracy, participation, co-operation, and well-being? How? To which degree is the community network able to foster a culture of togetherness and conviviality that brings together people? How?
Culture	Unity in diversity	To which degree is the community network a "geek public" that has an elitist, exclusionary culture or a "community public" that is based on a culture of unity in diversity? How can a culture of unity in diversity best be achieved?

Table 13: Checklist for sustainability issues in community networks

At the **environmental** level, community networks face a **contradiction between network effects and environmental problems**: The more users a network has, the better and attractive it is (network effect). But more Internet use today also tends to mean more energy consumption, more deployed hardware, and more use of digital media devices, which can increase the consumption of unclean energy sources and thereby the depletion and pollution of nature and the generation of e-waste that can harm humans and society. Community networks' environmental challenge is therefore how to attract a large user community, keep the network up-to-date with technological progress and at the same time rely on clean, renewable energy sources and avoid e-waste.

At the **economic** level, community networks face a **contradiction between the monopoly power of large communications companies and the resources required for managing the network as a non-profit, commonly owned and commonly governed, democratic, gratis good and service**: The communications sector is a highly concentrated industry. Large communications corporations own large parts of the Internet's infrastructure. Communications in market society tend to be shaped by monopoly power. Communication is a process that is necessary for human survival. In contemporary society, the access to communications networks and the Internet is therefore of importance for organising everyday communication. If means of communication are privately owned, then inequalities in access and use tend to emerge. Non-profit community networks can challenge the power of corporate communications corporations. They can be foundations of an alternative organisation of the Internet. But they also require resources such as hardware, labour-power, money, users, attention, reputation, influence, support, volunteers, etc. The history of alternative media has not just been a history of spaces for alternative, democratic communications, but also a history of resource precarity and unpaid, highly self-exploitative volunteer labour. The danger for alternative media is that they cannot economically survive or that they develop into privately owned for-profit companies that turn access, content or users into commodities and thereby foster inequality and exploitation. Community networks' economic challenge is to run community networks as democratic, non-profit, gratis commons that challenge the power of corporate monopolies and the economic concentration of communications, but can at the same time economically survive and do not exist as second-class Internet that is marginalised.

At the **political** level, community networks face a **contradiction between open, privacy-friendly participation and political control**: Community networks have the potential to be inclusive, allow

open participation, to be democratic and to enhance privacy and the protection from corporate and state surveillance. At the same time, given the prevalence of surveillance ideologies ("surveillance helps to fight and prevent crime and terrorism"), they face the threat of being shut down or criminalised by the state. They also face the problem how to avoid openness and being misused by criminals. Community networks' political challenge is how to be open, participatory and privacy-friendly and at the same time challenge the surveillance ideology and respond to actual criminal abuse.

A t **the cultural** level, community networks face a **contradiction between geek publics and community publics**: Community networks have the potential to be open public networks for learning, training, community engagement, togetherness and communication. But studies have shown that there is the danger that they develop a self-centred, closed geek culture dominated by techies that is unattractive for others and has an exclusionary and elitist character. There is also the danger that tech-experts develop into a power elite inside of such networks. Community networks' cultural challenge is how to foster a culture of unity in diversity and to be a community public.

Community networks in a society, in which power is asymmetrically distributed, face environmental, economic, political and cultural contradictions. They have potentials to foster sustainability in the information society, but at the same time face the problem of how to survive and not become part of powerful mechanisms that advance unsustainable development. Establishing a sustainable information society is not just a question of introducing new technological networks and organisation forms, it is also a question of changing the existing distribution of communication power and to foster struggles that question this power's asymmetrical distribution.

The contemporary Internet has a decentralised technological structure. But in it social structure, particular groups and individuals exert large economic, political and cultural power, which is at th heart of the Internet's contradictions. The result is that there is a lack of economic, political and cultural diversity. We can speak of a lack of diversity when a small group controls power in system. An Internet landscape, in which power is centralised, lacks such diversity that allows all users influence and participation. Centralisation and monopolies undermine the sustainability of communications systems.

In section 1.2.1, we have discussed Ivan Illich's (1973) analysis of technology and his concept of conviviality. He argues that blind belief in technological progress can result in a development of the two watersheds: New technology's first watershed results in specific advantages and the availability of more services. In the case of Internet infrastructure, the very emergence of the Internet has resulted in more possibilities for information, entertainment, and communication. In the second watershed, technologies can have unforeseeable negative consequences. In the case of the Internet, its development has led to the emergence of problems such as e-waste, online monopolies, online reputation hierarchies, privacy violations, online surveillance, targeted advertising as the model of the Internet as a shopping mall, etc. Illich calls for the responsible design of technology and society. "Rationally designed tools have become the basis for participatory justice" (Illich 1973, 26). In the context of Internet infrastructure, the question is how alternative networks, such as community

networks, can be a means for the establishment of a convivial, sustainable Internet.

Chapter 1 discussed sustainability in general, sustainability of the information society, and sustainability in the context of community networks. It has taken as its starting point the theoretical debate on how to define sustainability. We have seen that there are different understandings. It is, however, clear that sustainability concerns the holistic development of society. It looks at society as a whole and takes a macroscopic perspective. Talking about sustainability therefore means to discuss the role of certain phenomena in society. But of course specific communication technologies have very local contexts. A community network for example is used in the context of certain cities or regions. Therefore sustainability also takes on more local meanings and dimensions. The second version of this deliverable will feature an additional chapter that connects the global macroscopic understanding of sustainability to the local and micro-level of community networks.

Chapter 2 focuses on one specific dimension of un/sustainability: The role of monopolies in the European broadband market, the question how this market is regulated and the influence of policies on the market structure. It is a case-study of the economic dimension of the Internet infrastructure's un/sustainability. It also discusses the question if community networks can be a way of advancing the economic diversity and sustainability of the broadband market.

Endnotes:

---

[1] Somalia, the country most at risk of climate change's impacts, was not included in the UN Human Development Report 2015.

[2] http://www.ispreview.co.uk/index.php/2014/11/eu-unveils-gbp250bn-investment-plan-infrastructure-broadband.html

[3] http://ec.europa.eu/priorities/jobs-growth-and-investment_en

[4] See: Mobile networks hand small fortune to shareholders – but little to taxpayers. *The Guardian Online,* July 31, 2013. Vodafone-Verizone deal: Margaret Hodge raises alarm over tax loss. *The Guardian Online*, September 2, 2013. Tax breaks used by mobile phone networks face scrutiny. *The Guardian Online*, July 31, 2013.

[5] See: Luxembourg Tax Files Leaks: Tech Companies, http://www.icij.org/project/luxembourg-leaks/explore-documents-luxembourg-leaks-database, accessed on February 15, 2016.

[6] The following industries were for this purpose classified as information industries: advertising, broadcasting & cable, communications equipment, computer & electronics retail, computer hardware, computer services, computer storage devices, consumer electronics, electronics, Internet retail, printing & publishing, semiconductors, software & programming, telecommunications.

[7] Six of biggest 10 firms pay no UK corporation tax. *The Sunday Times*, January 31, 2016, p. 14.

[8] Toxic "e-waste" dumped in poor nations, says United Nations. *The Guardian Online*, December

14, 2013.

[9] http://www.thesecretlifeofthings.com/#!phone-facts/c611

[10] What is the lifespan of a laptop? *The Guardian Online*, January 13, 2013.

[11] Wikipedia: Tonne of oil equivalent, https://en.wikipedia.org/wiki/Tonne_of_oil_equivalent, accessed on March 6, 2015.

[12] Data source for all data in this paragraph: Global Energy Statistical Yearbook 2015, https://yearbook.enerdata.net, accessed on March 6, 2015.

[13] Data source: International Energy Statistics, https://www.eia.gov, accessed on March 6, 2015.

[14] https://wiki.freifunk.net/FAQ_Technik, accessed on March 7, 2016.

[15] Another example is New Orleans: After hurricane Katrina the city's population decreased from 437 186 in July 2005 to 158 353 in 2006 (*Los Angeles Times,* Storms also shifted demographics, census finds. June 7, 2006[15]. In order to make residency in New Orleans more popular, Democratic major Ray Nagin suggested implementing a gratis communal Wi-Fi[15]. BellSouth and other telecommunications companies attempted to boycott this plan (http://www.corp-research.org/e-letter/broadband-socialism).

[16] See: https://en.wikipedia.org/wiki/Tier_1_network

[17] https://en.wikipedia.org/wiki/Sprint_Corporation

[18] See https://en.wikipedia.org/wiki/Tier_2_network for an overview of important tier 2 networks that buy transit from tier 1 networks.

[19] See: https://en.wikipedia.org/wiki/List_of_Internet_exchange_points_by_size

[20] http://guifi.net/en/FONNC, accessed on February 8, 2016.

[21] Tech, telecom giants take sides as FCC proposes large public WiFi networks. *The Washington Post Online,* February 3, 2013.

[22] https://apps.fcc.gov/edocs_public/attachmatch/DOC-334757A1.pdf

[23] FAQ: The FCC's upcoming broadcast-TV spectrum auction. *Computerworld Online*, October 15, 2015.

[24] NSA Prism program taps in to user data of Apple, Google and others. *The Guardian Online.* June 7, 2013.

[25] Ibid.

[26] XKeyscore: NSA tool collects "nearly everything a user does on the internet'. *The Guardian Online.* July 31, 2013.

[27] GCHQ taps fibre-optic cables for secret access to world's communications. *The Guardian Online.* June 21, 2013.

[28] Ibid.

[29] GCHQ and European spy agencies worked together on mass surveillance. *The Guardian Online*. November 1, 2013.

2 The Broadband Internet Access Market in the EU

2.1 Introduction

The aim of this chapter is to assess the broadband Internet access market in the EU focusing on key policy developments, and to discuss the role of community networks within this context. The starting point of the chapter is the gradual liberalisation of telecommunications markets in the 1980s. Placed within a political economy framework, the chapter starts with a brief discussion of the historical context of the liberalisation process. This context is important for two main reasons. *First*, the chapter underlines the longevity and tenacity of the pro-competitive market restructuring process which, contra neoliberal thinking, has required continuous regulatory intervention and oversight. *Second* and related, the chapter points out that paradoxically telecommunications, and more recently Internet access, markets remain stubbornly less competitive than initially anticipated and, furthermore, largely controlled by the ex-monopolist telecommunications operators. Yet, despite a relatively high degree of market concentration in many EU countries and overall stable market shares enjoyed by the main telecommunications providers, investment in high-speed Internet networks has not materialised either in a timely fashion or to the desired extent. An added complication is the so-called digital divide within and between countries whereby rural areas in many, even big, European countries do not have Internet access whilst the level of service experienced in different geographical areas, even within the same country varies considerably (often referred as the "speed gap"). These findings relating in particular to the persistent, and often increasing, market concentration in the hands of (established) commercial players feeds into the previous chapter discussing the notion of sustainability and ICTs (Chapter 1).

Moreover, recent years have witnessed growing market consolidation across previously distinct media and communication markets, increasing further the market power of a handful of telecommunications/ media conglomerates. Indeed, regulation permitting, in response to technological convergence incumbent operators have moved up, down and across the electronic communications value chain. For instance, telecommunications operators have moved into broadcasting notably by launching IPTV and often acquiring sports rights to strengthen the appeal of their offer (e.g. BT in the UK); Vodafone a traditionally mobile telephony company has moved into cable TV; many countries have experienced consolidation in their mobile markets through mergers whereby the number of operators has decreased from 4 to 3 (e.g. in Germany, Austria and Ireland) whilst in other cases the incumbent fixed telecommunications operator has been allowed to enter the mobile market (e.g. the fixed incumbent BT acquired the largest mobile operator, EE, in Britain). As a result of this market activity, market operators are now offering triple- and quad-packages making it difficult for consumers to switch operators, even if they have the choice[1]. In advanced media markets such as Britain, such complex offers as well as varying inclusive call and data allowances make tariff transparency and clarity of contracts a core consumer concern (Europe's Digital Progress Report UK 2016)). Market concentration is a characteristic of national

markets but often large national players have expanded across the EU and thus they possess market power at European level too.

In short, despite decades of trying to open up the telecommunication market, it is increasingly the case that in many EU countries the same incumbent companies possess market power. It is not simply concentration of power in a handful of commercial operators that is of concern but also the potential for them to shape competitive conditions downstream both in the provision of competing infrastructure provision but also beyond infrastructure provision shaping access to services, content, and information, and in doing so the potential to threaten established rights and freedoms such as privacy and freedom of expression (for a recent analysis see Cave and Shortall 2016).

Two clarifications before the main sections of this chapter start. The first clarifications has to do with the term "Internet access". Overall, for analytical purposes, Internet access can be divided into three interdependent markets: connectivity, content and retail (PricewaterhouseCoopers 2016). This chapter deals with Internet connectivity defined as the availability of affordable and reliable broadband Internet access (D. Co. and T. European Commission 2015). It focuses on access networks, referring to backhaul infrastructure as needed. The content market comprises electronic goods and services and, in general, the reasons people go online whilst, finally, the retail market refers to sales and marketing actions that the Internet industry uses to attract people to the Internet (PricewaterhouseCoopers 2016, 7).

The second clarification relates to the notion of "broadband". Broadband referring in general to high-speed communications is not a new concept and has evolved over the years (see (Michalis 2007, 110-18). In the 1980s, broadband meant essentially ISDN (Integrated Services Digital Network), a single network to support all types of communication. But as the Internet began to grow fast, in particular from around the mid-1990s onwards, broadband has moved away from the ISDN concept. Now, and indeed in EU policy documents and initiatives, "broadband" refers to basic broadband networks and very high-speed, so-called next generation access (NGA) networks. According to this distinction:

> "(1) **Basic broadband** services can be delivered over several different technology platforms, such as xDSL, cable, mobile, wireless and satellite solutions. In its decision-making practice, the Commission uses the benchmark of at least 2 Mbps download speeds at affordable prices to consider a certain Internet access service as "basic broadband".
>
> (2) In the current definition, and subject to future technological and market developments, **NGA networks** are fixed fibre networks, typically FTTx solutions capable of providing at least 40 Mbps download speeds or advanced cable networks based on Docsis3.0 standard, capable of providing at least 50 Mbps download speeds." (Chirico and Norbert 2011, 51)

The present chapter adopts this more recent understanding of broadband and the distinction between basic broadband and NGA.

2.2 Liberalising European Telecommunications Markets

The liberalisation process of European telecommunications markets has already a 30-year history.

For analytical purposes, the process can be divided into two main phases: the first from the beginning of liberalisation in the mid-1980s since the early 2000s and the second phase from the early 2000s to the present with its main features becoming more visible since the 2008 economic crisis. These two phases are examined in turn.

2.2.1 The First Phase of Telecommunications Liberalisation: Copper Networks and the Emphasis on Market Competition

In the mid-1980s, economic arguments and the idea of trade in telecommunications were increasingly gaining ground. A combination of factors facilitated the shift to pro-competitive policies (e.g. (Braithwaite and Drahos 2000, Humphreys and Simpson 2005, Michalis 2007, Natalicchi 2001, Schneider 2002). Key factors were: technological developments, notably digitalisation; the initiation and progressive liberalization of the telecommunications markets in the USA and soon after in Japan and, within the EU, Britain which in turn fed into calls to other countries to do the same, calls which at the international level culminated in the GATT Uruguay Round (1986 to 1994) which for the first time included the liberalisation of services; the international liberalization of service industries, in particular those that rely heavily on telecommunications infrastructure and services for their transnational expansion such as finance; dissatisfaction of corporate telecommunications users in particular with the level (quality and choice) and value (price) they were getting under the monopolist telecommunications providers which, in turn, was affecting negatively their competitiveness.

Additional factors closer to Europe contributed to the strengthening of the liberalisation calls: the broader demise of national Keynesian economic consensus (Jessop 2002) and the concomitant ‘retreat’ of the State with the shift towards neoliberal economics and ideas in major European countries such as Britain, Germany and France; and the revival of European integration with the single market project and the associated call for breaking down national borders in order to create a pan-European market and get rid of small and fragmented national markets which provided insufficient economies of scale for European companies to be able to compete on the world market.

Originally in the 1980s, communication policy was influenced by Hayekian thinking which served to highlight the failings of state monopolies and to justify market liberalisation (Michalis 2016). At the heart of Hayekian thought is strong support for the market and opposition to state intervention (e.g. Hayek 1945). It views state interference as ill-conceived and considers free markets as crucial in delivering equilibrium and underpinning social welfare. In policy terms, this understanding contributed to the dismantling of bureaucratic, inefficient and unresponsive national monopolies, as was the case of telecommunications. Hayekian thought only supports state intervention in so far as it is circumscribed to enable the free functioning of the market. This can account for the fact that the introduction of liberalization was a managed (regulated) process, as opposed to deregulation and a withdrawal of rules. Regarding innovation, Hayekian thought claims that incentives for innovation will not come from state intervention but rather from the market itself: the higher the competition in a market and thus the more companies that exist, the greater the potential for innovation to materialise (Lee 2012). In short, from a Hayekian point of view, the primary policy aim is to foster market competition.

During the first phase of telecommunications market restructuring (roughly from the mid-1980s to the early 2000s) national monopolies were gradually dismantled. Liberalised markets were thought to assist the modernisation of networks and services, advance corporate efficiency and indirectly consumer welfare through lower prices and increased choice, and serve industrial policy objectives by allowing European ICT manufacturers to benefit from the bigger economies of scale of the larger European harmonised market.

For Noam (2010, 4) '[t]elecommunications infrastructure goes through technology-induced phases, and the regulatory regime follows.' In terms of technology then, and although the pace of market liberalisation has varied from country to country as have the resulting market structures and level of competition, some common elements of the first phase of liberalisation have been the following: the introduction of competition through cellular mobile technologies and the enhancement of services-based competition through mobile virtual network operators (MVNOs) whilst the policy towards fixed networks focused on (a) the existing copper network (e.g. local loop unbundling), (b) cable tv companies (where these existed) and their move into telecommunications and the Internet which followed the upgrading of their networks, and (c) what is commonly referred to altnets (alternative networks) which comprise new providers ranging from providing specialist communication services over their own infrastructure to pure resellers of communication services (Carse 2015).

