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Fibre alongside the Power Lines

Enacting Demand in the Context of the Broadband Strategy of Burgenland

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Xenia Valerie Hafez, BA

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Disclaimer

I work for the division responsible for telecommunications and postal services at the Austrian regulatory authority for broadcasting and telecommunications (RTR). This thesis lays out the results obtained during my own academic engagement, pursued independently from my employer. The views expressed herein shall not be attributed to RTR or the telecommunications commission (TKK), and they neither indicate nor prejudge the views of these independent regulatory bodies.

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[1] A story of fibre optics networks in Burgenland: Digital divides and broadband strategies (https://www.netidee.at/practices-demand-converging-infrastructures/story-fibre-optics-networks-burgenland)
Fibre optics all the way down: Traversing Burgenland by networks (https://www.netidee.at/practices-demand-converging-infrastructures/fibre-optics-all-way-down)
Broadening rural bandwidths: The case of fibre optics networks (https://www.netidee.at/fibre-alongside-power-lines/broadening-rural-bandwidths)
Demand enters the network: Of ontological multiplicity and fibre optics network deployment (https://www.netidee.at/fibre-alongside-power-lines/demand-enters-network)
The curious thing about demand and networks: Empirical findings from a case study on fibre optics networks (https://www.netidee.at/fibre-alongside-power-lines/curious-thing-about-demand-and-networks)
Fibre optics, energy providers and infrastructures: A review and contextualisation of the broadband strategy of Burgenland (https://www.netidee.at/fibre-alongside-power-lines/fibre-optics-energy-providers-and-infrastructures)

Abstract

Telecommunications networks are one of the many infrastructures which form an important part of everyday life. However, they are not ubiquitous, which sometimes leads to policy intervention aiming to reduce the digital divide. In general, this digital divide affects rural areas, as they are considered to be more costly to connect because of lower demand.

This thesis offers a case study of fibre optics network deployment in Burgenland, Austria, as guided by the broadband strategy developed for this region. Fibre optics networks have not yet been deployed everywhere, which allows me to observe the practices associated with infrastructure expansion. As the broadband strategy has set up a subsidiary of an energy provider to further its implementation, this case study also presents an example of how energy providers practise deployment.

To broach the topic of telecommunications network deployment from an STS perspective, I have focused on the role of demand in this process. Using the notion of ontological multiplicity (Mol, 2002), I have approached the deployment of these infrastructures as an ontological experiment (C. B. Jensen & Morita, 2015) where 'demand' becomes performative (Callon, 2007). Drawing on an analysis of the broadband strategy, two interviews and three instances of ethnographic fieldwork, the case study therefore follows how demand, understood as a practice, is enacted in the context of infrastructure deployment.

The empirical findings show how 'demand' is enacted in a heterogeneous manner under the circumstances framed by the broadband strategy: it can be seen using different instruments in a variety of places. Doing demand furthermore entails practices associated with making a business case or selecting particular forms of demand aggregation at various times in the deployment process. As the broadband strategy creates a link between the energy network and fibre optics deployment, 'demand' becomes, amongst other things, something that wind turbines do.

Contents

1. Introduction

If you are reading this thesis, it is quite likely that you have used fibre optics networks, in some way: they are part of the infrastructure through which you access the Internet. Multiple studies within the field of telecommunications research have explored fibre optics networks, predominantly from a technical, economic or legal perspective (e.g. Curram et al., 2019; Fisher et al., 2020; Howell & Potgieter, 2020; Strube Martins & Wernick, 2021; Zoz et al., 2021; Zuloaga et al., 2022). In the social sciences, however, telecommunications networks remain understudied, with only few contributions focusing on submarine fibre optics cables (Starosielski, 2020), the relation between usage practices and energy consumption (Lord et al., 2015; Morley, 2018; Morley et al., 2018) and policy frameworks for broadband deployment (Strover et al., 2021). This lack of research is particularly surprising due to a long and intensive engagement of the social sciences with energy infrastructures.

Even though telecommunications networks form an important part of our lives, and despite a significant amount of policy attention (e.g. European Commission, 2021), telecommunications networks cannot be found everywhere just yet. This becomes particularly clear once you begin to focus on wireline (fixed) or wireless (mobile) networks, and then even further according to a particular technology. My research begins precisely by focusing on one particular type of telecommunications network, namely fibre optics networks. And from there we can begin to wonder: why is it that these networks are built in some places but not in others? My research question distils this concern even further, and so, we will ask ourselves: *how does the broadband strategy of Burgenland enact demand in the context of fibre optics network deployment?* For anyone not used to these terms, we can triangulate the research question to make it a little clearer.

Rural areas are often not priorities for telecommunications providers to deploy networks, and so, a variety of approaches have been developed seeking to connect underserved areas (Gerli & Whalley, 2021; Holznagel et al., 2010; Strover et al., 2021). Among these, broadband strategies are a common policy intervention (Salemink et al., 2017), but they can take on quite different shapes. In the case we will look at in this thesis, the state of Burgenland has decided to stimulate fibre optics deployment in areas which are considered underserved, as well as improving connectivity overall through fibre optics backhaul networks, with a particular focus on Southern and Central Burgenland. To implement the strategy, Burgenland has set up a subsidiary of an energy provider, BE Technology, which should deploy fibre optics networks whenever opportunities for civil works related to the energy network arise.

Within the context set out by the broadband strategy, we will try to understand demand as ontologically multiple and enacted through practices (Mol, 2002). This allows us to both link to the existing literature on demand in the context of infrastructures (Shove & Trentmann, 2018), as well as go beyond this literature to explore demand as a concept which is performative (Callon, 2007) in the context of network deployment. In this way, we are able to follow an ontological experiment (C. B. Jensen & Morita, 2015) where the telecommunications network and the energy network become linked through deployment.

This thesis is organised as follows: I will first introduce you to the literature and the theoretical concepts I make use of, in order to contextualise my project and elaborate my research interest (chapter 4). We will then take a stroll through the methodological approach I have chosen and the research process in chapter 28, which will help you to understand how my research evolved. The empirical findings contained in chapter 39 are structured according to the research questions I developed, which we will revisit in more detail. As for the findings, we will first look at the broadband strategy of Burgenland in detail (section 40), and then dive into the practices of demand it gives rise to (section 59 and, as bonus material, Annex I: A differentiated approach to demand). This will help us understand the implications of the infrastructural companionship of energy and telecommunications networks subsequently in section 82. Following these explorations, we will explore how they have affected a municipality somewhere in Southern or Central Burgenland in chapter 5. To conclude, we will muster our findings in chapter 97 and draw some tentative, preliminary conclusions to round off our case study.

Before we move on, let me briefly explain the title I have chosen for this thesis. “Fibre alongside the Power Lines” is a homage to the infrastructural companionship of the fibre optics network and the energy network which we will explore together. In the course of our journey, we will see how the broadband strategy sets up a specific constellation of actors and creates a framework for these actors to practise demand. Practising demand is not an inconsequential part of network deployment: the places where demand is located are as important to building networks as the ease with which you can reach these places. Here, the broadband strategy does something new and creates conditions under which fibre optics deployment should follow the electricity network. Aside from creating a particular ontology of demand in relation to telecommunications network deployment, this move also invites a new dimension that is related to changing forms of demand in the electricity network. Instead of focusing on where the network should go, as illustrated by terms such as fibre-to-the-home, fibre alongside the power lines opens us up to the nuances of doing demand and deployment differently.

In this way, it is my tribute to a fascinating case that has surprised me time and again – and hopefully, it will do the same for you.

2. Literature review

Usually, this section is called State of the Art, serving to contextualise academic work within previous and ongoing research and reflection. I find it difficult to give it this name because my research is in between two scientific projects: one of them, called science and technology studies (STS), seeks to understand the role of society in knowledge, artefacts, infrastructures or innovation in society, but also the ways in which these sciences and technologies (re)configure a variety of social, environmental and material arrangements. It is an interdisciplinary field, where nuclear physicists begin to study innovation and historians enter the lab, but it is also a social science – and a comparatively young branch of social science.

Then there is the body of research which engages with telecommunications networks. This is also an interdisciplinary field, where engineers, economists and legal scholars contribute their analyses of telecommunications. Often with a focus on regulation, it seeks to understand the strategies used by telecommunications providers to deploy networks, how legal frameworks impact the development of markets, which kinds of pricing can be observed in connection with particular constellations of infrastructures and markets; but it also seeks to describe how different telecommunications networks work, what is necessary to connect networks, or to serve subscribers from different networks. While scholars of different disciplines conduct research on telecommunications, I do not have the impression that it is a consolidated field.

These sciences are not connected enough to present them as one and claim that in the course of a few pages, I can offer you an overview of the State of the Art. Instead, I have chosen to present you with a literature review which aims to help you understand where this research is coming from. For this reason, we will triangulate my research context via a few stepping stones. Since I am closest to this area, we will first take a look at how the social sciences have approached infrastructures and which kinds of aspects are highlighted in this perspective (section 5). Next, we will take a look at how infrastructures relate to demand to reach a point from where we can cross the deep waters between the social sciences and our case study. However, to help us cross safely, we need something more than a nod in the right direction: we need a concept. This is where the third section in this chapter comes in, which is where we form the theoretical skeleton of this thesis (section 11).

Yet these tools alone will not help us through the empirical journey later on, and, in any case, they do not mesh easily with that other scientific project of telecommunications research. In section 16, we will therefore become acquainted with fibre optics networks. From there, we will move on to what happens when networks are deployed (section 19), and even more specifically, which issues arise when networks are deployed in areas characterised by low population density, otherwise known as rural areas (section 21). In the penultimate section of this chapter (section 26), we will attempt both a recap and an outlook – after all, this chapter is only the beginning.

2.1. A primer on infrastructures

Infrastructures are strange creatures: they make it extraordinarily difficult to find a place to start. It seems impossible to follow a linear narrative because they are so many things in so many places at so many different levels, all at once. Take your phone, for instance: in the palm of your hand, you are holding resources extracted from remote places, powered by electricity generated from unknown sources, charged while you were on the train, at a café, at work or at home, connected to cellular networks using a SIM card or WiFi network, in order to access applications deemed permissible by the pre-installed software that are collecting data about how you move in social and physical spaces to shape how the world is presented to you through the Internet, which in turn relies on data centres distributed around the globe to present you with content produced according to predictions of what you would enjoy. The dizzying, head-spinning amalgamation of factors, the sudden shifts between scale and scope and reach, the continuous folding-in of materials and relations seemingly disparate – this is infrastructure.

Luckily for both of us, I am not attempting a study of infrastructure writ large. I have the luxury of building on the many researchers who came before me, employing the methodological and theoretical toolkits of anthropology and STS to understand how these elusive behemoths become integral parts of life. We will therefore first take a look at what the social sciences have attended to generally in research on infrastructures, before moving on to how the role of demand has been researched in this context.

2.1.1. Of infrastructures

For the most part, infrastructures become part of the background of our lives. There is no need to think about their workings, unless of course they fail, which is when they become hyper-obvious. These are among the characteristics formulated originally by Star and Ruhleder (1996; in Star, 1999), which offer a conceptual framework allowing for social science to approach the subject.

Within the framework developed by Star and Ruhleder, infrastructures can be understood as emergent, which means that they become more or less visible depending on the positionality and circumstances of the observer. They are entangled with people, which means that infrastructures are never merely technical, whether during their design, development, use, maintenance or decay. Last but not least, infrastructures are relational, which means that infrastructures make a range of different practices possible by different people (Star, 1999; Star & Bowker, 2006).

Based on this characterisation, Star and Ruhleder propose to focus on nine properties or, more accurately, dimensions of infrastructure (Star & Ruhleder, 1996; in Star, 1999, pp. 381–382).[2] My aim is not completeness, and hence I will focus only on the five dimensions I find particularly useful for my case: embeddedness, reach or scope, how infrastructure links to conventions of practice, its reliance on an installed base and how it is fixed in modular increments (Star, 1999, pp. 381–382).

Embeddedness means that "[i]nfrastructure is sunk into and inside of other structures, social arrangements, and technologies" (Star, 1999, p. 381). We feel that we can refer to the entire complex of materials, technologies, people, organisational practices etc. which make telecommunications possible as one infrastructure: telecommunications. Likewise, when talking about telecommunications, we take for granted the electricity powering the networks, the roads and rail tracks along which cables run, the training programmes created for the development and maintenance of networks – even though, of course, telecommunications as an infrastructure would not exist without them.

Infrastructures are characterised by their reach or scope – that is, the way in which they extend beyond a single place or time (Star, 1999, p. 381). For networks, this may seem obvious, as their purpose is precisely to connect places to each other to facilitate various forms of exchange; but at the same time, the heterogeneity of sites where infrastructures happen and the different ways infrastructures modify places remains notable (Hughes, 1993; Starosielski, 2020). Temporal practices may seem less obvious, but infrastructures are invoked to make futures (Appel, 2020) or even to shift certain practices to particular times, for instance when electrification and television combine to rearrange what people do at certain times (Smits, 2018).

Conventions of practice are crucial to infrastructures, both in that they shape infrastructures and are shaped by them in turn (Star, 1999, p. 381). We will go further into detail on how this relates to demand in a short while, but infrastructures are connected to ideas of how things should be done, which we can see in the evolving ideas about adequate room temperature and their relation to the spread and modification of central heating in the UK (Carlsson-Hyslop, 2018). They are equally connected to how things have always been done, for which the QWERTY keyboard I am typing on provides a good example (Star, 1999, p. 381). Simultaneously, they give rise to new ways of doing things: returning to

[2] For the sake of completeness, the full list would be: embeddedness, transparency, reach or scope, learned as part of membership, links with conventions of practice, embodiment of standards, built on an installed base, becomes visible upon breakdown, and is fixed in modular increments instead of all at once or globally (Star, 1999, pp. 381–382).

Smits (2018), electrification makes the rearrangement of sociomaterial practices in time and space possible, for instance through the introduction of night shifts (depending of course on the availability of electricity).

Infrastructures build on each other, which means they rely on an installed base (Star, 1999, p. 382). This is as 'simple' as the submarine fibre optics cables connecting continents following the footsteps of the telegraph and telephone wires of different materials and technologies preceding them (Starosielski, 2020), but can also extend to the necessity of ensuring backward compatibility, for instance in the case of computer software (Star, 1999, p. 382). In some cases, infrastructures rely on habits established in other contexts to be considered more useful. As Morley argues powerfully in the case of WiFi and mobile connectivity, becoming used to accessing the Internet in a non-stationary way within the house (e.g. through laptops connected to WiFi) helped accustom people to using the Internet in more than one place – and thus also to using mobile Internet via their smartphones (Morley, 2018).

The complexity of infrastructures mean that they are difficult to change all at once. Instead, they are fixed, adapted, or extended in modular increments (Star, 1999, p. 381). Gupta would add that it is their decay, their constant requirement of maintenance and repair, which makes infrastructures defined by their constant change (Gupta, 2020). Hughes (1993) captures this stepwise approach to infrastructure-making in his comparative historical account of the efforts surrounding the expansion of electricity networks, which remains a classic of studies on infrastructure in STS to this day.

Of course, the study of infrastructures is much broader than the research conducted by Star and Ruhleder. It was preceded by intensive preoccupation with infrastructures such as electricity grids (Hughes, 1993) or the infrastructural entanglement of colonialism and trade (Wolf, 2010[1982]). In fact, the social sciences have experienced what some have called an infrastructural turn (Buier, 2022; Hallinan & Gilmore, 2021; Slota & Bowker, 2017), where the focus of research on infrastructures moved away from the roads, pipes and sewers, dams, nuclear power plants and other large markers of infrastructural activity toward understanding infrastructure as a particular type of relation. What such a turn means is, I think, best summarised by Slota and Bowker, who offer the following proposition:

"We use a metaphor from botany—subtension—to express a particular attribute of the infrastructural relationship. In botany, a bract is a structure that supports and grows underneath a flower and serves to connect that flower to the stem of the plant. It is said, then, that the bract subtends the flower—they grow together, but the bract supports the continued growth of the flower and maintains its connection to the central plant. Infrastructure, then, subtends different fields and forms of work." (Slota & Bowker, 2017, p. 540)

With such an understanding, infrastructures no longer refer only to what you can touch, but encompass for instance knowledge infrastructures built on classification, categorisation (Bowker & Star, 1999) and standards (Carse & Lewis, 2017). Other research highlighted the temporalities enacted by infrastructures, particularly the temporalities of developmental modernity and the future ruin conditional to these infrastructures (Appel, 2020; Gupta, 2020).

But this move away from built infrastructures does not mean that social scientists no longer inquire into built infrastructures. An impressive contribution for instance is provided by Starosielski, who follows the undersea fibre optics network below and above ground (Starosielski, 2020).[3] Concerns over their environmental impacts (Boyer, 2020) and where the paths of these infrastructures lead stimulate a broad variety of research, some of which is re-examining the long-held assumptions related to demand and infrastructures (e.g. the volume edited by Shove & Trentmann, 2018) or inquiring into the role of imaginaries in constructing these infrastructural futures (Appel, 2020; Felt, 2017; Gupta, 2020), while others are calling for a critical engagement with how these infrastructures are not only relational and material (Starosielski, 2020), but entangled with processes of capital as well as capital's expansion into and reorganisation of socioecological relations (Buier, 2022).

2.1.2. Of demand in infrastructures

From all of these different ways of investigating infrastructures, one has gained my particular interest: the study of demand in the context of infrastructures. Out of a handful of reasons for my interest, two are intimately related to this thesis: firstly, the study of demand in the context of infrastructures allows me to extend the research on infrastructures in the social sciences to that of other disciplines working on telecommunications. Later on, we will take a closer look at how I have done this and why I think such an approach makes sense. For now, I would like to guide you through the second reason for my interest in the relation between infrastructures and demand. If you take a closer look, demand in the context of infrastructures is not so simple as one might think. As others have illustrated, infrastructures complicate the relationship between supply and demand which is presumed in economics and measured in engineering (Shove, Trentmann, et al., 2018, pp. 4–5; Shove, Watson, et al., 2018). Most of this research has focused on energy networks, but we will not be deterred by the preference in STS and anthropology for studying the body electric and instead look into what research on demand as a practice in the context of infrastructures can do specifically for this case study.

[3] It is telling that the undersea fibre optics networks connecting continents described by Starosielski (Starosielski, 2020) are magnitudes apart from the fibre optics networks in the landlocked region I focus on, even though they share a world not only because they are of the same kind, but because they are connected. Examples like this show the staggering levels and layers which infrastructures accumulate, fold in and make invisible.

Let us start with deployment, which in my view is a good illustration of how infrastructures expand. Electrification is the hugely complex process of extending electricity networks from power sources to the places where people live and use electricity: it involves a vast set of actors, which means engineers, (city) planners, businesses or consumers, and not least the sites, materials and equipment necessary to forge such connections (Harrison, 2018; Hughes, 1993; Smits, 2018). Studying electrification in Thailand and Laos, Smits (2018) observes that electrification is not a linear process, and the choice of whether or not to extend networks or even which power sources to use depended not only on supply or on the cost of deployment alone. Wavering between diesel generators and hydropower, the availability of electricity was not only accompanied by TVs and telephones, but by shifts in how people organised their working days or their houses; simultaneously, the question of connecting to local or regional electrical grids was more than a mere technical question, but steeped in political questions of control and integration. Considering the differences between the villages in Laos and Thailand, Smits observes that "demand is not autonomous, or somehow isolated from the means of provision, instead infrastructural development itself can prompt further energy demand […;] In some situations, it is the emergence of newly electrified practices that leads to the 'need' for new infrastructure" (Smits, 2018, p. 39). Demand not only as variable or relational, but as *entwined with the infrastructure via which it is practised* – this is, I think, a valuable avenue to explore. In the same volume, such an attempt is ventured by Morley (2018), which impressively shows how everyday practices of using mobile devices (i.e. laptops) to access the Internet at home via WiFi presented a "normalisation junction" – an embedding of devices and specific forms of infrastructural use into the everyday which made it normal to use the Internet in a mobile manner, thus driving the use(fulness) of mobile broadband.

While Morley would take us closer to the users again, for this case study, we need to go to a different site of demand, namely that of infrastructure-making. Observing infrastructural development through the devices and other everyday sociomaterial arrangements drawing on them opens us up to the question of *how demand is made (possible) through infrastructures*. To give us an idea about how this happens, let us take a look at Harrison (2018), who delves into the history of electrification in the USA and unearths how the kilowatt became a domesticated phenomenon, present in every house. Such a domestication and ubiquitous demand for energy, as Harrison shows, necessitated manifold ways of wiring: both the transmission lines across long distances and the interior wiring within homes were fundamental to making sure that power would arrive safely and reliably from the source to the users. A large coalition of actors was embroiled in this project, including of course the engineers working their way to reliable long-distance transmission (which, after all, ensured that energy sources such as hydropower plants could be used to provision electricity to distant cities); but also less well-known suspects, such as appliance manufacturers, the real estate industry, and the USA's National Electrical

Code. The National Electrical Code created and subsequently refined the notion of "adequately wired houses" (Harrison, 2018, p. 34), prompting newly built houses to be outfitted with ever more elaborate interior wiring, while appliance manufacturers took advantage of electrification and created ever more appliances relying on different types of currents, which made the use of electricity safer and also, over the course of time, changed the very concept of how well-wired houses should be. The availability of electricity even impacted how houses were designed, moving away from a design that tried to capture a maximum of natural light to designs which relied on electrical light.

In this way, the history of electrical wiring in the USA presented by Harrison shows us how closely the expansion of infrastructures is related to practices which manage, facilitate, or even 'automatically' create demand (i.e. through the concept of adequately wired houses). In fact, Harrison observes these practices as done by actors which would usually fall outside the scope of historical analyses of electrical infrastructures for the simple reason that *they are not actually energy providers*. I consider this a valuable study not only because approaching electrification through practices allows us to cast a wider web of potential actors, but because it draws our attention to how instrumental a 'mere' concept such as adequate wiring can become in the context of infrastructure deployment. As we will see later on, this also plays a role in our case study of fibre optics networks. A similar example is offered by Carlsson-Hyslop (2018), who follows the development of central heating in Britain and in doing so, shows how not only the concept of 'central heating' itself, but also the understanding of adequate indoor temperature, changed over time in response to and in conjunction with morphing infrastructures and practices.

And here, we come to the issue which the authors discussed so far leave unaddressed. If infrastructures co-develop with demand(s), then what is it that prompts the expansion of infrastructures in the first place? Where is the demand and what kind of demand is there before infrastructures exist? For now, we do not yet know what kinds of practices we will find in connection with the deployment of telecommunications networks; but thankfully, Silvast (2018) has already blazed a trail for us in regard to the operation of energy networks.

While Silvast sets out "to show how the electricity infrastructure works within and as part of a wider politics of provision, and to better understand how infrastructures and everyday consumption constitute each other" (Silvast, 2018, p. 172), the case discussed in fact also helps us on our quest, even though it is a very different one. Silvast illustrates how differently demand can be *seen and managed* within the same sector and even the same company. To understand the significance of these findings, we need to understand the context in which such practices occur. Energy markets in Europe are regulated, requiring functional separation of units dedicated to managing the energy network and those operating as traders on the European energy market. Between the "electricity network room" and the "energy market centre" (Silvast, 2018, p. 172), whatever could be called 'demand' is practised differently. In the electricity network room, demand becomes visible as outages and faults, as potentially interrupted. Such information would be of little use to the staff in the energy market room. Demand there emerges as fluctuations of energy provisioning at the European level, marked with changes in prices, and the aim is to balance the inputs and outputs of the system to achieve the best possible price. Although these two rooms are right next to each other physically, and the network as well as the organisational context create a link between these rooms (but not in all cases), they are worlds apart in terms of what demand means and how demand can be reacted to. Silvast convincingly argues that this separation of the rooms and the ensuing separation of practices is related to different political visions and a corresponding regulatory framework (Silvast, 2018, pp. 179–182).

The observation that demand is practised differently in different contexts asks us to take a radical step and depart from the idea that demand is only one invariable and context-free thing. To do so, we need to draw on theoretical approaches developed outside of infrastructure studies – and for this reason, I believe it is time for us to submerge ourselves in the epistemological waters from which I draw.

2.2. A sketch of theory

Now that we have become acquainted with research on infrastructures more broadly, and demand within infrastructures more narrowly, it is time to equip ourselves with the tools we will need to enter our case study. I have chosen to draw on two inseparable strands of theory, namely ontological multiplicity and sociomaterial practices. While we have already glanced at practices and their role in infrastructures, we are not yet familiar with ontologies as they are understood in STS, and so we will start by exploring this aspect first.

2.2.1. Of multiple ontologies

Let me be clear from the start: I have no fixed definition of what demand is or what it is not. Instead, I draw on the long line of research on performativity in STS and related fields to say that the very concept of 'demand' is context-specific, emerging within a particular constellation of actors who use this concept and whose actions are changed through this concept (Callon, 2007; Gherardi, 2016). This is to say that a theory like the Black-Scholes formula or marginalist analysis works within a particular assemblage (Deleuze & Guattari, 1987) or *agencement* which enacts this formula and therefore helps it to hold true – and for this very reason, concepts need (to create) their worlds (Callon, 2007). But significant as performativity is, focusing on the performativity of demand drags us away from infrastructures again, especially if we want to look at the relations between demand and infrastructures. My solution is to turn to something which at first glance seems entirely different. My understanding of demand is akin to Mol's (2002) understanding of atherosclerosis: demand is not merely a 'thing' that is there and exists independently of practice. Instead, demand is *an ontological*[4] *object that is multiple*.

One object which is multiple – a proposition which may sound strange at first, so let us go into the case described in detail by Mol (2002) after several years of fieldwork in a Dutch hospital. Following atherosclerosis around the hospital, Mol gradually observed how the disease of atherosclerosis involves a variety of heterogeneous practices. When they have trouble walking long distances or living with an amputated leg, patients do atherosclerosis in ways that doctors do not. Surgeons see atherosclerosis through an angiogram and evaluate how much of the leg needs to be amputated – yet the picture of atherosclerosis offered by an angiogram differs greatly from that of a sonogram, which relies on the pulse to determine the extent to which the veins are calcified in the leg. Pathologists use slices of tissue to determine whether and to which extent a patient had atherosclerosis when the patient, or their leg, is no longer alive: they do atherosclerosis by evaluating whether amputation was or would have been necessary, always after the fact. On the other hand, clinical practitioners who initially refer patients to the hospital encounter atherosclerosis through the way it limits the walking capacity of their patients and whether they can feel a pulse in their legs.

As Mol's observations show, there is no single 'thing' which could be called the one and true atherosclerosis. At an ontological level, what atherosclerosis is might be defined differently by each of these expert communities, but this does not mean that only pathologists see atherosclerosis for what it really is, or that only patients understand what having atherosclerosis really means: everyone is doing disease, albeit in different ways. Atherosclerosis 'hangs together' through – not despite – all of these practices, and practices offer an avenue to understanding how a multiple object such as atherosclerosis comes to be.

If atherosclerosis can be a multiple object which we can approach through understanding the practices involved in its construction, I would suggest that we can do the same with demand in the context of deployment. I am very specifically talking about demand in the context of deploying fibre optics networks, because I suspect that this would be a very different discussion when talking about demand in other contexts: for instance, when networks are set to be switched off, or when networks are

[4] I use the term 'ontology' frequently, so let me briefly explain what I mean when I use it. Ontology refers to the nature of being, which entails knowing what something is or understanding ways of being. What is means to be, or for something to be, can vary considerably and is imbricated in politics – that is, constant (re-)negotiations under changing circumstances.

operational, or even if we were talking about mobile networks. But this is a trail that we will follow much later on through empirical material.

2.2.2. Of sociomaterial practices

Unfairly, perhaps, I have so far withheld what it is that I mean by practices – and even more urgently, what sociomaterial practices are supposed to be. This is not an oversight on my part, but an unfortunate effect of the written format, which means that we can only go through one thing at a time. Having started with examples, however, gives us an advantage now that we are moving on to the theory, and hopefully it helps us to "see things in the middle, rather than looking down on them from above or up at them from below, or from left to right or right to left" (Deleuze & Guattari, 1987, p. 24).

Sociomaterial practices link things, people, times and places through their relations. Gherardi describes this as "the process whereby humans, artefacts, rules, technologies, sensible knowledge, legitimacy and any other practice resource become connected thanks to a collective knowledgeable doing" (Gherardi, 2019, 185). This probably sounds very abstract to you now, but we have already seen what this means: through practices which link the patient's walking distance, the calcification of veins in the leg, and an angiogram for instance, atherosclerosis becomes a certain kind of disease (Mol, 2002). Through practices which connect the configuration of homes to the transmission networks supplying electricity as well as the appliances which draw on it, electricity becomes a specific – namely a domesticated – kind of kilowatt (Harrison, 2018). Through practices which connect the energy network room to the sensors monitoring the electricity network, and the staff in this room via telephone to the field engineers who maintain the network and fix any disturbances, a certain kind of demand emerges (Silvast, 2018) which is done differently than in the energy market room.

These examples show us that sociomaterial practices are deeply steeped in ontologies, or ways of being, which of course also entail ways of knowing, making possible the "collective knowledgeable doing" (Gherardi, 2019, p. 185), i.e. sociomaterial practice, which links a variety of actors and places. I have abbreviated the humans and artefacts mentioned above as 'actors' because from an STS perspective, there is no good reason to exclude things from the scope of analysis when studying humans (e.g. C. B. Jensen & Morita, 2015). The pathologist's microscope is equally crucial for doing 'pathology-atherosclerosis' as the field engineers are to doing 'energy network room-demand'. In fact, the relations between these actors and within our sociomaterial worlds are not simply given, but constructed interactively (Gherardi, 2016) or even intra-actively (Barad, 2003) – the latter concept stressing even further that within a phenomenon, all actors are related, and differences made between actors are constructed by means of an agential cut that separates these actors into things-which-are-related, or "relata" (Barad, 2003, p. 815). This is probably heavy to digest, so we will go through it a little more slowly. We will also use the opportunity to talk about fibre optics networks for the very first time in our journey.

Fibre optics networks are a type of fixed-line very high capacity network, which offer fast download and upload speeds. Fibre to the Premises (FTTP) is considered to be the standard for very high capacity network and can be further divided into Fibre to the Home (FTTH) and Fibre to the Building (FTTB; Curram et al., 2019, p. 19). FTTH networks extend right into the area of use, e.g. the apartment, while the fibre optics part of FTTB networks ends where the building begins. Of course, these networks do not simply come out of thin air, but are connected to so-called backhaul and even further down the line to backbone, or core, networks: these two types of networks carry the combined traffic over longer distances. To visualise what this looks like, let us take a quick look at Figure 1.

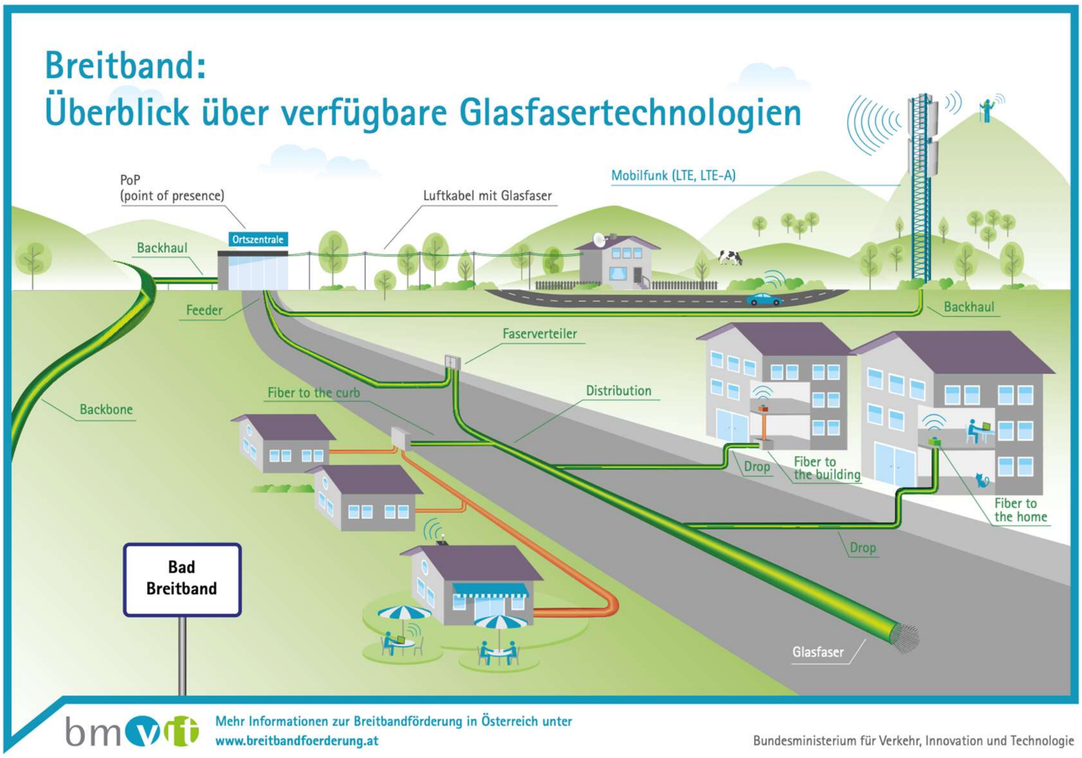

Figure 1: Visualisation of different kinds of fibre optics networks (BMVIT, n.d.). The green lines signify fibre optics cables, while the red lines signify copper or coaxial networks.

We will go into fibre optics networks again a little later in more detail. For now, what matters is what I have done in the previous paragraph: the phenomenon of fibre optics networks, which to you might have thus far been a unit without any further differentiation, has been split into FTTH, FTTB, and then some kind of long-distance transmission networks. By presenting the agential cut enacted by others before me, I have continued the established practice of making a difference between these networks.

This is what agential cuts are about: they make differences between things in specific ways in the very act of defining their relations to each other (Barad, 2003). Agential cuts are everywhere, and they are a powerful tool as well as a tool of power. I think that this notion is valuable for this case study for two reasons: first of all, it helps us understand what is happening when we submerge ourselves ever deeper in these infrastructures. Even if you had barely heard of fibre optics networks before, you will become folded into these infrastructures in the course of this journey, and ever more differences will be made between things which seemed the same to you. In this sense, agential cuts leave marks on what we are observing, showing the path we are taking just like the markings left on trees in the forest. But they also show that infrastructures are more than 'merely' technical, or material. Infrastructures are ontologically enmeshed: they encompass, create, modify or otherwise interact with people and things and practices in many varied ways of being.

To understand this a little better, we need to turn to the proposition advanced by Jensen and Morita (2015) and think of infrastructures as ontological experiments. They explain that "[i]nfrastructures […] give rise to ontological experiments because they are sites where multiple agents meet, engage, and produce new worlds" (C. B. Jensen & Morita, 2015, p. 85). Often, these ontological experiments are silent, like the long-stemmed rice of the Chao Phraya delta gradually becoming an infrastructure for preventing the flooding of cities, pulling its farmers along into infrastructural relations. At least equally often, Jensen and Morita argue, these ontological experiments do not become the centre of controversy or even political debate. Yet this does not mean that infrastructures are not political; rather, they are sites of *ontological politics*: renegotiations of what it is that things are. Not only are politics embedded in infrastructures, but infrastructures allow for political forms to emerge from the relations which infrastructures configure in an experimental manner. Experimental is a keyword here: leaning on Rheinberger, Jensen and Morita propose that the operations of infrastructures, like scientific experiments, "bring to life novel relations and objects that do not correspond with the intentions of policy makers and engineers" (C. B. Jensen & Morita, 2015, p. 83).

Understanding infrastructures as ontological experiments becomes possible once we hold on to the concept of practices and enactments – but we can also take another route, via performativity. Among the many authors engaging with performativity, Callon (2007) is probably best-known for applying this concept in a variety of studies. Performativity refers to the ability of things, ideas, documents, and whatnot to act on the world, and Callon leads us through an example to illustrate what performativity means by looking at the Black and Scholes formula. This formula forms the basis of an option pricing model which was previously widespread in financial markets. In order to work, the formula depended on sociotechnical arrangements – a world of measuring skewness, of software to provide quotes on a continuous basis, and of financial traders behaving like the formula expected them to. For this reason, the Black and Scholes model, far from being a 'neutral observer' or even a 'mere idea', "sets in motion events that without it would not have happened and that, once taken into account, lead to new sociotechnical *agencements* [i.e. assemblages]" (Callon, 2007, p. 324).

Even more so, performativity requires the creation of a world where the relations established by it are possible, which is why sometimes, concepts work in particular settings but not in others. There are actions necessary to make this world, like that of the Black and Scholes formula, hold together. Maybe we could call these actions *experiments*. Muniesa and Callon refer to experiments as "a crucible in which theories, discourses, practices, interests, and materials can be gathered together and elaborated." (Muniesa & Callon, 2008, p. 184). I do not fully subscribe to their definition of experiments, as we remain steeped in the context of infrastructures. However, as disparate as Mol's atherosclerosis and Muniesa and Callon's economic experiments may be, we have an intersection here where the ontological multiplicity of concepts meets performativity in an experiment of infrastructure.

We are back where we started: the relations between things and people and how these relations are made continuously (or in other words, constantly becoming). Like before, we know that relations are doings – disease doings, infrastructural doings, you name it –, but now we know that we should be on the lookout for actors, ontologies, and experiments once we head into the field. Following sociomaterial practices of demand may help us to map out relations within the situated context of infrastructures. And now having built our little raft, let us test it in the waters and head on to our fibre optics networks.

2.3. A cross-section of fibre optics networks

At last, we have come to the place where most theses on fibre optics networks probably start, namely with these cables capable of transmitting information in the form of light signals across long distances (Zuloaga et al., 2022). My research focus rests not on fibre optics networks in general, but on fibre optics networks built for telecommunications purposes, and for this reason, we will not look at the uses of fibre optics networks in other contexts here. Ideally, I want to equip you with all of the background information you need to launch into the empirical chapter – which means I am not striving to provide a full picture of fibre optics networks in telecommunications.

In the context of telecommunications, fibre optics networks are considered to be very high capacity networks because they offer higher bandwidths as well as better quality of service, e.g. in terms of latency, than other broadband technologies (Curram et al., 2019; Zuloaga et al., 2022). They are fixed-line networks, which means that if you subscribe to one of these networks, the cables extend all the way to your house. This is what fibre-to-the-premises (FTTP) networks are about, but these are actually differentiated even further into fibre-to-the-home (FTTH) and fibre-to-the-building (FTTB; Curram et al., 2019, p. 19). The difference between FTTH and FTTB lies in the interior wiring of buildings: if the cables for broadband transmission inside the building are based on fibre optics right up to the router, then you have an FTTH network, whereas FTTB networks only extend right up to the building (for a schematic, check out the depiction of the fictional village '*Bad Breitband'* in Figure 1). FTTP networks are considered to be the standard for very high capacity networks (Curram et al., 2019, p. 19) and they can achieve download speeds as well as upload speeds of at least 1 Gbit/s, and in theory, even a terabit per second (Zuloaga et al., 2022, p. 57). To give you a hopefully relatable example what this means: with download speeds of 1 Gbit/s, at least twenty people could simultaneously stream UltraHD or 4K videos using the same broadband access point (Breitsprecher, 2022).

In terms of actors, fibre optics networks take the centre stage in this case study; but of course, these networks are not the only ones which exist in our field. If you did go back to check Figure 1, you will see a mobile cell tower, and mobile broadband technologies indeed form a vital part of the broadband provision ecosystem. However, we will not discuss mobile technologies any further except for noting that for the most part, mobile networks rely on fixed networks because cell towers need to be connected to a backhaul network.[5] You might have noticed yet another acronym, namely FTTC. FTTC stands for fibre-to-the-curb/cabinet, and this means that the fibre optics network extends all the way to a distribution point at the curb, to which several houses are connected via a copper cable (Gerli & Whalley, 2021, p. 2; Zuloaga et al., 2022, pp. 55–56).[6] In comparison to FTTP networks, FTTC networks achieve up to 200 Mbit/s download speeds (Zuloaga et al., 2022, p. 56), but these download speeds are highly dependent on the length of the copper cable (Gerli & Whalley, 2021, p. 10; Zuloaga et al., 2022).

Which brings us to a brief overview of two of the main fixed-line networks for our context: firstly, the copper networks I have already mentioned as part of FTTC networks. On their own, they are usually called digital subscriber line (or DSL) networks. These networks originally offered only telephony services and were later upgraded to support broadband download speeds of up to 50 Mbit/s (Zuloaga et al., 2022, pp. 54–55). Secondly, we have coaxial networks, which were originally used for providing

[5] There are other ways of establishing backhaul networks for cell towers; but for the sake of simplicity, we need to push these issues aside.

[6] For the sake of completeness, there is also a version called FTTS, which stands for fibre-to-the-street; this means that fibre optics networks come closer to the end users' premises than with FTTC (Zuloaga et al., 2022, p. 56).

access to TV broadcasts. These coaxial networks achieve download speeds of up to 1.6 Gbit/s, with significantly lower upload speeds of 324 Mbit/s. They are considered to be a shared medium due to their technical design, which means that their capacity (e.g. download speeds) depends on the number of subscribers connected in a defined area (Zuloaga et al., 2022, pp. 58–59). Both copper networks and coaxial networks can be connected to fibre optics networks to achieve higher speeds: we have already encountered FTTC further above, while coaxial networks combined with fibre offer download speeds of up to 10 Gbit/s and upload speeds of up to 1 Gbit/s (Zuloaga et al., 2022, p. 61).

Copper and coaxial networks have experienced a differentiated historical development. While copper networks are near-ubiquitous and coaxial networks have also become widespread, FTTP networks are still quite rare, at least in Burgenland. Important as these other networks remain today, we will not explore them explicitly again. Instead, we will stick to FTTP networks, for the simple reason that these networks are necessarily newer than the others, and after all, we do want to know more about deploying networks for the first time.

So much for the network technologies we might usually encounter as subscribers – but networks are a little more complicated than just that. In fact, these technologies which we encounter as subscribers are called access networks. Access networks are connected to backhaul networks, which then connect to backbone (or core) networks. If you take another look at Figure 1, you can see both of these networks on the very left. While core networks are based on fibre optics cables, backhaul networks – at least in rural areas – do not necessarily rely on fibre optics cables. Download speeds are significantly lower if whichever kind of access network you are using is not connected to a fibre optics backhaul network. We are therefore also interested in fibre optics backhaul networks, the infrastructure making a fibre optics access network possible – the infrastructures of the infrastructures, so to say.

To sum up very briefly: fibre optics networks exist as one type of network among many, and often in combination with these other types. Depending on where you draw the line, fibre optics cables are already part of some level of the telecommunications networks. For the purposes of our journey, though, we continue along the path of our new fibre optics networks, by which we will mean FTTP in the access network and newly deployed fibre optics backhaul networks. Our choice is one of convenience for the purpose of a case study: in comparison to their more established peers, fibre optics networks are new. As such, they can tell us more about what happens when a network moves to places where it has not been before, which is incidentally what we will take a look at next.

2.4. A plane of network deployment

Acquainted as we are now with fibre optics networks, we need to cover one more topic before moving on to the next section, which is how these fibre optics networks move closer to our homes in the first place. The process of constructing and extending networks is called deployment, and the deployment of networks is an immensely expensive and complex endeavour. We will delve into the costs a little later; for now, it is more urgent to look into the context in which deployment happens.

First of all, let us continue our focus on the material. Fibre optics networks are as a rule deployed via ducts below ground, which means that often, trenches need to be dug, and in any case, wayleaves are necessary (Curram et al., 2019, pp. 32–33; Frischmann, 2012, pp. 215–216). Wayleaves grant those engaging in telecommunications deployment the right to place a cable across a certain space; within the limited space we are concerned with right now, wayleaves essentially grant their holder the opportunity to lay property across the property of others. Importantly, if someone already holds wayleaves, they do not have to be granted again – which means that the administrative process of getting approval for network deployment is greatly reduced for telecommunications providers with existing infrastructure as well as other providers of line-based infrastructure, such as energy providers (Curram et al., 2019, pp. 32–34). In a similar vein, coordinating civil works between telecommunications providers and utilities or even reusing existing infrastructures are considered to be effective ways to reduce the cost of deployment precisely because civil works make up the largest share of costs (Gerli et al., 2018, p. 729).

Which brings us to the actors usually involved in broadband deployment, namely telecommunications providers. In respect to deployment, it is important to note that "[p]rivate industry will suffer the high fixed costs associated with building new infrastructure only if there is positive expectation of profit" (Frischmann, 2012, p. 222). And here, we encounter our first differences between telecommunications providers.

In general, telecommunications providers come in various sizes and they may specialise on specific regions or technologies, or even specific types of customers (for a comprehensive overview, see Curram et al., 2019, pp. 17–18). I am not going to go into a lot of detail, but there are two things we need to know for now: firstly, telecommunications providers can be active at a variety of levels. Some offer retail services, which end users can subscribe to. Amongst these retail providers, some are focused on particular end user groups, such as business customers. Others offer wholesale services, which other telecommunications providers make use of in order to offer retail services, either voluntarily or imposed by regulation. Yet others offer both retail and wholesale services.

Secondly, telecommunications providers also have particular histories. Usually, there is one telecommunications provider, called the incumbent, which has the largest footprint within one country, alongside other commercial providers of various sizes which entered the field after the telecommunications market was liberalised. Some providers also focus on particular technologies: this is particularly the case for cable providers, which used to provide TV only but now also offer broadband via coaxial cables (Curram et al., 2019, pp. 17–18). These differences give rise to different strategies when it comes to deployment. For instance, many incumbents and commercial telecommunications providers prefer to upgrade their existing copper networks by investing in FTTC (Gerli et al., 2018, p. 735) or, in the case of cable providers, upgrading their coaxial cable networks and deploying fibre only in selected new areas (Curram et al., 2019, p. 18). These preferences are sometimes described as path-dependencies, meaning that providers will continue to invest in expanding or upgrading existing networks rather than creating new ones (Gerli et al., 2017, p. 745).

Broadband deployment is not only something that telecommunications providers do: in fact, there are significant policy interventions to improve access to broadband generally (e.g. European Commission, 2021; OECD, 2021) and in particular in rural areas (Gerli & Whalley, 2021; Salemink et al., 2017; Salemink & Strijker, 2016, 2018; Strover et al., 2021). This takes on a variety of forms, such as setting broadband coverage targets like the European Commission has done (European Commission, 2021), or setting broadband deployment targets like the broadband strategy of Burgenland has done (Amt der Burgenländischen Landesregierung, 2021). It can also mean that public funding is provided for deployment in underserved areas – which are to be found, more often than not, in rural contexts.

Public funding is important in the context of this case study, which is why we need to take a closer look at it. Under the European framework for state aid, which lays out rules for public funding, projects to improve access networks can only be subsidised under certain conditions.[7] Areas are therefore classified as either white, grey or black to signify their eligibility for funding by European member states (Feasey et al., 2018, p. 50). If networks offering over 30 Mbit/s download speeds neither exist nor will be deployed within three years, areas are classified as white and investments into networks in these areas can be financially supported by states through granting state aid (Curram et al., 2019, p. 17; Gerli & Whalley, 2021, p. 5; Salemink et al., 2017, p. 361). If only one operator provides a very high capacity network (Salemink et al., 2017, p. 361) or can provide a business case for doing so, an area is classified as grey and may be eligible for state subsidies after a more detailed review (Curram et al., 2019, p. 17; Feasey et al., 2018, p. 52). Black areas, on the other hand, have multiple very high capacity networks

[7] Subsidies for fibre optics backhaul and cabinets would be possible even in black areas, albeit under stringent conditions (Feasey et al., 2018, p. 52).

operated by more than one telecommunications provider. They are therefore considered to be highly competitive and do not qualify for state subsidisation (Curram et al., 2019, p. 16; Feasey et al., 2018, p. 52).

Before we move on, there are two things which are notable about this classification. First, it is thoroughly sociomaterial (Gherardi, 2016), as it takes into account not only the presence of certain kinds of telecommunications networks which are capable of certain download speeds, but also the presence of actors, i.e. a certain number of telecommunications providers. Secondly, the practice of classification is just that – a practice. I think we can observe it the same way as we would observe the concept of adequately wired houses (Harrison, 2018) or room temperature (Carlsson-Hyslop, 2018) or indeed the diagnosis of atherosclerosis (Mol, 2002).

Public funding is an instrument fit for a state wishing to intervene in broadband deployment, but states are not the only actors which may become involved. While we will go into it in more detail in the next section, for now, let us just note that municipalities, utilities[8] and community networks can play an important role in advancing deployment.

Let me attempt to summarise the ground we just covered. Fibre optics networks can be differentiated in a variety of ways: you have the differentiation within the access network, but also between access, backhaul and core networks. The conditions under which different actors expand or build fibre optics networks are highly contextual, and for this reason, policy intervention is common. From broadband strategies to public funding, these interventions give rise to a variety of specific actor-constellations. What I see in all of these factors is that network deployment is a practice – and for the next section, I would like us to explore what this practice is like in rural areas.

2.5. A plot of rural networks

We have already caught a few glimpses of rural areas thus far, but it is not yet clear why rural areas are special cases. Often, telecommunications providers are not very active in rural parts, which is generally defined as a market failure (Gerli et al., 2017; Preissl & Howell, 2021; Salemink et al., 2017). In the literature on this topic, authors seem to agree that it is more expensive to deploy fibre optics in rural areas. As deployment costs are recovered by acquiring a sufficient number of subscribers, in less populated and less densely populated rural areas, you do not have the same return on investment as in urban areas (Curram et al., 2019, pp. 30–31; Frischmann, 2012, p. 223; Gerli et al., 2017; Preissl &

[8] A utility is an organisation which provides services deemed essential, such as water, electricity, (rail)roads etc. Utilities can be publicly or privately owned.

Howell, 2021, p. 2; Salemink et al., 2017, p. 367; Salemink & Strijker, 2016, p. 780; Zoz et al., 2021, p. 37).

Recognising this, we now have a few options for how to proceed: for one, we can take it as a natural fact that demand equates to a density of subscribers and, when it reaches a certain critical mass, infrastructure will flow to meet this demand. I would advise against this because in doing so, we would preclude the possibility of understanding the how and why of these cases; but it is a choice you can make at this point. My choice is a different one, for I wish to understand the differences we have encountered briefly thus far between this 'natural fact' and the practices of our unusual actors, which we are about to explore in more detail. We will therefore continue on our path of thinking of network deployment as a practice. From the angle of doings, then, I would suggest that what we can observe is that in rural areas, *some telecommunications providers appear to perceive a lack of demand which is comparable in profitability to demand in urban areas*. Looking at how rural areas are enmeshed in network deployment could therefore help us learn more about deployment in general.

As I mentioned earlier, telecommunications providers are sometimes not very active in rural areas, which calls others to the table. Looking at these actors, then, we can see that they are often linked to communities or the public sector, although there are also telecommunications providers specialised on deploying in rural areas (Curram et al., 2019, p. 18; Gerli et al., 2017). In terms of public involvement, municipalities often get engaged, and their involvement occurs particularly frequently "in low demand regions" (Troulos & Maglaris, 2011, p. 852), where they either deploy fibre optics networks themselves, usually in cooperation with a publicly-owned energy provider, or they form public-private partnerships with private companies.

Despite their frequent involvement, energy providers are mostly overlooked as actors in this ecosystem. Often, their broadband deployment activities are in some way related to policy initiatives. As described by Gerli et al. (2018), public support is crucial to the involvement of utilities in broadband deployment. Interestingly, the scope of operations of the utility usually mirrors the scope of political involvement: local utilities were heavily involved when policy action was local, while national utilities tend to become active at the wholesale level when national governments are involved (Gerli et al., 2018, pp. 739–740).

Public-private partnerships on the other hand can vary in their set-up and the extent of public control: they can usually be differentiated according to who builds, designs or operates the network (Gerli & Whalley, 2021, p. 3). An important factor is who, in the end, has control over the network and where it goes, and the authors note a reverse trend in this field where publicly funded broadband networks often end up owned by private companies (Gerli & Whalley, 2021, p. 3).

Last but not least, I would like to mention community networks. There are a variety of ways to define community networks (Gerli & Whalley, 2021; Strover et al., 2021), but these are usually local initiatives which may or may not garner support from municipalities or local governments for their projects. For the most part, community networks try to retain control over the network they have built or funded instead of selling it to other businesses (Gerli et al., 2017; Gerli & Whalley, 2021; Salemink & Strijker, 2016, 2018; Strover et al., 2021).

We will follow the role of public actors now and take a closer look at selected case studies of these projects. These case studies are relevant to my own case because they contextualise the variety of initiatives to be found in Austria. In turn, they provide a backdrop for the case we are preparing ourselves for, namely the broadband strategy of Burgenland. While other cases exist, I have chosen these accounts because the methodology of their authors corresponds most closely to my own.

Since they are the furthest away from our case, let us start with community networks. The case we will take a look at is Broadband for the Rural North (B4RN), a not-for-profit initiative in the UK which helps small and remote communities build their self-funded networks. These networks are owned by the communities but operated by B4RN, which involves the communities in designing but also physically deploying the networks, achieving a cost of £700 per premise (Gerli & Whalley, 2021, p. 8). I am explicitly stating the cost here because this project aims to serve those left behind by other projects and simultaneously achieves much lower costs for FTTH deployment – an interesting outcome which, as the authors argue, results from the close attention to local specificities. However, citizen initiatives require a significant amount of skills and knowledge as well as dedication and perseverance (Salemink & Strijker, 2018), in addition to sufficient financial resources (Gerli & Whalley, 2021), which means that citizen initiatives may not be a realistic option for some rural communities.

Public-private partnerships can also take on a variety of forms, but usually operate on a larger scale than community networks. In one of the cases described in detail by Gerli and Whalley (2021), Broadband Development UK subsidised deployment of private actors using a gap-funding model[9] with the aim of facilitating 90% and later on 95% broadband coverage. The areas where broadband should be deployed were identified through consultations, and tenders were subsequently published for these areas which were mostly won by the incumbent seeking to deploy FTTC. Importantly, public authorities coordinating these tenders experienced several restrictions which made it difficult for the programme to effectively ensure that the hardest-to-reach communities would be connected, e.g. as the maximum cost

[9] When a gap-funding model is used, public funds are provided to ensure that private companies deploying the networks achieve a rate of return deemed acceptable (Gerli & Whalley, 2021, p. 6).

per premise was set to £ 1.700; however, universal coverage had also not been set out as the goal of the initiative (Gerli & Whalley, 2021, pp. 5–7).

Moving on to utilities, we can see that while they are comparatively less well-researched, their involvement in broadband deployment depends heavily on national frameworks for utilities[10] but can be significant, e.g. in Sweden (Gerli et al., 2018, pp. 732–733). From the cases discussed in detail by Gerli et al. (2018), the authors conclude that the regulatory framework for telecommunications had a minor impact on whether utilities became involved in telecommunications network deployment. Instead, the authors argue that "[c]ollaborations with public partners (e.g. local councils or municipalities), state aid and public interventions to reduce [the] digital divide have been more relevant for utilities, with a direct effect on their geographic focus and expansion strategies" (Gerli et al., 2018, p. 737). For the most part (with one exception in Italy), the deployment of telecommunications networks followed the geographic footprint of their own networks. Interestingly, the utilities described in these cases all deployed fibre optics networks, despite "the demand for gigabit connectivity [… being] unclear" (Gerli et al., 2018, p. 738).

Out of the various cases described by Gerli et al., I would like to focus on the case of Utsikt in Sweden. This network operates in the municipalities of Mjölby, Linköping and Katrineholm, which have some similarities in terms of population density with Southern Burgenland. In Sweden, the involvement of utilities in broadband deployment is historically strong, with projects commencing already in the mid-1990s and focusing mostly on fibre optics.[11] Utsikt is owned by two electricity providers, which are in turn owned by municipalities, and was founded in 1995. Today, Utsikt connects over 50.000 premises in both urban and rural areas with fibre optics networks, drawing on public subsidies in a few cases but mostly relying on its own revenues and loans for deployment. Initially, Utsikt offered retail services, but later on switched to wholesale operations on an open-access basis (Gerli et al., 2018, pp. 732–733). Unfortunately, we do not know enough about how these energy providers selected or prioritised areas for deployment; but this is, I think, one of the areas where my findings may contribute.

[10] Legal and regulatory frameworks for utilities, while tending toward harmonisation at European level, are currently still very heterogeneous (Gerli et al., 2018, p. 728).