Following pro-competitive market restructuring and the privatisation of the state monopoly providers, there was a widespread belief that investment in networks would come from private funding and access to capital markets, with no need to burden the public purse anymore (Cave and Martin 2010, Ruhle et al. 2011). Indeed, years of insufficient investment, the vast amounts of network modernisation that the move to digital networks required, the strain on public finances, monetarism and neoliberal ideas, all contributed to the processes of liberalisation and privatisation in the area of telecommunications (e.g. Hills 1986).

As the next section on the second phase of telecommunications market restructuring suggests, two shifts have taken place. Both shifts are inextricably linked to the broadly held conviction that the

general availability of high bandwidth access networks (NGAs) is a key driver for economic growth and prosperity. Given that the EU overall continued to lag behind its main trading partners in the rollout of NGAs and the aggravation of the economic woes following the 2008 financial crisis together they made high speed Internet connectivity an urgent highly political issue. The strategy during the first phase of telecommunications market restructuring with its emphasis on competition and private sector provision had failed to deliver Internet access in a timely fashion or at the desirable level. Hence, during the second phase of market restructuring there has been (a) a return of public intervention, not least in relation to funding and (b) a stronger and more visible focus on a Schumpeterian understanding of innovation which does not necessarily presuppose competitive market conditions but rather stresses that it is monopoly rents that matter and can increase the chances for innovation, that is advance the rollout of NGAs, and in doing so lift European economies out of recession.

2.2.2 The Second Phase of Liberalisation: The Internet, the Transition to NGAs, the Return of State Intervention and the Emphasis on Monopoly Rents

The belief that ICT is a key driver of economic growth and competitiveness can be traced back to the early 1950s (Preston 2001, Michalis 2007). By the late 1970s and early 1980s, the 'information society' notion encapsulating these ideas had become commonplace. Within the EU, political leaders meeting in November 1979 endorsed the 'information society' as the answer to Europe's socio-economic challenges (European Commission 1979). As the EU overall kept lagging behind its main competitors, notably the USA, and as evidence of the malleability of the concept, the information society has been subsequently relaunched at various points in time, most notably in 1994 with the so-called Bangemann report calling among others for the full liberalization of the telecommunications market (European Commission 1994a, European Commission 1994b, European Commission 1997).

Later, in the late 1990s, various factors (convergence in communication technologies, the commercialisation of the Internet, associated technological euphoria and the widening productivity and competitiveness gap with the USA) combined to decisively shift the focus of EU policy from full liberalisation in telecommunications market to the Internet. In December 1999, the EU launched the '*e*Europe - An information society for all' initiative aiming to bring every European online. With Europe overall continuing to lag behind, economic growth and competitiveness, with ICTs as the main determinants, reached the highest political level of the EU which culminated in its endorsement as a newly declared strategic goal at the Lisbon summit in 2000. EU political leaders committed to transform Europe into the 'most competitive and dynamic knowledge-based economy in the world, capable of sustainable economic growth with more and better jobs and greater social cohesion' by 2010 (EU European Council 2000, para. 5). The *e*Europe plan – renamed i2010 in June 2005 – was at the core of the so-called Lisbon agenda.

More recently, ten years on form the Lisbon agenda, in May 2010, with Europe facing the same economic challenges, and in many cases intensified in the aftermath of the 2008 financial crisis, this high level commitment to the significance of Internet connectivity was renewed under the Digital Agenda for Europe (DAE). The main goal is to create a digital single market and support Europe's

2020 strategy "for smart, sustainable and inclusive growth" for the next decade (European Commission 2010). The Digital Agenda put forward Internet penetration and, importantly, take-up targets.[2] It restates the objective of all European having access to basic broadband (below 30 Mbps) by 2013, whilst by 2020 all Europeans should have access to Next Generation Networks (at least 30 Mbps) with half of them subscribing to super-fast connections of 100 Mbps or higher. In short, just before the eclipse of the millennium, EU policy endorsed the Internet as its key objective and within a few years this moved on to broadband Internet and, more recently, with the DAE to fast and ultrafast broadband. According to one estimate the DAE targets required about €216 billion of investment and if the foreseen private and public investments are taken out, then there is a gap of €106 billion (Boston Consulting Group 2015, 5).

> "To achieve the objective of access to Internet speeds of above 30 Mbps it is estimated that up to EUR 60 billion of investment would be necessary and up to EUR 270 billion for at least 50 % of households to take up Internet connections above 100 Mbps. Such investments shall primarily come from commercial investors. However, the DAE objectives cannot be reached without the support of public funds. For this reason, the DAE calls on Member States to use 'public financing in line with EU competition and State aid rules' in order to meet the coverage, speed and take-up targets defined in EU2020." (European Commission 2013, para. 2).

When the policy on fixed networks moved to broadband connectivity, and in particular fibre optic networks, it became obvious that the hitherto strategy of relying on private funding and capital markets was not going to deliver or at least deliver fast enough and to the desirable level. This was more the case of countries which lacked an historical alternative network such as a cable tv infrastructure.

As the economist Eli Noam explains in describing the move from the early phase of Regulation 1.0 based on monopolistic market and analogue copper cable networks to the phase of Regulation 2.0 characterised by digitalisation, liberalisation and privatisation (the first phase of market restructuring here), in recent years we have entered a new phase:

> "fiber and high-capacity wireless are raising scale economies and network effects, leading to a more concentrated market. At the same time, the rapidly growing importance of infrastructure, coupled with periodic economic instabilities, increase the importance of upgrade investments. All this leads to the return for a larger role for the state in a *Regulation 3.0* which incorporates many elements (though using a different terminology) of the traditional regulatory system— universal service, common carriage, cross-subsidies, structural restrictions, industrial policy, even price and profit controls." (Noam 2010, 4, original emphasis in italics, added emphasis underlined).

Equally, two more economists note:

> "What a difference a few years make! Faced with the enormity of expenditure on next generation networks (NGNs), and particularly in next generation access networks (NGAs, the successor to the copper local loop), under pressure from the credit crunch, the earlier

> view [that reliance on public finances belonged to the past] has now virtually reversed itself." (Cave and Martin 2010, 505)

In short, in relation to high speed broadband networks, a growing number of economists recognise that the market alone cannot deliver and that some form of public funding, and public intervention more generally, "is now seen as necessary and appropriate almost everywhere, not simply as an aberrant feature of Asian economies" (Cave and Martin 2010, Noam 2010, Gómez-Barroso and Feijóo 2010). Indeed, the European Commission itself has recongnised that the DAE objectives cannot be achieved without the support of public funding and has called on member states to use "public financing in line with EU competition and state aid rules" in order to meet the coverage and speed and take-up targets set out defined in Europe 2020 (EC 2010, 21).

These views, however, tend to perpetuate the false state-market dichotomy: on the one hand the, wrong as it turned out, belief during the first phase of telecommunications liberalisation that the market can deliver (as if the state was ever absent) and on the other hand the recent re-emergence of the state as a key player in the rollout of high speed connectivity. In addition, what this state-market dichotomy misses is the potential of bottom-up approaches premised on citizens' initiatives. To a degree this can be attributed to the relatively smaller presence of such community networks, associated lack of information about them as well as of evidence about their benefits and pitfalls. It seems that, similar to other spheres of media activity, such community initiatives come as an after-thought in policy circles and it might take time for them to be recognised on a par with market and state initiatives[3]. To the extent that they are discussed at present, community networks are perceived as a minor factor of the overall broadband connectivity (e.g. (Mölleryd 2015) and destined to fill-in the gaps of provision in remote rural and other non-commercially attractive areas (so called 'white areas' in the EU). The potential of community networks to expand broadband connectivity and help bridge the digital divide inside and outside the EU has been noted (e.g. Forlano et al. 2011).

The shift of emphasis to broadband networks at the turn of the millennium and the subsequent 2008 financial crisis have not necessitated simply a rethink about the need for public funding but, at a broader level, a more fundamental rethink of policy. This rethink is inspired by Schumpeterian ideas on innovation (Michalis 2016). Indeed, Jessop takes this point further when discussing recent economic transformations and talks of the emergence of a Schumpeterian regime (Jessop 1993 and Jessop 2002, 95-139). Regulatory intervention, especially sector-specific rules are perceived as restrictive. Public policy should play an enabling role and aim at fostering an investment- and innovation-friendly environment. Unlike the prominence of Hayekian ideas during the first phase of telecommunications liberalisation, the assumption of the current Schumpeterian understanding is that the main precondition for innovation is not competition but rather the provision of the right incentives to economic agents that will allow them to invest and innovate. Such incentives include R&D subsidies and strong intellectual property rights. Importantly, not only inter-firm competition is not a prerequisite but actually large, even monopolistic, companies stand a better chance to promote innovation (e.g. Schumpeter 2010 [1943]). Large telecommunications providers put such arguments forward very strongly. With economies still facing huge challenges and struggling to achieve noteworthy growth rates and with the accompanying belief that the answer to economic

woes lies with investment in superfast Internet connections, policy makers appear to accept uncritically the need to invest in NGNs quickly and to believe such innovation can lift economies out of stagnation. They seem prepared to allow market concentration and even the temporary return to oligopolistic / monopolistic market structures in the name of innovation.

The following sections cover the arguments put forward by the European telecommunications Networks Operators' Association representing mainly former monopolist telecommunications operators.

For ETNO the policy aim has changed and regulation should change follow:

> "The EU should create the right conditions for European operators to maximise investments in advanced digital infrastructures … Old rules designed primarily to spur competition in existing networks should be replaced by a technology neutral framework that provides the right incentives to innovate and deploy new networks, thereby supporting sustainable infrastructure-based competition. [...] priority should be to maximise investment incentives and innovation, while ensuring that end-users continue to benefit form competitive markets …" (ETNO 2016, 2).

ETNO continues:

> "The internal market should first and foremost be a space for free initiative by market players, instead of being designed and planned under regulatory obligations." (ETNO 2016, 4).

These two extracts from a recent ETNO position paper confirm the ascendency of Schumpeterian thinking. ETNO emphasises the urgency and importance of the right incentives for innovation and investment in high capacity networks. The appeal to the significance of "free initiative" implies ETNO's resistance to regulatory intervention especially if this regards "old rules" aiming to foster competition in networks. Elsewhere ETNO has elaborated on what it considers as "rigid and prescriptive rules" that stifle investment in infrastructure and thus should be abolished: network access obligations, price regulation, in particular cost-orientation requirements which serve to minimize profit margins and restricts monopoly rents, and network neutrality rules on network traffic management among others (ETNO 2015, 18, 21).

ETNO explains

> "By focusing regulation on the incumbents' legacy networks [notably access requirements], and extending such "default regulation" also to investments in new networks by the same operators, the regulatory framework has generally lost sight of other actors' activities and their market positions." (ETNO 2016, 9)

Indeed, a noteworthy 'regulatory holiday' case arose in in Germany. Regulatory holidays refer to an initial period of no regulation in order to boost investment in high-capacity networks. For example, an amendment to the German Telecommunications Act in 2006 aimed exempt the incumbent Deutsche Telekom exempted from regulation in return for investing in a fast Internet access network (NGA). In 2009, the European Court condemned this regulatory holiday provision and

demanded that competitors should be allowed to access Deutsche Telekom's high-speed network (ECJ 2009).

There is evidence of regulatory forbearance from outside the EU too. For instance, in 2003 the Federal Communications Commission in the USA deregulated the market for high-speed Internet access and ruled that those investing in fiber optic networks would be exempted from access obligations. Crawford (2013) argues the absence of regulation resulted in market consolidation - effectively duopolies in both the wired and wireless markets – and higher prices for US Internet users for less speedy service.

For ETNO, competition in the emerging high-speed connectivity market has a place as long as it is infrastructure-based. The potential for infrastructure-based competition, as opposed to greater regulated use of the incumbent's existing infrastructure ranging from total reliance in the case of reselling to some investment in order to upgrade parts of it as in the case of local loop unbundling, has preoccupied policy makers and analysts even during the era copper networks. Given that economies of scale and network effects are even more pronounced in the case of NGN, as Noam noted (Noam 2010, 4 see quote above), it is unlikely that infrastructure competition is a realistic scenario in the case of NGNs. Policy debates and interventions in the EU and beyond, in particular the debate on functional separation, supports this (e.g. BT's Openreach in the UK). Arguably, the likelihood for infrastructure-based competition is even smaller in smaller countries/ markets. It therefore seems that infrastructure competition is more likely a theoretical scenario (the legislative framework in place allows such market entry) but it is highly improbable as a realistic scenario in the context of NGNs, except perhaps in very few cases in high-density and high-traffic business areas. The experience with the degree and form of competition in the telecommunications market so far confirms this. It is more likely, as Noam notes (Noam 2010, 4) that fibre and high capacity-wireless will lead to more concentration.

In addition to deregulation, ETNO has also called for market consolidation, for allowing operators to take advantage of the substantial economies of scale that a telecommunications single market can offer (ETNO 2015, 5). Again, this is a well-rehearsed argument in the history of communication policy based on the unproved assumption that firm size matters and in particular big forms have a better chance to deliver innovation and investment. Market fragmentation refers to both too many ex-ante rules and too many telecommunications operators in the market. Statements like "There are more than 100 mobile operators across the EU, whereas in the United States there are only four and three in China" (Thomas 2013) and "Why is it a necessity […] that two million Slovenians have more operators than one billion Chinese?" (ETNO ThinkDigital 2015) are regularly voiced by incumbent operators.

Berec, the collective body of national European regulators, has condemned the Telecommunications Single Market regulation proposals of the outgoing European Commission presented in September 2013 which largely echoed the arguments of the big commercial operators, notably significantly less regulation and room for market consolidation. Berec warned that the proposals signaled "a significant shift in policy orientation" (BEREC 2013, 2) and represented a move away from pro-competitive regulation, putting at risk market competition and, by extension, undermining consumer benefit.

European fixed and mobile operators have in recent years seen their revenues decrease and yet they are expected to invest massive amounts of money in rolling out NGAs. This can help perhaps explain their calls for new regulation (notably deregulation and consolidation) in the era of transition to NGAs. The following figures show different market players experience different trends in revenues and capital expenditure (CAPEX) based on 2013 data. As the Broadband Commission explains, in particular mobile revenues declined for the third consecutive year, mainly due to lower mobile termination and roaming rates following regulatory intervention. In contrast, cable operators saw their revenues growing, primarily because of TV revenues, whilst 'altnets' being mostly 'smaller and most agile' players find it easier to gain market share. Capex commitments on the other hand are rising for all players except 'altnets'. (Broadband Commission 2015, 12)

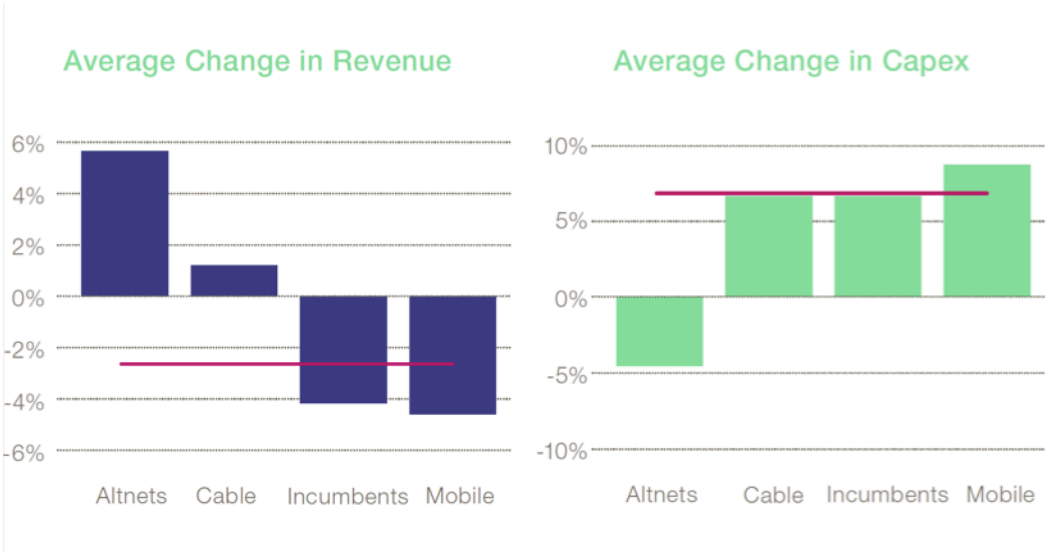

Figure 13: Disparities in Growth in Telecom Revenues & CAPEX for Different Players, 2013

Note: European telecom revenues under pressure – average % change in telecom revenue by type of player (left); average % change in CAPEX, which is increasing for all players except altnets (right)

Source: (Broadband Commission 2015, 13).

Declining revenues and rising capex help explain recent wave of M&A deals in Europe. Market consolidation has been more pronounced in the mobile sector where in various countries (including Austria, Ireland and Germany) the number of mobile operators was reduced from four to three. In the last year however in Britain, although the fixed incumbent BT got regulatory approval to acquire the largest mobile operator EE, the sale of mobile player O2-Telefonica to 3 HK-

Hutchinson was rejected by both the national and European regulators. The details of each deal are of course important and can help explain regulatory approval or rejection. Still, some commentators are asking whether this rejection signals the end of market consolidation in the European mobile landscape. As Gassot (2016) rightly observes, even if that were to be the case, there are other ways for the industry to consolidate. One approach is to the fixed-mobile convergence. There is already evidence of this: Vodafone is no longer a pure-mobile player having bought cable tv stakes in Germany and Spain thereby decreasing its reliance on the incumbent's backhaul infrastructure. As Gassot notes such fixed-mobile deals are somewhat easier to get approval given that regulators do not perceive the two markets (fixed-mobile) are substitutes. The second approach for Gassot is consolidation across national borders towards which the Commission historically has taken a more lenient view.