[11] It is notable that the pattern of involvement of utilities in Sweden appears to mainly have reflected their geographic scope: backbone networks were deployed by regional and national electricity providers, while local utilities focused on access networks (Gerli et al., 2018, p. 732).

I would like to stress that for all of these initiatives, the ‘problem of demand’ exists just as it does for telecommunications providers.[12] After all, these initiatives do not begin to relocate people to decrease the distance between the premises to be connected, or to increase the number of people living in a given area. There is no significant material change in the circumstances for deployment. Instead, these initiatives develop different approaches to deploying networks *and also to scoping out and making demand*. For instance, Salemink and Strijker described how rural, community-led broadband initiatives in the Netherlands created an “inventory of demand” (Salemink & Strijker, 2016, p. 785) allowing them to proceed with the project, followed by a campaign to convince people to sign up and subsequent demand aggregation through a pre-contracting rate – which means that in advance of the network being deployed, 50% or more of the people to be connected need to commit to subscribing to the network-to-be-deployed (Salemink & Strijker, 2016, pp. 785–786). Gerli and Whalley describe the pivotal role of demand aggregation for the operations of B4RN, where each parish was required to raise enough funding within the community to connect everyone within the parish before the project commences. In contrast to the Dutch cases, however, subscriptions in advance were not required (Gerli & Whalley, 2021, pp. 7–8).[13] Amongst this lively variety of practices, however, it still remains nebulous how utilities or energy providers engage in these practices. We will try to find our niche here by exploring these practices through empirical findings.

Before we finish, let us focus on one more important issue which I have already mentioned further above, in one of the quotes: the digital divide. In principle, the digital divide refers to differences in terms of access to, use of, or positive outcomes related to the Internet (Gerli et al., 2017, p. 744; Gerli & Whalley, 2021, pp. 1–2; Salemink et al., 2017; Salemink & Strijker, 2018, p. 762). Going into the issues of the digital divide would require much more space than we have here, but it is important to understand that differences in access to broadband in rural areas are the reason why many of the actors we have discussed become active in the first place – municipalities and other policy makers, potentially together with utility providers, and also community initiatives. Broadband networks, in this view, are more than merely a nice-to-have. One way to make this argument more relatable is to wrap it in more infrastructures: the analogy of this approach would be to say that it may be acceptable to have a reduced range of products at the grocer’s in rural areas, but it is not acceptable to not have enough electricity to power your run-of-the-mill household devices just because you are in the countryside. For these

[12] Interestingly, Gerli and Whalley note that the ‘problem of demand’ appears to persist for telecommunications providers even after the networks have been built, because the remote communities to be connected are too small as to be of interest to large telecommunications providers (Gerli & Whalley, 2021, p. 9).

[13] The take-up rate, which is the number of premises opting for a subscription to this network, was usually around 65% (Gerli & Whalley, 2021, p. 8).

initiatives, the Internet belongs to the realm of everyday requirements like electricity, and should therefore be equally available in rural areas just like it is in cities. These approaches not only consider broadband to be essential for everyday life, but argue for *a certain kind* of broadband connection that is comparable to that in cities. Such a development is reminiscent of the journey of concepts such as room temperature (Carlsson-Hyslop, 2018) and adequately wired houses (Harrison, 2018), where not only access to heating or electricity came into focus but particular kinds of usage enabled by these infrastructures.

According to Salemink et al., one key limitation of the literature on the digital divide is that it focuses on either the demand or the supply side, with the former stressing the need for inclusion and the latter stressing the costs of deployment (Salemink et al., 2017, p. 368). As we know from our earlier encounters with infrastructures and demand, such a split misses out on the interrelations between supply and demand in the context of deployment in rural areas. From where I am standing, this split looks more like an agential cut than a necessity, and I think we can cross it safely with our little raft of sociomaterial practices and ontological multiplicity. In sketching these cases, I tried to highlight that significant differences exist when fibre networks are deployed by different actors. If we follow the remarkable variety of practices related to demand, perhaps like the practices of atherosclerosis we followed for a while alongside Mol (2002), we might be able to understand these differences better.

What we have seen in this section is that deployment in rural areas can be tricky and is not a priority for established telecommunications providers – although some alternative providers may develop their business case around it. Frequently, concerns around the differences in access and quality call public initiatives to the table, which may be connected to administrative or government projects (e.g. municipalities, funding programmes, public-private partnerships) or may emerge from a grassroots, bottom-up movement. Often, municipal projects partner up with utilities and energy providers. All of these ‘unusual’ actors seem to be mostly focused on fibre optics networks, which sets them apart from the focus on FTTC displayed by established telecommunications providers. As different as these initiatives are, they all face the challenge and cost of deploying networks in areas which are not as highly or densely populated as urban areas, and they develop a variety of different strategies to deployment. In the case of public- or community-affiliated initiatives, these initiatives are often motivated by reducing the digital divide between urban and rural areas.

2.6. Conclusion

Before moving into the field, I think it would be good to briefly take stock of our path so far. Infrastructures in the social sciences have been researched using a variety of approaches. One of these tries to understand the role of demand in the context of infrastructures, and while a broad range of questions have been opened up, in particular on the role of demand in infrastructural contexts, there are no studies to date focusing on the role of how demand is conceptualised in the context of infrastructure development.

Other research has focused on the specific ways in which telecommunications networks, and particularly fibre optics networks, are deployed. This research provides us with a general idea of how network deployment is organised, which factors influence deployment, and the differences in network deployment in rural and urban areas. Furthermore, it brings up the digital divide as an issue which not only should be attended to, but has given rise to various strategies aiming to increase broadband deployment in rural areas.

What strikes me is that the different ways in which demand is practised – conceptualised, measured, engaged with and reacted to – affects and effects how deployment is done. And it is here amongst these intricate details of practices and relations where the tools of STS seem right at home to me. Based on the literature reviewed, I hope that my research can make a minor contribution to understanding the interrelations between demand in the context of deploying telecommunications infrastructures from the perspective of the social sciences. For telecommunications research, I believe there are valuable things to learn about the involvement of energy providers in broadband deployment and how policy interventions aiming to close the digital divide may be organised. To my knowledge, this is the first such attempt in either field specifically focused on the context of fibre optics networks in Burgenland (or Austria), which will hopefully shed new light on these developments.

Having acquired parts of what we need to know about the setting of this field, I would like to invite you to join the next part of our journey, where we will get to know the tools I have used to bring us from what we know now to my empirical findings.

3. Methods

3.1. Introduction

Methods form an integral part of how researchers can understand processes and make these accessible to others. Which methods are suitable for conducting research in a given field therefore depends on the field: which processes and aspects we seek to understand, how the field is entangled with others in a wider setting, how existing academic work has approached this field and how we employ theoretical approaches to provide a certain sensitivity towards a specific set of issues. In this section, my aim is to provide a clearer picture of the setting of the case I have chosen and to explain my research conduct within this particular context. We will first take a look at the questions I used to orient my research before moving on to my research design and finally to the analysis process.

3.2. Research questions

To guide my research endeavours, I developed one main research question and three sub-questions. My main research question is: *how does the broadband strategy of Burgenland enact demand in the context of fibre optics networks deployment?* This question seeks to understand fibre optics network deployment as an emergent becoming of the material, in the sense of an assemblage – a changing constellation of actors hanging together through their relations (Deleuze & Guattari, 1987; Gherardi, 2016). What I want to understand, overall, is how certain conceptions and practices relating to demand are enacted within the framework set by the broadband strategy and shaped by fibre optics networks deployment as a wider 'web' of practice (Gherardi, 2019). As this research question is heavy with theory, I have rooted it in three sub-questions aiming to open up my research to the empirical field.

Sub-question 1 grapples with the issue of what is happening at the level of the broadband strategy and who the actors are in this field. It is formulated as: *how does the broadband strategy offer a field for or means of action for particular actors?* Addressing this research question helps us explore the interrelations which characterise the field and simultaneously gives us a chance to ease into the constellations we will encounter further down the road.

With sub-question 2, I try to take us deeper into the aspects related to demand and ask: *how does demand become enacted through specific practices at the level of the broadband strategy and during the material deployment of fibre optics networks?* Following this sub-question allows us to head right into a thicket of ontological and infrastructural entanglements while remaining grounded through our empirical path.

Combined, these two sub-questions open up a third sub-question, which is: *how do the materialities of energy infrastructure interact with the deployment of telecommunications infrastructure in the case of co-deployment by an energy provider?* Knowing already what you have not yet discovered, one of the more unique features of this case study is that an energy provider has been tasked with deploying telecommunications networks. Through this sub-question, we get the opportunity to take a closer look at what it means when infrastructures accompany each other.

3.3. Research design

Having laid out my research questions, I owe you a few more words on how I have designed my research approach. I am interested in gaining a deeper understanding of a relatively well-bounded case which means that I am conducting a case study (Mabry, 2008). This implies that a number of choices have to be made regarding the research design, which I aim to discuss in this chapter.

3.3.1. Practice-based case studies

In the previous chapters, I have stressed the importance of practice in my approach to the topic – what I am looking for, after all, is not 'demand itself' but how demand is practised in a specific context and configuration. The research I conducted for this thesis is built on a case-study approach. Generally, case studies rely on qualitative methods due to their suitability for interpretivist approaches; they focus on providing depth (instead of breadth, as is the case with quantitative approaches), draw on emergent design, and expand datasets by including new sources and exploring new questions (Mabry, 2008, p. 216). I have chosen to focus on an atypical case for my research question because they help "to account for enigmatic counterexamples at the margins of generalized explanations, offering invaluable opportunities to improve abstracted representations of social phenomena" (Mabry, 2008, p. 217).

In this methodological framework, the aim is not to assemble a representative sample, as the case study does not aim to be representative either. Sampling is purposive: instead of assembling a random sample (of documents, say, or interviewees), the aim is to sample according to what is considered particularly notable (Mabry, 2008, pp. 223–224). My sample thus emerged from the core focus of my research questions: after analysing the broadband strategy, I got in touch with potential interviewees who were affected by the strategy or had a specific role within its framework.

3.3.2. Reflexivity

One important cornerstone of qualitative research is transparency regarding the researcher's situatedness within the field. Reflexivity should, ideally, offer a way for others – researchers, research participants, readers – to follow along the decisions made during the research design, the analysis and presentation of results (Law, 2004).

In my case, positionality is a sensitive issue which has sprung up in several ways and I will therefore address these issues in some length. To start off, I am a white woman born in Vienna, Austria, who has lived in Northern Burgenland for several years. By training, I am a social and cultural anthropologist, which is to say that my approach to social science research is by default oriented towards ethnography. For the past few years, I have been working for the Austrian telecommunications regulator, RTR, albeit not in a function which draws on my anthropological background. After becoming immersed in this regulatory context, I decided that for my master's thesis, I want to experiment with the perspectives and methods offered by anthropology and STS – mainly to see what would come out when I apply these to the field of telecommunications research, which is mostly shaped by other disciplinary approaches.

With this idea in mind, I developed several possible topics I deemed adjacent to my work: connected in a sufficiently close manner to warrant experimentation, but not a matter of regulatory oversight per se. Out of the topics I presented initially, I narrowed the topic down to fibre optics network deployment, and at a later point, I decided to focus only the broadband strategy of Burgenland. Around the same time, reading Callon's (2007) explorations on the performativity of economics, I started wondering what would happen when you take a closer look at the concept of demand. This tiny seed sprouted in the following months into a question – how are the conditions created in which the economic framework (of users exerting demand) can hold? For telecommunications, a precondition for users to exert demand is surely that there is a network. So how does it happen that certain types of networks are available in some places but not others, and what does demand have to do with all of this?

These developments are important because they accompanied me throughout the fieldwork and analysis as well as the writing of this thesis. As I mentioned right at the start, this thesis does not represent the opinion of my employer or TKK and I have conducted my research independently from my work. However, while this thesis is clearly an academic project, my research participants are themselves subject to regulatory requirements in a broad sense. The people I spoke with are required to align their practices with the regulatory framework for telecommunications, even though my topic is not exactly an issue of regulation.

Most guidelines for good research practice are clear about disclosing whether, and which kind of, research is conducted, in addition to receiving informed consent (E. A. Jensen & Laurie, 2016, p. 49). In my case, it was necessary to go beyond this level of transparency in specific research contexts. In line with good research practice, I informed those of my research participants with whom I conducted interviews clearly about my professional context in addition to informing them about the purpose and framework of the thesis, and that the results of my thesis neither reflect nor prejudge regulatory activities. My interview partners had the opportunity to read the transcripts of the interviews and comment on both the transcript and the summaries so that they could, if deemed necessary at a professional level, intervene and request additional anonymity measures or a reformulation.

Participant observation is more tricky in this regard: I clearly informed the organisers of workshops in which I participated of my research and how data would be used, as well as my professional background. At the events, I informed the people I met there about my research project and research interest, but I did not disclose my professional background. Given that some of my colleagues attended the events as well, and that it is not possible to attribute what was said to anyone with whom I had a personal exchange at events or in other contexts, negative professional consequences for my interlocutors are unlikely.

3.3.3. Overview of the data collected

The corpus of research materials I have gathered could be structured in several ways, so I will start by sorting it according to the methods I used to collect it and elaborate on its significance in the context of the thesis.

My research began with documents, and they accompanied me throughout the research process. I started out my research by experimenting with the theoretical approach I had chosen and applying it to a study on the factors which influence whether or not telecommunications providers invest in deploying very high capacity networks (Curram et al., 2019). In doing so, I worked out what could be considered a baseline, offering me something to which I could compare the materials I was collecting (see Annex I: A differentiated approach to demand). This proved particularly helpful in the next step of analysing the broadband strategy of Burgenland, which is the document around which the entire case unfolds. My analysis of the broadband strategy is one of the cornerstones of this thesis, but the significance of my findings was further underlined and also expanded by the materials collected using other methods.

In the course of ethnographic fieldwork and in connection with interviews, other documents emerged, such as the legal framework for electricity, press releases related to the broadband strategy as well as broadband deployment in Burgenland more generally, the Austrian funding guidelines for broadband deployment, the broadband atlas,[14] and what I would consider (in the context of this thesis) to be background material – information in various formats about fibre optics networks more generally, on

[14] Breitband Atlas: https://breitbandatlas.gv.at/

fibre optics for energy networks, as well as presentations and other documents which I came across during fieldwork.

I attended two conferences related to fibre optics networks for approximately half a day each. The field notes resulting from these conferences were crucial for situating the broadband strategy of Burgenland within its wider context of state-affiliated broadband projects and the question of rural fibre optics deployment. Three other research opportunities arose while discussing the transcript of the first interview, exchanging about the topic with an employee of a telecommunications provider, and during a trip to Southern Burgenland for my second interview. Amongst these, the third ethnographic experience has been delightfully unexpected and valuable, allowing me to understand how the people I encountered related to the deployment of fibre optics networks where they lived and worked.

Last but not least, I conducted two interviews: one with a person responsible for implementing the broadband strategy, and another with a mayor in Southern Burgenland. The first interview is integral to this thesis, as it gave rise to a number of new themes and contextualised many of the observations I had made in the course of the document analysis. The second interview gave me a better understanding of how these deployment projects come into being in the municipalities and what they look like from their perspective. I have used it in this thesis mainly to illustrate the case and to make the processes involved in broadband deployment more relatable, just like the interview helped to ground my observations.

After this short summary of the data I have collected, the most important questions still await – how have I collected this data, why have I chosen these particular methods, and how have I analysed the data. These are the questions we will explore in more detail in the subsequent sections.

3.3.4. Data collection

Generally, qualitative methods for collecting data in the context of case studies include interviews, observations and the analysis of documents related to the site or case, or any combination of these (Mabry, 2008, p. 218). During my fieldwork, I drew on all of these methods to collect data. As I analysed the data collected on a continuous basis, new opportunities for collecting data emerged: the data collected thus informed the data collection process. For this reason, while the methods are presented separately in the text, it should be clear that this is only a matter of presentation – in fact, it is difficult to detangle the relative contribution of these methods to the results of the thesis.

Reading the literature on network deployment (e.g. Curram et al., 2019; Gerli & Whalley, 2021; Salemink & Strijker, 2018), it seemed to me that implicitly, telecommunications networks go where there is ‘demand’, and a ‘lack of demand’ is reflected in a lack of telecommunications networks. Due to this uneasy relationship, I was from the outset interested in the material dimensions of demand, and this inflection was present both in the way I chose sites for data collection, in the type of questions I asked during interviews, and in the analysis of these data.

The topic of my research is both highly politicised and closely interwoven with concerns about business confidentiality, since the matters I explore are, in some ways, business secrets: confidential information about where networks will be deployed and at which point a 'critical mass' of potential subscribers is reached to make the business case of deploying networks. This is actually an environment where gatekeepers are important mediators of access to potential research participants and to information, and I expected particular difficulty due to my professional background (see section 29). I was quite lucky in the beginning, but my subsequent requests for interviews were ignored or outright denied due to compliance concerns. Participant observation was also a matter of gatekeeping: even though I had the advantage of encountering a wide range of perspectives at each of the conferences I attended, these conferences were focused on particular topics and designed for a specific audience. The result of these access constraints is that my two interviewees were a senior manager and a mayor, while the attendees of the conferences were government officials, managers, investors and consultants – and thus this thesis, amongst other things, is a study of elites.

3.3.4.1. Documents

The case study I have selected hinges on a document, and for this reason, two documents play a particularly important role. The study by Curram et al. (2019) on investment in very high capacity networks is comparatively recent and by virtue of its design (based on interviews with telecommunications providers) and institutional context (contracted by BEREC)[15] can be considered fairly settled knowledge about how telecommunications providers approach deployment and investment. The broadband strategy of Burgenland (Amt der Burgenländischen Landesregierung, 2021), on the other hand, does not seek to contribute to a knowledge base. Instead, the strategy aims to make a difference by initiating fibre optics networks deployment, setting out goals and making a specific entity responsible for reaching these goals: in short, the strategy is explicitly performative (Gherardi, 2019).

My approach to documents focuses on their role in practices (Prior, 2008). The questions I have asked are therefore, how is demand enacted in a particular way through a document? Which role do various documents play in shaping and legitimising practices of demand? To understand the role of these documents within their community, I particularly paid attention to which documents were referenced

[15] BEREC is the Body of European Regulators of Electronic Communications and facilitates the harmonised implementation of the legal framework for telecommunications. Every regulatory authority responsible for telecommunications is represented in BEREC and participates in its working groups.

and how research participants related to them. For example, during my research, the funding guidelines of BMF and FFG came up as important conceptual tools, as well as the broadband atlas. Together, these documents shape how demand is conceptualised geographically, while also mediating relations between different broadband technologies. Additionally, the funding guidelines – a part of the funding programme – enact a particular temporality for broadband deployment: the rhythms of funding become the rhythms of project planning.

3.3.4.2. Interviews

As mentioned further above, I conducted two semi-structured in-person interviews (E. A. Jensen & Laurie, 2016, pp. 173–175) of each 40 and 150 minutes in length. One of these was held with a person directly linked to the broadband strategy, where we explored both the strategy as well as network deployment (*Interview 1*, 2022). The other interview was held with a mayor of a municipality where we discussed the developments related to broadband and fibre optics deployment (*Interview 2*, 2023). Both interviewees received the questions in advance along with the consent forms to ensure that they could gather information or coordinate within their organisations, if necessary. I have included the questions of the interviews as an appendix (Annex II: Interview guidelines).

The interviews were recorded, summarily transcribed and translated to English (E. A. Jensen & Laurie, 2016, p. 237). What I mean by a summary transcription is that I transcribed a shortened version of the audio, supplemented by quotes which were translated in a verbatim manner. Two words which held a particular meaning in German remained untranslated as in vivo codes, namely "*Daseinsvorsorge*" and "*Leidensdruck*", and they appear in German throughout the thesis.

Due to the potentially sensitive nature of the information shared during interviews, I provided interview participants with the translated transcript of the recordings, who then had the opportunity to comment on the transcript or request the omission of direct quotes I selected during transcription in the final publication. This process also served as a form of triangulation (Mabry, 2008), where I summarised some of the insights I had gained from the interview and provided interview participants with the opportunity to respond to my preliminary interpretation, thus facilitating validation by my interview participants.

3.3.4.3. Participant observation

Participant observation is often considered the gold standard of anthropology and has become a cornerstone of ethnographic approaches developed by a variety of disciplines. It involves finding opportunities to participate when something is being done, or when something is happening (Armstrong, 2008) – which, admittedly, sounds vague at first. Yet this vagueness has the effect of opening research to sites which were previously not considered, allowing the researcher to take the same paths as people and things, and retains flexibility towards emerging themes.

During my research, three major opportunities to conduct participant observation arose: I attended a workshop focused on broadband strategies from the perspective of various states in Austria and Germany in September and a conference on fibre optics network financing in November. In January, I spent a day in a municipality in Burgenland on the sidelines of my second interview with the mayor of this municipality. In addition, I had shorter exchanges when discussing the first interview transcript as well as encountering an employee of one of the telecommunications providers active in Burgenland.

I recorded my experiences by writing field notes and, once digitised, linking these field notes with the documents related to the event. Field notes took on a quite different structure depending on the type of occasion. What they had in common, however, was basic information about who was speaking and what they were saying, as well as reflections on what I observed.

3.3.5. Analysing data

I have already mentioned how closely analysis and data collection were related during the fieldwork conducted for this study. For this reason, there is not really a cut-off point when data collection ceased and data analysis commenced; instead, the concept of data analysis which I use here signifies an iterative process where data is analysed and subsequently re-analysed in the light of new data. Such an approach is not unusual, as it can bring valuable insights within a certain analytical framework (Charmaz, 2008). In particular, my approach to analysis was influenced by grounded theory. Grounded theory allows for patterns to emerge, which is why it is a popular analytical method for qualitative data (Charmaz, 2014). While I cannot claim to a full-blown grounded theory approach, as the timeframe of the study is too short to make solid theoretical contributions, my analysis aims to raise a line of questions based on empirical findings.

For the broadband strategy, I conducted one round of qualitative open coding using TAMSAnalyzer, which means that I sifted through the data and marked themes and patterns linked to sentences or paragraphs. These codes were refined during a second round of coding for the same file, where I paid particular attention to how the coded passages relate to their context and with each other.

Then I began to compare the content of the broadband strategy with a preliminary framework developed based on an analysis of how demand is discussed in the study conducted by Curram et al. (2019). Curram et al. (2019) investigate in depth which factors influence the decisions of telecommunications providers to invest in the deployment of fibre optics networks. As I have not been able to find any research which addresses the question of how demand is understood by telecommunications providers, I decided to treat the study as primary material, albeit for a rather limited purpose. This means that after elaborating a rough framework and identifying four practices of demand based on descriptions of the authors, I mapped this framework onto the broadband strategy (Amt der Burgenländischen Landesregierung, 2021) to understand how practices of demand identified in the broadband strategy overlap (or not) with those of telecommunications providers in Curram et al. (2019).

Importantly, neither document problematises the role of demand: Curram et al. (2019) note the lack of demand for VHCN as problematic and stress the importance of securing demand, and the broadband strategy – amongst other things – discusses the importance of caring for future demand (Amt der Burgenländischen Landesregierung, 2021). Neither document sees a need for defining demand or discussing the implications of certain approaches to demand,[16] and so I have analytically worked my way through these questions in the empirical chapter.

Next to these 'major' or main documents which I analysed and encoded, other documents came along in the course of research which helped me contextualise the analysis. Apart from the funding guidelines mentioned earlier, these included documents related to the legal framework for electricity, which I encountered for the first time. When they came up during my fieldwork, I retrieved them and noted their relation to the fieldwork without coding them. Another class of documents I collected were materials related to the conferences I attended, such as the programme, the presentations or recaps of the event. I sifted through these materials when putting my field notes into a digital format, using them to check for potential interview partners or cross-checking my field notes, but refrained from coding them.

Equally important for my fieldwork were the interviews I conducted, the conferences I participated in and the conversations I had with actors in the field. The first type turned into transcripts, while the other types were recorded as field notes. After digitalising my field notes and finalising the transcripts, I conducted two rounds of coding as described further above: in an initial round of coding, I tried to understand what was happening in the data. In a second round of coding, I checked whether these codes made sense and how they relate to the context.

Unlike most grounded theory approaches, I did not code in a line-by-line manner, but focused on incidents (Charmaz, 2014, pp. 128–132). An incident would be, for example, relating demand to subscribers, i.e. referring to gaining or losing subscribers for a particular network (coded as demand>subscribers); or highlighting synergies, e.g. through positioning fibre optics networks as going along with energy networks (coded as synergies). Once this was provisionally completed, I started

[16] The lack of engagement with demand as an explicit category is not unique to these documents. In general, literature concerned with broadband deployment takes demand as a given category which need not be explained; this goes for most literature on telecommunications which I have come across.

comparing these incidents with each other, trying to understand, for instance, whether certain codes reoccurred in particular contexts but not in others. One example of this would be synergies, which was of course highly present with energy providers but also in the broadband strategy, even though it did not occur in observations of investors.

Based on these comparisons of incidents, I began to write memos, which essentially means that I began to describe how these codes relate to each other and which insights can be gained from these codes. I compared memos on codes with each other to begin to understand how these codes relate to each other, and which codes would be suitable as categories. These memos then became the basis for my discussion of the empirical data in this thesis, where I used the categories that seemed most relevant and analytically productive within the context of my research question (Charmaz, 2014, pp. 138–147). Some of these codes, like overbuilding (where concerns around other providers deploying a fibre optics network in the same area as an already existing fibre optics network were brought up), did not make it to the final thesis. Even though there is a fascinating tension between overbuilding and lack of coverage (where concerns around the lack of networks in certain areas were described), they were not strong enough to stand as their own category in the context of the research questions.

3.4. Conclusion

In the course of this section, I tried to provide an insight into the research process in order to flag the limitations but – I hope – also signal the strengths of my findings. In particular, I attempted to provide a genealogy of the research process, laying out which moments were formative for my further engagement with the research design, the data collected and the analysis of the data.

Using document analysis, participant observation, and interviews, I collected a variety of types of data which were eventually rendered into text. I analysed these texts by creating codes and comparing these codes to arrive at analytical observations and insights, recorded as memos. The final product of my thesis emerged from further analytical engagement with these memos. Several issues made the process of data collection slightly complicated. Access was a particular challenge for interviews, due in part to my own positionality and to the way in which the topics touch on business-sensitive issues. However, while there are not a lot of data collection instances, the data I have managed to collect is rich in quality. This speaks to the case study approach I have chosen, which aims to provide a detailed exploration of a concrete, limited case.

With these disclaimers, I think we are ready to move on into the empirical findings. As in the rest of the thesis, my aim is to be a guide through this field, to the best of my ability. While this means that the scenery presented is necessarily partial, I believe this to be an interesting way for you to encounter the topic of fibre optics networks (which is generally, as someone from the field said, not very sexy).

4. Empirical findings

In the preceding chapters, I have tried to lay out the foundations of this research project – how other researchers have approached similar topics, where my theoretical and methodological approaches come from, and the major landmarks which will reoccur in this main section. I have provided details on fibre optics networks, on the public funding instruments underpinning these activities, and an introduction to the actors and issues we will encounter in the hope that this will help you orient yourself in a potentially unfamiliar landscape. What I would like us to do in this section is to follow how these concepts unfold together, guided by my main research question: *how does the broadband strategy of Burgenland enact demand in the context of fibre optics networks deployment?*

We will start with what seems most obvious, namely the broadband strategy of Burgenland. Section 40 lays out how actors are rallied by the broadband strategy of Burgenland, and how certain kinds of fields for and means of action emerge from the strategy for these actors. This section tries to address my first sub-question: *how does the broadband strategy offer a field for or means of action for particular actors?* Understanding which actors are enrolled by this strategy also entails understanding which actors are not addressed explicitly by the strategy, but nevertheless play a role in the ecosystem of fibre optics deployment.

I am not merely interested in the content of the broadband strategy, but rather how it enacts specific practices by setting out conceptual frames, roles and tasks. I am intrigued specifically by how 'demand' emerges as a performative concept, meaning it acts upon the world. Through this account of practices of demand, we will trail the role of an economic concept in the making of infrastructure, while also exploring how 'demand' can be done differently. This strand of interest leads me to my second sub-question: *how does demand become enacted through specific practices at the level of the broadband strategy and during the material deployment of fibre optics networks?*

Building on these sections, I would like to lead you to one last stop. Often thought apart from each other, what stands out in this case study is how thinking infrastructures together changes how these infrastructures develop. Here again, I will use the account of practices of demand to guide this exploration of my third sub-question: *how do the materialities of the energy infrastructure interact with the deployment of telecommunications infrastructure in the case of co-deployment by an energy provider?*

With that being said, off we go: onwards into the field.

4.1. Bringing fibre optics to Burgenland

For this case study, everything starts with the broadband strategy of Burgenland – which, however, does not mean that the broadband strategy starts from nowhere. Our aim in this section is to explore: *how does the broadband strategy offer a field for or means of action for particular actors?*

Even though it acts as our place of departure, the broadband strategy cannot be removed from its geographic and historic context. It emerges from this context to rally actors for the causes it identifies, setting pathways for some of these actors, and it has an effect on particular times and places. For this reason, we will depart from a brief lay of the land to start embedding the broadband strategy into its context. We will next walk through the concerns it develops and move on to how these concerns are themselves embedded in a wider context, namely that of Austria and the European Union (EU). Next, we will see how the broadband strategy assembles actors and mobilises them in different ways. To close off, we will look at how these contexts, issues and actors have affected a particular place.

4.1.1. Starting from somewhere

Unlike drawing lines on an abstract flat surface, broadband deployment happens in a multidimensional context steeped in matter(s) of a sociomaterial nature. We already know that rural areas present a challenge due to low population density and volume, and that networks sprawl geographically, which is to say that they are necessarily embedded in their environments. Let us therefore take a peek at which challenges fibre optics networks face and how they have developed over time.

As the third smallest state in Austria, Burgenland encompasses 171 municipalities, of which 13 are cities, meaning they have at least 10.000 inhabitants. Despite having the lowest population numbers in Austria (Statistik Austria, 2022), about 62,7% of the state are considered permanent settlement area (*Dauersiedlungsfläche an Der Katasterfläche in %*, n.d.). To give you some perspective on what this means in the Austrian context: in total, about 38,8% of Austria is considered to be permanent settlement area and the only Austrian state with a higher share of permanent settlement area is Vienna, at 77,3% (*Dauersiedlungsfläche an Der Katasterfläche in %*, n.d.). In total, about 30% of households in Burgenland are said to be located in rural areas (*Conference 1*, 2022). Municipalities in rural areas do not correspond to cities, towns or villages; instead, a municipality such as Neuhaus am Klausenbach (Jennersdorf, Southern Burgenland) comprises four cadastral municipalities (Bonisdorf, Kalch, Krottendorf and Neuhaus am Klausenbach; Bundesamt für Eich- und Vermessungswesen, 2022) which all together count 920 residents ('Ortsteile', n.d.).

Burgenland is divided into three districts: Northern Burgenland, Central Burgenland and Southern Burgenland. Nearly 55% of the population live in the five districts of Northern Burgenland while the four districts of Central and Southern Burgenland comprise 134.678 inhabitants (Statistik Burgenland, 2022b). This relation is however inverted when looking at the size of these districts: together, Central and Southern Burgenland make up nearly 55% of the area (Statistik Burgenland, 2022a).

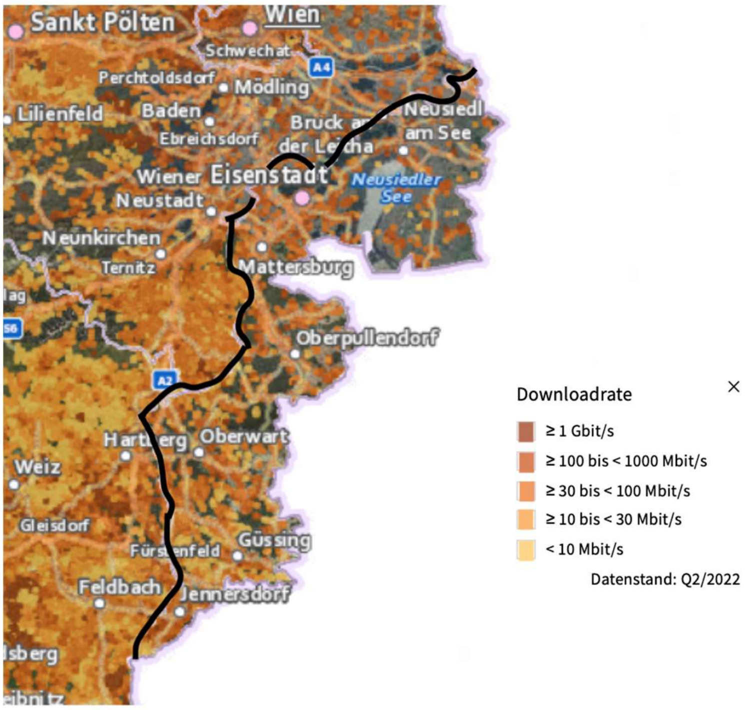

Figure 2: Fixed networks in Burgenland according to download speed (BMF et al., 2022; border line re-traced to enhance its visibility).

In terms of networks, this already tells us a little bit about the challenges broadband deployment faces: we have low population density and people seem to be spread out instead of clustered. It is therefore not surprising that if you look at the broadband atlas (BMF et al., 2022), some of these municipalities contain 'white areas', where access to fixed broadband networks offering download speeds of at least 30 Mbit/s does not exist, and 'grey areas', where there is only one fixed network offering such speeds.[17] Fibre optics networks are, overall, scarce in Burgenland. Looking at the latest

[17] The conceptual framework for white and grey areas is not represented visually in the broadband atlas. Instead, the two lightest shades of yellow would correspond to white areas, and the third-lightest shade (orange-brownish) may signify a grey area. However, this is not certain, as the broadband atlas does not provide us

data, we can see that when combining different types of fibre optics networks,[18] Burgenland has a total of 10.280 fibre optics access points, which amounts to 0,69% of all fibre optics access points in Austria (RTR, 2023). That would be in total sufficient to cover ten rural municipalities of the size of Neuhaus am Klausenbach, which is, all things considered, not a lot. However, Figure 2 also shows us that these networks are not distributed evenly: at the moment, the vast majority of these fibre optics access points are not located in rural municipalities like Neuhaus am Klausenbach, as the darkest spots in the broadband atlas are usually in urban areas (BMF et al., 2022).

One significant moment in the history of these networks in Burgenland was 2009, when a large part of the existing fibre optics networks changed hands. In this year, the state-owned energy provider BEWAG sold B.net, its subsidiary which owned and operated broadband networks, to Kabelsignal AG, a subsidiary of EVN (burgenland.ORF.at, 2009a, 2009b). BEWAG later on became Energie Burgenland and has since renamed itself to Burgenland Energie. EVN was and still is a utility provider in Lower Austria, one of the states neighbouring Burgenland, while Kabelsignal has rebranded to kabelplus. The 1.300 km fibre optics network held by B.net thus became the property of Kabelsignal (burgenland.ORF.at, 2009a), and then kabelplus, which is now mainly, but not exclusively, active in Northern Burgenland (*Interview 1*, 2022). Ever since then, little information about fibre optics deployment is publicly available, but this is in part because not much has happened (*Interview 1*, 2022; *Interview 2*, 2023). Ten years later, we arrive at the moment where our case starts. In 2019, the government of Burgenland began working on the broadband strategy (*Interview 1*, 2022), which was published at the beginning of 2021 (Amt der Burgenländischen Landesregierung, 2021; Land Burgenland, n.d.).

Before continuing to the concerns it identifies and seeks to address, let me briefly map out what we know so far: population numbers in Burgenland are low in comparison to other Austrian states, while simultaneously, people tend to live spread out. Fibre optics networks do not play a large role in Burgenland overall, and the most widely publicised development in terms of fibre optics networks was actually the sale of the fibre optics network owned by a subsidiary of Burgenland's energy provider to that of Lower Austria's energy provider – and since then, fibre optics networks have not exactly overgrown Burgenland. However, when we look at Figure 2, we can also see that even though there are few dark orange spots representing gigabit-capable networks, Burgenland is bathed in shades of yellow

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with a colour scheme to determine how many fixed networks of a particular technology are available in a given geographical area.

[18] RTR differentiates between passive FTTH access, FTTH access provided via networks which fully belong to the provider, and FTTB or other types of fibre access. We are not concerned with this differentiation for the purposes of this thesis.

to orange. Unlike what we might expect in the context of digital divides, we can see that fixed networks are widely available in Burgenland.[19] This brings us to a very complicated question: which problem is the broadband strategy actually trying to address?

4.1.2. Addressing concerns

It makes sense intuitively that a policy document such as the broadband strategy has been developed to solve a problem. However, for our case here, it is very important to understand what this problem is and how it is framed, which is why our path will now lead us through the concerns identified in the broadband strategy.

4.1.2.1. Defining a problem

For the broadband strategy of Burgenland, like for other documents of its kind, a central concern is that there is not enough deployment activity in rural areas, which are as a rule less well-connected. In the case of Burgenland, it is important to take a closer look at this problem – because if you look at most sources, it is not obvious that there is a problem. After all, most of Burgenland is awash in different shades of yellow and orange, and in the second quarter of 2022, Burgenland had 90,8% coverage, coming in third after Salzburg (99,9%), Vienna (97,7%) and neck-at-neck with Vorarlberg (90,7%) (RTR, 2022a).

One of the first moves the broadband strategy makes is therefore to acknowledge that most households and businesses do indeed have access to broadband (Amt der Burgenländischen Landesregierung, 2021, p. 32). However, it then introduces the qualifier that it is important to keep in mind what these networks can be used for and for how long they can be used. *The presence and absence of certain kinds of telecommunications networks present a concern to the broadband strategy*. In other words, it is not enough to have just any network: the networks should be 'future-proof', which the broadband strategy takes to mean gigabit-capable connections (Amt der Burgenländischen Landesregierung, 2021, pp. 32–33).[20] Looking then at this type of networks, we see that Burgenland has the highest share of connections below 30 Mbit/s, which means its overall coverage can be compared to Vorarlberg. However, the share of gigabit connections in Vorarlberg amounts to nearly 26% whereas in Burgenland, not even 2% of connections have a bandwidth of 1 Gbit/s or more (RTR, 2023).

[19] The broadband atlas presents fixed and mobile networks separately, which is why I am specifically referring to fixed networks here.

[20] The statistics I am invoking here are of course more recent (2023) than those included in the broadband strategy (2021). However, the relatively minor changes between 2021 and 2023 show us that at the very least, the problem identified *as such* in the broadband strategy is persistent.

Therefore, depending on how you look at it, there may or may not be a problem with the broadband networks available in Burgenland – after all, there are some kinds of networks in Burgenland. The broadband strategy handles this potential difference in problem framing not only by specifying that this problem exists in relation to specific kinds of networks, but also by introducing geographic differentiation. Hence, after acknowledging that overall, you can find broadband networks in Burgenland, the strategy makes an important qualification: "at a regional level – in particular in the central and southern districts of Oberpullendorf, Oberwart, Güssing and Jennersdorf –, there is a lack of future-proof, sustainable broadband infrastructure for people and businesses" (Amt der Burgenländischen Landesregierung, 2021, p. 32; my translation).[21] So far, the problem the broadband strategy presents us with is that in certain parts of Burgenland, certain types of networks do not exist.

The problem, however, does not stop here. As mentioned earlier, Burgenland has both low population numbers and a high share of permanent settlement area. This phenomenon is what the broadband strategy refers to as "dispersed settlement structures" (Amt der Burgenländischen Landesregierung, 2021, p. 65). Houses which are generally further apart are considered to be characteristic of Burgenland's "[settlement] structure and topology [… with] centres [which] are usually very small" (*Interview 1*, 2022). In addition, there is a strong North/South divide in Burgenland (*Conference 1*, 2022), meaning that these regions have very different preconditions and requirements. Yet despite these differences, the most easily available statistics aggregate to a state level (i.e. Burgenland) and cannot be drawn on to solidify the claim that coverage in the districts of Central and Southern Burgenland is indeed comparatively worse than that in Northern Burgenland.

However, through the specification of the broadband strategy, we have now arrived at a problem which is defined not only in terms of networks and circumscribed geographically. The problem is also exacerbated by sociomaterial conditions, namely settlement structures, which put these places at a rather low place on the priority list of market-driven deployment, as we already know from the literature.

4.1.2.2. Relating a problem to a wider context

We still have a little way to go to understand why this problem is a matter for a broadband strategy, or indeed, a matter where a state should get involved. In this context, the broadband strategy posits a strong connection between the lack of high-capacity digital infrastructure and the threat of people and companies migrating elsewhere (Amt der Burgenländischen Landesregierung, 2021, p. 15). The reason

[21] I have decided to retain the ambiguity of the German phrasing: "sustainable" should therefore not automatically be taken to mean environmentally sustainable, but instead refers to a wider theme of long-lasting, economically sustainable and potentially also environmentally sustainable.

for action is not individual inconvenience (of the flavour of "why can I not watch Netflix?"), but population-level effects of a lack of gigabit-capable digital infrastructure. This concern is reflected in the intention expressed in the broadband strategy to "further increase competitiveness and on the other hand to raise employment levels in rural areas" (Amt der Burgenländischen Landesregierung, 2021, p. 32; my translation). The realm of the problem – a lack of access to high-capacity broadband – is thereby moved effectively away from the individual sphere of possible action and into a sphere of action of the state: it is no longer my problem as the inhabitant of a village in Burgenland, who is dissatisfied with broadband access, but Burgenland, the state, which is concerned with what happens when too many people are dissatisfied with their broadband access.[22]

State-level problems have the merit that the state can react to them. They also mean that the solution is also understood within the context of other state-level problems. This brings us to the specific ways in which the problem of a lack of fibre optics networks unfolds in the context of the broadband strategy of Burgenland. In the course of following the broadband strategy around, two important factors emerged as shaping 'what it is all about', even though they are not explicitly addressed in the document itself: environmental sustainability and the security of critical infrastructure.

Security of critical infrastructure is a complex issue – after all, what is defined as critical infrastructure, what security means and how infrastructures (critical or not) relate to security can vary significantly in different contexts. The most notable thing about the topic of security of critical infrastructure is that in fact, the broadband strategy does not mention the terms 'security' or 'critical infrastructure' a single time. From the document of the broadband strategy alone, it would not be considered part of the problem complex of fibre optics networks. For the people I spoke with later on, however, it formed an inseparable part of the problem the broadband strategy was trying to address. They characterised broadband deployment as an essential ingredient of critical infrastructure and as safeguarding its security (*Conference 1*, 2022). For them, to the extent that critical infrastructure should be treated with priority and remain in state control (*Conference 1*, 2022; *Interview 1*, 2022; *Interview 2*, 2023), the conclusion follows that broadband deployment in connection with critical infrastructure should be driven by the state. This means that the problem of the security of critical infrastructure, as a part of the concerns the broadband strategy tries to address, is firmly understood as another state-level problem.

[22] It is particularly interesting that the state-level problem of a lack of deployment in rural areas is enclosed by market failure (cf. Amt der Burgenländischen Landesregierung, 2021, p. 38). The implicit message is that if the market were functioning, there would not be a problem of state-level dimensions. I think it could be worthwhile to further investigate the dynamics of how 'failure' is attributed by state and market actors in this particular context.

Let us conclude with environmental sustainability. In contrast to security or critical infrastructure, the broadband strategy provides a link to this concern in the document itself, even though it may at first glance be indecipherable. One of the aims of the broadband strategy sets out that fibre optics deployment should take place at access level in connection with the expansion and reinforcement of electricity networks, accompanied by the reference: "#mission2030" (Amt der Burgenländischen Landesregierung, 2021, p. 66).

#mission2030 stands for something significantly larger even though the reference in the document remains rather cryptic, at least to outsiders – like us! It is in fact a reference to the Austrian climate and energy strategy, aiming to achieve a climate-neutral, decarbonised energy sector by 2050 (BMNT & BMVIT, 2018, p. 15). One of the concerns identified in the climate and energy strategy relates to mobility, and the switch to electric vehicles is positioned as an important means to achieve the emissions reductions targets of the EU (BMNT & BMVIT, 2018, p. 16). At the same time, the climate and energy strategy highlights the importance of the digitalisation of the energy sector and its potential for overcoming challenges related to the decentralisation of the energy grid (BMNT & BMVIT, 2018, p. 23).

One of these concerns is well-reflected in the broadband strategy. Home office is discussed there as an effect of the Covid-19 pandemic which is here to stay, in turn driving the need for higher bandwidths (e.g. Amt der Burgenländischen Landesregierung, 2021, p. 15).[23] Accounts of the broadband strategy, on the other hand, stress that deploying fibre optics networks is a way of enabling people to commute less (in particular to Vienna), thus reducing the environmental footprint of the region (*Conference 1*, 2022; *Interview 1*, 2022).[24] Hidden in plain sight, the reference to the climate strategy tells us something not only about the wider scope of the problem identified by Burgenland, but also something about the actors involved: unlike us, they are insiders to this climate strategy and know about #mission2030. In fact, as energy providers, they are primary addressees of this other strategy.

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[23] We will encounter the significance of environmental sustainability again in section 4.3, because tasking an energy provider with deploying fibre optics networks creates an opportunity for concerns which are unrelated to telecommunications to play a role in the deployment of these networks. For now, it is important to note that the broadband strategy does not explicitly address the links between renewable energy generation and telecommunications. Its main concern in regards to environmental sustainability is the impact of commuting, and fibre optics networks are regarded as a long-lasting means of reducing the frequency of commuting.

[24] Incidentally, this concern is widely shared by other state-affiliated deployment projects (*Conference 1*, 2022; *Conference 2*, 2022). It also leads to a radically different perspective on how to classify premises: whereas in most cases, and indeed also in the broadband strategies of various Austrian states, a difference is made between businesses and households, facilitating home office through broadband deployment means that *connections in every household need to be business-capable* (*Conference 2*, 2022).

4.1.2.3. Setting aims to solve a problem

In this initial sighting, we have learned that the broadband strategy is concerned about the population-level effects of a lack of gigabit-capable telecommunications networks, security of critical infrastructure, and sustainability. We should now take a closer look at what the strategy says should be done about this problem.

One of the cornerstones of the broadband strategy is that a subsidiary of Burgenland Energie shall be created and tasked with implementing the strategy (Amt der Burgenländischen Landesregierung, 2021, p. 67). Originally named EBBG, this subsidiary has since changed its name to BE Technology, and this is the name we will use henceforth. What is it then that BE Technology should do to solve the problems identified by the broadband strategy?

An important starting point for us is that the strategy seeks to achieve areawide gigabit connectivity based on fixed or mobile networks (Amt der Burgenländischen Landesregierung, 2021, p. 66). However, there are two important caveats which show that the strategy seeks to contribute to this goal, not to achieve it alone. On the one hand, the broadband strategy is clear that it only supports fibre optics deployment in areas which do not yet have networks capable of over 100 Mbit/s download speeds (Amt der Burgenländischen Landesregierung, 2021, p. 66). This means that the activities of the broadband strategy are focused solely on a certain type of fixed network, i.e. fibre optics networks, in areas which do not have a certain kind of network, i.e. capable of certain download speeds. On the other hand, areawide gigabit connectivity is not an aim to be achieved by BE Technology alone, but by all actors active in network deployment.

The activities of BE Technology are actually specified in the other goals. The most important one for our purposes is that BE Technology should deploy access networks in the case of co-deployment opportunities, a sufficient pre-contracting rate or municipal contributions to deployment costs (Amt der Burgenländischen Landesregierung, 2021, p. 66). In general, BE Technology therefore has three options for fibre optics deployment: firstly, to piggyback on other civil works projects in the framework of co-deployment, for instance when the energy network requires reinforcement or modification. Secondly, it can draw on a very particular practice of demand, namely pre-contracting, in order to launch a deployment project. Thirdly, a project can be initiated when a municipality finances a part of the cost. I would like to add to these aims one of the measures set out in the strategy, namely that BE Technology should, wherever possible, apply for public funding to secure funds for its deployment activities (Amt der Burgenländischen Landesregierung, 2021, p. 67).

The overall objective of improving gigabit connectivity as well as the principles for how BE Technology should approach deployment could be considered more general and overarching, as they do not yet tell us specifics about who should be connected by when. These questions are addressed by the other aims set out by the broadband strategy, which are linked to a timeline (Amt der Burgenländischen Landesregierung, 2021, p. 66):

- from 2021 onwards, FTTH deployment in coordination with the expansion/reinforcement of electricity networks should take place in three underserved cadastral municipalities every year;
- by 2023, all mobile radio transmitters should be connected to a backhaul fibre optics network;
- by 2025, every municipality in Burgenland should have at least one passive fibre access point (point of presence);
- by 2030, fibre optics coverage should already be extensive:
    - all public administrative and educational institutions, business parks and industrial sites should be connected to an FTTH network,
    - at least 60% of households and 100% of businesses should be connected to an FTTP network (the rest should be connected by self-sustained deployment by the private sector),
    - and areawide 5G deployment should be facilitated by making infrastructure (backhaul, sites, electricity connections, masts etc.) available at market conditions.

Looking at these aims gives us plenty to unpack, but for our purposes right now, I would like to highlight two dimensions. To begin with, we can see how the strategy establishes specific relations between infrastructures and technologies: we have the connection of fibre optics networks and the energy network in cadastral municipalities considered underserved in terms of broadband, but we also have the relation of fibre optics as enhancing mobile (and in particular 5G) networks through backhaul deployment, and of making the infrastructure on which mobile networks build more easily available. Adding to this dimension, the aims spelled out by the broadband strategy establish particular relations between places and fibre optics networks: underserved cadastral municipalities should be furnished with an FTTH access network, municipalities should have a fibre optics backhaul network (expressed through at least one point of presence), and certain sites should be connected to an FTTH network while (a certain percentage of) others should be connected to FTTP networks.

This is quite a heavy mix of levels of aggregation and differentiation, but as we will see, some of these aims are more relevant to what we are trying to understand here while others are not. For now, we have an urgent issue awaiting us: after all, the broadband strategy of Burgenland was not only developed for a particular context, but also developed in relation to other strategies and approaches.

4.1.3. Aligning concerns and approaches

The concerns identified by the broadband strategy are inseparable from the local context in Burgenland, even though they are not unique. The measures developed by the broadband strategy on the other hand are very closely related to both a broader policy context and also to other broadband strategies in Austria. These relations are very present in the document itself, as the broadband strategy seeks to demonstrate the lessons learned from comparable initiatives (Amt der Burgenländischen Landesregierung, 2021, p. 34; *Interview 1*, 2022). We will therefore briefly take a look at how the broadband strategy relates to the European broadband targets, then move on to looking at the policy context in Austria and more specifically in Burgenland. Finally, we will explore what the broadband strategy's Austrian peers have set out to do.

4.1.3.1. Drawing on high-level aims

As it is discussed in the broadband strategy, the broader policy context for connectivity targets reaches all the way to the connectivity targets set by the European Commission.[25] One of the policies it references, namely the Gigabit Strategy of the European Commission, sets out several goals, two of which are particularly relevant to this case study: all European households should have access to a 100 Mbit/s network by 2025, and all main socio-economic drivers should have access to gigabit connectivity (European Commission, 2021). This means that by 2025, every household in Europe should have broadband access capable of reaching at least 100 Mbit/s – and the same access should have enough capacity to offer higher download speeds[26] with an upgrade within the next two years. Note that the targets refer to every household, which also means rural households. In addition, 'main economic drivers' should have broadband access capable of 1 Gbit/s download speeds.

The targets specified by the Austrian federal government are very much in line with these European ambitions. The work programme of the Austrian federal government 2020-2024, quoted in the broadband strategy of Burgenland, includes "developing the broadband strategy 2030 with the aim of achieving nationwide coverage with gigabit connections (fixed and mobile) by 2030" (Amt der Burgenländischen Landesregierung, 2021, p. 42; my translation), as well as various levers which could contribute to achieving this goal. This federal broadband strategy sets out that by 2030, symmetric gigabit-capable access networks will be available nationwide (BMVIT, 2019, p. 18). Together with the funding programmes Broadband Austria 2020 (FFG, n.d.-a) and Broadband Austria 2030 (FFG, n.d.-b), the federal broadband strategy sets the framework in and through which the broadband strategies at state level operate.

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[25] The broader policy context is very much in flux, hence I am focusing on the strategies identified by the broadband strategy. The latest connectivity targets actually specify that every household should have access to a gigabit connection by 2030 (European Commission, 2022).

[26] The Gigabit Strategy does not explicitly say that the speeds it refers to are download speeds; rather, it is implied that these are download speeds. The differentiation is nevertheless important: if the Gigabit Strategy were referring to symmetric download and upload speeds, it would be a full-fibre strategy.

The broadband strategy of Burgenland also references the policy context of Burgenland. The government of Burgenland, in its work programme for 2020-2025, set out that every household should have access to high speed broadband. The work programme explicitly refers to two types of networks: fibre optics networks and mobile networks. It also offers a regional qualification by highlighting the need to deploy networks in Southern Burgenland, as well as an explicit reference to the funding context – both through the ambition of drawing on public funding as well as by defining the areas of priority as the 'white spots' (Amt der Burgenländischen Landesregierung, 2021, p. 44).

While the case of Burgenland has some unique features, the broadband strategy of Burgenland is certainly not alone in its ambition to improve broadband access. In fact, Burgenland is one of the two most recent Austrian states to develop a broadband strategy (Amt der Burgenländischen Landesregierung, 2021, p. 76; *Conference 1*, 2022). As these other initiatives were expressly discussed in the broadband strategy with the aim of learning from their lessons, I would suggest we look briefly at what other states in Austria have been trying to achieve and their approaches to deploying broadband networks.

4.1.3.2. Tying up with other Austrian broadband strategies

After putting the broadband strategy in the context of its political filiation, we now see how the targets from one context were translated and transformed at different levels. Many of these levels apply not only to the broadband strategy in Burgenland, but to all broadband strategies in Austria. For this reason, I propose we now move to contextualise the approach developed by our strategy by comparing it with its siblings.

Let us start with the two states bordering Burgenland. Lower Austria founded nöGIG, the Lower Austrian Fibre Optics Infrastructure Corporation, which is backed by the investment firm Allianz Capital Partners and cooperates with EVN in regard to backhaul networks (Amt der Burgenländischen Landesregierung, 2021, pp. 77–78). In Styria, the Styrian Broadband and Digital Infrastructure Corporation (sbidi) cooperates strategically with Energie Steiermark and sometimes with municipal utilities, taking on the role of an advisory body for municipalities but also engaging in deployment activities in white areas (Amt der Burgenländischen Landesregierung, 2021, pp. 79–80; *Conference 1*, 2022). Both of these states focus their activities on areas where it can be ascertained that demand for fibre optics exists: in Upper Austria, this is evidenced by a pre-contracting rate of 40%, meaning that 40% of households or businesses in an area need to sign up before deployment starts (Amt der Burgenländischen Landesregierung, 2021, p. 78), whereas in Styria, a list of criteria is used to determine whether a municipality is suitable for a deployment project by sbidi (Amt der Burgenländischen Landesregierung, 2021, p. 80).

Upper Austria also chose to create a company for deploying broadband, the Fibre Service Corporation, which at the time of writing the broadband strategy both partnered with the regional energy provider Energie AG but also competed with it (Amt der Burgenländischen Landesregierung, 2021, pp. 83–84).[27] Interestingly, Upper Austria has specified that deployment should take place from the outside in – this means that deployment should start at the borders of white areas and gradually move towards the more well-connected centres (Amt der Burgenländischen Landesregierung, 2021, pp. 83–84).

In Carinthia, the Broadband Initiative Carinthia (BIK) can deploy networks in white areas, but needs partners to deploy in mixed areas. At the time when the broadband strategy was published, the regional energy provider Kelag was noted as having different priorities (Amt der Burgenländischen Landesregierung, 2021, p. 83), but they have since entered into an active partnership with BIK (*Conference 2*, 2022). Tirol, on the other hand, chose to centre its broadband strategy on the municipalities, creating an agency to support them in deploying fibre optics networks (Amt der Burgenländischen Landesregierung, 2021, pp. 81–83). The initiative in Tyrol is closest to the municipal networks we encountered earlier, as the municipalities become the driving forces for deployment and subsequently also the owners of the fibre optics networks; here, demand does not play a role in terms of prioritisation of areas (*Conference 1*, 2022). Last but not least, the state of Salzburg has very little to do because its regional telecommunications and energy provider has achieved almost full coverage (Amt der Burgenländischen Landesregierung, 2021, p. 85).[28]

What these approaches show us is that there is a wide variety of approaches possible for solving the problem of a lack of rural connectivity. We can recognise some of the elements chosen by the broadband strategy here, I think – for instance, the involvement of the energy providers is not unusual, as they have been involved in Carinthia and Upper Austria directly or partnered with these projects in various forms in Lower Austria and Styria. However, while the broadband strategy of Burgenland does point to the relevance of a sufficient level of demand for prioritisation, it does not spell out clear thresholds, as has been done in Upper Austria or Styria. We will return in more depth to these issues later on – in the meantime, our next step is to take another look at the actors involved and enrolled by the broadband strategy of Burgenland.