Before ending this section, it is worth noting that ETNO refers to **municipal networks** and how these in particular are often not taken into account in market analyses thereby concluding wrongly that the market is less competitive than it actually is. Hence, in discussing network access regulation, ETNO observes that one major change since the beginning of liberalisation is that

> "[i]n several Member States, local/regional fibre deployment by players such as utility companies and municipalities is leading to increasingly competitive and heterogeneous market structures in high-speed broadband access, also with the potential to significantly distort competition in competitive areas" (ETNO 2016, 6).

It adds:

> "None of the above-mentioned trends were anticipated when the basis of the current European telecoms framework was being developed in the late 1990s. This entails that the objectives of the current framework are not compatible anymore with today's market trends and the need to foster massive investments in high-speed broadband infrastructures.
>
> The focus of the new access framework has to shift to the promotion of investments and innovation in NGA networks, safeguarding the efficient level of competition that permits this level of investment." (ETNO 2016, 7)

The argument here is twofold. First, if utility and municipality networks are not included in market review assessments then the competitive picture that is depicted therein is wrong since it is concluded that there is less competition in the market and thus relatively onerous regulatory obligations on incumbent operators need to be maintained. Second, such networks have the potential to "significantly distort competition in competitive areas" possibly means that utility and municipality networks might be acceptable only and strictly as an exception in so-called "white areas" that is locations where demand for broadband is not being and is unlikely to be met by the market. One can reasonably assume that similar arguments may be put forward by ETNO in relation to community networks.

Capitalising on the general conviction that NGNs are a powerful driver of economic growth, the last part of the quote above stresses that the policy priority is innovation and investment in NGAs; if the delivery of this pressing objective is at odds with a competitive market structure, so be it.

These arguments and thinking are not new. They can be traced back to the early 2000s and the heated policy debates around the Regulation on local loop unbundling requiring incumbent operators to grant competitors access to the last-mile of their networks in an effort to boost competition and advance the deployment of broadband networks, as well as the Recommendation on relevant product and service markets in 2003 and its focus on the nascent broadband market for the purpose of deciding if needs ex ante regulation (see Michalis 2007, 203-5).

2.3 Market Data and Market Concentration

The focus of this section is on fixed broadband connections since mobile alternatives cannot yet offer viable high-speed connections. Writing in 2010, Noam noted that

> 'The transmission rate of public wireless tends to operate at about one tenth of that of public wireline, with both rising in tandem. This leaves a significant role to wireless for medium-speed uses, which is all that many users need at present.' (Noam 2010, 6).

This remains the case today. It is expected that mobile broadband will complement fixed broadband and it is important to note the crucial role of fixed technologies in providing backhaul networks (Broadband Commission 2015, 19). Moreover, as Troulos and Maglaris (2011, 845) rightly observe European regulation deals mainly with local access 'therefore preserving incumbents' historical advantage in long-distance markets'. Indeed, the data presented in this section focuses on connectivity (access) and does not capture the situation in relation to backhaul networks.

Fixed broadband subscriptions in the EU (covering xDSL, basic and NGA cable, FTTP, and WiMax networks) have increased in recent years. Of course there are variations within and between countries.

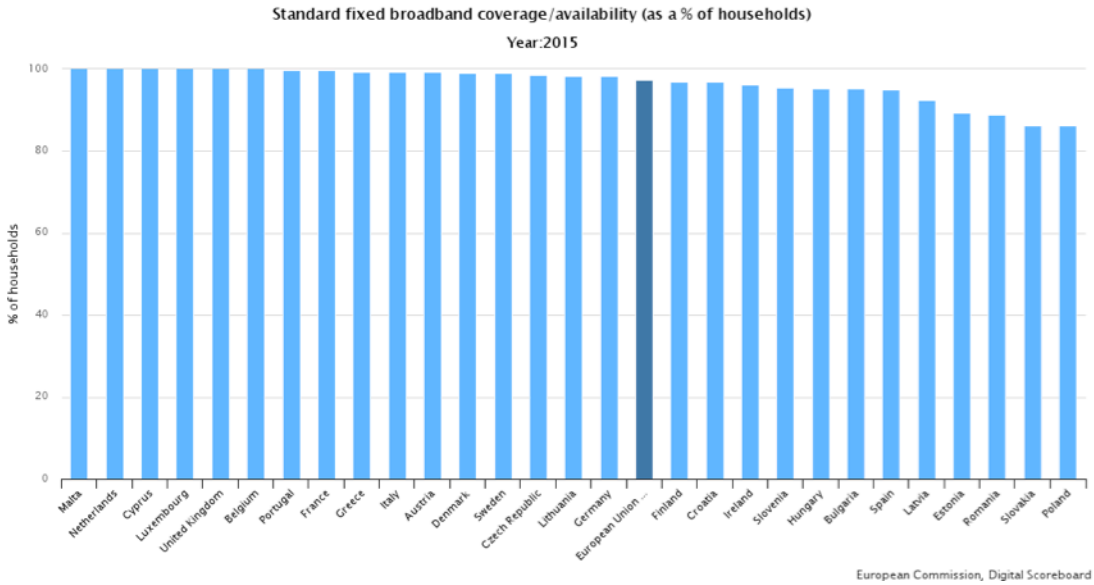

Figure 14: Standard fixed broadband coverage as a % of households in the EU

Note: Coverage is a supply indicator defined as the percentage of households living in areas served by xDSL, cable (Basic and NGA), FTTP or WiMax networks.

Source: D. S. M. European Commission 2015b

It is interesting to note the market shares of incumbents and new entrants in the overall fixed broadband market. The following table presents a rather encouraging picture where years of liberalisation have resulted in reducing the stronghold of incumbents, quite significantly in some cases such as Bulgaria where new entrants control 76% of the market. The EU average is incumbents controlling 41% of fixed broadband market, with the highest concentration recorded in Lithuania where the incumbent controls 67% of the market.

Country	Incumbents	New entrants
BG	24%	76%
RO	26%	74%
CZ	28%	72%
PL	30%	70%
UK	32%	68%
SK	35%	65%
SI	34%	66%
IE	35%	65%
SE	36%	64%
FR	39%	61%
EU	41%	59%
NL	42%	58%
DE	42%	58%
EL	43%	57%
HU	42%	58%
BE	46%	54%
ES	44%	56%
LT	46%	54%

IT	47%	53%
PT	46%	54%
MT	48%	52%
HR	51%	49%
LV	59%	41%
EE	58%	42%
DK	57%	43%
AT	58%	42%
CY	63%	37%
LU	67%	33%
FI	na	na

Table 14: Fixed broadband subscriptions – operator market shares (July 2015)

Note: Market share based on fixed broadband subscriptions (lines). New entrants mean operators that did not enjoy special and exclusive rights or de facto monopoly for the provision of voice telephony services before the liberalisation.

Source: D. S. M. B. I. European Commission 2015

A noteworthy point is the generally higher degree of competition witnessed in many Central and Eastern European (CEE) countries, which is surprising at first sight given that these countries launched the liberalisation process later. For various country-specific conditions prominent in CEE countries but not in Western European countries (like the absence of a good quality and widely available copper network and less cost and risk in investing in alternative infrastructure) CEE countries have managed essentially to leapfrog Western European countries (Serdarević et al. 2016) Lemstra, Voogt, and van Gorp 2015, 259). The approach to liberalisation that CEE countries have followed is different from the approach followed by Western European countries. The latter adopted what is known as the 'Ladder of Investment' (LoI) strategy where regulation aimed at progressively encouraging entrants to invest in their own networks and thus decrease their reliance on the network of the fixed incumbent operator (Cave 2014). LoI was the strategy adopted during the copper network era and an example is local loop unbundling. It the era of NGNs and the transition to fibre networks the policy priority has shifted towards roll-out, as discussed above (also Cave 2014).

The Herfindahl index can be used to indicate the degree of market concentration in the broadband market. The graph is based on data as of June 2014.

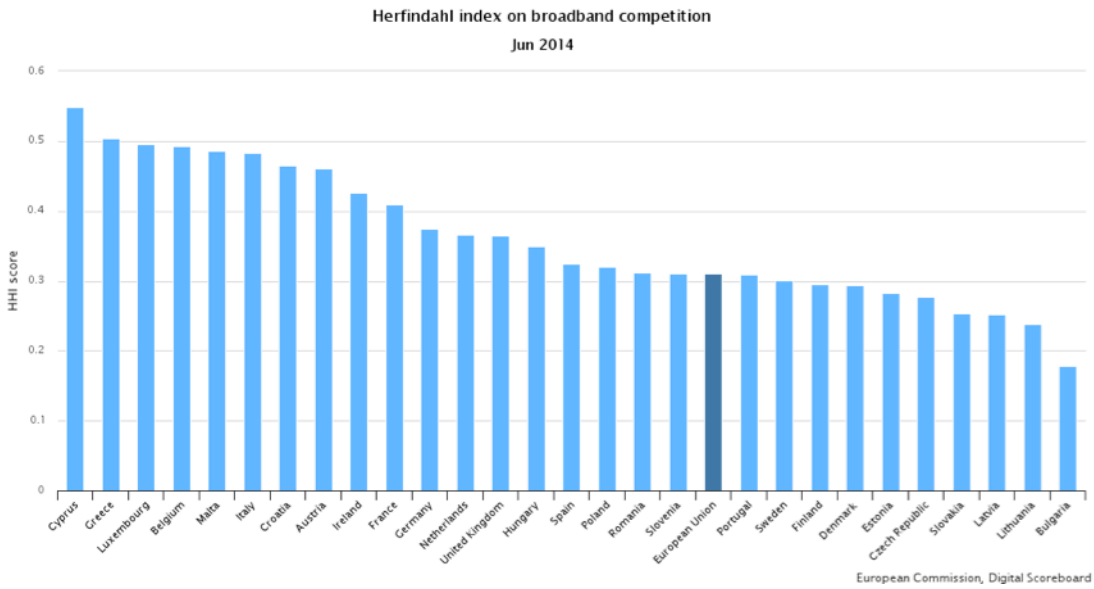

Figure 15: The Herfindahl index on broadband competition, June 2014

Source: D. S. M. European Commission 2014

As the European Commission explains on the website, the Herfindahl index here takes into account seven different connection technologies: xDSL, full or shared LLU, Cable, FTTH, FTTB, Other NGA, Other. The respective market shares of these connection technologies are expressed in percentage of all fixed broadband subscriptions. A small index (such as in Bulgaria) indicates a competitive industry with no dominant technological platform. A high index indicates concentration over one or few platforms. The information presented here does not reveal concentration in individual platforms. The assumption is that competition across platforms mitigates the lack of (or lesser) competition in a single platform. In other words, the benefits of inter-platform competition outweigh the pitfalls of minimal or non-existent intra-platform competition.

This drawback is recognised by Lemstra, Voogt, and van Gorp (2015). They support a modified Herfindahl Hirschman Index (HHI*) as being better at representing market structure by capturing competition between technological platforms: PSTN, CATV, FttH, and the market shares of access-based competitors (Lemstra, Voogt, and van Gorp 2015, 253). While they critique the HHI on the grounds that by capturing the market share of all operators, it overstates the competitive pressure from cable operators since the latter commonly run a monopoly in their service area and do not compete with each other, they acknowledge that the drawback of the HHI* index is that the market shares of operators using the same technology are taken together and so, for instance, the modified index cannot account for the competitive pressure of small access players But they justify their preference for the HHI* index because it offers a better picture of the competition between the PSTN and CATV incumbents (Lemstra, Voogt and van Gorp 2015, 266).

One can look more closely at broadband coverage, by looking at **rural** coverage, where “rural” is

defined as an area with less than 100 people per km^2, ranges from total coverage in Malta, Cyprus, Luxembourg, the Netherlands, to 54.9% in Latvia, with the EU average at 90.6%. The data presented here lack detail as they refer to all possible technologies that can support broadband and cannot highlight cases of so-called speed-gap where in many cases rural areas, even if they have connectivity, enjoy substantially slower access speeds.

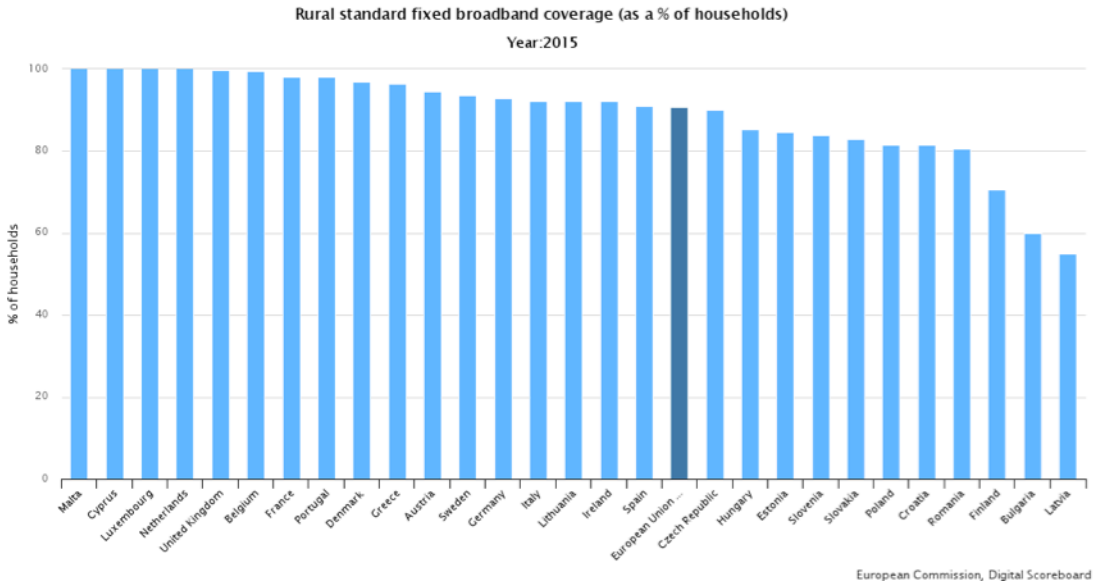

Figure 16: Rural standard fixed broadband coverage (as a % of households). Year 2015

Source: (D. S. M. European Commission 2015a)

With regard to the technologies offering fixed broadband, the table below indicates the prominence of DSL. DSL technologies upgrade the historical copper cable network. Arguably then, the larger the share of DSL subscriptions, the higher the reliance on the infrastructure of the incumbent fixed operator.

Technology	**Market share**
DSL (VDSL included)	69%
Cable (DOCSIS 3.0 included)	19%
FTTH/B	9%
Other	4%

Table 15: Fixed broadband subscriptions - technology market shares at EU level. July 2015
Source: (D. S. M. European Commission 2015f)

Technology	Market share
Incumbents	52%
New entrants	48%

Table 16: DSL subscriptions - operator market shares at EU level (VDSL included) - July 2015
Source: (D. S. M. European Commission 2015d)

In countries where CATV networks are absent of negligible, reliance on DSL is heavier. Two detailed tables are provided in Appendix 1, one showing the percentage of DSL subscriptions by operators market shares by EU member state (Table 1A) and another showing the share of cable broadband subscriptions in fixed broadband by EU member state (Table 2A).

Looking closer at NGA networks, the contribution of cable operators is noteworthy but one should keep in mind the (near) absence of this technology in many countries as the table just above indicates.

Technology	Share %
vDSL	29%
FTTH	14%
FTTB	11%
Cable	45%
Other NGA	1%

Table 16: NGA subscriptions by technology at EU level – July 2015
Source: D. S. M. European Commission 2015g

The following table depicts the challenge of meeting the DAE targets. A more detailed breakdown by EU member state is provided in Appendix 1 (Table 3A).

Category	Share %
Above 144 Kbps and below 30 Mbps	70%
30 Mbps and above and below 100 Mbps	19%
100 Mbps and above	11%

Table 17: Fixed broadband subscriptions by speed at EU level (Digital Agenda categories) – July 2015

Source: (D. S. M. European Commission 2015g)Source: EC, Digital Single Market Broadband Indicators – July2015, http://ec.europa.eu/newsroom/dae/document.cfm?action=display&doc_id=14329

Turning now to fibre connections, the perception today remains that Europe is lagging behind. The latest OECD data show that in June 2015 Japan and S. Korea were the leaders. But the next 16 countries were European (and 14 were EU members states) as the graph below shows.