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[27] In the time since then, these initiatives have been merged to avoid causing confusion (*Conference 1*, 2022).

[28] Two states are missing in the account of the broadband strategy – Vorarlberg, the westernmost state of Austria, and Vienna. Vienna is a city-state, hence its challenges are somewhat different, while Vorarlberg only published its broadband strategy in 2022 (Land Vorarlberg, n.d.).

4.1.4. Getting actors involved

As much power as documents can have, they cannot, by themselves, connect underserved municipalities and other entities to fibre optics networks. They can, however, establish a set of relations between different actors, arranging them in ways considered conducive to their goals. This is an important step for our case, because the relations thus established by the broadband strategy perform a space in which the practices we will look into later become possible. In this section, I do not aim for a complete exploration of all actors in this space. Instead, we will focus on those actors which are significant in the context of the case – a cast of characters to help us recognise who we will meet further down the road. For this reason, we will give most weight to BE Technology, then take a look at the state of Burgenland followed by the telecommunications providers, investors and municipalities. Last but not least, I think it would be helpful to gain an understanding of what networks as well as households and businesses are (supposed to be) doing in the space created by the broadband strategy.

4.1.4.1. Calling up BE Technology

We have already encountered the star of the show: BE Technology. Unlike other Austrian states, the broadband strategy of Burgenland has decided not to create a state organisation tasked with broadband deployment. Instead, it established a new subsidiary of the regional energy provider, Burgenland Energie, which was initially called Energie Burgenland Breitband GmbH (or EBBG) (Amt der Burgenländischen Landesregierung, 2021, p. 67) but has since changed its name to BE Technology. In addition, the broadband strategy established two positions as broadband coordinators, one assigned to a representative of BE Technology and one to a representative of the state of Burgenland (*Interview 1*, 2022; Land Burgenland, n.d.).

BE Technology was specifically created through the broadband strategy in order to further broadband deployment. As a wholly-owned subsidiary of Burgenland Energie, BE Technology should remain the owner of the passive fibre optics networks it deploys and also offer access to these networks on a wholesale basis[29] to other telecommunications providers (Amt der Burgenländischen Landesregierung, 2021, p. 57). BE Technology should seek to acquire public funding for its deployment activities, which

[29] The model chosen is called a passive layer open model, which means that BE Technology offers the ducts and fibre optics cables (layer 1) to active providers, which add network equipment to make the provision of services via these fibre optics cables possible (layer 2), on top of which a service provider can offer broadband subscriptions to end users (layer 3). In this model, the active provider can also be a service provider, but does not necessarily have to be (Amt der Burgenländischen Landesregierung, 2021, p. 23). This means that once the network exists, BE Technology and one or two other providers will be involved at a wholesale level for each subscriber via these networks.

comprise planning, construction and operation of passive broadband networks in white areas (i.e. areas with networks capable of maximum 30 Mbit/s download speeds – which are simultaneously those areas eligible for funding) with a focus on backhaul networks (Amt der Burgenländischen Landesregierung, 2021, p. 58). Besides these responsibilities related directly to the networks, BE Technology should be involved in the coordination and prioritisation of broadband deployment, thus interacting with a wide variety of actors such as the state of Burgenland, the telecommunications providers (primarily regarding 4G/5G deployment plans), municipalities and of course the civil engineering companies responsible for civil works (Amt der Burgenländischen Landesregierung, 2021, p. 58).

One important point to note, and we will return to this a little later, is that one of BE Technology's tasks is to "[b]uild capacities and know-how regarding the deployment of passive broadband networks, taking into consideration synergies with the core business" (Amt der Burgenländischen Landesregierung, 2021, p. 58; my translation). The broadband strategy creates a strong link between the tasks of BE Technology and 'the core business' – that is, Burgenland Energie's core business. Burgenland Energie is an energy provider, or rather: the subsidiaries of the Burgenland Energie group are involved in the energy sector in various ways (Burgenland Energie, n.d.). Tethered in such a way by the broadband strategy, BE Technology may be responsible for broadband deployment, but it remains closely integrated with the energy sector because it is embedded within a company active in this sector. It furthermore remains closely affiliated with the state – not only because it is directly created to implement a strategy developed by the state of Burgenland, but also because the state of Burgenland controls 51% of the shares of Burgenland Energie (Burgenland Energie, n.d.; *Interview 1*, 2022). Last but not least, BE Technology and the state of Burgenland are each required to provide one broadband coordinator (*Interview 1*, 2022; Land Burgenland, n.d.).

4.1.4.2. Reserving space for the state

At this point, we need to take a brief look at the role of the state. While BE Technology is tasked with implementing the strategy, the state of Burgenland also foresees several roles for itself and considers itself mainly a coordinator for these various actors. The responsibilities of the state of Burgenland specified in the broadband strategy include fostering "positive conditions for broadband investments in accordance with the European, national and local broadband strategies" (Amt der Burgenländischen Landesregierung, 2021, p. 60; my translation), mainly through the following actions: adapting legislation at state level,[30] raising awareness for the importance of broadband infrastructure, drawing on

[30] This includes, for instance, integrating FTTH/FTTB deployment more closely into housing development subsidies for end-users – which bears remarkable similarity to the efforts described by Harrison (2018) to stimulate electrification in the USA.

and increasing the strength of regions and municipalities in broadband deployment, and engaging with the telecommunications providers regarding their 5G roll-out plans (Amt der Burgenländischen Landesregierung, 2021, p. 61).

Beyond what the broadband strategy tells us about the role of the state, we also need to understand that the document itself has been developed by the state of Burgenland. The framing of the problem, so crucial to the solution developed, originates from the perspective of the state of Burgenland.

The intervention of the state of Burgenland also comes about ten years after the decision to sell B.net to EVN. By selling B.net to another company, the state of Burgenland no longer owned a company which deploys networks (*Interview 1*, 2022; *Interview 2*, 2023). EVN may be state-owned, but its owner is the neighbouring state of Lower Austria, not Burgenland. From the perspective of the state of Burgenland, then, the remaining actors engaged in network deployment are not state-owned or state-affiliated, and the field of action for the state became significantly more restricted.

4.1.4.3. Fitting in telecommunications providers, investors and municipalities

In the broadband strategy, telecommunications providers mainly take on a side role: their (lack of) activity in specific areas is why the broadband strategy intervenes in the first place. This is summarised neatly by the broadband strategy: “Established providers deploy networks mainly in areas with a higher population density, where it makes sense economically. Due to high demand, more than one provider is active in conurbations. There, the market works and so does competition” (Amt der Burgenländischen Landesregierung, 2021, p. 19). But this lack of activity only occurs in relation to the main concern of the broadband strategy, which is fibre optics networks, as mobile networks are widespread even in less densely populated areas. For this reason, telecommunications providers appear multiple times as actors with whom BE Technology should coordinate regarding mobile network deployment (e.g. Amt der Burgenländischen Landesregierung, 2021, p. 60) or even regarding information about the total cost of deployment (Amt der Burgenländischen Landesregierung, 2021, p. 67). Their role is significant, and as we will discover later on, they are crucial actors in the planning phase; but the broadband strategy does not foresee any particular measures or responsibilities for them.

Before moving on, let us quickly take a look at other actors whose roles are not addressed explicitly by the broadband strategy. First off, let us start with the investors. Except for pointing out their risk-averseness and likely lack of interest in investing in Burgenland (Amt der Burgenländischen Landesregierung, 2021, p. 37), we do not learn much about their activities from the broadband strategy. This does not mean that investors are not active in Burgenland: in fact, ÖGIG (backed by Allianz

Capitals Partners), Speed Connect Austria and Meridiam are active in Burgenland (*Field Notes*, 2023; *Interview 1*, 2022; *Interview 2*, 2023). These investors are relevant to the broadband strategy insofar as the deployment activities investors finance remove the territories in which they are active from the field of action for the broadband strategy. From the perspective of the broadband strategy, this is a welcome development, as it seeks to increase access to fibre optics networks by whichever means or through whichever actors possible (Amt der Burgenländischen Landesregierung, 2021, p. 66; *Interview 1*, 2022).

However, investors are important for the broadband strategy because they affect the choice of actor tasked with implementing the strategy: "Looking at Burgenland, it needs to be taken into account that scale effects will be lower in comparison to other states, and for this reason, a corporation financed by the state of Burgenland and notified at EU level will be less attractive to investors due to high risk and low profits. It is therefore necessary to think about alternative ways of advancing broadband deployment" (Amt der Burgenländischen Landesregierung, 2021, p. 37; my translation). In this view, Burgenland is a relatively small state with a comparatively small population, and settlements in rural areas tend to sprawl out instead of clustering. The high costs of deployment ensuing from such a settlement structure combined with the low population density make for a situation which is not very attractive to investors, at least in the assessment of the broadband strategy. For this reason, the broadband strategy shies away from setting up a corporation focused on deploying fibre optics networks, as other Austrian states have done, instead seeking an alternative path to connecting underserved areas. This alternative path consists of linking fibre optics deployment to energy infrastructures, which the broadband strategy considers to be better suited to local circumstances, and choosing BE Technology for implementing its aims.

The second important group of actors are the municipalities. For the broadband strategy of Burgenland, municipalities and districts have an important role as recipients of information and promoters of activities related to broadband deployment (Amt der Burgenländischen Landesregierung, 2021, p. 35): they are responsible for infrastructure planning, can allow for deployment via their property, and are considered to be one element of possibly the largest end-user of broadband services (Amt der Burgenländischen Landesregierung, 2021, p. 21). Despite these important levers available to the municipalities, they are not accorded any specific formal responsibilities specifically related to broadband deployment – quite unlike Tyrol, for instance.

Behind the scene presented by the broadband strategy, however, municipalities have an important role: they are very well-informed about the challenges experienced at local level and where the need for broadband is highest (*Interview 1*, 2022; *Interview 2*, 2023). As the entities responsible for granting permits, they furthermore determine the speed of deployment to a large extent and are involved in the planning of the deployment from an early stage onwards (*Interview 1*, 2022; *Interview 2*, 2023). At the same time, this means that BE Technology and the state of Burgenland need to help municipalities to understand the process of network deployment and how certain ways of deploying networks impact how other networks can, or cannot, be deployed in the future (*Interview 1*, 2022) – a crucial question to which we will return later on.

4.1.4.4. Getting networks to households and businesses

I would like to mention two more actors which I deem essential to how the broadband strategy moves forward: on the one hand, the networks themselves, and on the other hand, households and businesses. While they are not addressed as actors themselves in the broadband strategy, they are important for understanding which framework for deployment practices the strategy creates.

Telecommunications networks are relevant as actors on two counts. Firstly, fibre optics networks are highly relational because they are not exclusive: moving them down to the access network increases the capacity of the existing networks, whether these are fixed or mobile. While such an increased capacity is already understood as worthwhile, it is important to understand that the broadband strategy does not consider fibre optics networks as equivalent to other networks: in fact, these other fixed and mobile networks are understood as bridging technologies until fibre optics are ubiquitous, and mobile networks are understood as accessory and supplementary to fibre optics networks precisely because the latter are 'merely' a shared medium (Amt der Burgenländischen Landesregierung, 2021, pp. 26–28; *Interview 1*, 2022). Such an approach is not unique in Austria and shared by many of the state-affiliated deployment projects as well as the municipalities in other parts of Austria (*Conference 1*, 2022; *Conference 2*, 2022).

Secondly, network deployment is rarely something which happens in isolation, especially in the context of state aid. State-affiliated projects can only become active in geographic areas circumscribed by a lack of fixed networks offering a certain minimum capacity, i.e. in 'white areas' eligible for public funding (Amt der Burgenländischen Landesregierung, 2021; BMVIT, 2019; *Conference 1*, 2022; *Conference 2*, 2022; *Interview 1*, 2022; *Interview 2*, 2023; FFG, n.d.-b). This means that even though other fixed telecommunications networks are considered to become obsolete on the long run (Amt der Burgenländischen Landesregierung, 2021, p. 28; *Interview 1*, 2022), their existence and capacity are in fact key to where fibre optics networks are deployed: the existence of networks in some areas closes these areas off to state-funded initiatives. The broadband strategy of Burgenland clearly spells out this requirement: BE Technology should deploy access networks in underserved areas (Amt der Burgenländischen Landesregierung, 2021, p. 58), which are simultaneously the areas where the market fails (Amt der Burgenländischen Landesregierung, 2021, p. 67).

While we may not find fibre optics networks in these areas, we do find households and businesses there, which are the reason for engaging in broadband deployment in the first place. The lack of access to high-capacity broadband experienced by households and businesses sets the broadband strategy in motion, which as we already know seeks to address a state-level problem of people and businesses moving away (Amt der Burgenländischen Landesregierung, 2021, p. 13). At the same time, households and businesses, as we saw earlier, are where fibre optics networks are supposed to move in the long run (Amt der Burgenländischen Landesregierung, 2021, p. 66). In this way, they are akin to a finish line: just like a marathon is done when its runners have made it to the finish line, the broadband strategy's work is done when fibre optics networks have reached 60% of households and 100% of businesses by 2030 (Amt der Burgenländischen Landesregierung, 2021, p. 66). To stick with the metaphor of a finish line, these households and businesses are expected to be mostly passive – they are not expected to run themselves, rather to wait patiently for the runners to arrive.

Importantly, the broadband strategy focuses solely on the *deployment* of fibre optics networks. Its aims are achieved when a sufficient number of households and businesses have access to a fibre optics network; it is not concerned with how many households and businesses actively use such a network. For this reason, the broadband strategy of Burgenland as well as others of its kind (for instance at European level) end at a specific point, namely at 'premises passed', i.e. when premises have access to a network. For investors and telecommunications providers, on the other hand, the relevant target is that of 'premises connected', i.e. premises actively subscribing to a network (*Conference 1*, 2022; *Conference 2*, 2022).[31] These distinctions make an important difference, especially when the network is not yet in place, as premises connected require a different set of activities on top of those activities required for premises passed.

4.1.5. Conclusion

After exploring the broadband strategy in more detail, we have come to a point where I think it would be good to formulate some conclusions. First of all, we can see that the specific circumstances Burgenland finds itself in, both generally and in terms of networks, have created a situation where the state of Burgenland has decided to intervene and advance fibre optics deployment through a broadband strategy.

[31] These categories of 'premises passed' and 'premises connected' are not mutually exclusive and actually build on each other: every premise connected first needs to be a premise passed. However, their use implies subtle, but important ontological differences in terms of when a network is completed. The gap between the first and the second category is what is called the "demand gap" and visualised on a quarterly basis in RTR's Internet Monitor (RTR, 2023).

In order to intervene, the strategy first needs to define the problem. As we have seen, the problem which the broadband strategy of Burgenland tries to solve is first reduced to fibre optics networks and limited to particular areas, and simultaneously expanded to the scale of what I have called a state-level problem. At this scale, it is the effects of many people and businesses not having access to high-speed broadband networks that becomes a concern, and other issues begin to play a role in the problem. These wider concerns include the question of critical infrastructure and, in tandem with the strategy on climate neutrality, also the topic of environmental sustainability.

As a consequence, the broadband strategy proposes a series of aims and measures, which help us understand what it is that the broadband strategy seeks to achieve. In doing so, we encounter again a geographic limitation – namely to Southern and Central Burgenland –, but we also begin to see the impact of the framework provided by public funding programmes through the focus on white areas. Last but not least, through the coupling of fibre optics deployment in underserved cadastral municipalities to the upgrade and reconfiguration of the energy network, we get our first hints of how the energy network and the fibre optics networks relate in this case study.

With this in mind, we are ready to move on to the next section, where we will explore how demand is enacted within this complex constellation of actors.

4.2. Practising demand in the context of fibre optics deployment

Even though this section contains the keyword ‘demand’ in its title, we are not going to look at the number of premises connected to a fibre optics networks, or the number of people subscribing to a fibre optics network.[32] Instead, our focus will be on what it is that our main actors consider to be demand – and, more narrowly, what ‘sufficient demand to deploy a network’ looks like in this context. To do so, we will need to turn back to ontological multiplicity, in the hope that it will help us understand how demand works in the setting of this case study.

We already had a brief encounter with the many ways for broadband strategies to approach the question of demand a little earlier, and we saw something fascinating: some of these broadband strategies prescribe specific ways of measuring demand, e.g. on the geographic basis of municipalities, or of securing demand, like with the 40% pre-contracting rate. This gives us our first taste of how complex the matter of demand is when you look at what demand is understood to be and by whom it is understood to be practiced, but also when you look into where and when demand ‘occurs’. We will now attend to these complexities, and our focus in this chapter is to understand: *how does demand become constructed through specific practices at the level of the broadband strategy and during the material deployment of fibre optics networks?*

In order to become more familiar with this question, we will wander through some of the practices of demand I have come across in the course of this case study. These practices vary in terms of the actors implicated within them, in terms of their scale and scope, and certainly in terms of the arrangements which emerge through them. What they do have in common, however, is their role in making demand-and-the-network. These practices of demand are significant in the context of this case study because they shape how fibre optics networks are made, and simultaneously how demand can be done, as well as by whom it can be done.

4.2.1. Seeing demand

I have previously argued that demand is a concept which can be understood as multiple, and we will now return to the case study to ground these reflections in the empirical. Our motto in this section is understanding the ways in which demand can be ‘seen’: broadly speaking, how that object which is

[32] For those of you whose heart sank in disappointment, please take a look at the study recently published by RTR, which discusses how subscriptions to fibre optics networks have developed and which strategies have been employed to encourage people to become subscribers (2022b).

called demand is understood in the very specific context of network deployment, as practised in the ontological framework set out by the broadband strategy of Burgenland. For this reason, we will first delve into where demand is located, and even more interestingly, how demand is translated between geographical frames. Considering the importance of the relation of the object ‘demand’ to the object ‘network’, we will look at how demand is practised in relation to other infrastructures. Finally, we will attend to the ways in which this particular demand-object begins to trouble the notion of ‘demand’ as clearly attributable to any one actor.

4.2.1.1. Locating demand

The ambition of the broadband strategy is to intervene in a problem, which we explored earlier in section 43 – and a problem first needs to be defined before it is addressed. Similarly, to deploy networks, you first need to figure out where you want to build them.

In the case we are following here, there are multiple answers to this question, and one of them relates to the framework for public funding. The broadband strategy of Burgenland, following the work programme of the government of Burgenland for 2020-2025, prioritises deployment in white areas (Amt der Burgenländischen Landesregierung, 2021, p. 31). The term “white areas” is drawn from the funding context, where white areas and grey areas may receive public funding (FFG, n.d.-b). These areas are considered regions where market failures occur: the market, of its own accord, does not produce a desirable outcome. Therefore, the state may intervene and, by making funding available, create incentives to achieve a desirable outcome.

What is interesting about this framework is that in practice, it becomes entangled with where demand is located. During our conversation, my interview partner made the observation that “demand is definitely where the white areas are in Southern Burgenland” (*Interview 1*, 2022). These areas where no fixed broadband connections offering more than 30 Mbit/s are available suddenly become linked to demand: demand is, in this view, *where networks are not*. As we already know, networks do not exist in these areas because telecommunications providers perceive a lack of demand. The perspective offered here is diametrically opposed to common ideas about network deployment in rural areas.

Although this seems astonishing at first, it is by no means a peculiar or singular approach. Even investors in fibre optics deployment clearly highlighted the advantages of working in areas where no other networks exist, as everyone will subscribe to fibre optics networks if they are the only available networks (*Conference 2*, 2022). This shows us that white areas do not only signify areas without networks: they also become a frame of reference, or rather a wide-spread form of shorthand both for where the state may intervene and where demand is located (encountered at *Conference 1*, 2022;

Conference 2, 2022). Although public funding does not account for all deployment activities, its ontological framework of white and grey areas spreads out far beyond the context of public funding.

In general, deploying networks in areas without other comparable technologies at more affordable prices is an easier thing to do for investors and telecommunications providers alike (*Conference 2*, 2022; Curram et al., 2019).[33] For state-affiliated fibre optics deployment on the other hand, other networks and technologies play a role because they circumscribe the areas where these projects may become active (*Conference 2*, 2022): demand in a funding context can, after all, only be located in those areas which lack other networks.

4.2.1.2. Translating demand into geographic frames

As we have already seen, white areas are defined in terms of networks at a 100m x 100m grid level (FFG, n.d.-b). This means that they do not align with administrative boundaries, such as (cadastral) municipalities, and they also do not differentiate between areas which are populated and those which are not; in theory, an entirely unpopulated area may be eligible for funding (*Interview 1*, 2022). As such, they do not actually reflect 'demand' in the sense that someone or something will (be able to) use the network. For this reason, I referred to white areas as a form of shorthand: the actors deploying networks remain responsible for layering these frames of reference (municipalities, white areas, potential subscribers) on top of each other to create a workable deployment plan. In the case of BE Technology, this is achieved through merging two public datasets, namely that of the broadband atlas and that of the populated areas in Austria. This allows BE Technology to see where people are, but networks are not (*Interview 1*, 2022). The demand for the networks to be deployed in the case of Burgenland lies in the overlap of these categories: it is where people are, but networks are not.

Merging these datasets also works as a form of independent evidence for lived experiences, which is the next point I would like to discuss briefly. Further above, I already mentioned that the broadband strategy sets out that BE Technology should engage with a broad spectrum of stakeholders. Indeed, "experiences with the market" (*Interview 1*, 2022) are crucial for BE Technology to facilitate its prioritisation, which encompass both exchanges with the telecommunications providers and with the municipalities (Amt der Burgenländischen Landesregierung, 2021, pp. 38, 67–68; *Interview 1*, 2022). Often, the information available to the telecommunications providers about the location of existing and planned networks is better than that available via other sources, which is why they are important

[33] The importance of other networks for deployment contrasts starkly with the perceived unimportance of networks for end users – that is, as long as the networks meet their needs and are affordable (*Conference 1*, 2022; *Conference 2*, 2022; *Interview 1*, 2022). This is because subscriptions to other types of networks are as a rule cheaper than subscriptions to fibre optics networks (Amt der Burgenländischen Landesregierung, 2021, p. 20).

exchange partners. However, it is actually the exchanges with the municipalities which are key in the network planning phase. The mayors or heads of the municipal office, who are often responsible for broadband deployment, know *where fibre optics networks make the largest difference*: according to my interview partner, they know everyone personally, and they know, at address-level, whether the broadband connection available to the household or business is sufficient for working or participating at school (*Interview 1*, 2022; *Interview 2*, 2023). In this sense, the municipal officials offer a way to match the abstract concept of demand and the concrete, physical buildings with each other, thereby translating local circumstances into a format that BE Technology can parse through their own network planning instruments.

What I have described as the knowledge about where networks are insufficient can also be referred to in other ways. In Austria, people involved in the deployment of fibre optics networks in rural areas refer to this as *Leidensdruck*, which literally means the pressure/weight of suffering. For the state-affiliated actors advancing fibre optics deployment all over Austria, *Leidensdruck* signifies how the digital divide feels to the communities, and the parts of communities, which are affected by it (*Conference 1*, 2022; *Conference 2*, 2022; *Interview 1*, 2022). By matching the map of networks with the map of people, BE Technology can conceptualise *Leidensdruck* as located at the intersection of populated areas and white areas, where people are and networks are not. This helps to realise the goal of the broadband strategy: connecting those 15% whom it considers to be particularly challenging to connect, who are incidentally the ones who experience this *Leidensdruck*.

4.2.1.3. Bringing in the future

In general, demand for bandwidths[34] is understood to get people to subscribe to different, and usually more expensive, telecommunications offers via a higher-capacity network. Like in other contexts of telecommunications network deployment, bandwidths play a role in this case study, as bandwidth predictions are used for prioritising where networks should be deployed (*Interview 1*, 2022), but their significance extends beyond this aspect.

To understand why the broadband strategy focuses on fibre optics networks, we need to know that it is not merely a lack of bandwidth *at the moment* which drives network deployment. Like in other contexts (*Conference 1*, 2022; *Conference 2*, 2022), the lack of available bandwidths is not just, and not necessarily, related to the here-and-now, but to predictions of future requirements (Amt der

[34] The very concept of bandwidths is ontologically charged, and I am using it here as it occurs in the field – which is to say, ‘bandwidths’ in this thesis refers not to the range of frequencies within a waveband which are used for a transmission, but to the upload and download speeds available to users. Needless to say, these concepts are two facets of the same phenomenon.

Burgenländischen Landesregierung, 2021, p. 25ff; *Interview 1*, 2022). Simply put, the broadband strategy as well as most of the telecommunications community predict that people will require better upload and download speeds in the future, or rather: that the applications used in the future will be built around networks which have a higher download and upload capacity, and that higher-capacity networks will be the prerequisite for using these applications. Leaving this next-level chicken-and-egg problem of networks and applications aside, we can nevertheless appreciate how the question of seeing demand thus also becomes a question of timeframes, as it entails decision about which timeframe for a network is relevant. This timeframe, for the broadband strategy, is already oriented towards the future –it is future demand for bandwidths which are crucial to the deployment project, not (only) the current usage of bandwidths (Amt der Burgenländischen Landesregierung, 2021, pp. 18–19; *Interview 1*, 2022).

But there is another timeframe which comes crashing into the framework of the broadband strategy. Deploying networks is a resource-intensive and time-consuming process, which means that even if all the resources were available – including not only money, but also the materials for the network and the people skilled in putting the networks where they should go –, it would not be possible to have full coverage from one day to the next (*Conference 2*, 2022). While the broadband strategy has its eyes set on fibre optics networks as the only solution in the long term, it tries to account for the short term through another type of network. This is why mobile networks are referred to as a potential interim solution (Amt der Burgenländischen Landesregierung, 2021, p. 26) to temporarily alleviate *Leidensdruck* in underserved areas (*Interview 1*, 2022). Through this positioning, a clear temporality of networks emerges: fibre optics networks are conceived of as long-lasting and durable, even in the face of future usage, whereas other types of networks are transient, but necessary in order to address an acute problem.

4.2.1.4. Relating demand to other infrastructures

We have gone into some depth now about how demand in the context of deployment is related to people, but we have only scratched the surface of how demand relates to other networks and infrastructures beyond telecommunications. After all, fibre optics networks are not only deployed for a medical facility to conduct a CT within 40 seconds (European Commission, 2021), or for a family of five to stream 4k videos individually at the same time (Breitsprecher, 2022): they feed into other infrastructures as well. I would therefore like to touch upon how demand is conceptualised in relation to other things and infrastructures in two main ways: one of which is related to mobile networks and the other to co-deployment.

One aspect stressed repeatedly by the broadband strategy, but also other actors involved in state-affiliated deployment projects, is that fibre optics networks are vital for providing connectivity for mobile networks (Amt der Burgenländischen Landesregierung, 2021, p. 27; *Conference 1*, 2022;

Conference 2, 2022). The broadband strategy even argues that “[f]ibre optics network deployment is an essential prerequisite for 5G rollout” (Amt der Burgenländischen Landesregierung, 2021, p. 61), which means that in order to further the deployment of faster mobile networks, fibre optics networks need to be deployed first. For this reason, many in the field argue that fibre optics networks should be understood as integral to, and not as a replacement for, mobile networks (*Conference 2*, 2022), while the broadband strategy of Burgenland considers mobile connectivity complementary to fibre optics networks (Amt der Burgenländischen Landesregierung, 2021, p. 26). In this way, retail demand for mobile networks transfers onto fibre optics networks: it becomes demand for backhaul and core networks at a wholesale level.[35]

The notion of co-deployment offers another way to drag other infrastructures into the issue of fixing the digital divide, which refers to sharing civil works between fibre optics networks and other infrastructural modifications. Co-deployment is considered to be an effective way of decreasing the cost associated with deployment. The broadband strategy aims to facilitate co-deployment wherever possible and specifically sets out that BE Technology should deploy access networks when coordination opportunities arise (Amt der Burgenländischen Landesregierung, 2021, p. 65).

The focus on co-deployment creates a situation where civil works of a completely unrelated nature may affect the prioritisation of an area for the deployment of fibre optics networks, provided they are of a scale and time which makes sense for BE Technology (*Interview 1*, 2022). Interlinked in such a way, fibre optics deployment can take place sooner if the circumstances are right, as BE Technology can wait until such a moment in time when co-deployment opportunities arise if there is no other way to reasonably deploy fibre optics networks in an area by means of funding (*Interview 1*, 2022). For this reason, co-deployment means that the ways in which other things and infrastructures change in response to their environment become relevant to the deployment of fibre optics networks. In addition, through a constellation of infrastructures, the temporality of fibre optics deployment changes.

While we will go deeper into the details and implications of the concept of co-deployment later on, what we need to know now is that in the constellation created by the broadband strategy, there is a very strong emphasis on co-deploying fibre optics networks together with modifications to the energy infrastructure. By anchoring co-deployment in the broadband strategy and tasking an energy provider to implement it in tandem with its own operations, a new realm of demand opens up: through these

[35] Why telecommunications providers see retail demand for mobile networks in areas where they consider demand for fixed networks to be insufficient is beyond the scope of my research questions, but it is an interesting topic for further research. It gains particular relevance because in certain regions in Austria, pilot projects have been launched where municipalities deploy fibre optics networks and mobile network operators use them to provide mobile connectivity (*Conference 2*, 2022).

connections with other infrastructures, demand becomes related not only to people, but to *other networks* – a very different notion of demand indeed than the one related to subscribers.

4.2.1.5. Shifting to the largest end-user in Burgenland

"Whose demand?", will be our final question for this section. Here, I want to first bring us back to one of the concerns of the broadband strategy, which we encountered earlier – namely, the security of critical infrastructure. In connection with the broadband strategy, critical infrastructure encompasses hospitals, Internet of Things (IoT)-related sites, water infrastructure, fire fighters and other blue light organisations (*Interview 1*, 2022). Defining critical infrastructure in such a way has an effect in the context of our case study: by positioning critical infrastructure as places to be connected with fibre optics networks, any settlement with such sites will be furnished with at least one fibre optics point of presence (*Interview 1*, 2022). The same goes for the public authorities and schools which the broadband strategy of Burgenland wants to see connected to fibre optics networks by 2030 (Amt der Burgenländischen Landesregierung, 2021, p. 66). In this constellation, demand becomes a way of making networks reach certain places which can be found even in underserved areas. We can observe a similar effect when the broadband strategy stresses that there is significant demand for fibre optics networks from "the largest end user" in Burgenland, namely the public sector (Amt der Burgenländischen Landesregierung, 2021, p. 21). What the broadband strategy does here is aggregate demand using a different scale: not geographically, but based on sectors.[36]

The shift in perspective from geographic to sectoral frames of understanding demand is particularly informing. I came across several indications that by furthering the deployment of fibre optics networks, states seek to stimulate, amongst other things, competition between providers with the aim of driving down the price of subscribing to fibre optics networks (*Conference 1*, 2022; *Interview 1*, 2022). Incidentally, this effort to stimulate competition by deploying a network is related to current pricing practices, which link the price of the product to the download and upload speeds made possible by the service; but simultaneously, it is also related to the predicted future bandwidth requirements (*Interview 1*, 2022). If indeed pricing continues to be practised as it is now, and it indeed becomes necessary to subscribe to ever higher bandwidths, then from a long-term perspective, the largest end user in Burgenland risks running into ever higher subscription fees. Fibre optics networks are therefore hailed as a way out of this dynamic, precisely because their capacity is determined by the network equipment and not by the network cable (*Interview 1*, 2022) – which means that future upgrades are vastly cheaper.

[36] Notably, such an aggregation by sectors instead of geographies is well-aligned with the broadband targets set out at other levels, for instance those of the European Commission (2021).

Looking closely at how demand is defined and rendered an object, at the geographic and temporal frames in which it is placed, at how demand is put into practice in relation to other infrastructures and institutions, the concept of demand which we encountered during the literature review becomes significantly less flat. Throughout this section, I tried to show you some of the manifold ways in which demand can be conceptualised – and I am sure that by now, the concept of 'demand' has become multifaceted and scintillating with sheer variety in your eyes. From the very act of locating demand in places where people are and networks are not, to the translation of the lived experience of a lack of connectivity into a geographical framework at address-level, and then to the layering of the future into the question of demand, we have followed how the concept of demand is at work in a deployment context. Even further, we began to explore how demand becomes linked to more than people, relating instead to infrastructures and institutions. Of course, we could tread this path even further, but this would take us away from the route we have set out to explore. Instead, I would suggest that we now turn to how this multiplicity-laden notion of demand works in the context of fibre optics deployment.

4.2.2. Building networks where demand is

Having gone deeper into how demand is conceptualised within the context of this case study, I would like to shift from what demand is considered to be to how this concept is put into practice, although the differentiation between both is volatile at best. Now that demand has acquired a textured complexity, let us take a look at what this complexity does when we start to build networks.

When we go back to the aims of the broadband strategy (Amt der Burgenländischen Landesregierung, 2021, pp. 66–68), we can see that there is considerable tension between the aim of connecting everyone (even the last 15%), the aim of connecting everyone as cheaply as possible, and the aim of connecting everyone with the most 'future-proof' infrastructures possible. Deploying networks to connect everyone has an inclusionary ambition, seeking to alleviate the *Leidensdruck* experienced due to the digital divide. The second aspect of connecting everyone as cheaply as possible, on the other hand, introduces criteria which may lead to exclusion: it entails a weighing of costs and benefits, a reflection on whether cuts in some areas may lead to lower overall costs, and to which extent these lower costs may be sufficiently valuable to justify any required cuts. The third aspect of future-proof infrastructures adds to the complexity of decision-making by introducing a temporal element to the difference made between the types of networks to be deployed. The result of this temporality is that the network becomes related to its suitability for projected demand (instead of current demand).

We can understand each of these aspects as related to practices of demand, but they also stand in considerable tension to each other, For this reason, these considerations need to be sorted out when engaging in network deployment projects. Our next concern will therefore be to trail how these understandings of demand are put into practice in the context of deployment.

4.2.2.1. Dealing with networks done previously

We have spent quite some time already with the relation between demand and other networks, but we have now come to a point where we can return to it anew from a different angle. While I have not focused my research on their deployment practices, we need to look to how telecommunications providers are understood to act if we seek to understand the framework in which the broadband strategy and its implementation necessarily operate. The factors which we will explore are not unique to the context of Burgenland or Austria, and as we saw in the literature review, they form a part of what others have described as a market failure.

Centres are relatively densely populated, even in rural areas, which means that it is easier and cheaper to deploy networks in centres. As a consequence, they are considered to be more attractive to connect for investors and telecommunications providers (*Interview 1*, 2022). This is why projects led by the private sector, which promise to deploy quickly and cheaply, often lead to short-term wins for the municipalities: they do end up getting a network, but only in those areas which already have networks (*Interview 1*, 2022). In addition, the "telecommunications philosophy" (*Conference 1*, 2022) of network deployment is understood to be one of incremental modification, which expresses itself in a preference for deploying fibre optics networks to a point of presence and then upgrading the surrounding network to FTTC.[37] As a consequence, buildings in centres often have better broadband connections than those at the outskirts, both because they are preferred areas for deployment and because they are located closer to the fibre optics point of presence.[38] Last but not least, in the understanding of state-affiliated deployment initiatives, telecommunications providers prefer to keep their established networks profitable for as long as possible by keeping subscribers on them for as long as possible to delay the costs incurred by network deployment (*Conference 1*, 2022). This means that they are considered to be less interested in quickly upgrading a fixed network, as their primary interest lies in recouping prior deployment costs and gaining a profit from the existing networks.

The combination of these factors together has very material consequences. It leads to what one participant called the "Dalmatian effect" (*Conference 2*, 2022) and another one termed "patchwork carpet of networks" (*Conference 1*, 2022). The so-called cherry-picking practice of only connecting

[37] The phenomenon of telecommunications providers sticking to FTTC has also been described by a report evaluating the previous rounds of public funding in Austria (Neumann et al., 2017, pp. 47, 50).

[38] To recall, the download and upload speeds achievable via an FTTC network depends on how far a subscriber is away from the fibre optics point of presence.

those areas which are easiest to connect leads to black spots amongst amidst grey and white areas, where only certain areas are connected to a superior network. State-affiliated deployment projects are concerned with the outcomes of these practices firstly because their area of intervention is limited by black spots – and we will return to this again a little later. Secondly, as recalled by the broadband strategy, the type and topology of the available networks as well as the number of users affect how much bandwidth is available at specific points if the network is a shared medium (Amt der Burgenländischen Landesregierung, 2021, pp. 18, 26). This means that within a geographic area that is administratively the same (e.g. a municipality), there can be vast differences in terms of broadband access *based on the distance of premises from certain points*.

On the one hand, the combination of these factors means that we need to conceive of *Leidensdruck* as a thoroughly geographical phenomenon that emerges from the differences enacted between centres and margins. On the other hand, we can see how network access can become a practical political problem within a municipality. Since mayors are equally responsible for white, grey and black areas, they feel the pressure exerted by those who experience *Leidensdruck* to remedy these differences (*Interview 1*, 2022; *Interview 2*, 2023). As a consequence, the municipality needs to navigate these networks, the *Leidensdruck* which their constituents experience, and the deployment activities. In this sense, the broadband strategy and the municipalities converge on a problem, which has an effect on how they enact demand. Before we turn to this point, however, we need to head over to the framework offered by public funding, which will allow us to pick up the trail of the Dalmatian effect and what it means for state-affiliated broadband deployment.

4.2.2.2. Using state aid

As we saw earlier, the funding framework is particularly relevant for state-affiliated deployment projects because their activities are circumscribed by this framework and thus limited to white and grey areas. In the context of this case study, the white areas are also drawn on to locate demand: demand is understood to be where the white areas are (*Interview 1*, 2022). Beyond this practice of locating demand, however, the funding framework is made clearly relevant by one of the measures of the broadband strategy, which spells out that fibre optics networks are to be deployed "in areas with market failure by [BE Technology] as backhaul and, in case of synergies with the core business, as access networks, making maximum use of new funding programmes for large-scale deployment (BBA 2030 – Open Net)" (Amt der Burgenländischen Landesregierung, 2021, p. 67; my translation).

Applying for public funding thus forms a very important part of the activities of BE Technology, and I would therefore suggest that we take another look at what this means for the entangled practices of demand and deployment of access networks. First and foremost, through these entanglements, the rhythms of state aid become part of the deployment cycle. Deployment which is publicly funded has to align with the planning cycle of state aid, where funding is made available at certain times. This requires structuring the planning phase in accordance with the funding programme: presenting a plan, submitting it for approval, making changes to comply with any feedback and launching into deployment happen within the funding cycle (*Interview 1*, 2022). The speed of publicly funded deployment is therefore determined by the funding process.

Secondly, we need to think again about the relationship between white, grey and black areas. As we have already seen, centres tend to be well-connected, while the white and grey areas tend to be at the margins of settlements. But networks do not appear out of the blue, they are necessarily, thoroughly, and always, connected. This means that in order to connect the margins, BE Technology will necessarily have to go through the centres, without connecting them even though they could (*Interview 1*, 2022). Unintentionally, there will always be some measure of overbuilding existing networks even deployment aims solely to connect the margins.

We can observe a similarly unintentional mechanic to state aid when it comes to connecting these very same white and grey areas. As presented by my interview partner (*Interview 1*, 2022), within the context of the Austrian funding programme, it is necessary for a network to cover 95% of the white and grey areas in order to receive funding for up to 65% of the costs. If the network covers 80% of the white and grey areas, the project is eligible to receive funding for 50% of its costs. The percentages of premises passed required by the funding programme have the peculiar feature that they do not specify which buildings should be connected, only how many: in other words, they are geographically meaningless. Yet they still have an effect on deployment, which we can see when we take a look at how funded projects play out. Based on the requirements of the funding programme, in an average settlement of 50 premises in Southern or Central Burgenland, at least 47 premises have to be connected in order to receive funding – and the last three premises are usually the hardest to reach (*Interview 1*, 2022). As a consequence, those three hardest-to-reach premises may not be included in the scope of the deployment project, and it may instead become necessary to find alternative means of connecting them (*Interview 1*, 2022).

In terms of state aid, we can therefore observe a strange phenomenon: there is no mechanism provided by public funding to ensure that the 5% which are hardest to reach are amongst the 95% or the 80% which need to be connected. Even though demand overlaps geographically with the populated white areas in the context of the broadband strategy, state aid alone is not enough to ensure that this demand expressed in *Leidensdruck* is met through network deployment. To understand why this is the case, we need to turn to that phase of network deployment where actors try to achieve a balance between costs, revenues and other considerations.

4.2.2.3. Making a business case

Deploying networks is a matter of making a business case – which seems simple, at first glance, since it involves finding ways to cover the cost of a network. Let us therefore take a closer look at how this intricate masterpiece of accounting and taking-into-account comes into being. In general, it is common to calculate deployment costs on a per-premises basis, using the assumption of a certain take-up rate, and we can find the same pattern in the broadband strategy.

According to the broadband strategy of Burgenland, the cost of connecting all premises in underserved areas to a fibre optics network would amount on average to 5.896 Euro per premise (Amt der Burgenländischen Landesregierung, 2021, p. 52). This amount is quite high, and so the broadband strategy proposes to reduce this average cost per premise to 4.417 Euro using synergies achieved through co-deployment. However, even this reduction is not enough just yet: from the perspective of the broadband strategy, it is only possible to achieve an "economically viable" average cost of 2.500 Euro per premise by drawing on public funding (Amt der Burgenländischen Landesregierung, 2021, p. 52).

From the difference made to the outcome by the broadband's strategy use of synergies, we can already see that some factors in calculating the cost of deployment are highly variable. Synergies are proposed as levers to reduce costs because according to the broadband strategy, civil works are the largest contributor to the cost of deploying a network, amounting to between 60% (Amt der Burgenländischen Landesregierung, 2021, p. 48) and 70% (*Interview 1*, 2022) of the total cost. A simple way to reduce the cost of deployment would be to limit civil works by deploying only in centres, which of course causes the Dalmatian effect in rural municipalities. However, the broadband strategy chooses to take another path, as its interest lies in connecting those who are experiencing *Leidensdruck*. It has taken us a while to arrive at this point, but the cost reductions of co-deployment are the reason why the broadband strategy creates a link to the energy infrastructure. We will follow the implications of this link between infrastructures a little later, but for now, there are further dimensions of making a business case which we need to explore.

Before moving into the details of how the business case is made in Burgenland, I would like us to dwell briefly on how an average cost per premises works. As discussed by a conference participant, if your ambition is to connect everyone, then average costs help to *legitimise extending the network to the hardest-to-reach*: the actual cost of extending the network all the way out there can be mixed with the actual cost of extending the network to those closest to the access point, ending up with an average that is economically reasonable (*Conference 1*, 2022). At the same time, connecting everyone at once also has the effect of reducing the total cost by increasing the scale of the project (*Conference 2*, 2022). While the broadband strategy overall strives to reduce the average cost per premises, we need to bear in mind that the average cost can also serve as a justification for deploying to the outliers.

But making a business case is not only a matter of art and technique: there are factors which resist the business case. Of these factors, one of the most important ones is the topology of the network. This brings us back to the Dalmatian-spotted municipalities, where the centres have been connected and the margins remain omitted. Once a network has been deployed in such a way, all accounting techniques to legitimise the effort of connecting underserved areas suddenly become futile: "as soon as it [i.e. the network] is built and only the centre is connected and the rest is not, you end up with about 20.000-30.000 Euro per premises and this cannot be financed, even over a hundred years this business case does not work" (*Interview 1*, 2022). On the one hand, we can thus see that where demand is identified as sufficient matters beyond the momentary situation of deployment. Where demand is considered sufficient to deploy a network changes the materiality of the network, and in turn, the network topology affects which level of demand is necessary to secure the economic viability of future network deployment.

On the other hand, the practice of making a business case thereby extends beyond the calculation of costs to raising awareness about the interlinked nature of the network topology and the business case. Alongside its deployment activities, BE Technology informs municipalities about these effects so that they understand that deployment projects in their area should also connect hard-to-reach premises instead of only the centres (*Interview 1*, 2022). Their informational activity does not aim to prevent the deployment of networks by others, as this would run counter to the intention of the broadband strategy. Rather, their engagement with the municipalities on this topic seeks to retain the viability of business cases for fibre optics network deployment – whether these business cases are made by them or by others.

Before moving on to our next site, I would like to return to a key point in the quote we just explored – namely that of time. Making a business case is not only about dealing with networks done previously (although there are considerable ties to this aspect) or finding ways and means to reduce costs without trading off too much on the goals of deployment. In order to make a business case, you need to define a time horizon. To recall, if a network is deployed only in the centre, leaving out the premises at the margins, a business case does not work even over a hundred years (*Interview 1*, 2022). While BE Technology does not have a lot of flexibility in terms of where people and previously existing networks are, it can draw on longer time horizons to *make a business case work*. Later on, we will return to the issue of time, but our next stop will be related to the take-up rate which implicitly forms part of the calculation of the business case.

4.2.2.4. Securing demand in advance

We have already seen glimpses of it, but the time has come to turn our attention fully to the issue of how much demand is necessary to make the deployment of a network seem reasonable. Demand aggregation is one of the most common ways to establish whether or not demand is sufficiently high to justify deploying a network. It is a curious practice in its own right, which would certainly merit further research, especially because it is so well-established in almost all of the deployment projects I have come across during my fieldwork (*Conference 1*, 2022; *Conference 2*, 2022). There are two dimensions to securing demand which we will explore: the first one relates to the pre-contracting rate, which signifies the number of premises committing to subscribing to the network before it is built. The second one is the take-up rate, which makes a difference to how deployment is calculated and entails its own set of practices – and for this reason, we will discuss the take-up rate very briefly now, and again in the next section in more detail. It is important to keep in mind that pre-contracting as well as take-up rates and other forms of stimulating demand are not 'merely' marketing (whatever that would mean): their occurrence in the context of deployment projects points to their performativity, or in other words, to their ability to anchor infrastructures and make markets.

As mentioned above, demand aggregation plays a pivotal role in calculating the cost of network deployment: the broadband strategy calculates that a take-up rate of 100% leads to investment costs of about 1.500 Euro per premises, a take-up rate of 50% to investment costs of slightly over 2.000 Euro per premise, and a take-up rate of 30% to investment costs of nearly 3.000 Euro per premise (Amt der Burgenländischen Landesregierung, 2021, p. 50). Even though this is only presented as an example, it is clear that the take-up rate makes an impressively large difference, because the number of subscribers to a network determines the distribution of the cost among them. Therefore, by increasing the number of subscribers to the new network, the cost of deployment per premises can be reduced. If this is done in advance of the network being built, it is called a pre-contracting rate, and achieving a high pre-contracting rate helps to lower the cost of deployment per premises. Simultaneously, a high pre-contracting rate validates that demand exists in advance of deploying a network.

For these reasons, securing a minimum pre-contracting rate is an important practice amongst various fibre optics deployment projects in Austria, whether or not they are state-affiliated. The specifics differ wildly between initiatives in different regions or states: some require a 40% pre-contracting rate (*Conference 2*, 2022), while others add a minimum number of units to be connected on top of a pre-contracting rate (*Conference 1*, 2022). For many private-sector actors, in particular investment-backed projects, achieving a specified pre-contracting rate is an essential precondition for deployment (*Field*

Notes, 2023; *Interview 1*, 2022; *Interview 2*, 2023).[39] In between these variations, some actors furiously argue that the time it takes to accumulate demand commitments from so many people interferes with the project timelines and thus ruins the very project a pre-contracting rate endeavours to establish (*Conference 2*, 2022).

Burgenland has, in some sense, taken middle ground on this issue. The broadband strategy sets out that "the predetermined willingness of residents and businesses to subscribe to a higher quality connection ('take [up] rate')" (Amt der Burgenländischen Landesregierung, 2021, pp. 65–66; my translation) is supposed to be one of the criteria for BE Technology to choose where to build networks. However, the broadband strategy does not specify how high a 'sufficient' pre-contracting rate (or in its own words, "the predetermined willingness") should be. We can therefore understand this provision to be an acknowledging nod into a potential direction without any binding requirements, which makes it a particularly interesting aspect to observe empirically.

To understand how BE Technology and the broadband strategy of Burgenland approach the pre-contracting rate, we need to go back to geographies. As I mentioned earlier, one of the challenges with white areas is that they do not correspond to other administrative geographies, such as municipalities and cadastral municipalities. In combination with the practice of counting pre-contracting rates at a municipal level, this gives rise to unique challenges. As my interview partner explained, BE Technology focuses on the areas "where the *Leidensdruck* is highest, which is in the white and grey areas, and there, the existence of demand is a given and you will reach a demand of 70-80%, but if you look at municipalities it will become difficult to reach 40%" (*Interview 1*, 2022).

If the broadband strategy were to require a predetermined take-up rate of 40% at a municipal level, that would mean that a high percentage of those premises at the centre of a municipality must declare their willingness to switch to a different network in order for those at the margins to be connected to a network. Considering that municipalities often consist of several cadastral municipalities, it could also mean that people in one village of a municipality must confirm their interest in switching to a fibre optics network so that the network will be deployed to a different village in this municipality. For my interview partner, pre-contracting rates cannot be regarded as a panacea (*Interview 1*, 2022): a pre-contracting rate alone cannot be the sole determinant of where networks are built if the aim is to eventually achieve full coverage. In other words, the broadband strategy opens up space for dealing with

[39] While I have not had the chance to talk to the actors engaged in such investor-backed deployment, from the information I have gained in other encounters, they rely on demand aggregation of 40% at a municipal level (*Field Notes*, 2023; *Interview 2*, 2023).

demand in ways which are more granular and situated than pre-contracting rates calculated at municipal level.

4.2.2.5. Adding premises up

A moment ago, we walked into the issue of the pre-contracting rate, and we saw that the broadband strategy does not specify which pre-contracting rate would be sufficient to justify the commencement of a deployment project. Another aspect the broadband strategy of Burgenland remains silent on is the take-up rate it would envisage once the network has been built, i.e. the number of premises which should subscribe to the network. As we saw earlier, broadband strategies tend to be rather indifferent about this topic: their job ends when the premises are connected to a network. This approach is quite different from the one taken by private-sector initiatives, whose bottom line depends on achieving as high a take-up rate as possible. Nevertheless, we can observe that in the wake of these deployment activities, the take-up rate becomes very important to a different group of actors – namely the municipalities.

Regardless of whether the deployment project was led by BE Technology or a telecommunications provider, the municipality I spoke with was actively engaged in what they termed ‘getting a good quota together’ (*Interview 2*, 2023; my translation and paraphrase). My interview partner recounted in vivid detail how the municipality had not only sought to initiate fibre optics deployment at various moments in time, but began to liaise with the telecommunications providers and the municipal residents whenever a potential opportunity arose. These activities aiming to achieve a good take-up rate included organising information events and motivating people to subscribe to the new network (*Interview 2*, 2023). Taking a closer look at two instances is quite illustrative to see how the take-up rate is done in practice – and for the sake of simplicity, we will focus on two cases where no pre-contracting rate was required.[40]

In the first case, the deployment project was initiated in a relatively small area of that municipality. Without any pre-contracting rate required in advance, the efforts of the municipal officials led to roughly 70% of the premises thus connected subscribing to different telecommunications providers via the newly built fibre optics network (*Interview 2*, 2023). As the area was quite small, the take-up rate looks completely different at a municipal level (provided you do not take into account how many premises even have access to a fibre optics network). Achieving this take-up rate, calculated at the level of the affected households, was a matter of pride for the municipality: it showed that the deployment initiative was both necessary and successful.

[40] Another potential project failed precisely because the minimum number of subscribers considered to be necessary to make deployment viable could not be reached (*Interview 2*, 2023).

In a second case, a provider engaged in deployment nearby approached the municipality with a list of addresses which could be connected to a fibre-optics network using ducts that had already been laid previously. Here, again, the municipal officials first identified and then began to rally the potential subscribers by organising information events (*Interview 2*, 2023). As the project has yet to be completed, what this means for the take-up rate remains an open question, but it is clear that the municipality plays a significant role in producing demand. But this example also highlights the entanglement between existing and possible networks, since the project could only be initiated without a pre-contracting rate because the ducts are already there (*Interview 2*, 2023).

As different as these cases are, we can see that from the perspective of the municipalities, the take-up rate can be an important instrument to demonstrate the success of a deployment project. Through the take-up rate, a justification for the network is established, even when this happens after the fact. Engaged in making a project 'worth it', the municipalities enact subscribers, which are subsequently considered to be demand. In addition, from these examples we can see that the take-up rate is not a practice which has a specific place in the chronology of network deployment. Instead, the take-up rate jumps backwards in time to lend authority to the claim that a fibre optics network is necessary. In this sense, the timeline of demand in the sense of the take-up rate as seen by the municipalities is directly opposed to the timeline of demand in the sense of the pre-contracting rate. Network deployment as done by these practices is not a chronological process; in some cases, the linear time of *chronos* gives way to *kairos*, the time of opportunity.

In the preceding sections, I have tried to guide you through the uneasy relationship between demand and supply in the context of network deployment. We have cautiously traversed what demand means and where you can find it, and what this does to boundaries between infrastructures and even markets. Our next move was to embed these conceptualisations, observing how BE Technology needs to wrestle with demand and the material to make a business case, and what the pre-contracting rate and take-up rate do within the context of deployment. But there is more to learn about demand in our case study, and we will do so by exploring the ways in which demand is done differently.

4.2.3. Doing demand otherwise

In STS, ways of doing otherwise are significant because they highlight potential avenues for change. In the context of this case study, I believe they are particularly interesting because they help us understand how fibre optics deployment is practised by actors which do not take centre stage in most accounts of these processes.

I have already mentioned that demand in this context is not only understood as something which occurs now, but also in the future: amongst other things, fibre optics networks are deployed in order to respond to future requirements. I would now like to look at temporality more closely, because it leads us to the concept of *Daseinsvorsorge*. I cannot think of any equivalent in English, but an approximate translation of this term could be 'to make provisions for the possibility of existence (or something/someone existing) in the future'. It feels like a concept related to insurance,[41] not to broadband deployment, but it is widely used in the Austrian context of state-affiliated broadband deployment (*Conference 1*, 2022). We need to explore it at some length as the broadband strategy draws on this concept for parts of its reasoning.

4.2.3.1. Investing in communities

Daseinsvorsorge denotes the ambition of providing every household and business with the choice of whether to connect to a network sufficient for their current and future needs (*Conference 1*, 2022; *Conference 2*, 2022). Within this framework, fibre optics networks are an investment into the future of rural communities (*Conference 1*, 2022; *Conference 2*, 2022). In the broadband strategy, this ambition is expressed most succinctly when the work programme for 2020-2025 of the government of Burgenland is cited: "We consider reliable access to a high performance network to be a universal service to the population […] Our aim is to provide high-speed broadband to every household in Burgenland" (Amt der Burgenländischen Landesregierung, 2021, p. 31).[42]

The approach taken by *Daseinsvorsorge* is different from network deployment conditional on sufficient demand described earlier. It takes the result of the network deployment as its point of departure, aiming to avoid a "two-tier society" (*Conference 1*, 2022) by providing the same opportunities to people, regardless of whether they live in the centre or down the road, or how many people use the network there. Deploying networks in such a framework means caring for the community by caring less about individual properties of premises, e.g. whether their proximity to the centre or their usage for business or residential purposes. We can see this effect most succinctly in how the framework of

[41] The role of insurance providers in this field should not be underestimated: some insurance providers, especially pension funds, have taken a liking to fibre optics networks and acquired them in the expectance of a stable, albeit low, source of revenue. In any case, these actors do not seem to be the sources of the term *Daseinsvorsorge*.

[42] Please note the way that the term "universal service" is used here to refer to ensuring that everyone in Burgenland has access to a *high-performance* telecommunications network as a *public duty*. This is very different from the way the term "universal service" is used in a telecommunications context, where it means that everyone has the right to receive access to *basic* telecommunications service to be established by telecommunications providers (RTR, n.d.).