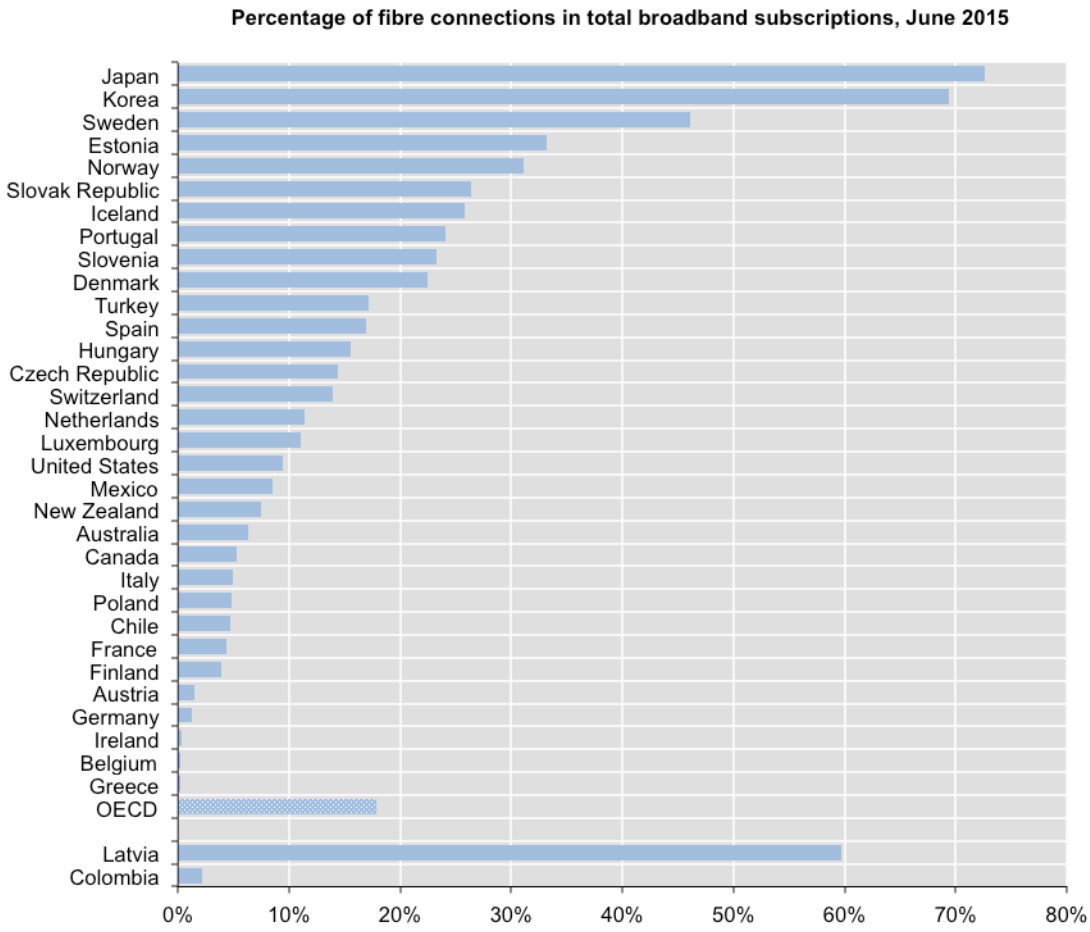

Figure 17: Percentage of fibre connections in total broadband subscriptions, June 2015

Notes:

Definitions: Fibre subscriptions data includes FTTH, FTTP and FTTB and excludes FTTC. Some countries may have fibre but have not reported figures so they are not included in the chart.

Germany : DSL includes VDSL (FTTC); Cable excludes cable infrastructure based on FTTB/FTTH; FTTB/FTTH includes fibre lines provided by cable operators.

Mexico : Fixed broadband subscriptions data include only the country's bigger operators.

United Kingdom: No fibre data is available as DSL includes all Fibre technologies (FTTH, FTTP, FTTB and FTTC) because the breakdown between these technologies is not available yet.

United States : Data for June 2015 are estimates

Colombia and Latvia are in the process of accession to the OECD

Source: OECD 2015.

It is worth drawing attention to Sweden, the country with the highest percentage of fibre

connections outside Asia. Municipal and community networks have played a significant role and this also underscores the competitive pressure these networks can provide to incumbent players in stimulating investment (Mölleryd 2015, 10).

We now turn to the position of municipal and community networks in the EU's broadband strategy.

2.4 Municipal and Community Broadband Networks

As noted above, the primary source of financing broadband networks has been private investment by, in many EU countries, the incumbent telecommunications operators. However, given the economic and social significance attributed to broadband networks, in recent years municipal networks have appeared in an increasing number of countries within the EU (e.g. Denmark, France, Spain, Sweden, UK) as well as outside the EU (e.g. Australia, Japan, New Zealand, USA). Yet, while 'municipal networks are present in a number of countries, […they] represent a minor part of their overall broadband markets' (Mölleryd 2015), 10).

In 2015, the OECD produced a report assessing the experience with municipal broadband networks in various OECD countries (Mölleryd 2015). The report puts forward a wide definition of municipal networks:

> "Municipal networks are defined here as high speed networks that have been fully or partially facilitated, built, operated or financed by local governments, public bodies, utilities, organisations, or co-operatives that have some type of public involvement." (Mölleryd 2015, 5).

This definition includes the narrower definition of **community networks** (see also below the definition provided by the European Commission):

> 'Community investment is another option where local residents, businesses and municipality subsidise a network through gap funding.' (Mölleryd 2015, 14)

Both the OECD and the European Commission definition provided below define 'community networks' narrowly on the basis of the source of funding, largely overlooking other aspects (advantages) of these networks.

The models of and experience with municipal broadband networks in the selected OECD countries varies. What is worth stressing here is that there have been cases where the municipal networks have developed as an alternative infrastructure and thus have increased competition in the Internet service provision market. This conclusion in the OECD report is very important as it underlines the potential of municipal (and community) networks to provide Internet services at least on a par with private commercial players in terms of reliability, resilience, quality, and affordability. They can provide services either in competition with private commercial providers, meaning that without them there would be less market competition with all the consequences that this implies, or, as stand-alone providers (that is sole or main providers) avoiding the pitfalls of non-sustainability identified in the previous chapter such as emphasis on profitability without the benefits necessarily passing on to consumers through investment or more attractive bundles of services. In addition, Crawford (2014) argues that "open municipal-level fiber networks" in the USA can support "fair

and equitable Internet access" in line with Open Internet principles (that is adhering to network neutrality principles) without the need for specific regulation on this, a further advantage whereby a crucial public policy objective can be achieved without regulatory intervention. She explains that "[s]uch networks typically provide a superior and less expensive option to wholly private networks operated by Internet service providers like Comcast and Time Warner." Thus, as the evidence in the OECD report demonstrates, municipal networks and community networks should not be seen as merely a solution for non-commercially attractive areas within a country (gaps-filling scenario).

Given the potential advantages that municipal networks offer, one can see them growing beyond local provision and connecting disparate municipal networks within and across countries. Indeed, in 2015, the FCC in the USA overruled state laws and provided that municipal broadband providers can expand their services beyond their boundaries (FCC 2015).

Originally municipal networks relied mostly on unlicensed wireless technologies (WiFi and wireless mesh networks), but more recently they deploy licensed wireless technologies such as WiMax and increasingly fibre optic cables (Cisco 2006 and Mölleryd 2015, 8).

It is precisely the potential of municipal and community networks to provide real competition to private commercial operators that critics focus on. For critics, municipal (and community) networks "may sometimes compete unfairly with private sector providers or become a local monopoly for infrastructure" (Mölleryd 2015, 5. See also ENTO's remarks above). It would appear that the issue here is not the potential for a monopolistic market structure as such but rather its ownership: if the monopoly provider is owned or controlled by a municipality or a community then this seems as not acceptable; if however, it was to be owned or controlled by a private commercial provider then it seems that it is acceptable. Unfair competition here refers to public funding and the question of state aid, examined in the next section. It is worth noting that similar strong arguments against municipal and community networks have been raised in the USA too, a market that following years of deregulation, more recently in the market for high speed Internet access, has witnessed consolidation resulting effectively in duopolies in both the wired and wireless segments (e.g. Crawford 2013). Crawford (2013) documents how, in the absence of regulatory oversight, such strong market concentration in the hands of a handful of private commercial wired and wireless operators has resulted in less innovation and investment, higher prices for less speedy service compared to other countries, and the widening of the digital divide.

As noted, the European Commission's 2020 Strategy has reaffirmed broadband Internet access as a core priority. In examining the role that public authorities can play, the European Commission has presented four **investment models**. The choice of a model, the Commission notes, is a political decision based on socio-economic circumstances and development goals. The Commission goes on to explain that

> 'A fundamental choice has to be made on the level of commitment and the role the public authority takes vis-à-vis the market, the citizens, and the businesses in the region.' (European Commission 2016b)

The first approach is the **publicly run municipal network model** whereby the public authority

designs, builds and operates (**public DBO**) a broadband network in a municipality or region which is then made available to interested market players. This investment model is common in Nordic countries.

The second investment approach is the **privately run municipal network model** whereby the public authority outsources the building and operation of a broadband network in the municipality or region to a private company who then offers it on typically an open access basis to market service providers who provide services to end users (separation of infrastructure from services provision). Upon the end of the concession period, the municipal authority can renew the concession and grant it to the same or another private company, or it can decide to adopt the first municipal network model and thus become more involved in broadband network provision. This investment approach is also known as the public concession model. Examples can be found in continental Europe such as in rural France and Italy.

The third investment approach is the one that is more relevant to this project. It is the **community broadband model**. It is a bottom-up model whereby the investment is the private initiative of citizens. The European Commission states that

> 'Such projects have generally been *very successful in driving the take-up* rate among the end users and in building *financially sustainable* cases.' (European Commission 2016b, emphasis added)

One can encounter differing forms of competition under the community broadband network model. For instance, community broadband networks can adopt an open business model or procure services from one operator. "The public authority can support co-financing and right-of-way (RoW) granting, regulation and coordination with other infrastructure deployments and access to public infrastructure and points of presence to provide backhaul connections. Public authorities can also help establish fair conditions for all operators seeking access to the infrastructure." (European Commission 2016b). The Commission concludes that "A vibrant sector of broadband co-operatives and small private initiatives" has grown up in parts of the Netherlands and the UK.

At the time of writing (May 2016) the European Commission lists on its website 8 community broadband networks in six countries (Denmark, Finland, Germany, the Netherlands, Spain and Sweden) singled out for best practices. The list is replicated here:

Title	Description / explanation	Country
Asko Island | Denmark	Deployment of a fiber network by the service provider SEAS-NVE, following the organized expression of interest by citizens and local actors.	Denmark
Broadband deployment and operation | Stockholm	The Broadband deployment and operation project supports and coordinates local/rural FTTH broadband projects in the Stockholm archipelago with state funding and PPP-dialogues, from pre-studies to the...more	Sweden
CAI Harderwijk open network | Harderwijk	CAI Harderwijk converged from a conventional cable operator to a complete open network with structural separation. Regulated open networks reveal a lack of competition in services and innovation....more	Netherlands
Connected-Communities Paderborn - Gütersloh | Nordrhein-Westfalen	The districts of Paderborn and Gütersloh identified the construction of a high speed broadband network in its rural areas that were lacking adequate coverage as a top priority. Therefore, an...more	Germany
Fiber optic Brigachtal | Baden-Württemberg	The village of Brigachtal has ventured into the fibre optic technology and built an own fibre network for all inhabitants. 1.351 households were supplied, 12 km main cable was deployed and 140 km...more	Germany
guifi.net Foundation | Barcelona	The guifi.net foundation is a comprehensive initiative where various stakeholders (volunteers, ISPs, public administrations, etc.) cooperate to plan, deploy and operate network infrastructure as a...more	Spain
Kuuskaista Network Cooperative | West Finland	The Kuuskaista network cooperative in West Finland manages fiber optic connections that reach about 1500 households, located mainly in rural areas. Their goal is to give people and businesses in...more	Finland
Network cooperative Kajo | Finland	The network cooperative Kajo cooperates with water cooperatives in water supply projects, installing optical fibre cable pipes in the same trenches with water supply pipes. Duration: 2000-2003	Finland
OnsNet | Nuenen	State-subsidies (Kenniswijk program) allowed for the deployment of a community-owned network in Nuenen. Duration: 4/2004 – 12/2004	Netherlands
Tuningen model project German Federal Ministry of Economy | Tuningen	In this project, FTTB with 6 fibres per house connection in star-wiring per house has been deployed in the entire municipality. The network is in operation since 2012. The network is owned by the...more	Germany

Table 18: Community Broadband Model – Best practices in the EU

Disclaimer:

The networks reported here are a mixed set of Community Networks, Municipal Networks, and Locally-Based Access Operators, some of them might even be for-profit operations, which we exclude from the netCommons classification of Community Networks.

Source: European Commission undated

More details about each project presented in a comparative form are provided in Appendix 2.

The last investment approach is the **operator subsidy model**. In contrast to the first investment approach, here one or more, typically incumbent or alternative market players design, build and operate the network, act as vertically integrated operators and provide services to end users. The public authority's role is indirect and limited to funding (subsidising) provision to commercially attractive areas. This so-called private DBO is encountered in Germany.

2.4.1 State Aid and Community Networks

Public funding comes under EU state aid rules. In general, State aid is prohibited in the Treaty of the EU (art. 107 TFEU) but in certain cases it might be allowed. In investigating state aid cases, the European Commission needs to do two things: first, establish if the public funding in question constitutes state aid, and, second, if yes, establish whether it is contrary to the internal market and EU competition rules and thus inadmissible. Put differently, state aid, if found, is not automatically unlawful.

In 2013, the Commission published new guidelines explaining how the EU State aid rules apply to public funding for the deployment of broadband networks (European Commission 2013). These guidelines revised the previous once issued in 2009 in light of the Commission's State aid to broadband investigations and streamlined them to reflect the priorities in the Digital Agenda for Europe.

The purpose of this section is to draw attention to aspects of the Guidelines that are relevant to community, and to a lesser extent municipal, networks.

The guidelines explain the circumstances when measures to support the deployment of broadband may not constitute State aid within the meaning of the TFEU. Significantly, these include measures supporting the rollout of broadband for non-commercial purposes (European Commission 2013, para. 11), and "measures provided on normal market terms and transparent and non-discriminatory assistance to all interested operators to facilitate the acquisition of rights of way". (Moorcroft 2013. See also European Commission 2013, para. 29)

> *"The roll-out of a broadband network for non-commercial purposes might not constitute State aid* because the network construction does not favour any undertaking [See, for instance, European Commission 2007b]. However, if such a network is subsequently opened for the use of broadband investors or operators, State aid is likely to be involved." (European Commission 2013, para. 11)
>
> "State aid measures can, under certain conditions, *correct market failures*, thereby improving the efficient functioning of markets and enhancing competitiveness. Further, where markets provide efficient outcomes but these are deemed unsatisfactory from a

> cohesion policy point of view, *State aid may be used to obtain a more desirable, equitable market outcome*. In particular, a well- targeted State intervention in the broadband field can contribute to reducing the 'digital divide' between areas or regions where affordable and competitive broadband services are on offer and areas where such services are not." (European Commission 2013, para. 5, emphasis added)

On the basis of the above, three provisions in the State aid guidelines are relevant to community networks and potential public funding support: the non-commercial character of the network, the correction of market failure, and the promotion of a better market outcome, especially in terms of bridging the digital divide and advancing social cohesion. The emphasis on correcting market failure and strengthening cohesion has been confirmed in State aid decisions[4]. In 2007 the then EU Competition Commissioner Neelie Kroes commented on a specific State aid case as follows:

> "Investment in broadband networks is primarily a matter for private companies. State subsidies for such networks are only acceptable if they address a well-defined market failure or cohesion problem. I am glad that the city council of Prague modified its plans so that the project can go ahead without distorting competition." (European Commission 2007a)

Furthermore, public funding for broadband networks may qualify as a service of general economic interest (SGEI). The deployment and the operation of a broadband infrastructure can qualify as an SGEI only "where it can be demonstrated that private investors are not in a position to provide in the near future adequate broadband coverage to all citizens or users, thus leaving a significant part of the population unconnected" (European Commission 2013, para. 20) and if the network provides universal connectivity to all users (as opposed to , for instance, connectivity to just business users for instance) and grant wholesale access on open, fair, and non-discriminatory terms (European Commission 2013, para. 24). Finally, compensation should be reasonable and cover costs plus allow a reasonable profit (European Commission 2013, para. 26).

> "However, if State aid for broadband were to be used in areas where market operators would normally choose to invest or have already invested, this could significantly undermine the incentives of commercial investors to invest in broadband in the first place. In such cases, State aid to broadband might become counterproductive to the objective pursued. The purpose of State aid control in the broadband sector is to ensure that State aid measures will result in a higher level, or a faster rate, of broadband coverage and penetration than would be the case without State aid, while supporting higher quality, more affordable services and pro-competitive investments. The positive effects of the aid should outweigh the distortions of competition." (European Commission 2013, para. 6).

From the above, it seems that an advantage of community over municipal networks is that they might not necessarily be subject to State aid rules if no public funds are involved. Community networks are bottom-up and investment is typically the private initiative of citizens. Viewed in this way, promoting the development of community networks can be interpreted as support for private initiative and entrepreneurship with the aded benefits of sustainability, non-commerciality, active and participatory provision (discussed below). Alternatively, if State aid (public funding) is involved it could be acceptable if the network was not for-profit, if it was to correct market failure,

and if it was to result in 'a more desirable, equitable market outcome' (European Commission 2013, para. 5)

2.4.2 Advantages and Challenges of Community Networks

Although no two community networks are the same, a fundamental common feature of community networks is their "alternative" character (see for instance Table 18 and Appendix 2). "Alternative" here refers to the fact that community networks are typically different from the conventional commercial Internet connectivity model in various aspects, notably in terms of topology, architecture, ownership, business model, economic development and social inclusion (Forlano et al. 2011, 2; Saldana and et al. 2015, 3-4).

On the one hand, notwithstanding differences among them, for Saldana and et al. (2015, 4) conventional commercial networks share the following four characteristics: they are usually large scale networks spanning entire regions; they are controlled in a top-down centralised manner; they require a considerable investment in infrastructure; and finally the users "tend to be passive consumers, as opposed to active stakeholders, in the network design, deployment, operation and maintenance."

Community networks on the other hand are distributed, self-managed networks with the following common characteristics:

> "- They are built and organized in a decentralized and open manner.
>
> - They start and grow organically, they are open to participation from everyone […].
>
> - Knowledge about building and maintaining the network and ownership of the network itself is decentralized and open. Community members have an obvious and direct form of organizational control over the overall operation of the network in their community sometimes agreeing to an open peering agreement." (Saldana and et al. 2015, 6-7)

Forlano et al. (2011, 2) explain that community networks leverage these characteristics "for economic development and social inclusion through truly holistic and locally oriented processes."