Daseinsvorsorge dissolves the differentiation between buildings used for work or for leisure when people argue that following the Covid-related developments of the past years, “we have learned that every connection has to be business-capable” (*Conference 2*, 2022). Organising network deployment in such a way relates to the framing of broadband availability as a state-level problem, where lack of Internet access is a concern at the level of communities and not (only) individuals (Amt der Burgenländischen Landesregierung, 2021, pp. 13–19).[43]

Shifting the network from a market affair to a public concern in the particular case of Burgenland goes hand-in-hand with a specific model for organising relations between telecommunications providers. Earlier, I mentioned that the broadband strategy prescribes a wholesale-only model for BE Technology, which is to say, its networks will be available for other telecommunications providers but not directly for retail subscribers (Amt der Burgenländischen Landesregierung, 2021, p. 58). The network infrastructure built by BE Technology should thus remain its property while becoming available to other telecommunications providers. Even though it was likely chosen for reasons related to the regulatory framework, the model selected by the broadband strategy is met with enthusiasm by municipalities as it alleviates their concern that someday, the network may cease to be maintained (*Interview 2*, 2023). Deploying a network with an open-access model is therefore perceived to be a way of making sure the network will be available to all for as long as possible. As a curious side-effect of this model, using the network becomes more than ever the choice of active providers (*Interview 1*, 2022) and users (*Interview 2*, 2023), which means demand as practised by these actors is no longer pre-determined by the network cables.

4.2.3.2. Expanding time horizons

Rather than changing any particular element in the process of deployment, *Daseinsvorsorge* changes the framework of time considered relevant. The broadband strategy of Burgenland argues that long payback periods are one of the challenges for fibre optics network deployment because their timeframes are “incompatible with short-term profit interests of service providers and telecommunications operators” (Amt der Burgenländischen Landesregierung, 2021, p. 21).[44] Building networks that are

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[43] I do not wish to romanticise fibre optics deployment by state-affiliated actors in Burgenland or, for that matter, in Austria. Ontologies which start at the population-level are not all-seeing: they have specific positionalities, advance particular interests, and have certain blind spots, just like any other ontology. We can, however, learn more about these specificities by understanding in which ways they contrast with others.

[44] It is not alone in making this argument: as noted by a conference participant, the problem with network deployment is that it not correspond to the timelines of investors, who do not have the patience to wait so long (*Conference 2*, 2022).

profitable within five to fifteen years means building networks which are cheaper as they encompass only those premises which are easiest to reach.

The framework of *Daseinsvorsorge* leads to different kinds of calculations. The aim is to have a network which will last for as long as possible (*Conference 1*, 2022; *Interview 1*, 2022), minimising the necessity of recurring civil works which are viewed as disruptive (*Conference 2*, 2022; *Interview 2*, 2023). Fibre optics networks emerge as a special kind of network: they are so attractive in this context because their capacity to handle future demand, in the sense of an intensity of usage, means that "we do it [fibre optics deployment] once and then it is done and we have peace for the next 30 years" (*Conference 2*, 2022). In other words, in communities which have experienced the wrong side of the digital divide, the timeline under consideration is at odds with the idea that just any network will do. Instead, a specific network is necessary to satisfy the requirements of the time horizon of *Daseinsvorsorge*.

Calculating with a timeframe of fifty years or more also allows for different considerations to play a role, such as security or sustainability, and these in turn help to justify deploying networks in a different way (*Conference 1*, 2022; *Interview 1*, 2022). Such timeframes are not an option for telecommunications providers, who (have to) "think like private sector actors" (*Interview 1*, 2022). However, just because actors like BE Technology can use different timeframes does not mean that anything is possible. As we saw earlier, how networks have already been built needs to be factored into the costs of expanding the network or deploying a new network: at some point, even a timeframe of a hundred years or more is not enough to make network deployment economically viable (*Interview 1*, 2022).

4.2.3.3. Doing infrastructures instead of demand

Another consequence arises from the approach offered by *Daseinsvorsorge*, which I think is best illustrated by an observation made by my interview partner: "the state is there to ensure that fibre optics networks are built in a way that makes fibre optics a matter of *Daseinsvorsorge*, just like electricity or water; we need to move away from the discussion around bandwidths and fibre optics towards a discussion around infrastructures and *Daseinsvorsorge*, and only then the state of Burgenland like the other Austrian states will be able to implement the broadband strategy" (*Interview 1*, 2022). We need to unpack this quote a little because it is instructive about what is 'actually' at stake when it comes to fibre optics deployment.

From the perspective of *Daseinsvorsorge*, infrastructures are more than markets, products or services (*Conference 1*, 2022; *Conference 2*, 2022): they are deeply integrated into everyday practices and the way how people go about life. *Daseinsvorsorge* recognises these entanglements and therefore tries to move fibre optics networks into the conceptual realm of water and electricity in order to differentiate them *from other telecommunications networks*. Whatever material similarities these networks may have, fibre optics networks are envisioned as different from a copper or a coax network. On the one hand, this shift entails a different vision of what the network should do: fibre optics networks are understood to enable a basic right to access the Internet, on top of which you can create a market which will offer that access. This approach posits that the network is the basis for the market (i.e., first you have the network and then you get subscribers), instead of the market being the basis for the network (i.e., first you need subscribers and then you get a network). In this sense, *Daseinsvorsorge* assumes that demand will come once the network is there – it is built into the network.

At the same time, there is a more complex nuance that relates to the specific qualities of fibre optics networks. In the context of *Daseinsvorsorge*, fibre optics networks become allied with other types of networks where the intensity of usage, number of users and types of applications used are *no longer predetermined by the capacity of the network connection*. A household with a fibre optics connection does not need to manage the consumption habits of its members because bandwidth is available in abundance. A business with a fibre optics connection does not need to plan for the latency requirements of future applications. Fibre optics networks are thought to disentangle how the network will be used from the cables used for the network, precisely because the speed is determined by the more easily replaceable active equipment. In this way, the network becomes defined by how long it will remain suitable for the everyday practices of its users. As a consequence of both of these movements, what fibre optics networks, from the perspective of *Daseinsvorsorge*, can no longer be understood only in terms of the ontological framework applied to telecommunications networks.

The development of other projects in Austria seems to indicate that *Daseinsvorsorge* as a practice of doing demand otherwise has achieved quite successful deployment outcomes (*Conference 1*, 2022; *Conference 2*, 2022). Insofar as *Daseinsvorsorge* removes demand as a central element for its deployment activities, it shows that doing demand and doing deployment are not firmly interlinked practices, but this does not mean that *Daseinsvorsorge* necessarily works completely without demand. In Burgenland at least, where *Daseinsvorsorge* plays a role at a strategic level, demand nevertheless continues to be done through a variety of practices. Certain ways of practising demand are even premised on *Daseinsvorsorge* in the context provided by the broadband strategy. Seeing demand in precisely those areas where others have not perceived it, as well as making a business case work for areas which are not interesting for other actors, are notable ways of practising demand because they are different – and they are different because they are guided by *Daseinsvorsorge*.

4.2.4. Conclusion

Before moving on, I would like to look back at some of the highlights we encountered. Demand can be understood as a practice and, as a practice, plays out differently in specific contexts. This depends on actors, on environments, on the web of practice in which any particular practice is embedded, at any particular moment. What we see have seen in this case study is that 'demand' goes beyond stimulating demand, or managing demands on networks; instead, the very notions of what demand is and what counts as (sufficient) demand emerge through practices of those engaging in network deployment. The empirical findings we accompanied in the context of this case study not only support the value of such a theoretical lens, but also open up new ways of thinking about network deployment. Looking at practices of demand, we can see how the lack of deployment in rural areas is not 'simply' a failure of the market, but could be understood as a set of ontologies in practice. Other approaches to deployment may draw on different ontologies for their practices, and it is these entwined ontologies and practices which we attended to empirically.

Our first path led us to observe how demand is conceptualised by the broadband strategy. Most importantly, we got to see where demand is located – at the intersection between the white areas and the populated areas – and learned about the importance of translating the dissatisfaction with a network capable of less than 30 Mbit/s download speeds into a geographic framework that can be used for planning a network. We had our first odd encounter with time, where we realised that given the time it takes to build them and their durability, these networks are built to satisfy the demand (in terms of usage) of the future instead of the present. Later on, we saw how other infrastructures, like mobile and also energy networks, become a source of demand specifically for fibre optics networks. Last but not least, we explored how the broadband strategy uses specific frames of reference to define the public sector as the largest end-user in Burgenland.

This path showed us how doing demand makes a difference in deploying networks, changing how areas are prioritised and what that means for future deployment. We became familiar with the challenge of dealing with demand in the white areas when some areas are black, even though networks deployed in white areas necessarily go through black areas, and also learned that deploying networks in a public funding framework means that networks intended to satisfy demand are built according to particular rhythms. Considering the factors which need to be weighed at different moments in time, we learned of the pragmatics of making a business case for a fibre optics network – in particular, how the power of time, i.e. extending the business case to fifty years, can be limited by the power of matter, i.e. the networks which have already been built. These concerns brought us to the pre-contracting rate, which may solidify certain kinds of business cases even if it undermines deployment in small areas; and also to the take-up rate, where we saw how important the take-up rate is to justify, in a time-hopping manner, the network which has been built.

The last part of this sub-chapter was concerned with the ways in which demand is done differently. In this section, we delved into how some actors take a different approach to deployment. In the conceptual framework of *Daseinsvorsorge*, demand is not only conceptualised in a different way but using other timeframes, and drawing on distinct valuation practices, to achieve outcomes which are not possible for the private sector. Importantly, we became acquainted with the implications of conceptualising fibre optics networks as *ontologically distinct from telecommunications networks*. This turns fibre optics networks into something which should be available to everyone without specific preconditions. At the same time, we saw how *Daseinsvorsorge*, at least in Burgenland, does not stifle the practice of demand; on the contrary, it is what makes certain ways of doing demand differently possible.

So far, we have mostly sidestepped the connection between fibre optics networks and electricity networks forged by the broadband strategy of Burgenland. After learning earlier that the energy infrastructure is brought into the mix by the broadband strategy, we now know that it seeks to harness the synergies between these infrastructures to reduce the cost of civil works. But just like *Daseinsvorsorge* has ontological consequences for what a network is, practising fibre optics deployment through the energy network has consequences for how deployment is done. Invariably, both affect how demand is enacted, because they change the parameters of who counts and who is easiest to reach. And for this reason, we will now turn to the ontological experiment advanced by the broadband strategy to explore what happens to demand when fibre optics networks are made to run alongside power lines.

4.3. Electrifying fibre optics deployment

When first roaming through the framework established by the broadband strategy of Burgenland, we came to realise that the fibre optics networks we are interested in are set to be deployed by the subsidiary of an energy provider. Our next meander through demand touched upon how demand begins to be related to other infrastructures, and thus gave us some signposts as to what it could mean when infrastructures are thought as functionally separate, but concomitant. I would now like to guide us through what this means for network deployment. In this section, we will dedicate our focus to exploring the question: *how do the materialities of energy infrastructure impact the deployment of telecommunications infrastructure in the case of co-deployment by an energy provider?*

We will therefore first look into fibre optics as part of energy networks in general, and more specifically in Austria, to then move on to how the broadband strategy draws on these modes of companionship to advance deployment of broadband networks. Lastly, we will look into how the way these networks are deployed may change if fibre optics networks follow the power lines to their destinations in Burgenland.

4.3.1. Managing energy networks

Before we get any deeper, we need to understand why fibre optics networks are used in energy networks. After all, several energy providers in Austria are involved in broadband deployment, usually when it comes to backhaul networks (Amt der Burgenländischen Landesregierung, 2021, p. 34), but the simple fact that they provide access to their backhaul networks tells us very little about why they have such networks in the first place. Let us therefore turn briefly to the use of fibre optics networks for energy networks in general, before looking at why the energy networks are changing.

4.3.1.1. Relying on fibre optics

To a certain extent, energy providers deploy fibre optics networks for their own commercial reasons (*Conference 1*, 2022; *Interview 1*, 2022). The broadband strategy of Burgenland references this repeatedly, which is why we have already come across the “core business” in a variety of contexts (e,g. Amt der Burgenländischen Landesregierung, 2021, p. 67), but it does not explain where this usage comes from. For that, we need to turn elsewhere.

Energy systems are incredibly complex and achieving the stability of the network is no easy feat because ‘stability’ means that “the produced amounts of energy always have to correspond to the consumed amounts of energy at any time of the day or night” (*Interview 1*, 2022). Lately in particular, the organisation of flows within the electric grid is undergoing changes due to a wider variety of renewable power sources being connected to the grid. Energy providers are increasingly confronted with the phenomenon of prosumers (*Conference 1*, 2022), which is to say that people are increasingly producing their own electricity or interested in doing so. More distributed sources of renewable energy, in turn, require increased management capabilities and also call for the reinforcement of the electricity network (*Interview 1*, 2022). These developments are heightened by the energy transition which is promoted by strategies such as #mission2030 (BMNT & BMVIT, 2018).

Telecommunications networks play a role within these other infrastructures because they enable continuous monitoring of the networks through the transmission of information – and therefore make the energy networks manageable. Fibre optics networks are particularly important for relays within energy networks: only licensed microwave systems and fibre optics are suitable telecommunications systems for primary communications channels for relaying (Lehpamer, 2016, pp. 23–24).[45] Elements of the energy network as diverse as switchgear, substations, or transformers, and energy sources such as wind turbines or solar parks are connected via fibre optics networks in Burgenland (*Interview 1*, 2022). In this way, fibre optics networks contribute towards maintaining the stability of energy systems across a variety of levels.

This brings us to the last point before we move on: as we can see from Figure 3, the energy network is commonly divided into low-voltage, medium-voltage and high-voltage levels. Roughly, these categories could be translated as access, backhaul and core networks, and so we will commence by thinking of low-voltage networks as access networks, medium-voltage networks as backhaul networks and high-voltage networks as core networks. It is quite likely that they map out differently, and these network layers certainly have a number of differences which cannot be translated directly. However, our purpose is not to establish whether or not they correspond exactly, but to follow them when they do converge – and for this purpose, such a translation is useful.

[45] Secondary communications channels, which are used in case the primary systems fail, can draw on a wider variety of telecommunications technologies and often have to be geographically separate to provide an effective protection against the simultaneous failure of both communications systems (Lehpamer, 2016, p. 24).

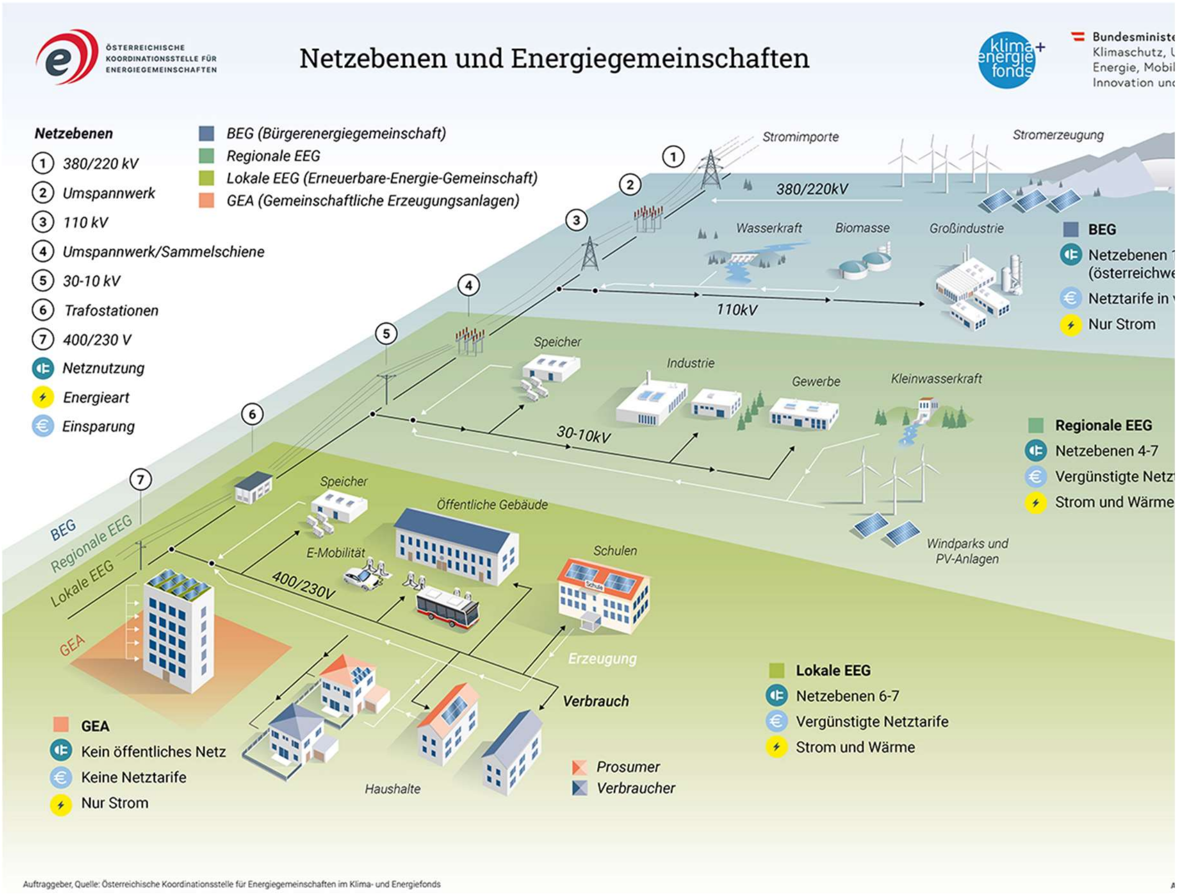

Figure 3: Depiction of the layers of the energy network in conjunction with the network footprint of various renewable energy communities. This depiction intersects the types of organisation which are possible for renewable energy communities (citizen energy community, regional energy community, local energy community and community production plant) with their corresponding network layers ("Netzebene") to illustrate the possible reach of these communities. It also shows the interactions between "consumers", whose energy consumption is depicted as a black arrow heading towards the premises, and "prosumers", whose energy production is symbolised by white arrows leaving the corresponding premises (Österreichische Koordinationsstelle für Energiegemeinschaften, n.d.).

4.3.1.2. Framing energy

As mentioned earlier and as we can see from Figure 3, the energy market and especially the electricity infrastructure are changing in response to wider issues. The changes in electricity distribution triggered by prosumers do not come in isolation, but are backed by law, both at European as well as at national level. The legal framework for energy is extensive in Austria, and so I will not delve into it in detail, but one or two ground rules appear within this case study that need to be explained in a little more detail.

On the one hand, we have the question of access to the energy network for any provider of renewable energy. The Austrian Electricity Industry and Organisations Act (ElWOG) sets out that energy providers must grant access to the network in accordance with the approved terms and conditions and system usage fees. Even more specifically, renewable energy plants with an output of up to 20 kW (bottleneck capacity) have to be connected to the network upon reasoned request of the user (ElWOG, 2010). In combination, this means that energy providers need to connect new sources of energy to the grid within a specific timeframe. Knowing of the challenges which renewable energy pose to the electricity grid, it is also necessary to provide for enhanced management of these energy sources. From a purely legal standpoint alone, the electricity network needs to be manageable in order to be billable, bringing us back to the requirement of some form of telecommunications system for the electricity network – but not necessarily fibre optics networks.

In addition to access conditions, there are legal provisions that can trigger reinforcements of the energy network. The version of the ElWOG applicable in Burgenland (Bgld. ElWG 2006, 2006) sets out that distribution network operators must connect all users to the energy network even if this means that the distribution network needs to be optimised, strengthened or expanded. Exceptions to this rule exist, of which only issues of technical incompatibility or reasonable security considerations should affect the majority of users. Furthermore, the period by which the system can be used needs to be specified in the network access agreement: in the context of low voltage network levels, this shall be no later than one year after the conclusion of the contract.

The legal framework for energy clearly sets out time limits within which changes to the energy network need to be implemented. This shows us that the expansion, modification or reinforcement of the energy network has a certain rhythm, tied both to initial deployment and to subsequent changes made necessary by renewable energy generation. Through these rhythms, the way in which supply and demand are undergoing changes in the energy sector are fed back into the network. To put it differently, changing forms of demand in the energy sector triggers changes in the energy network, and these changes have deadlines. And with this important insight, we will turn to how the networks transmitting power and information are reconfigured as companions in the case of Burgenland.

To attempt a snapshot of what we just surveyed, we can say that from the perspective of energy providers, there are quite a lot of things to do when it comes to the network – both in response to someone requesting access to the network, and in response to wider-reaching changes related to distributed forms of electricity generation. As we know already, some of these changes directly involve telecommunications, as electricity networks in general need to be manageable and therefore connected. However, in the legal framework for electricity, we cannot find a single provision relating directly to fibre optics networks – and yet somehow, the broadband strategy has drawn the legal framework for energy infrastructures into the fray of broadband deployment. In the next sections, we will attend to this accomplishment more closely.

4.3.2. Making networks go together

Now that we understand a little better in which ways fibre optics networks form part of energy networks, which kinds of requirements exist for energy networks in Burgenland, and how these can be roughly mapped out into a telecommunications context, we will go back to the broadband strategy and excavate the ontological link between networks and which role this link should play in fibre optics deployment. By way of a refresher, let us first go back to one aspect that has been comparatively more central in previous chapters: the cost of deployment.

According to the broadband strategy, the total cost of deploying fibre optics networks in the 14 municipalities with the worst coverage would amount to 26,7 million Euro (Amt der Burgenländischen Landesregierung, 2021, p. 52). A large chunk of these deployment costs are attributed to civil works, which is to say, opening streets, digging up the earth, laying ducts in the ground, filling the holes back up and repairing the street. The broadband strategy says this type of expense accounts for 60% of deployment costs (Amt der Burgenländischen Landesregierung, 2021, p. 48), while one of my interviewees estimates it amounts to approximately 70% (*Interview 1*, 2022). For the broadband strategy of Burgenland, co-deployment is the solution to reducing these expenses, thus arriving at an estimate of 19,6 million Euro (Amt der Burgenländischen Landesregierung, 2021, p. 52).

For this reason, the broadband strategy repeatedly stressed the importance of co-deployment and synergies with the energy network. We will now move on to what these synergies mean in practice – first by following the synergies in terms of actors, and then by diving into the synergies created by the legal framework for electricity networks.

4.3.2.1. Putting hand in glove

Surveying the broadband strategy earlier on, we encountered both BE Technology and Burgenland Energie as actors which are involved in the broadband strategy. After its historic involvement in broadband deployment, Burgenland Energie has become a source for the newly-created subsidiary of BE Technology, which is now tasked with implementing the broadband strategy. We have already learned that this choice of actors is significant because it allows Burgenland to become involved in broadband deployment, but these actors were also chosen because of the opportunities they offer for a strategy relying on co-deployment.

Wishing to leverage co-deployment synergies, the broadband strategy therefore identified Burgenland Energie as “the leading provider of line-based infrastructure” (Amt der Burgenländischen

Landesregierung, 2021, p. 37; my translation) at a regional level. As such, Burgenland Energie was considered to be the most likely actor to engage in large-scale civic works (*Interview 1*, 2022). While we already know the story of BE Technology, its proximity to Burgenland Energie creates further synergies in terms of actors.

Among the many subsidiaries of Burgenland Energie, Netz Burgenland and BE Service are the most closely involved in broadband deployment (*Interview 1*, 2022), and hence the most relevant for this case study. These two fully-owned subsidiaries of Burgenland Energie (Burgenland Energie, n.d.; Netz Burgenland, n.d.-a) offer a mix of knowledge and qualifications which become useful for the deployment of fibre optics networks: Netz Burgenland is the electricity distributor in Burgenland (Burgenland Energie, n.d.; Netz Burgenland, n.d.-b), while the varied tasks of BE Service include the provision of technical and administrative support, for example in relation to the energy network (Burgenland Energie, n.d.). Both of these companies have gained some experience with deploying fibre optics networks, and even have a task force which they can draw on for servicing fibre optics networks in case splices need to be performed or if projects need to be executed or accompanied (*Interview 1*, 2022). While this does not suffice to deploy an entire network, the task force in particular means that BE Technology does not have to negotiate expensive service-level agreements with contractors and can instead rely on services provided by members of the group (*Interview 1*, 2022). Not acknowledged as such in the broadband strategy, the pooling of knowledge and skills set in motion by the broadband strategy is actually the point where synergies start to work.

This shared knowledge pool is fundamental to the way co-deployment is practised by BE Technology. As mentioned earlier, there is a connection between the commercial interests of the energy provider and the deployment of fibre optics networks in Burgenland, which are recognised explicitly in the broadband strategy: deployment of fibre optics networks should take place "taking into account synergies in the area of commercial use of such networks for the purposes of the core business" (Amt der Burgenländischen Landesregierung, 2021, p. 67; my translation). The deployment of fibre optics access networks is even more explicitly tied to the energy network, as the broadband strategy sets out that access networks should only be deployed "in cases of synergies with the core business" (Amt der Burgenländischen Landesregierung, 2021, p. 67; my translation). The matters of the core business include any kinds of changes to the energy network – those required by the legal framework, by the more distributed forms of electricity production in a prosumer market, or those required to maintain the safety and security of the energy network –, and they need to be attended to by Netz Burgenland and BE Service.

Situated right next to the actors responsible for modifying the energy network in response to matters of the core business, BE Technology can take on a different perspective to network deployment because of the knowledge available to it. Remarkably, this other perspective is fundamentally independent in its prioritisation and temporality from the framework of telecommunications state aid or even demand as it could be related to telecommunications. We will therefore take a closer look at both aspects in the next sections.

4.3.2.2. Inviting kairos

Covering the legal framework for energy networks a while back, we saw that the energy network must comply with a number of legal requirements. Some of these requirements directly involve telecommunications networks or services, such as the requirement to ensure that networks of a certain capacity are manageable, while others relate to the reinforcement of the energy network, for instance when it comes to more distributed power sources. This means that civil works become necessary for reasons unrelated to broadband connectivity or to the intention to bridge the digital divide between rural and urban areas.

The broadband strategy latches onto these requirements of the energy network and specifies that whenever civil works are necessary, either related to backhaul networks in general or to access networks in underserved areas, *fibre optics networks should be deployed as well* (Amt der Burgenländischen Landesregierung, 2021, p. 67). The remarkable step taken in this ontological experiment of infrastructural companionship is to explicitly state that broadband deployment should piggyback on the modifications made to the energy network. Through the broadband strategy of Burgenland, civil works unrelated to broadband deployment, or even fibre optics networks, become opportunities for fibre optics deployment to bridge the digital divide.

Of course, such close ties are only possible through the convergence of actors we observed earlier. In its own business interest, Netz Burgenland plans for modifications to the energy networks, sometimes years in advance (*Interview 1*, 2022). Within the group, BE Technology can therefore not only draw on skills and expertise, but also – crucially – on information about when and where modifications to the energy network will occur (*Interview 1*, 2022). What emerges from the information available to Netz Burgenland is *a right time for a place* in the context of fibre optics deployment. In this way, an opportune moment, or *kairos*,[46] can be identified for deployment in a particular area, where costs can be reduced

[46] In contrast to linear time (or *chronos*), *kairos* cannot be measured with a timepiece. Instead, *kairos* is a framework for how things, over time, fall into place – or in other words, time measured in terms of opportunities.

by binding infrastructural deployment together. Getting broadband to underserved communities no longer remains an issue of the telecommunications network alone: instead, the rhythms of the energy network, the requirements of a different legal framework, and the changes of the energy market all become opportunities to bring fibre optics along. What demand means in this context takes on a different flavour because it is seen through the lens of opportunities related to the energy network. With this in mind, let us now turn to what it means materially when fibre optics follow electricity.

4.3.3. Following electricity

Having observed how fibre optics networks are integral to the operations of energy providers and how the legal framework makes energy networks move, we next came to see how the broadband strategy explicitly seeks to draw on the dynamics to create overlaps between these infrastructures in the context of deployment. As we are already familiar with the importance of the materiality of the telecommunications network for any deployment project, I think we should now take a look at the role played by the materiality of the energy infrastructure. Our next route will let us take us to the paths of fibre optics networks when they accompany electricity networks.[47]

4.3.3.1. Instigating fibre optics deployment

As we noted earlier, the legal framework for energy networks may cause changes to the energy network under certain circumstances. I believe we should now explore which of these circumstances are activated by the broadband strategy and BE Technology in the deployment context.