The differences between conventional commercial networks and community networks just discussed are relevant regardless of whether a community network corrects market failure (that is the network serves a so-called white area where there is total lack of a broadband Internet network) or whether a community network competes at some level with commercial networks. This last observation might be linked to the scale of the community network, an attribute to be discussed in more detail in other parts of this project. For instance, a community network addressing a market failure might be smaller in scale and possibly have a stronger social character compared to a community network which competes at some level with commercial networks and is likely to have larger scale and be more concerned with having a sound growth strategy.

But the point this Section wishes to emphasise is that economic attributes (including scale) is only one dimension of community networks. *It is precisely the rich multi-level diversity that community networks bring vis-à-vis conventional commercial networks that is crucial and a key requirement*

for sustainability. As noted, this diversity refers not just to how much market competition, if any, community networks can offer but, importantly, diversity refers in addition to technological, ownership, organisational and social aspects too. Thus, *if a core prerequisite for sustainability is diversity, then the development of community networks becomes an integral part of sustainability*. Put differently, sustainability will gain from the multi-dimensional diversity of community networks in relation to conventional commercial networks. In this sense *conventional commercial networks and community networks are complementary,* not substitutes.

Based on the above discussion, it is clear that community networks can deliver various advantages at differing levels. They can contribute to expanding broadband connectivity often in commercially unattractive areas or enhance competition in already connected areas. Connectivity brings with it significant economic and social benefits. These economic and social benefits can be more pronounced in the case of community networks. *First*, community networks are bottom-up initiatives and the cooperation among citizens that is required by definition can strengthen societal ties and community bonding, and enhance social cohesion. *Second*, in case the community networks are operated not for-profit, then arguably they can offer more affordable connectivity thereby expanding the reach of the socio-economic benefits that connectivity brings. *Another* benefit is the potential of community networks to provide sustainable Internet connectivity whilst respecting fundamental rights (Saldana and et al. 2015, 6-7). *Finally* and related, community networks tend to be open access as opposed to closed and proprietary access which is commonly the case with commercial networks. Hence, unlike many commercial networks, there is no centralised traffic management and any compatible consumer device can connect to an open access community network (Forlano et al. 2011, 20). As the CAI Harderwijk open network in the Netherlands puts it 'it is guided by a societal not a commercial standpoint.' (European Commission undated)

Of course, community networks face challenges. Some of these challenges are common to all broadband Internet networks. Their success is not guaranteed, even if they manage to get off the ground. Like municipal networks, community networks are "far from being always financially successful, irrespective of whatever other benefits they bring to a community via improved broadband. [….] An important consideration is that commercial and technological changes occur following the entry of a new municipal [or community] broadband network, including the responses from other players, which can lead to more competition." (Mölleryd 2015, 17).

Other challenges seem unique to community networks. For instance, the necessary technical skills to build, operate and manage the network have to come from the community setting it up. Other skills might be needed, depending on the business model of the community network, such as sales and marketing skills. Even if these skills are available within a given community, not many members might possess them making the community network the responsibility of very few people or even a single individual. Another challenge is the commitment required to keep the show on the road, to make sure that the network runs efficiently and can cope with expanding demand. This brings us to the last main challenge which is the potential of community networks to expand beyond localities and serve larger areas within, and as a next step, across countries. At the moment, community (and municipal) networks tend to be seen as *access* networks confined to a locality or

municipality. By definition, this makes these networks reliant on presumably commercial operators' backhaul networks for connections beyond the locality. This scenario on the one hand can increase the costs of community networks, especially if they operate in remote areas, and on the other hand it preserves the historical stronghold of incumbent commercial operators in long distance markets (see Troulos and Maglaris 2011, 845).

2.5 Concluding Remarks

Community networks appear at odds with the strong and long-standing emphasis on private commercial provision of communication infrastructure and services, and a broader policy framework being overall antithetical to public intervention in the economy and society, especially if it has the potential to antagonise and minimise commercial opportunities.

The EC has in recent years recognised municipal networks and community networks. It refers to them as a potential investment scenario. This policy rethinking with respect to Internet access is the result of the failure of the total reliance on private market initiatives to deliver in a timely manner and at the socially describable level, and supporting evidence from existing municipal and less so (mostly because of lack of studies) from community networks in a selection of countries. However, it seems that community networks are seen as the exception to the rule, as destined to fill-in gaps in provision in non-commercially attractive parts of a country, mostly in remote or rural areas. If more evidence were to become available regarding the potential of community networks, one would expect the EC to become more supportive of such initiatives through policies that facilitate the deployment of community networks. The benefits of community networks are not confined to economic and market competition aspects but, as discussed, also include technological, political, organisational and social aspects. Community networks therefore promote diversity at various levels (technological, political, organisational, social and economic) and such diversity is a fundamental requirement for sustainability.

Recognition of community networks by the EC is a welcome starting point. But more needs to be done. If, as argued here, community networks can deliver diversity and diversity is a requirement for sustainability, then European and national policy-makers will have to do more to promote the development of such networks. To start with, community networks need to be included and represented at policy discussions. Policy issues that are of interest to community networks include spectrum management (e.g. the promotion and safeguard of unlicensed spectrum, the potential of tv white spaces), regulatory parity so that community networks can enjoy the same privileges that other market players do (e.g. participation in public tenders, access to passive infrastructure elements), and lastly and related regulatory fairness by making sure that community networks are not unduly burdened with regulatory obligations (e.g. registration fees for non-profit players, see De Filippi and Tréguer, Félix 2015, 23). In short, a suitable policy framework and proper regulatory actions are needed in order that community networks flourish alongside conventional commercial networks and are able to deliver the documented multi-faceted benefits and thus support sustainability.

Endnotes:

1 An example here is the belated recognition of community media alongside private and state/public media at national and EU levels.

2 It is worth mentioning here a more recent imitative along those lines, GAIA (Global Access to the Internet for All). Launched in 2014, it it an Internet research Task Force initiative. See GAIA 2014.

3 Triple offers include the provision of telephony, Internet and tv. Quad offers have in addition mobile telephony.

4 As of the end of April 2016, the Commission had ruled on 145 State aid to broadband cases (C. D. G. European Commission 2016).

3 Appendix 1: Broadband data by member state

Country	Incumbent	New entrants
FR	42%	58%
UK	40%	60%
EL	43%	57%
ES	48%	52%
IT	49%	51%
DE	53%	47%
EU	52%	48%
IE	53%	47%
SI	61%	39%
HR	61%	39%
SE	66%	34%
DK	73%	27%
NL	73%	27%
LU	74%	26%
SK	75%	25%
PL	75%	25%
CY	78%	22%
CZ	81%	19%
PT	88%	12%
AT	88%	12%
HU	92%	8%

BE	93%	7%
LT	99%	1%
EE	99%	1%
LV	100%	0%
MT	100%	0%
RO	100%	0%
BG	100%	0%
FI		

Table 1A: DSL subscriptions - operator market shares (VDSL included) - July 2015
Source: D. S. M. European Commission 2015d

Country	**Cable subscriptions %**
EL	0%
IT	0%
LV	4%
LT	4%
FR	7%
LU	11%
RO	12%
HR	12%
SK	13%
BG	16%
ES	18%
CZ	18%
SE	19%

EU	19%
UK	19%
CY	19%
DE	21%
EE	22%
FI	23%
DK	28%
IE	29%
SI	30%
AT	32%
PL	34%
PT	34%
NL	44%
HU	48%
BE	51%
MT	51%

Table 2A: Cable broadband subscriptions share in fixed broadband (DOCSIS 3.0 included) - July 2015

Source: (D. S. M. European Commission 2015c)Source: EC, Digital Single Market Broadband Indicators – July2015, http://ec.europa.eu/newsroom/dae/document.cfm?action=display&doc_id=14329

Country	Above 144 Kbps and below 30 Mbps	30 Mbps and above and below 100 Mbps	100 Mbps and above
BE	22%	51%	26%
BG	51%	43%	6%
CZ	69%	23%	8%
DK	58%	32%	9%
DE	75%	18%	6%
EE	73%	20%	7%
EL	96%	4%	0%
ES	71%	15%	14%
FR	85%	7%	8%
HR	97%	3%	0%
IE	49%	33%	17%
IT	95%	4%	1%
CY	96%	4%	0%
LV	44%	14%	42%
LT	42%	41%	17%
LU	60%	31%	9%
HU	51%	29%	20%
MT	42%	57%	1%
NL	38%	44%	18%
AT	79%	17%	4%
PL	70%	21%	8%
PT	43%	31%	25%
RO	37%	14%	49%

SI	79%	14%	8%
SK	70%	20%	10%
FI	69%	8%	23%
SE	43%	16%	42%
UK	64%	29%	7%
EU	70%	19%	11%

Table 3A: Fixed broadband subscriptions by speed (Digital Agenda categories) – July 2015
Source: (D. S. M. European Commission 2015h)

4 Appendix 2: Best Practice Community Networks in the EU

Part 1/2: Scope/ area, Financing, Number of HH supplied, Technology and Speed

Project	*Scope/ Area*	*Financing*	*Number / share of HH supplied*	*Technology*	*Speed*
Asko Island | Denmark	Local Island	Private investment	400	Fibre network	≥30 Mbps
Broadband deployment and operation | Stockholm	Regional Archipelago	State funding & PPP dialogue (78.95% EU funds ; 21.05% public co-financing) Reuse of revenues to expand coverage: Reused revenues	Over 2000 new household connections	FTTP/H FTTx+ triple play	≥100 Mbps
CAI Harderwijk open network | Harderwijk	Local	100% private investments Reuse of revenues to expand coverage: To reuse the revenues from the network to further infrastructure expansion is inherent to the constitutional aims of the foundation CAI Harderwijk.	Date: September 1, 2015 Number: 9.442 Percentage: 50 Date: January 1, 2018 Number: 17.000 Percentage: 90 350 businesses Percentage: 16	FTTP/H, Docsis 3 Cable	≥100 Mbps
Connected-Communities Paderborn - Gütersloh |	interregional	100% private investments	Date: September 1, 2015 Number: 600	DSL, VDSL, FTTP/H, FTTB,	≥100 Mbps

Project	Scope/ Area	Financing	Number / share of HH supplied	Technology	Speed
Nordrhein-Westfalen		Reuse of revenues to expand coverage: Revenues will be used for the deployment of additional backbone infrastructure and technologies in order to provide high-speed internet to the most remote areas not connected.	Percentage: 10 Date: September 1, 2025 Number: 6000 Percentage: 100 Date: September 1, 2015 Number: 118 Percentage: 20 Date: September 1, 2025 Number: 590 Percentage: 100	Docsis 3 cable	
Fiber optic Brigachtal | Baden-Württemberg	Local	National funds: 10% Loans: 90%	Date: October 30, 2013 Number: 900 Percentage: 40 Date: September 30, 2015 Number: 2251 Percentage: 100 BUSINESSES: Date: October 30, 2013 Number: 140 Percentage: 40 Date: September 30, 2015 Number: 294 Percentage: 100	FTTP/H	≥100 Mbps
guifi.net Foundation |	National	Loans: 10%	Households supplied:		

Project	Scope/ Area	Financing	Number / share of HH supplied	Technology	Speed
Barcelona		Private investments: 90% Reuse of revenues to expand coverage: More than 15% through the compensation system: The economic compensation system balances the contributions that were accounted for and the resource usage of for-profit participants.	Number: 30.000 Percentage: 99 Number / share of businesses supplied: Number: 30 Percentage: 99	FTTP/FTTH	≥30 Mbps
Kuuskaista Network Cooperative | West Finland	Regional	Regional funds. Community financing. EU funds	Number: 2.500	FTTH and FTTB	≥100 Mbps
Network cooperative Kajo | Finland		National funds (grants by Employment and Economic Development Centre). community financing (cooperative)			≥30 Mbps
OnsNet | Nuenen	Local	6.4 Mio EUR subsidy package was used.		FTTH	≥100 Mbps
Tuningen model project German Federal Ministry of Economy | Tuningen	Local	Type of sources / instruments: 27% Community financing Share of sources National funds: 63% Loans: 10%	Number: 250	FTTP/H	≥100 Mbps

Disclaimer:

The networks reported here are a mixed set of Community Networks, Municipal Networks, and Locally-Based Access Operators, some of them might even be for-profit operations, which we exclude from the netCommons classification of Community Networks.

Source: Compiled and adapted by the author from European Commission undated.

Part 2/2: Participatory Process, Unique characteristics and Success factors

Project	*Participatory process*	*Unique characteristics*	*Success factors*
Asko Island | Denmark	Partnership of local businesses, citizens, holiday home owners at Asko Island and SEAS-NVE.	SEAS-NVE is also an energy company. When renovating the power cable at Ask Island, SEAS-NVE has decided to rollout fiber and to replace the existing undersea cable.	Prior to the decision of the rollout SEAS-NVE, about 50 percent of the local businesses and 300 of the permanent residents and holiday home owners at Ask Island expressed their interest in a swift inquiry. The local water supply company has put a property area at the disposal for the establishment of a network technology cabinet and the local municipality has received funding from the rural district funds for the establishment of the cabinet. Moreover, local entrepreneurs are contributing to the project by digging trenches for the cable. The renewing of the power cable was used as an opportunity to give the Island NGA access.
Broadband deployment and operation | Stockholm	Stockholm County Board, Stockholm County Council, SIKO, separate community broadband project in the archipelago: Blidö, Gräskö, Möja, Nämndö, Ornö, Runmarö. All potential projects in the Stockholm archipelago - from Arholma to Landsort.	Coordinating development efforts of several smaller island communities and overseeing them from beginning to end. The archipelago is known for difficult physical transport and improvable communications networks. Travel time is equal to the sparse rural inner lands of northern Sweden, regardless of its proximity to Stockholm.	Close contact between communities, contractors and public officials creating mutual trust. High level of community involvement and a shared sense of urgency to carry out local development.
AI Harderwijk open network | Harderwijk	CAI Harderwijk created and introduced their market proposition by carefully listening to what the market demands. Often, decisions are made based on individual views on the market. However excellent these views can be, they will not deliver good practices if they do not satisfy the market needs. The market is not only the end-consumer, but also (not least) the service provider who must (wants to) deliver the services on the network. In this environment, the open network is a link in the chain. The open network of CAI Harderwijk will only be used if that chain is working. For CAI Harderwijk (that has no own services on the FttH network), it is of the utmost importance that there is a participatory process to make the chain working. CAI	CAI Harderwijk is an existing cable operator that made a unique choice in the market to withdraw itself from delivering services and concentrate on delivering infrastructure and facilitate the use of it.	Both copper parties (cable and DSL) in the community of Harderwijk are now using the FTTH network. The FTTH network is used from a societal standpoint, competition is maximised on the network making CAI Harderwijk an example in the market according to the consumers union.

Project	*Participatory process*	*Unique characteristics*	*Success factors*
	Harderwijk therefore takes a facilitating role to involve all stakeholders: - Service providers in a primary phase to make the network answer up to their needs and in the operational phase, when processes do not cover an issue in the chain, - End-consumers to make them aware what the network can offer them and to be an escalation point for them when processes do not cover their problem - Authorities to create support and coordinate policies, - The deliverers of new innovative services by facilitating the participatory process and the services to work.		
Connected-Communities Paderborn - Gütersloh | Nordrhein-Westfalen	The districts of Paderborn and Gütersloh are responsible for the management and coordination of the project. The model used for the construction, upgrading and/or leasing of infrastructure has been decided on individually by the different communities within the districts in order to offer the most optimal and sustainable solutions. The different models to be implemented in combination with each other are: - The infrastructure will be financed, constructed and leased by private investors - Cable providers will upgrade its already existing infrastructure to be able to additionally offer high speed internet -The infrastructure will be financed, constructed and leased by local communities - Governmental grants will be used in order to finance the uneconomical funding gaps - Satellite and radio links will be used to cover the most remote areas -MICUS Strategic Consultancy has provided the districts with an extensive FTTB implementation plan -The networks will be operated and distributed by the providers BITel GmbH, Unity Media and Deutsche Telekom, as well as by private investors themselves	The combination of two rural districts in a joint effort to provide a broadband expansion project to a population of more than 600.000 inhabitants provides an innovative approach with multiple models to reach rural areas lacking sufficient coverage. By the end of the project, over 91% of households and businesses will have access to FTTB speeds of at least 50 Mbps. What makes this project especially unique is the fact that it was able to unite a multitude of investors, telecommunication providers, government funding organizations and communities in order to realize optimal coverage expansion, cost reduction and investor returns.	By the two districts of Paderborn and Gütersloh participating in this joint effort, it allows for the project to potentially reach more than 600.000 inhabitants, which leads to the implementation of high cost reduction measures and the attraction of private investments, usually not possible in such rural areas. By using an approach that applies customized methods to meet the different challenges of each area, every community is receiving the optimal and most cost effective solution. Local investment and engagement for the project is high due to the fact that the FTTB-network roll out is being overseen and coordinated by the district administrations. Moreover, involvement by the local telecommunications company BITel creates additional local engagement.
Fiber optic Brigachtal | Baden-Württemberg	• Planning: MKTH Hohentengen, Kirchstraße 4, 79801 Hohentengen am Hochrhein • Tender documents: BIT Ingenieure AG, Goldenbühlstraße 15, 78048 Villingen-Schwenningen • Judicial assistance: iuscomm Rechtsanwälte, Panoramastraße 33,70174 Stuttgart • Promotion and consulting: Regierungspräsidium Freiburg, Abteilung 3 Landwirtschaft, Ländlicher Raum, Veterinär	Brigachtal is a community with 5.000 inhabitants between the towns Villingen-Schwenningen and Donaueschingen. Brigachtal consists of the districts Kirchdorf, Klengen and Überauchen. The river Brigach and the railroad divides the district Überauchen from the other two	Originally, it was planned to build 350 household connections. The successful project today includes 466 household connections. Other communities will benefit from the experiences and knowledge of the project Brigachtal and might achieve the same results.

Project	*Participatory process*	*Unique characteristics*	*Success factors*
	-und Lebensmittelwesen, Bertholdstraße 43, 79098 Freiburg i.B. and Ministerium für Ländlichen Raum Baden-Württemberg, Kernerplatz 10, 70182 Stuttgart • Marketing, construction management, construction supervision, billing, blowing in the housholding cables: Eigenbetrieb Glasfasernetz Brigachtal, St. Gallus-Straße 4, 78086 Brigachtal	districts. The PoP was built for various reasons central for all districts near the town hall in Kirchdorf, since also the Brigach and the railroad had to be crossed three times. With the help of hydraulic-circulation-drilling, the Brigach has been crossed. The railroad crossing was accomplished with a small, old, 50 m long and 5 m deep canal construction under the rail-road. The only 80 cm wide opening was surmounted with the micro-tunneling-process.	
guifi.net Foundation | Barcelona	Fully open and participatory process, regulated as a common-pool resource. Citizens and organizations are active stakeholders. The guifi.net ecosystem is very rich in terms of variety of participants, each of them playing a strategic role.13.407 users are registered in the guifi.net portal and 55 in mailing lists.	Common-pool resource as management model for a critical infrastructure (see doc in link 3 for details)	In general: Participation, cost reduction, knowledge transfer, cost sharing, public accountability. The guifi.net community has created and developed a methodology based on the commons management principles that has scaled up and has become sustainable by being open and neutral to diverse technological choices, to traffic, and to participants, including volunteers, professionals, and public administrations. The guifi.net community has evolved to accommodate growth throughout the collective development and usage of tools for coordination. That includes i) tools for communication; ii) tools for network planning and management; iii) a participation framework with organisational tools such as the community license, the Foundation, or collaboration agreements; and iv) governance tools including conflict resolution, and economic compensation. The result is a healthy community of more than 13,000 registered participants, a network infrastructure of more than 40,000 declared nodes with more than 28,500 operational, and a total length of around 50,000 km of links, connected to the global Internet. The guifi.net case is solid proof that infrastructures can be effectively managed as a commons. In fact, the guifi.net case has enough differences, complexity, coherence, and completeness that it may deserve its own specific model, the guifi.net model. This model of

Project	*Participatory process*	*Unique characteristics*	*Success factors*
			telecommunications infrastructures, compared to conventional models, is socially, economically, and environmentally more effective in its context: socially because it is based on the non-discriminatory and open access principles which empower people and preserve the infrastructure's sovereignty; economically and environmentally because the sharing paradigm on which it is based, the common pool resource, maximises the utilisation of resources; and the model shows to scale well. Contrary to the trend of privatising public infrastructures, such as the telephone network, we claim the opportunity for transformation and development of network infrastructures held in common.
Kuuskaista Network Cooperative | West Finland	The Kuuskaista network cooperative was founded in November 2002. The public interest Cooperative is owned by its members and other interested parties. The cooperative works closely with municipalities in the region (6NET=backbone owned by the municipalities in the region, Alavus, Kuortane, Lehtimäki, Soini, Töysä, Ähtäri) and the network is part of the Kuusiokunnat regional network. Kuuskaista is an Open Access network, but it also provides and improves new generation of services to its owners and also to the other open networks.	• huge area with villages without any kind of broadband connection • low density in rural area (8,42 inhabitants / km2) • big national operators had no interest to invest to rural areas. Instead they have begun to withdraw their telecom connections. • high ICT costs and interest to co-operate more in municipalities.	Co-operation among communities as well as individuals, companies, service providers and other telecom operators. Investment plan from the owners. Investment on the centres would pay itself back in a few years due to bigger amount of potential customers.
Network cooperative Kajo | Finland	Kajo cooperates with water cooperatives in water supply projects. The water cooperative acts as the principal client and supervisor in water supply projects. The water cooperative plans the routes of the water supply network, concludes the land use agreements using a common form and submits the invitations to tender. As for the optical fiber cable network, Kajo determines the locations of the connection wells, membership agreements, connection agreements and material purchases and acts as the supervisor during the construction of the network.	The challenges faced during joint construction schemes have included: 1. Funding decisions have caused delays in project starts 2. Fragmented construction (from the point of view of the network cooperative) 3. Municipalities struggle to fund water supply projects; as a result, there is not much willingness to provide the network cooperative with funding. Water cooperatives require that the optical fiber cables installed in the same trenches with water supply pipes must be laid inside protective piping. Installing the optical	Success factors in general for joint construction works are the provision of information at a sufficiently early stage and a good cooperation between the parties.

Project	*Participatory process*	*Unique characteristics*	*Success factors*
		fiber cables inside pipes is, however, slightly more expensive that laying the cables directly into the trench.	
OnsNet | Nuenen	Residents decided to transfer their subsidy to a private limited company called NEM B.V. The NEM was set up to operate the glass fiber network. Residents - who transferred their subsidy to NEM - could become members of a cooperative OnsNet. The aim was that Ons Net would receive 95% of the shares in NEM. This financial structure enabled Ons Net to achieve a penetration rate of fiber infrastructure of 97 percent within the first year of operation and the provision of triple play services (TV, Internet and Telephony) in the area. Business model: Community-owned wholesale model (PPP) at the beginning; later the ownerships was shared with a private company.		This kind of approach is able to solve any uncertainty related to demand evolution because it is mainly based on a demand aggregation initiative.
Tuningen model project German Federal Ministry of Economy | Tuningen	-3 town meetings with citizens -2 information evenings -2 days contract completions information	Tuningen is a rural area, covered with less than 3 Mbps. After the project implementation, the area benefits from fast internet connections. Several services are now available: Dark fibre for businesses for internal communication via satellite of the businesses, live worship service, council sessions live (planned), doctor's appointments via internet with documentation of the vital data (planned) strengthening of the competition between the providers (before: 1 provider, now open access level 3; own net of the municipality)	• Securing of influx through fast internet • Establishment of new companies through fast internet • Communication of external branches of a company through exclusive fibre access of the company.

Disclaimer:

The networks reported here are a mixed set of Community Networks, Municipal Networks, and Locally-Based Access Operators, some of them might even be for-profit operations, which we exclude from the netCommons classification of Community Networks.

Source: Compiled and adapted by the author from European Commission undated.

5 Bibliography

Antoniadis, Panayotis, and Ileana Apostol. 2014. 'The Right (S) to the Hybrid City and the Role of DIY Networking'. *The Journal of Community Informatics* 10 (3). http://www.ci-journal.net/index.php/ciej/article/view/1092.

Apostol, Ileana, Panayotis Antoniadis, and Tridib Banerjee. 2008. 'From Face-Block to Facebook or the Other Way Around?' In *Sustainable City and Creativity: Promoting Creative Urban Initiatives, International Meeting. Naples*. Citeseer. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.218.6904&rep=rep1&type=pdf.

Arendt, Hannah. 1958. 'The Human Condition. Chicago'. *Chicago, IL.: University of Chicago Press*.

Aristotle. 1932. *Politics [Translated by Harris Rackham]*. London: Heinemann.

———. 1992. *Physics: Books I and II.* Oxford: Oxford University Press.

———. 2004. *Nicomachean Ethics*. Cambridge: Cambrige University Press.

Baig, Roger, Felix Freitag, and Leandro Navarro. 2015. 'On the Sustainability of Community Clouds in Guifi. Net'. In *12th International Conference on Economics of Grids, Clouds, Systems and Services (GECON 2015). Cluj-Napoca, Romania: IEEE*, 1:3.

Baig, Roger, Ramon Roca, Felix Freitag, and Leandro Navarro. 2015. 'Guifi.net, a Crowdsourced Network Infrastructure Held in Common'. *Computer Networks*, Crowdsourcing, 90 (October): 150–65. doi:10.1016/j.comnet.2015.07.009.

Baldé, Kees. 2015. *The Global E-Waste Monitor 2014: Quantities, Flows and Resources*. United Nations Univ., Inst. for the advanced study on sustainability.

Baliga, Jayant, Robert Ayre, Kerry Hinton, and Rodney S. Tucker. 2011. 'Energy Consumption in Wired and Wireless Access Networks'. *Communications Magazine, IEEE* 49 (6): 70–77.

Bar, François, and Hernan Galperin. 2004. 'Building the Wireless Internet Infrastructure: From Cordless Ethernet Archipelagos to Wireless Grids'. *COMMUNICATIONS AND STRATEGIES.*, 45–70.

Barro, Robert J., and Jong Wha Lee. 2013. 'A New Data Set of Educational Attainment in the World, 1950–2010'. *Journal of Development Economics* 104: 184–198.

Beck, Ulrich. 1992. *Risk Society: Towards a New Modernity*. Vol. 17. Sage.

Bell, Daniel. 1976. *The Coming of Post-Industrial Society. A Venture in Social Forecasting. With a New Introd. by the Author*. Basic Books Incorporated.

Benkler, Yochai. 1999. 'From Consumers to Users: Shifting the Deeper Structures of Regulation toward Sustainable Commons and User Access'. *Fed. Comm. LJ* 52: 561.

———. 2002. 'Some Economics of Wireless Communications'. *Harv. JL & Tech.* 16: 25.

———. 2003. 'The Political Economy of Commons'. *Upgrade: The European Journal for the Informatics Professional* 4 (3): 6–9.

———. 2006. *The Wealth of Networks*. Yale University Press.

———. 2013. 'Commons and Growth: The Essential Role of Open Commons in Market Economies (Reviewing Infrastructure: The Social Value of Shared Resources by Brett M. Frischmann)'. *University of Chicago Law Review* 80 (3): 12.

BEREC, [Body of European Regulators of Electronic Communications]. 2013. 'BEREC Views on the Proposal for a Regulation "laying down Measures to Complete the European Single Market for Electronic Communications and to Achieve a Connected Continent"'. BEREC. http://berec.europa.eu/eng/document_register/subject_matter/berec/download/0/2922-berec-views-on-the-proposal-for-a-regula_0.pdf.

Boston Consulting Group. 2015. 'Five Priorities for Achieving Europe's Digital Single

(Commissioned by ETNO)'. https://etno.eu/datas/publications/studies/FINAL_BCG-Five-Priorities-Europes-Digital-Single-Market-Oct-2015.pdf.
Bourdieu, Pierre. 1986. *Distinction: A Social Critique of the Judgement of Taste*. JSTOR. http://www.jstor.org/stable/42854200.
Braithwaite, John, and Peter Drahos. 2000. *Global Business Regulation*. Cambridge: Cambridge University Press. https://books.google.co.uk/books?hl=en&lr=&id=DcEEW5OGWLcC&oi=fnd&pg=PR6&dq=Global+Business+Regulation+&ots=OxbnKCF5m8&sig=nnOuncGlOpgTxzbI2ncGLNu0vy8#v=onepage&q=Global%20Business%20Regulation&f=false.
Broadband Commission. 2015. *The State of Broadband 2015: Broadband as a Foundation for Sustainable Development*. Geneva: ITU and UNESCO. http://www.broadbandcommission.org/documents/reports/bb-annualreport2015.pdf.
Broadband Opportunity Council. 2015. 'Report and Recommendations'. https://www.whitehouse.gov/sites/default/files/broadband_opportunity_council_report_final.pdf.
Bukodi, Erzsébet, and John H. Goldthorpe. 2013. 'Decomposing "social Origins": The Effects of Parents' Class, Status, and Education on the Educational Attainment of Their Children'. *European Sociological Review* 29 (5): 1024–1039.
Carpentier, Nico. 2008. 'The Belly of the City Alternative Communicative City Networks'. *International Communication Gazette* 70 (3–4): 237–255.
Cave, Martin. 2014. 'The Ladder of Investment in Europe, in Retrospect and Prospect'. *Telecommunications Policy* 38 (8–9): 674–83. doi:10.1016/j.telpol.2014.04.012.
Cave, Martin, and Ian Martin. 2010. 'Motives and Means for Public Investment in Nationwide next Generation Networks'. *Telecommunications Policy* 34 (9): 505–12. doi:10.1016/j.telpol.2010.07.003.
Cave, Martin, and Tony Shortall. 2016. 'How Incumbents Can Shape Technological Choice and Market Structure – the Case of Fixed Broadband in Europe'. *Info* 18 (2): 1–16. doi:10.1108/info-12-2015-0057.
Chirico, Filomena, and Gaál Norbert. 2011. 'State Aid to Broadband: Primer and Best Practices.' *European Commission Competition Policy Newsletter* 10 (1): 50–57.
Cisco. 2006. 'Evolution of Municipal Wireless Networks'. http://www.cisco.com/c/en/us/products/collateral/wireless/aironet-1300-series/prod_white_paper0900aecd8057255d.pdf.
Crawford, Susan. 2013. *Captive Audience: The Telecom Industry and Monopoly Power in the New Gilded Age*. New Haven: Yale University Press. https://books.google.co.uk/books?hl=en&lr=&id=i54oPcdI7kAC&oi=fnd&pg=PP2&dq=Captive+Audience:+The+Telecom+Industry+and+Monopoly+Power+in+the+New+Gilded+Age&ots=It4dnsKtm5&sig=Z5JtZX-6VsAzpHlh6_GS7RKEak4.
———. 2014. 'The Wire Next Time'. *New York Times*, April 28. http://www.nytimes.com/2014/04/28/opinion/the-wire-next-time.html?_r=0.
Credit Suisse Research Institute (CSRI). 2014. 'Global Wealth Report 2014'.
———. 2015. *Global Wealth Databook 2015*. Zürich: Credit Suisse.
Damsgaard, Jan, Mihir A. Parikh, and Bharat Rao. 2006. 'Wireless Commons Perils in the Common Good'. *Communications of the ACM* 49 (2): 104–109.
De Decker, Kris. 2015a. 'How to Build a Low-Tech Internet'. *Low-Tech Magazine* October 26, 2015.
———. 2015b. 'Why We Need a Speed Limit for the Internet'. *Low-Tech Magazine* October 19, 2015.
De Filippi, Primavera, and Félix Tréguer. 2015. 'Expanding the Internet Commons: The Subversive Potential of Wireless Community Networks'. *Journal of Peer Production*, no. 6(January).

http://peerproduction.net/issues/issue-6-disruption-and-the-law/peer-reviewed-articles/expanding-the-internet-commons-the-subversive-potential-of-wireless-community-networks/.

De Filippi, Primavera, and Tréguer, Félix. 2015. 'Expanding the Internet Commons: The Subversive Potential of Wireless Community Networks'. *Journal of Peer Production* 6.

De Rosnay, Melanie Dulong. 2015. 'Peer-to-Peer as a Design Principle for Law: Distribute the Law'. *Journal of Peer Production*, no. 6: 1–9.

Deutz, Pauline. 2014. 'A Class-Based Analysis of Sustainable Development: Developing a Radical Perspective on Environmental Justice'. *Sustainable Development* 22 (4): 243–52. doi:10.1002/sd.1528.

Dimogerontakis, Emmanouil, Leandro Navaro, Bart Braem, and Roc Meseguer. 2016. 'Socio-Economic Experiences, Challenges and Lessons in Community Networks around the World. Draft Manuscript.'

Dusek, Val. 2006. *Philosophy of Technology: An Introduction*. Vol. 90. Blackwell MaldenOxfordCarlston. http://aleteya.cs.buap.mx/~jlavalle/filMetInvComp/Philosophy_of_Technology__An_Introduction.pdf.

ECJ, [European Court of Justice]]. 2009. 'Judgment of the Court of 3 December 2009 — European Commission v Federal Republic of Germany (Case C-424/07)'. http://curia.europa.eu/juris/document/document.jsf?text=&docid=73876&pageIndex=0&doclang=EN&mode=lst&dir=&occ=first&part=1&cid=236653.

Enders, Judith C., and Moritz Remig. 2014. *Theories of Sustainable Development*. Routledge. https://books.google.co.uk/books?hl=en&lr=&id=dx0cBQAAQBAJ&oi=fnd&pg=PP1&dq=Enders,+Judith+C.+and+Moritz+Remig.+2015.+Theories+of+Sustainable+Development:+An+Introduction&ots=r2iaX62_8g&sig=m8So1wTi6BLHnn0ymkW4jUJtdNc.

ETNO, [European Telecommunications Networks Operators' association]. 2015. 'Achieving a Stronger Digital Union. ETNO Contribution to the Digital Single Market Strategy'. https://etno.eu/datas/publications/studies/DIGITAL%20STRATEGY-72dpi_website.pdf.

———. 2016. 'ETNO Policy Paper Towards a New Telecoms Framework'. ETNO. https://etno.eu/datas/publications/2016_Publications/2016_Summary_TelcoFrameworkReview.pdf.

ETNO ThinkDigital. 2015. 'Interview – Aiming for a Stronger Europe with Less National Division'. http://www.think-digital.eu/?n=2015/283.

EU European Council. 2000. 'Lisbon European Council 23-24 March 2000. Presidency Conclusions'. http://aei.pitt.edu/id/eprint/43340.

European Commission. undated. 'Digital Single Market - Community Broadband Model - Best Practices'. https://ec.europa.eu/digital-single-market/en/broadband-best-practices?combine=&field_speed_performance_value=All&field_business_model_value=community+broadband+model&field_bpcountry_tid=All.

———. undated. 'Digital Single Market - Community Broadband Model - Best Practices: CAI Harderwijk Open Network'. https://ec.europa.eu/digital-single-market/en/content/cai-harderwijk-open-network-harderwijk.

———. 1979. 'European Society Faced with the Challenge of New Information Technologies: A Community Response. COM(79) 650'. European Commission. http://aei.pitt.edu/id/eprint/3806.

———. 1994a. 'Europe and the Global Information Society: Recommendations to the European Council [Bangemann Report]'. European Commission. http://aei.pitt.edu/1199/1/info_society_bangeman_report.pdf.

———. 1994b. ‘Europe’s Way to the Information Society. An Action Plan. COM (94) 347’. European Commission. http://aei.pitt.edu/id/eprint/947.
———. 1997. ‘Green Paper on the Convergence of the Telecommunications, Media and Information Technology Sectors, and the Implications for Regulation. Towards an Information Society Approach, COM(97) 623’. European Commission. http://aei.pitt.edu/id/eprint/1160.
———. 2007a. ‘Press Release. State Aid: Commission Considers Prague Municipal Wireless Network Project Does Not Constitute State Aid, IP/07/722’. http://europa.eu/rapid/press-release_IP-07-722_en.pdf.
———. 2007b. ‘State Aid No NN24/2007 - Czech Republic. Prague Municipal Wireless Network. C(2007)2200.’ http://ec.europa.eu/competition/state_aid/cases/219861/219861_688145_7_1.pdf.
———. 2010. ‘A Digital Agenda for Europe’. http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52010DC0245&from=EN.
———. 2013. ‘EU Guidelines for the Application of State Aid Rules in Relation to the Rapid Deployment of Broadband Networks (2013/C 25/01)’. *Official Journal of the European Union*, no. C: 1–26.
———. 2015. ‘Connectivity: Broadband Market Developments in the EU. Digital Agenda Scoreboard 2015.’ http://ec.europa.eu/newsroom/dae/document.cfm?action=display&doc_id=9929.
———. 2016a. ‘The Investment Plan for Europe State of Play’. http://ec.europa.eu/priorities/sites/beta-political/files/ip-eu-state-of-play-jan-2016_en.pdf.
———. 2016b. ‘Digital Single Market - Investment Models’. https://ec.europa.eu/digital-single-market/investment-models.
European Commission, Competition Directorate General. 2016. ‘Commission Decisions on State Aid to Broadband’. http://ec.europa.eu/competition/sectors/telecommunications/broadband_decisions.pdf.
European Commission, DG Communications and Technology. 2015. ‘Monitoring the Digital Economy and Society 2016-2021’. European Commission. http://ec.europa.eu/eurostat/documents/341889/725524/Monitoring+the+Digital+Economy+%26+Society+2016-2021/7df02d85-698a-4a87-a6b1-7994df7fbeb7.
European Commission, Digital Single Market. 2014. ‘Digital Agenda Data - Herfindal Index on Broadband Competition’. http://digital-agenda-data.eu/charts/analyse-one-indicator-and-compare-countries#chart={‘indicator-group’:‘broadband’,‘indicator’:‘bb_hhi’,‘breakdown’:‘TOTAL_FBB’,‘unit-measure’:‘hhi’,‘ref-area’:[‘AT’,‘BE’,‘BG’,‘HR’,‘CY’,‘CZ’,‘DK’,‘EE’,‘EU28’,‘FI’,‘FR’,‘DE’,‘EL’,‘HU’,‘IE’,‘IT’,‘LV’,‘LT’,‘LU’,‘MT’,‘NL’,‘PL’,‘PT’,‘RO’,‘SK’,‘SI’,‘ES’,‘SE’,‘UK’]}.
———. 2015a. ‘Digital Agenda Data - Rural Standard Fixed Broadband Coverage (as a % Households) Year 2015’. http://digital-agenda-data.eu/charts/analyse-one-indicator-and-compare-countries#chart={‘indicator-group’:‘broadband’,‘indicator’:‘bb_srcov’,‘breakdown’:‘TOTAL_POPHH’,‘unit-measure’:‘pc_hh_all’,‘ref-area’:[‘AT’,‘BE’,‘BG’,‘HR’,‘CY’,‘CZ’,‘DK’,‘EE’,‘EU28’,‘FI’,‘FR’,‘DE’,‘EL’,‘HU’,‘IE’,‘IT’,‘LV’,‘LT’,‘LU’,‘MT’,‘NL’,‘PL’,‘PT’,‘RO’,‘SK’,‘SI’,‘ES’,‘SE’,‘UK’]}.
———. 2015b. ‘Digital Agenda Data - Standard Fixed Broadband Coverage/Availability (as a % of Households). Year 2015’. http://digital-agenda-data.eu/charts/analyse-one-indicator-and-compare-countries#chart={%22indicator-group%22:%22broadband%22,%22indicator%22:%22bb_scov%22,%22breakdown%22:%22TOTAL_POPHH%22,%22unit-measure%22:%22pc_hh_all%22,%22ref-area%22:[%22AT%22,%22BE%22,%22BG%22,%22HR

%22,%22CY%22,%22CZ%22,%22DK%22,%22EE%22,%22EU28%22,%22FI%22,%22FR%22,%22DE%22,%22EL%22,%22HU%22,%22IE%22,%22IT%22,%22LV%22,%22LT%22,%22LU%22,%22MT%22,%22NL%22,%22PL%22,%22PT%22,%22RO%22,%22SK%22,%22SI%22,%22ES%22,%22SE%22,%22UK%22]}.

———. 2015c. 'Digital Single Market Broadband Indicators - Cable Broadband Subscriptions Share in Fixed Broadband (DOCSIS 3.0 Included) - July 2015'. http://ec.europa.eu/newsroom/dae/document.cfm?action=display&doc_id=14329.

———. 2015d. 'Digital Single Market Broadband Indicators - DSL Subscriptions: Operator Market Shares at EU Level (VDSL Included) - July 2015'. http://ec.europa.eu/newsroom/dae/document.cfm?action=display&doc_id=14329.

———. 2015e. 'Digital Single Market Broadband Indicators - DSL Subscriptions: Operator Market Shares (VDSL Included) - July 2015'. http://ec.europa.eu/newsroom/dae/document.cfm?action=display&doc_id=14329.

———. 2015f. 'Digital Single Market Broadband Indicators - Fixed Broadband Subscriptions - Technology Market Shares at EU Level July 2015'. http://ec.europa.eu/newsroom/dae/document.cfm?action=display&doc_id=14329.

———. 2015g. 'Digital Single Market Broadband Indicators - Fixed Broadband Subscriptions by Speed at EU Level (Digital Agenda Categories) - July 2015'. http://ec.europa.eu/newsroom/dae/document.cfm?action=display&doc_id=14329.

———. 2015h. 'Digital Single Market Broadband Indicators - Fixed Broadband Subscriptions by Speed (Digital Agenda Categories) - July 2015'. http://ec.europa.eu/newsroom/dae/document.cfm?action=display&doc_id=14329.

———. 2015i. 'Digital Single Market Broadband Indicators - NGA Subscriptions by Technology at EU Level - July 2015'. http://ec.europa.eu/newsroom/dae/document.cfm?action=display&doc_id=14329.

European Commission, Digital Single Market Broadband Indicators. 2015. 'Fixed Broadband Subscriptions - Opertor Market Shares'. http://ec.europa.eu/newsroom/dae/document.cfm?action=display&doc_id=14329.

Europe's Digital Progress Report UK. 2016. 'United Kingdom | Digital Single Market'. Euroepan Commission. http://ec.europa.eu/newsroom/dae/document.cfm?doc_id=15749.

FCC, [Federal Communications Commission, USA]. 2015. 'Memorandum Opinion and Order Preempting Certain Challenged Provisions of Tennessee and North Carolina Law Restricting Municipal Provision of Broadband Service, FCC 15-25'. https://apps.fcc.gov/edocs_public/attachmatch/FCC-15-25A1_Rcd.pdf.

Feenberg, Andrew. 2006. *What Is Philosophy of Technology?* Springer. http://link.springer.com/chapter/10.1057/9781403983053_2.

Forlano, Laura, Alison Powell, Gwen Shaffer, and Benjamin Lennett. 2011. 'From the Digital Divide to Digital Excellence: Global Best Practices for Municipal and Community Wireless Networks'. http://eprints.lse.ac.uk/29461/1/__lse.ac.uk_storage_LIBRARY_Secondary_libfile_shared_repository_Content_Powell,%20A_From%20digital%20devide_Powell_From%20the%20digital%20divide_2014.pdf.

Frischmann, Brett M. 2012. *Infrastructure: The Social Value of Shared Resources*. Oxford University Press.

Fuchs, Christian. 2003a. 'Some Implications of Pierre Bourdieu's Works for a Theory of Social Selforganization'. *European Journal of Social Theory* 6 (4): 387–408.

———. 2003b. 'Structuration Theory and Self-Organization'. *Systemic Practice and Action Research* 16 (2): 133–167.

———. 2007. *Internet and Society: Social Theory in the Information Age*. Routledge.

———. 2010a. 'Alternative Media as Critical Media'. *European Journal of Social Theory* 13 (2):

173–192.
———. 2010b. ‘Theoretical Foundations of Defining the Participatory, Co-Operative, Sustainable Information Society’. *Information, Communication & Society* 13 (1): 23–47.
———. 2011. *Foundations of Critical Media and Information Studies*. Taylor & Francis. https://books.google.co.uk/books?hl=en&lr=&id=K2Zo8wAymHAC&oi=fnd&pg=PP1&dq=Foundations+of+Critical+Media+and+Information+Studies.&ots=z5-WqPQmKH&sig=rZ6N7YgVGj_4oLom0A6FaTmRQDY.
———. 2014. ‘The Dialectic: Not Just the Absolute Recoil, but the World“s Living Fire That Extinguishes and Kindles Itself. Reflections on Slavoj Žižek”s Version of Dialectical Philosophy in“ Absolute Recoil: Towards a New Foundation of Dialectical Materialism”.’ *tripleC: Communication, Capitalism & Critique. Open Access Journal for a Global Sustainable Information Society* 12 (2): 848–875.
———. 2015. *Reading Marx in the Information Age: A Media and Communication Studies Perspective on Capital*. Routledge.
Furhoff, Lars. 1973. ‘Some Reflections on Newspaper Concentration’. *Scandinavian Economic History Review* 21 (1): 1–27.
GAIA. 2014. ‘GAIA (Global Access to the Internet for All Research Group).’ https://irtf.org/gaia.
Gandy Jr, Oscar H., and others. 2013. ‘Wedging Equity and Environmental Justice into the Discourse on Sustainability’. *tripleC: Communication, Capitalism & Critique. Open Access Journal for a Global Sustainable Information Society* 11 (1): 221–236.
Gassot, Yves. 2016. ‘Is This the Beginning of the End of Major M&A Deals in Europe’s Telecoms Sector?’ May 24. http://blog.idate.fr/is-this-the-beginning-of-the-end-of-major-ma-deals-in-europes-telecoms-sector/.
Giddens, Anthony. 1984. *The Constitution of Society: Outline of the Theory of Structuration*. Univ of California Press. https://books.google.co.uk/books?hl=en&lr=&id=x2bf4g9Z6ZwC&oi=fnd&pg=PR9&dq=Giddens,+Anthony.+1984.+The+Constitution+of+Society.+Outline+of+the+Theory+of+Structu-ration.+Cambridge:+Polity+Press.%E2%80%A8&ots=jMZL1rzycy&sig=CrZ6h4xecav5CG1QlzjKLK530HM.
Giddings, Bob, Bill Hopwood, and Geoff O’brien. 2002. ‘Environment, Economy and Society: Fitting Them Together into Sustainable Development’. *Sustainable Development* 10 (4): 187–196.
Giovanella, Federica. 2015. ‘Liability Issues in Wireless Community Networks’. *Journal of European Tort Law* 6 (1): 49–68.
Gómez-Barroso, José Luis, and Claudio Feijóo. 2010. ‘A Conceptual Framework for Public-Private Interplay in the Telecommunications Sector’. *Telecommunications Policy* 34 (9): 487–95. doi:10.1016/j.telpol.2010.01.001.
Greenstein, Shane. 2015. *How the Internet Became Commercial: Innovation, Privatization, and the Birth of a New Network*. Princeton University Press. https://books.google.co.uk/books?hl=en&lr=&id=a3wkCQAAQBAJ&oi=fnd&pg=PP1&dq=Greenstein,+Shane.+2015.+How+the+Internet+Became+Commercial.&ots=1FZamgCGKl&sig=rf_M0DeIMTB3wXteL4uIMEhGoHk.
Gurstein, Michael. 2007. *What Is Community Informatics and Why Does It Matter?* Monza: Polimetrica.
Habermas, Jürgen. 1985. ‘The Theory of Communicative Action, Volume 2: Lifeworld and System: A Critique of Functionalist Reason’. http://philpapers.org/rec/HABTTO-3.
Hardin, Garrett. 1968. ‘The Tragedy of the Commons’. *Science* 162 (3859): 1243–1248.
Hartmann, Michael. 2010. ‘Elites and Power Structure’. In *Handbook of European Societies*, 291–323. Springer. http://link.springer.com/10.1007%2F978-0-387-88199-7_10.

Harvey, David. 2005. *A Brief History of Neoliberalism*. OUP Oxford. https://books.google.co.uk/books?hl=en&lr=&id=F5DZvEVt890C&oi=fnd&pg=PT2&dq=A+Brief+History+of+Neoliberalism&ots=P77mSNRZKq&sig=sTvv_NxYUcEZqio54WJTeQHB0EY.

———. 2011. 'The Future of the Commons'. *Radical History Review* 2011 (109): 101–107.

Hayek, Friedrich A. 1945. 'The Use of Knowledge in Society' 35 (4): 487–95.

Heinrich Böll Foundation. 2002. *The Jo'burg Memo. Fairness in a Fragile World*. Berlin: Heinrich Böll Foundation.

Hess, Charlotte, and Elinor Ostrom. 2003. 'Ideas, Artifacts, and Facilities: Information as a Common-Pool Resource'. *Law and Contemporary Problems* 66 (1/2): 111–45.

———. 2011. *Understanding Knowledge as a Commons: From Theory to Practice*. MIT Press.

Hills, Jill. 1986. *Deregulating Telecoms - Competition and Control in the United States, Japan and Britain*. London: Frances Pinter.

Hilty, Lorenz M., and Thomas F. Ruddy. 2010. 'Sustainable Development and ICT Interpreted in a Natural Science Context: The Resulting Research Questions for the Social Sciences'. *Information, Communication & Society* 13 (1): 7–22.

Hofkirchner, Wolfgang. 2013. *Emergent Information: A Unified Theory of Information Framework*. Vol. 3. World Scientific. https://books.google.co.uk/books?hl=en&lr=&id=vnvr-AwK3okC&oi=fnd&pg=PR5&dq=Emergent+Information:+A+Unified+Theory+of+Information+Framework&ots=R5cfiRFlPg&sig=_9eWJvHK22DOCRZ8yFTckKWA22k.

Horkheimer, Max, Theodor W. Adorno, and Gunzelin Noeri. 2002. *Dialectic of Enlightenment*. Stanford University Press. https://books.google.co.uk/books?hl=en&lr=&id=l-75zLjGlZQC&oi=fnd&pg=PR14&dq=horkheimer+adorno+dialectic+of+the+stanford&ots=CsNENtT6tB&sig=UmLfddwt4qqVV6bzfYfR_ipL0aE.

Humphreys, Peter, and Seamus Simpson. 2005. *Globalisation, Convergence and European Telecommunciations Regulation*. Cheltenham and Northampton, MA: Edward Elgar. https://books.google.co.uk/books?id=mePHohaHobQC&printsec=frontcover&dq=Globalisation,+Convergence+and+European+Telecommunications+Regulation&hl=en&sa=X&ved=0ahUKEwjLss2F2rbNAhVED8AKHS7IDuIQ6AEIHjAA#v=onepage&q=Globalisation%2C%20Convergence%20and%20European%20Telecommunications%20Regulation&f=false.

Illich, Ivan. 1973. *Tools for Conviviality*. Glasgow: Fontana/Collins.

International Labour Organisation. 2015. *World Employment Social Outlook: Trends 2015*.

Jameson, Fredric. 1991. *Postmodernism, Or, the Cultural Logic of Late Capitalism*. Duke University Press.

Jessop, Bob. 1993. 'Towards a Schumpeterian Workfare State? Preliminary Remarks on Post-Fordist Political Economy.' *Studies in Political Economy* 40 (Spring): 7–39.

———. 2002. *The Future of the Capitalist State*. Cambridge: Polity.

Karabarbounis, Loukas, and Brent Neiman. 2014. 'The Global Decline of the Labor Share'. *The Quarterly Journal of Economics* 129 (1): 61–103. doi:10.1093/qje/qjt032.

Khan, Mohammed Adil. 2015. 'Putting "Good Society" Ahead of the Economy: Overcoming Neoliberalism's Growth Trap and Its Costly Consequences'. *Sustainable Development* 23 (1): 55–63. doi:10.1002/sd.1571.

Klein, Naomi. 2015. *This Changes Everything: Capitalism vs. the Climate*. Simon and Schuster. https://books.google.co.uk/books?hl=en&lr=&id=Vh9ICgAAQBAJ&oi=fnd&pg=PA1&dq=Klein,+Naomi.+2014.+This+Changes+Everything:+Capitalism+vs.+The+Climate.+&ots=v_ryYoMIZ0&sig=kqU1yKwiLbX3oUbWkiORETLFAcg.

Kostakis, Vasilis, and Michel Bauwens. 2014. *Network Society and Future Scenarios for a*

Collaborative Economy. Palgrave Macmillan. https://books.google.co.uk/books?hl=en&lr=&id=2uNQBAAAQBAJ&oi=fnd&pg=PP1&dq=Network+Society+and+Future+Scenarios+For+A+Collaborative+Economy&ots=z-BQLMFg0O&sig=dNGryg4T7pjQX4ZvKNL0kZEnqdg.

Lee, Timothy. 2012. 'Two Views of Innovation - Forbes'. http://www.forbes.com/sites/timothylee/2012/05/27/two-views-of-innovation/#7c8ab4d47f4e.

Lemstra, Wolter, Bart Voogt, and Nicolai van Gorp. 2015. 'Measuring Broadband in Europe: Development of a Market Model and Performance Index Using Structural Equations Modelling'. *Telecommunications Policy* 39 (3–4): 253–68. doi:10.1016/j.telpol.2015.01.006.

Lewis, Justin. 2014. *Beyond Consumer Capitalism: Media and the Limits to Imagination*. John Wiley & Sons. https://books.google.co.uk/books?hl=en&lr=&id=h_y2AgAAQBAJ&oi=fnd&pg=PT5&dq=Lewis,+Justin.+2013.+Beyond+Consumer+Capitalism.+Media+and+the+Limits+to+Imagination.+&ots=4tM6dWpax3&sig=ugqQpZ16w4gniyJDuuF-XBkhp0g.

Li-Hua, Richard. 2009. 'Definitions of Technology'. In *In A Companion to the Philosophy of Technology, Ed. Jan Kyrre Berg Olsen, Stig Andur Pedersen and Vincent F. Hendricks*, 18–22. Malden, MA: Wiley-Blackwell.

Lo Cigno, Renato, and Leonardo Maccari. 2014. 'Urban Wireless Community Networks: Challenges and Solutions for Smart City Communications'. In *Proceedings of the 2014 ACM International Workshop on Wireless and Mobile Technologies for Smart Cities*, 49–54. ACM. http://dl.acm.org/citation.cfm?id=2633669.

Lukacs, Georg. 1971. 'History and Class Consciousness: Studies in Marxist Dialectics (R. Livingstone, Trans.)'. *London: Merlin*.

Maccari, Leonardo. 2013. 'An Analysis of the Ninux Wireless Community Network'. In *Wireless and Mobile Computing, Networking and Communications (WiMob), 2013 IEEE 9th International Conference on*, 1–7. IEEE. http://ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=6673332.

Maccari, Leonardo, and Renato Lo Cigno. 2015. 'A Week in the Life of Three Large Wireless Community Networks'. *Ad Hoc Networks* 24: 175–190.

Magdoff, Fred, and John Bellamy Foster. 2011. *What Every Environmentalist Needs to Know about Capitalism: A Citizen's Guide to Capitalism and the Environment*. NYU Press. https://books.google.co.uk/books?hl=en&lr=&id=SjgUCgAAQBAJ&oi=fnd&pg=PA7&dq=What+every+environmentalist+needs+to+know+about+capitalism&ots=INXQJEzR2a&sig=lKZemZx2ak9ZPM7in19AkBxo6WM.

Marx, K. 1844. 'The Economic and Philosophic Manuscripts of 1844 and the Communist Manifesto, Trans'. *M. Milligan. Amherst, NY: Prometheus Books*.

Maxwell, Richard, and Toby Miller. 2012. *Greening the Media*. OUP USA. https://books.google.co.uk/books?hl=en&lr=&id=j1nfiQ1eKWAC&oi=fnd&pg=PP2&dq=maxwell+Greening+the+Media&ots=5YoqjCuUyy&sig=eTHIc2z0Qnhshl5ZQmbYBHpHu0k.

Medosch, Armin. 2015. *The Rise of the Network Commons*. http://www.thenextlayer.org/NetworkCommons.

Michalis, Maria. 2007. *Governing European Communications: From Unification to Coordination*. Lanham, MD: Lexington Books.

———. 2016. 'New Networks, Old Markets Structures? The Race to Next Generation Networks in the EU and Calls for a New Regulatory Paradigm'. In *European Media Policy for the 21st Century, Eds. Seamus Simpson, Manuel Puppis and Hilde Van Den Bulck*, 139–60. London: Routledge.

Mölleryd, Bengt G. 2015. 'Development of High-Speed Networks and the Role of Municipal Networks'. OECD Science, Technology and Industry Policy Papers 26. http://www.oecd-ilibrary.org/science-and-technology/development-of-high-speed-networks-and-the-role-of-municipal-networks_5jrqdl7rvns3-en.

Moorcroft, Victoria. 2013. 'New Guidelines in Place for Assessing State Aid for the Deployment of Broadband'. Bird & Bird Law Firm. http://www.twobirds.com/en/news/articles/2010/new-guidelines-place-assessing-state-deployment-broadband0113.

Mosco, Vincent. 2015. *To the Cloud: Big Data in a Turbulent World*. Routledge. https://books.google.co.uk/books?hl=en&lr=&id=YwbvCgAAQBAJ&oi=fnd&pg=PP1&dq=Mosco,+Vincent.+2014.+To+the+cloud:+Big+data+in+a+turbulent+world.+&ots=UVWu4w3ku4&sig=JeJUc1FDNZWvNGJvZ03N1PymuG4.

Mulder, Karel, Didac Ferrer, and Harro van Lente. 2011. *What Is Sustainable Technology? Perceptions, Paradoxes and Possibilities*. Sheffield: Greenleaf Publishing.

Musiani, F. 2014. 'Decentralised Internet Governance: The Case of a 'peer-to-Peer Cloud'. *Internet Policy Review* 3 (1). http://policyreview.info/articles/analysis/decentralised-internet-governance-case-peer-peer-cloud.

Natalicchi, Giorgio. 2001. *Wiring Europe: Reshaping the European Telecommunications Regime*. Lanham, Md. and Oxford: Rowman and Littlefield. https://books.google.co.uk/books?id=UJfsxtd-zm0C&printsec=frontcover&dq=Wiring+Europe.+Reshaping+the+European+Telecommunications+Regime&hl=en&sa=X&ved=0ahUKEwiT7N_V2rbNAhVMBsAKHanOB-MQ6AEIHDAA#v=onepage&q=Wiring%20Europe.%20Reshaping%20the%20European%20Telecommunications%20Regime&f=false.

Noam, Eli. 2009. *Media Ownership and Concentration in America*. Oxford University Press. https://books.google.co.uk/books?hl=en&lr=&id=Kd_1STqyGFcC&oi=fnd&pg=PR9&dq=Noam,+Eli.+2009.+Media+Ownership+and+Concentration+in+America.+Oxford:+Oxford+University+Press.&ots=5s8hJEre-v&sig=JDDa-f8EJz7Jurq_m2rkQJgYJLA.

Noam, Eli M. 2010. 'Regulation 3.0 for Telecom 3.0'. *Telecommunications Policy* 34 (1–2): 4–10. doi:10.1016/j.telpol.2009.11.004.

O'Connor, James. 1994. 'Is Sustainable Capitalism Possible'. *Is Capitalism Sustainable*, 152–175.

OECD. 2015. 'OECD Broadband Portal: Percentage of Fibre Connections in Total Broadband Subscriptions, June 2015'. OECD. www.oecd.org/sti/broadband/oecdbroadbandportal.htm.

Oliver, Miquel, Johan Zuidweg, and Michail Batikas. 2010. 'Wireless Commons against the Digital Divide'. In *Technology and Society (ISTAS), 2010 IEEE International Symposium on*, 457–465. IEEE. http://ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=5514608.

Parodi, Oliver. 2015. 'The Missing Aspect of Culture in Sustainability Concepts'. In *Theories of Sustainable Development, Ed. Judith C. Enders and Moritz Remig*, 169–87. London: Routledge.

Piketty, Thomas. 2014. *Capital in the Twenty-First Century*. Harvard University Press.

Powell, Alison. 2008. 'WiFi Publics: Producing Community and Technology'. *Information, Communication & Society* 11 (8): 1068–1088.

Powell, Alison, and Leslie Regan Shade. 2006. 'Going Wi-Fi in Canada: Municipal and Community Initiatives'. *Government Information Quarterly* 23 (3–4): 381–403.

Preston, Paschal. 2001. *Reshaping Communications: Technology, Information and Social Change*. London: Sage. https://books.google.co.uk/books?hl=en&lr=&id=F__RzTHbNNUC&oi=fnd&pg=PR9&dq=paschal+preston&ots=QOcRrU3Z36&sig=Gh7MIjApz_W2sJhNkY95ZWlg4lk.

PricewaterhouseCoopers. 2016. 'Connecting the World: Ten Mechanisms for Global Inclusion'. Accessed June 20. http://www.strategyand.pwc.com/reports/connecting-the-world.

Quental, Nuno, Júlia M. Lourenço, and Fernando Nunes da Silva. 2011. 'Sustainable Development Policy: Goals, Targets and Political Cycles'. *Sustainable Development* 19 (1): 15–29.
Reydon, Thomas AC. 2012. 'Philosophy of Technology'. In *Internet Encyclopedia of Philosophy, Ed. James Fieser and Bradley Dowden*. http://www.iep.utm.edu/technolo.
Rifkin, Jeremy. 2014. *The Zero Marginal Cost Society: The Internet of Things, the Collaborative Commons, and the Eclipse of Capitalism*. Macmillan.
Rose, Carol. 1986. 'The Comedy of the Commons: Custom, Commerce, and Inherently Public Property'. *The University of Chicago Law Review* 53 (3): 711–781.
Rucevska, I., C. Nellemann, N. Isarin, W. Yang, N. Liu, K. Yu, S. Sandn\a es, et al. 2015. 'Waste Crime-Waste Risks, Gaps in Meeting the Global Waste Challenge'. *A UNEP Rapid Response Assessment, United Nations Environment Programme and GRID-Arendal, Nairobi and Arendal*.
Ruhle, Ernst-Olav, Igor Brusic, Jörg Kittl, and Matthias Ehrler. 2011. 'Next Generation Access (NGA) Supply Side interventions—An International Comparison'. *Telecommunications Policy* 35 (9–10): 794–803. doi:10.1016/j.telpol.2011.06.001.
Sadowski, Bert, and others. 2014. 'Consumer Cooperatives as a New Governance Form: The Case of the Cooperatives in the Broadband Industry'. http://cms.tm.tue.nl/Ecis/Files/papers/wp2014/wp1403.pdf.
Saldana, J., and et al. 2015. 'Alternative Network Deployments. Taxonomy, Characterization, Technologies and Architectures. Internet Draft for GAIA [Global Access to the Internet for All]'. https://tools.ietf.org/html/draft-irtf-gaia-alternative-network-deployments-00.
Sandoval, Marisol, and Christian Fuchs. 2010. 'Towards a Critical Theory of Alternative Media'. *Telematics and Informatics* 27 (2): 141–150.
Sandvig, Christian. 2004. 'An Initial Assessment of Cooperative Action in Wi-Fi Networking'. *Telecommunications Policy* 28 (7): 579–602.
Savage, Mike. 2015. *Social Class in the 21st Century*. Penguin UK. https://books.google.co.uk/books?hl=en&lr=&id=TE3ZCQAAQBAJ&oi=fnd&pg=PT5&dq=Social+Class+in+the+21st+Century&ots=twTHKGzgC5&sig=Q4wcG-_EtLKQnVEfv7EYevLZyMM.
Savage, Mike, Fiona Devine, Niall Cunningham, Mark Taylor, Yaojun Li, Johs Hjellbrekke, Brigitte Le Roux, Sam Friedman, and Andrew Miles. 2013. 'A New Model of Social Class? Findings from the BBC's Great British Class Survey Experiment'. *Sociology* 47 (2): 219–250.
Schneider, Volker. 2002. 'The Institutional Transformation of Telecommunications Between Europeanization and Globalization'. In *Governing Telecommunications and the New Information Society in Europe, Ed. Jacint Jordana*, 27–46. Cheltenham: Edward Elgar.
Schuler, Douglas. 1996. *New Community Networks: Wired for Change*. ACM Press/Addison-Wesley Publishing Co. http://dl.acm.org/citation.cfm?id=226884.
Schumpeter, Joseph. 2010. *Capitalism, Socialism, and Democracy*. London: Routledge.
Serageldin, Ismail*Cohen. 1995. 'The Human Face of the Urban Environment : Proceedings of the Second Annual World Bank Conference on Environmentally Sustainable Development'. 15021. The World Bank. http://documents.worldbank.org/curated/en/1995/09/697059/human-face-urban-environment-proceedings-second-annual-world-bank-conference-environmentally-sustainable-development.
Serdarević, Goran, Matt Hunt, Tom Ovington, and Clive Kenny. 2016. 'Evidence for a Ladder of Investment in Central and Eastern European Countries'. *Telecommunications Policy* 40 (6): 515–31. doi:10.1016/j.telpol.2016.02.007.
Sohn-Rethel, Alfred. 1978. *Intellectual and Manual Labour: A Critique of Epistemology*. Macmillan London. http://www.autodidactproject.org/other/sohn-rethel-x.html.

Stallman, Richard. 2001. 'What Is Free Software?' http://www.gnu.org/philosophy/free-sw.en.html.
Stiglitz, Joseph, Amartya Sen, and Jean-Paul Fitoussi. 2009. *Report by the Commission on the Measurement of Economic Performance and Social Progress*. CMEPSP.
Stoll, Klaus. 2005. 'How Wi-Fi Came to El Chaco'. *The Journal of Community Informatics* 1 (2). http://ci-journal.net/index.php/ciej/article/viewArticle/232/189.
Tapia, Andrea Hoplight, Alison Powell, and Julio Angel Ortiz. 2009. 'Reforming Policy to Promote Local Broadband Networks'. *Journal of Communication Inquiry*. http://jci.sagepub.com/content/early/2009/08/05/0196859909340799.abstract.
Therborn, Göran. 2012. 'The Killing Fields of Inequality'. *International Journal of Health Services* 42 (4): 579–589.
Thomas, Daniel. 2013. 'EU Regulators Adopt Measures to Reform Telecoms Market'. *Financial Times*. http://www.ft.com/cms/s/0/41958a7e-1aee-11e3-a605-00144feab7de.html#ixzz3VDcjQgvd.
Triventi, Moris. 2013. 'Stratification in Higher Education and Its Relationship with Social Inequality: A Comparative Study of 11 European Countries'. *European Sociological Review* 29 (3): 489–502. doi:10.1093/esr/jcr092.
Troulos, Costas, and Vasilis Maglaris. 2011. 'Factors Determining Municipal Broadband Strategies across Europe'. *Telecommunications Policy* 35 (9–10): 842–56. doi:10.1016/j.telpol.2011.07.008.
UNHDR. 2015. *United Nations Human Development Report 2015*. New York: United Nations Development Programme.
United Nations. 2015. '| Human Development Reports'. http://hdr.undp.org/en/2015-report.
United Nations Conference on Environment & Development (UNCED). 1992a. 'Agenda 21. Adopted at the United Nations Conference on Environment & Development, Rio de Janeiro, Brazil, 3-14 June 1992.' https://sustainabledevelopment.un.org/content/documents/Agenda21.pdf.
———. 1992b. 'Rio Declaration on Environment and Development. Adopted at the United Nations Conference on Environment & Development, Rio de Janeiro, Brazil, 3-14 June 1992.' http://www.un.org/documents/ga/conf151/aconf15126-1annex1.htm.
United Nations Conference on Sustainable Development (UNCSD). 2012. *The Future We Want*. http://www.un.org/disabilities/documents/rio20_outcome_document_complete.pdf.
United Nations General Assembly. 2015. 'Outcome Document of the High-Level Meeting of the General Assembly on the Overall Review of the Implementation of the Outcomes of the World Summit on the Information Society'. http://workspace.unpan.org/sites/Internet/Documents/UNPAN95735.pdf.
Vega, Davide, Llorenc Cerda-Alabern, Leandro Navarro, and Roc Meseguer. 2012. 'Topology Patterns of a Community Network: Guifi. Net'. In *Wireless and Mobile Computing, Networking and Communications (WiMob), 2012 IEEE 8th International Conference on*, 612–619. IEEE. http://ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=6379139.
Verdegem, Pieter, and Christian Fuchs. 2013. 'Towards a Participatory, Co-Operative and Sustainable Information Society?' *Nordicom Review* 34 (2): 3–18.
Williams, Raymond. 1985. *Keywords: A Vocabulary of Culture and Society*. Oxford University Press. https://books.google.co.uk/books?hl=en&lr=&id=KnNWD9EYCGgC&oi=fnd&pg=PA11&dq=Williams,+Raymond.+1983.+Keywords.+A+vocabulary+of+culture+and+society.+New+York:+Oxford+University+Press.&ots=YlWPW2qThM&sig=St3Vet04gvhg5u6akTZ-_3VIyC0.
World Commission on Environment and Development (WCED). 1987. *Our Common Future*. Oxford University Press Oxford.
World Summit on Sustainable Development (WSSD). 2002. 'Johannesburg Declaration on Sustainable Development'. http://www.am.lt/VI/en/VI/files/0.038700001106642945.pdf.

World Summit on the Information Society. 2003. ‘WSIS Geneva Declaration of Principles: Building the Information Society: A Global Challenge in the New Millennium’. http://www.itu.int/net/wsis/docs/geneva/official/dop.html.

———. 2005. ‘Tunis Agenda for the Information Society.’ http://www.itu.int/net/wsis/docs2/tunis/off/6rev1.html.

WSIS+10 High-Level Event. 2014. ‘WSIS Outcome Documents’. Geneva: ITU.

WSIS Civil Society Plenary. 2003. ‘“Shaping Information Society for Human Needs”: Civil Society Declaration to the World Summit on the Information Society’. http://www.itu.int/net/wsis/docs/geneva/civil-society-declaration.pdf.

———. 2005. ‘Much More Could Have Been Achieved: Civil Society Statement on WSIS’. http://www.worldsummit2005.de/download_en/WSIS-CS-summit-statement-rev1-23-12-2005-en.pdf.

Ziegler, Rafael, and Konrad Ott. 2011. ‘The Quality of Sustainability Science: A Philosophical Perspective’. *Sustainability: Science, Practice, & Policy* 7 (1). http://search.proquest.com/openview/2e16bfce643cd129f4c2ec0ca1b01a90/1?pq-origsite=gscholar.

The netCommons project

July 3rd, 2016

netCommons-D2.1/1.0

Horizon 2020