As users have a right to be connected to the network, and installations for energy sources with a capacity above a certain threshold need to be made manageable (*Interview 1*, 2022), BE Technology re-interpreted these legal requirements for energy networks in the light of broadband deployment. The outcome of its reading brings a new proposition: if you construct wind turbines or set up a photovoltaic plant, BE Technology will bring fibre optics along (*Conference 1*, 2022; *Interview 1*, 2022). With this link forged, users engaging in the generation of renewable energy are doing more than simply triggering changes in the energy network: they create circumstances under which there could be a reason to co-deploy fibre optics networks that are perceivable for an actor both tasked with deploying fibre optics networks and close to an energy provider.

[47] I am explicitly referring to electricity networks here because they were foregrounded in this case study, although I have heard of projects in Germany where fibre optics deployment was linked to district heating (*Conference 1*, 2022).

But next to wind turbines and solar panels, there are also concerns about the security and stability of the energy network which may lead to modifications (*Interview 1*, 2022). The energy network, extensive as it is, is also fragile and susceptible to failure due to external factors. These external causes of failure could mean a lot of things when it comes to electricity networks, but they are intimately tied to local circumstances – to where and how the energy network passes through its environment. From the perspective of an energy provider, these potential sources of disruption need to be managed to the extent possible, in some cases requiring an intervention in how the network is built. For instance, overhead power lines crossing forests are at a higher risk of failure than those which cross fields, which means that energy providers prefer to lay them below ground rather sooner than later (*Interview 1*, 2022). In the mode of fibre following electricity, this means that opportunities for co-deployment are likely to emerge sooner along overhead power lines running through forests than along those which cross fields. Municipalities or villages connected by the energy network, but separated by a forest, would therefore be higher on the priority list for deployment than those separated by a field. To me, this is fascinating: under which other circumstances could a forest stretching between rural municipalities be conceived of as conducive to satisfying demand for broadband and bridging the digital divide?

From this connection, we come to realise that the concern with the security of critical infrastructure, which we cannot find in the broadband strategy as represented in its document form but has since become a mainstay of its implementation, is also a concern of the energy network. Not only should the security of all critical infrastructures be safeguarded through the deployment of fibre optics networks; the activities to guarantee the stability and security of the energy network itself are also what bring fibre optics networks along.

4.3.3.2. Taking fibre optics along

Through the issue of the overhead power lines, we have already caught a glimpse of the material dimension to the infrastructural companionship of energy and fibre optics networks. To observe its implications more closely, let us look at three examples: overhead power lines, transformers and roof racks.

Currently, fibre optics cables already stretch along electricity networks, like in the case of the ground wires of 110 kV and 380 kV power lines, where copper cables are intertwined with a fibre optics cable (*Interview 1*, 2022). This shows that certain power lines, under certain circumstances, can be suitable routes for fibre optics cables – but, importantly, not in all circumstances. For instance, although the current practice of entwining fibre optics and high-voltage power lines could be extended to medium-voltage power lines, such a technique would likely cause operational problems for low-voltage power lines (*Interview 1*, 2022). Regardless of the ontological experiment of connecting fibre and electric networks, the materiality of these networks resists at certain points, and thus their companionship finds its limits in the interference of frequencies.

Between the higher-voltage and the low-voltage networks lie the transformers, which is where we will turn to next. In Burgenland, transformers currently use mobile networks to transmit data aggregated by the smart metres. However, for reasons of data security, transformers are increasingly connected to fibre optics networks (*Interview 1*, 2022). The need for the data transmitted by smart metres to be as secure as possible brings fibre optics networks closer to the buildings and homes. When we put the pulling function of smart meters in conjunction with the practices of demand we have observed, we can see that the demand of the energy network is quite radically different from the demand of subscribers or businesses because it stresses data security over bandwidth capacity.

Overhead power lines, as we just discovered, are not always suitable companions to fibre optics networks, at least not for the crucial distance in the low-voltage network level between the transformers and houses. However, not all low-voltage energy networks are currently beneath the ground. A roof rack is an apparatus which carries electricity networks, allowing them to pass from house to house through the air. When electricity networks are wired via roof racks, a row of houses – let us name them A to C – becomes connected. In case the first house (A) experiences a power outage, all houses down the line (B and C) are also cut off. Not something very desirable, all in all, if you are an energy provider, as this constellation increases the chance of disruptions that need to be fixed (*Interview 1*, 2022). The situation is equally undesirable if you are an owner of one of these houses – not only because your access to electricity depends directly on your neighbour's careful handling of their roof, but also because the roof racks are in the way if you want to put up a solar panel (*Interview 1*, 2022). Although generally not widespread anymore, roof racks still exist in some areas in Southern Burgenland and for reasons of the energy network, they need to be replaced. In the framework created by the broadband strategy, this is yet another opportunity for fibre optics networks to come along (*Interview 1*, 2022).

4.3.4. Creating space for alternatives

In the previous two subchapters, we surveyed the actors participating in this complex feat of sociomaterial organisation and then trailed the paths created by different practices of demand. With this last plateau, we caught a glimpse of how electricity networks and fibre optics networks are made to go together. This brings us to the most significant point of all: how these infrastructures intermingle and how the broadband strategy uses this intermingling with the effect of putting BE Technology into a position to do demand differently.

It is the combination of the constellation of actors created by the broadband strategy, the aims set out including the aim of *Daseinsvorsorge*, and the movement of the energy network which make this case notable. When deploying fibre networks, BE Technology can either combine the deployment activities it has been made responsible for with the network management and improvement activities of Netz Burgenland, or it can apply for funding to deploy to underserved areas. In the first case, BE Technology can deploy fibre whenever a good opportunity arises, following the *kairos* of the energy network. In the second case, its activities are restricted only to the white areas and grey areas. But since either option can be a viable way to deploy fibre optics networks for BE Technology, they can combine these activities in what may be considered the 'perfect scenario': a small, contiguous area with many potential premises where networks can be deployed using synergies with Netz Burgenland (*Interview 1*, 2022). If we continue taking the broader approach to demand and understand it as a practice, the question of where demand is easiest to reach takes on an entirely new dimension.

What are the implications of this infrastructural companionship created by the broadband strategy? I think the best way to summarise it is a direct quote from my interview partner: "[t]he art lies in using opportunities to connect people in whichever way seems best over time; if Netz Burgenland is planning to lay power lines underground which thus far run overhead in the next five years, then sadly the person living there will have to wait five years but as soon as the modification of the energy network occurs, fibre optics cables will be laid as well – this way, you will not reach 100% immediately, but with funding you have a basis for ensuring 95% coverage" (*Interview 1*, 2022).

With this quote, we also see how certain issues, such as the 5% without coverage, may remain unresolved on the side of the provider. But the link to the energy network offers agency to these remaining 5% because they can engage in renewable energy production. In a best-case scenario, this triggers civil works related to the electricity network which in turn creates an opportunity for BE Technology to co-deploy fibre optics networks. It is true that connecting new sources of electricity to the energy grid does not have to be free of charge (*Interview 1*, 2022); nevertheless, we suddenly have a potential for a community to influence the deployment of a fibre optics network.

The quote I included earlier also points to the recurring motif of time. We have seen earlier how important time is for making a business case, and how the long-run calculations within the framework of *Daseinsvorsorge* lead to conclusions about which networks should be deployed where that contrast starkly with those of the private-sector sectors actors we looked into. With the energy network entering the mix, we now have a new timeline which enters the field: the timeline of the energy network, where prioritisation happens amongst other things due to safety and security concerns related to the energy network. Given these potentials and possibilities opened up by the broadband strategy, fibre optics deployment truly does become an art – amongst other things, an art of selecting the best timeframe to fit the material circumstances.

4.3.5. Conclusion

As we saw at the beginning of this section, energy networks are not strangers to fibre optics networks, let alone telecommunications networks more broadly. Within a purely legal framework, some overlaps exist, but they are not immediately obvious as conducive to our case at hand: while legal provisions exist which require energy networks to be manageable, and also to be billable, they do not specifically call for fibre optics networks. Yet the legal framework for energy networks goes far beyond isolated areas connected with telecommunications, as it specifies who should be connected to the energy grid and by when these connections need to be achieved, thereby potentially triggering changes to the energy network. It is precisely this movement of infrastructures which the broadband strategy renders significant by forging a connection between these networks, which in turn enacts the framework for energy networks as a field of opportunity for broadband deployment.

With its selection of actors, the broadband strategy ensures that every opportunity for civil works offered by the energy network will be known, and provides the space for planning network deployment within a longer timeframe. Yet infrastructural companionship is also material all the way through and if we take a closer look, we can see that this companionship affects where fibre optics networks go in such a deployment scenario. Wind turbines become reasons for fibre optics networks to go places and data security pulls fibre optics along to the transformers. The replacement of roof racks becomes a fortuity allowing electricity and fibre optics networks to cohabitate in ducts, while whether or not overhead power lines run through forests becomes a matter of when networks might become concomitant. Thinking fibre optics deployment as infrastructural companionship affords other opportunities, other timeframes, and also other priorities. Moreover, when infrastructures are made to go together like in this case, 'demand' acquires a slightly different flavour and a very different time horizon.

5. Moving networks to places: a short case study

As we have been meandering through the broadband strategy and some difficult concepts related to demand for quite a while, I would like to take us to a place where we can observe how these aspects have played out in practice. For this reason, we will now take a closer look at a municipality somewhere in Southern or Central Burgenland. Our municipality consists of several cadastral municipalities, as is often the case, and counts about 1.500 inhabitants in total.

Broadband availability within this municipality is highly heterogeneous. Certain areas have better broadband connections because of their proximity to particular places: mobile connectivity is best near the fire departments of each village, where mobile network cells are located, while fixed network connectivity is best near the municipal office, which is where fibre optics point of presence is located. This means that the municipality is a mix of black, grey and white areas (*Interview 2*, 2023).

Looking at the history of networks here, we can see that while mobile networks were upgraded and new technologies were deployed, fixed networks saw little activity. In connection with a street renovation project in 2005 or 2006, ducts were laid below the *Landesstraße*, which connects this municipality with others, as well as below the streets connecting to this main street. In 2013, these ducts were used to provide a fibre optics backhaul network to the main village of the municipality, thereby increasing the speed of the existing broadband networks. Other villages in the same municipality remained connected by a copper backhaul network (*Interview 2*, 2023).

In the past few years, this lack of fixed network development had been especially problematic for the business park located within the municipality. Together with the municipal officials, the occupants had been struggling to get access to better broadband offers for several years. Turning to one of the telecommunications providers, the municipal office received an offer for connecting the business park with fibre optics networks. This initial offer would have required the municipality to pay at first nearly 60.000 Euro or, after negotiations, nearly 50.000 Euro. The offer was discussed several times but, as payments this high were not an easily feasible option for the municipality, no final decision was made. Likewise, the municipality had been approached several times by investor-backed projects, but no construction ensued – even though federal funding would have been available (*Interview 2*, 2023).

After the broadband strategy was developed, it brought about a flurry of activity, which started out with a pilot project launched by BE Technology. This project happened in conjunction with a renovation of the gas, water and electricity infrastructure, and over fifty premises received an FTTH connection. As the opportunity to deploy fibre optics networks together with the other infrastructural work came at short notice, a pre-contracting rate was not required (*Interview 2*, 2023).

Following this attempt, BE Technology identified a cadastral municipality in this municipality, which was previously connected via copper backhaul, as a good place to deploy fibre optics networks and applied for public funding. Here, households had struggled through the Covid-19 pandemic with about 8-10 Mbit/s download speeds available for the entire household. While the construction for this project will be completed within 2023, other areas within the municipality have already been identified as potential areas for future projects (*Interview 2*, 2023).

Aside from the deployment activities of BE Technology, the broadband strategy indirectly led to two other projects. After the successful experience of getting fibre optics networks without having to pay extra, the municipality turned to BE Technology in the hope that they would solve the business park's connectivity needs. BE Technology informed them that they could not intervene, because unbeknownst to the municipality, suitable infrastructure for fibre optics networks already existed in this area. Equipped with this new information, the municipality turned to the telecommunications provider which owned this infrastructure, and finally managed to find a solution for the business park. By engaging with the municipality, this telecommunications provider then realised that it could provide fibre optics networks to premises in a different area, approaching the municipality with a list of potential premises. Importantly, neither project led to extra costs to the municipality – that is, other than the cost of organising meetings to get together a good take-up rate (*Interview 2*, 2023).

Whether or not the project was led by BE Technology, the municipality played an active role in the making of the take-up rate, or as they put it, in getting a good quota together. This entailed approaching those people who would be able to connect to a network and organising information events to communicate the products available as well as the benefits of the fibre optics network. In this way, the municipality expressed its support for the fibre optics network and tried to motivate people to subscribe to it. For the one project which has so far been completed, the municipality thus achieved a take-up rate of ca. 70% (*Interview 2*, 2023).

In this case study, we see several phenomena that we encountered in the previous chapters. Firstly, we can observe how identifying demand is a crucial issue. BE Technology identified demand in connection with a good opportunity in relation to the energy network or with public funding – that is, within the framework the broadband strategy set for its operation. For the other projects, the municipality had to make demand visible, and the telecommunications providers had to render it viable. When we look at the business park, the outcome of the business case for the first and the second provider diverged precisely because one owned infrastructure and the other did not, rather than any factual differences in terms of the number of potential subscribers. This shows us how demand is made viable through the calculations of the business case.

Secondly, as we discussed earlier, the question of making demand is not only something which is done by those deploying networks. In fact, the municipality takes an active role in getting people to subscribe to the fibre optics network: where the broadband strategy considers its work done, the municipality stepped in to transition premises passed into premises connected. Through their practices, the municipality legitimises the networks being built in the first place, but they do so by enacting demand in terms related to subscribers. The subscribers are, in the end, what counts.

We can also observe how the framing provided by the broadband strategy works. Given that critical infrastructure should be connected to fibre optics networks, and that each village in the municipality has a fire department, the reasoning follows that every village should have at least one fibre optics point of presence. Even the cadastral municipality, which would have otherwise remained connected with a copper backhaul cable, thus becomes a place where demand matters enough to justify deploying a network – although to make the business case, you still need public funding.

Finally, we have seen the importance of fibre optics networks moving together with other infrastructures. Fibre optics networks have come to this municipality several times through co-deployment opportunities: this goes for the ducts in 2005/2006, but also for the pilot project launched by BE Technology, which was premised on a renewal of other infrastructures that created an opportunity to bring fibre optics networks along. However, co-deployment is an opportunity here not just in terms of infrastructural companionship, but also for reducing the disturbances to public life, as the municipality is concerned about streets being opened up too frequently.

This leaves us only with the question of why the municipality wants to get fibre optics networks in the first place. The quality of the broadband connection in certain parts of the municipality has been difficult and residents in these areas have frequently approached the municipal office to ask them to find a solution. In the view of the municipality, fibre optics networks are as essential to today's standard of life as running water, and in ten years, houses with a fibre optics connection will be as normal as houses with running water. The municipality therefore aims to ensure that slowly, everyone in the municipality receives a fibre optics network (*Interview 2*, 2023). On the one hand, we can see here how *Leidensdruck* puts pressure on local policy makers to become active because certain parts of the area they are responsible for are unhappy with their broadband connection. Simultaneously, the concern with the standard of life and the future are key ingredients of the *Daseinsvorsorge* approach.

6. Conclusion

We started out our journey looking into research on infrastructures and which role practices play in the making of infrastructures. Looking into telecommunications networks, and more specifically, fibre optics networks, it became clear that one of the crucial moments in deployment revolves around identifying where there is sufficient demand to deploy a network. Our angle to understand this phenomenon has been to view demand as ontologically multiple – that is, emerging through specific practices, and not a category which is predefined and stable (Mol, 2002).

Understanding demand as something that the companies and organisations engaged in network deployment do offered us an entry-point into this gloriously intricate world, yet this reading of the literature leaves several questions open: we do not know how demand is enacted in concrete instances, and we have even less information about how energy providers enact demand when they deploy networks. Our focus therefore converged on the question of how demand is enacted when a broadband strategy enrols an energy provider in the deployment of fibre optics networks. We grappled our way through this case by way of document analysis, two interviews and three opportunities for participant observation, which have allowed us to explore a small case study in great depth and detail.

We started our journey observing that the broadband strategy of Burgenland sees and tries to solve a problem: there are very few fibre optics access networks in Burgenland, and the overall coverage with fixed broadband networks above a certain bandwidth threshold is particularly poor in Central and Southern Burgenland. The broadband strategy does not frame this problem only in terms of a lack of individual choice (as in, the problem is that people in Southern and Central Burgenland cannot opt for higher-speed products), but also in terms of the long-term effects of a lack of suitable infrastructure on population and economy. For the broadband strategy, fibre optics networks promise to be a solution to the problems of population decline in rural areas and increasing limitation of economic opportunities to cities. Through the connection with the energy strategy, the broadband strategy also takes in the concern of pollution caused by people commuting to cities. Last but not least, the concern with the security of critical infrastructures becomes an important element of the broadband strategy through the practices of those tasked with its implementation (even though this concern is not mentioned as such in the document).

Out of the many ways in which broadband deployment can be organised, the broadband strategy of Burgenland takes the route of creating a subsidiary of an energy provider to ensure that fibre optics networks will be deployed in Southern and Central Burgenland. The focus of the activities of the newly created BE Technology should lie on underserved municipalities and backhaul networks. Relying on our empirical material, we have thus trailed how demand is done in this particular case, where an entity deploys fibre optics networks which is close to an energy provider and, through its mandate, also affiliated with the state.

We thus followed the instruments used by BE Technology to locate demand in places categorised in particular ways, such as white areas,[48] to learn that in this case study, demand is where people are and certain types of networks are not. Later on, we discerned that fibre optics networks are not only built for the future, but they are also positioned as longer-lasting than other networks. This creates a specific temporality of networks in general, where mobile networks can be considered interim solutions. Staying with the mobile networks, we then realised that other infrastructures require fibre optics networks, and that demand for these other infrastructures makes fibre optics deployment necessary – or in other words, demand for other infrastructures transfers onto fibre optics networks. Last but not least, we saw that potential users can be reframed along sectoral lines, instead of geographic lines, to come to the conclusion that public authorities are the largest end-user in Burgenland whose demand needs to be met.

Taking a closer look at how demand is done during network deployment, we observed how it makes a difference where you start a network, how you define an area or even which kinds of frameworks you use to aggregate people and places. In this case, deploying networks can be an issue of navigating the space around the well-served black areas to comply with public funding requirements and also the deployment targets, which focus on white and grey areas. At the same time, in order to meet demand in white areas, networks need to run through the black areas. We also saw how the requirements for receiving state funds, while setting out that a specific percentage of premises need to be covered, still lack a mechanism to ensure that the hardest-to-reach are connected first.

Aside from state aid, however, network deployment relates intimately to how business cases are made. Hence, we saw that using an average cost allows you to mix up the cheapest and the most expensive premises to arrive at an economically reasonable number, and that invoking synergies or applying a different timeline allows demand to figure differently in the calculation (but also that there are limits to such practices when only the margins are left to be connected). Following up on demand aggregation, we learned that the pre-contracting rate requires a certain percentage of people to subscribe to the network in advance of it being built. For this reason, pre-contracting rates are not a solution to everything and also a geographical challenge, because pre-contracting rates at municipal level do not fit

[48] The terms 'black', 'grey' and 'white areas' derive from the framework of public funding for telecommunications networks. Black areas thus signify areas where more than one network capable of 100 Mbit/s or more is available. In white areas, only one network exists which is capable of 30 Mbit/s or less. Grey areas have only one network capable of between 30 Mbit/s and 100 Mbit/s, but it is unlikely that private investments will lead to another network being built (cf. FFG, n.d.-b).

easily with the white and grey areas at 100m x 100m grid level. But practices of demand also occur at the other end of network deployment, when a municipality tries to get together a good quota to demonstrate that building a network without demanding a pre-contracting rate turned out to be worthwhile.

Our path has then led us to see how demand can be done otherwise, if only in the context of a particular constellation of actors which are arguably affiliated with the state. Under the framework of *Daseinsvorsorge*, the premise of demand being necessary for justifying the deployment of a network becomes less relevant, as long-term concerns for the future of rural communities push to the fore. A key mechanism for this move lies in dealing with time differently: taking a long-term perspective to network deployment leads to the conclusion that the best network is one which you can put in the ground and not have to think about further for the next thirty years, regardless of how the network is used. Last but not least, we have encountered the argument that within the framework of *Daseinsvorsorge*, it is necessary to define fibre optics networks as infrastructures instead of as products, and thus available to all without specific preconditions.

In this way, we have seen how demand related to telecommunications networks emerges, is justified or even discarded at the stage of deployment. Yet within this case study, another way of 'doing demand otherwise' becomes possible that relates to the energy infrastructure. After all, the broadband strategy launches an ontological experiment of infrastructures (C. B. Jensen & Morita, 2015) by anchoring activities revolving around fibre optics networks with the core business of an energy provider.

Step by step, we have approached what it means when fibre optics networks become engulfed in the market developments and legal framework of energy infrastructures (cf. Gerli et al., 2018). However, in this case, these developments take place because the deployment of the fibre optics network is conceived of as concomitant with modifications of the energy network. This link sets up a companionship of two infrastructures that allows them to move together. Suddenly, changes in how an infrastructure is organised (less centralised, more distributed) have an effect on how the infrastructure for another sector is deployed – precisely because they are linked through the broadband strategy's selection of actors. In this particular situation, demand for network deployment may become related to the energy infrastructure through the way in which the energy infrastructure moves.

Troubling demand by looking at it through the lens of practice (Mol, 2002) in this small case study gave us a foothold onto the many ways in which infrastructures are a matter of manifold ontological experiments (C. B. Jensen & Morita, 2015). Many questions remain unaddressed, ripe for further exploration, and the case study approach I have chosen is not suitable for overarching generalisations. But there are some tentative conclusions I would like to advance. First of all, seeing demand as ontologically multiple (Mol, 2002) has given us insight into the richness of practices that enact demand. Instead of flattening demand, we have been able to access where demand is understood to be, how it is observed, and what the various actors in our case study do about demand. By letting demand become ontologically multiple, we have also seen how fibre optics networks are more than one thing.

Secondly, in this case study, the ontological experiment (C. B. Jensen & Morita, 2015) of linking infrastructures through deployment changes how these infrastructures are done. Positioning fibre optics networks as a companion to the energy network changes the calculation of how much demand is sufficient to justify deploying a fibre optics network. But it also binds the fibre optics network to the rhythms of the energy network, that is, to how the energy network is modified in response to more distributed forms of electricity generation. In this way, fibre optics cables riding along the power lines and hurtling towards wind turbines highlight the more-than-human actors which may become part of practices of demand.

Thirdly, the examples we have explored add another facet to the concept of economics being performative (e.g. Callon, 2007; Muniesa & Callon, 2008). To recall, by performative, I mean that something evokes a world in which it becomes viable. I think that demand as it is enacted here is an illustrative case on two accounts. On the one hand, ‘demand’ is enacted as a reason to deploy networks. In this case, the mandate of *Daseinsvorsorge* enacts demand by using conceptual tools like white areas, different kinds of maps, and also the flexibility of time to justify deploying a network. Making a business case becomes, amongst other things, a way of enacting demand so that it allows a network to come into being. Importantly, in this case, ‘demand’ can be used in a variety of ways, thus justifying network deployment and also justifying a longer-term perspective beyond current usage.

On the other hand, we can see the durability of such enactments when they become part of infrastructures – how demand is enacted during deployment matters throughout the long lifetime of a network. If ‘demand’ enacted at the stage of building a network includes everyone, then at a later stage, everyone can subscribe to a network. However, if ‘demand’ does not include everyone, then this has consequences both for how demand can be enacted in future network deployment projects (which need to make a business case) as well as for who may use the network in the future.

To conclude, I think that understanding demand as emerging from practices, instead of being a given, allows us to question how demand is done. It allows us to engage with network deployment as ontological work. Who is excluded from networks and affected by the digital divide is not only inherent in where the network is built, but arises from specific practices which enact a network ontology. Besides experimenting with these practices, as the broadband strategy of Burgenland has done, we can certainly also use the tools provided by STS to observe them as they unfold.

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8. Annex I: A differentiated approach to demand

During my research process, I developed a framework for understanding demand as it is enacted during deployment. Although not related directly to my research question, I have decided to include this framework here as an annex to my thesis, as it has been an instrumental baseline to which I compared the broadband strategy and my findings from the field. While I focus on Curram et al. (2019), the ways in which demand is done which I have identified here can be found in other studies as well (e.g. Strube Martins & Wernick, 2021). In essence, this annex discusses an example of the existing literature on the topic to develop a re-framing of 'demand' as seen through the theoretical lens of practices.

Demand is commonly understood as eventually linked to retail and to end-users (cf. RTR, 2022b; Strube Martins & Wernick, 2021). However, when we take a look at how 'demand' influences deployment, we see that the projected usage of networks and the geo-social situatedness of premises also play an important role. For this reason, I would suggest that understanding the decisions made by operators when investing into deployment can provide a starting point for understanding the role of demand in deployment.

As discussed by Curram et al. (2019), demand of subscribers is a key factor for telecommunications operators when deciding if, where and when to deploy fibre networks. Curram et al. observe that some types of operators may deploy very high capacity networks (VHCNs) or upgrade existing non-VHCNs in order to protect their subscriber base and counter a perceived threat from networks deployed by other operators; others may (temporarily) wait and see to understand the "level of demand" (Curram et al., 2019, p. 22) experienced by other operators in a specific area. Importantly, demand plays a significant role in financing network deployment: operators may follow a series of strategies to increase the confidence of investors in the capacity of the network-to-be-deployed to generate revenue, for instance by accumulating a track record in securing subscribers (Curram et al., 2019, p. 37).

For telecommunications operators, demand translates into (future) revenue streams, in the sense that "demand for VHCN *performance* will increase the percentage of subscribers gained per property passed" (Curram et al., 2019, p. 40; my emphasis). It is significant that the authors refer to performance in this context, because here we see demand as related to something the network can do, and implicitly, what it can do in comparison to other networks. In this context, demand is positioned as something which happens in response to a particular constellation of telecommunications networks and can be observed via an increase in subscribers.

In the account provided by Curram et al., the decision of investing in the deployment of VHCNs is based on the calculation of the net present value of different deployment and investment options: "What investors want to establish is whether the expected cashflows from an investment will exceed the expected costs, including a discount rate that represents the cost of capital. This is the Net Present Value (NPV) of an investment" (Curram et al., 2019, p. 23).

Considering the importance of revenues, we need to know a little more about which kinds of revenues could be important in the field of telecommunications network deployment. According to Curram et al. (2019, p. 25), revenues may be generated by granting wholesale access to resellers, leasing infrastructure such as ducts, dark fibre and internal building wiring, as well as retail sales of products and services. To reduce revenue risk and increase the number of subscriptions, operators may employ different strategies aiming to secure revenues on the retail or wholesale side by ensuring that enough businesses or households will subscribe. These strategies include, for instance, demand aggregation, local community support, or anchor tenants (Curram et al., 2019, pp. 46f and 73f; Gerli & Whalley, 2021, p. 7).

All of these revenue options depend on some type of demand, at some level – but to simply chalk it up to demand seems a bit too easy, as it does not tell us anything about how different conceptions of demand are put to work in specific contexts. But before attempting to unpack what is folded into the concept of demand, I would like to briefly discuss the issue of competition. As other authors have noted, "investment strategies in broadband markets are influenced by the interaction of three dimensions: market, policy and technology [, where the market dimension] includes the demand for broadband services as well as competition in the provision of broadband infrastructure" (Gerli et al., 2017, p. 730). This shows us that competition is one of the factors influencing the decision to invest in deploying networks, but I think it can also tell us a bit more about how demand works in this context.

Competition could be considered as the likelihood that demand for telecommunications products and services will not translate into revenues for an operator, as "[e]ven if there is consumer demand for VHCN, overbuild of VHCN infrastructure can split that demand between infrastructure operators" (Curram et al., 2019, p. 47). For this reason, Curram et al. (2019, p. 26) distinguish between competition in four settings: competition against inferior technology, where "competing infrastructures with significantly inferior speeds and/or latency are less of a threat to revenues if that technology is not meeting the demand of a significant proportion of end users in the areas" (Curram et al., 2019, p. 26); competition against superior technology, which may pose a significant danger to the revenue stream; competition against equal technology, where it is assumed that "roughly equal capabilities will divide market share between them" (Curram et al., 2019, p. 26); and potential competition, where future revenues are threatened by potential networks of equal or superior quality. Citing another report, the authors note that "the threat of potential competition could result in some areas not covered by a VHCN even if there is enough demand to support a VHCN" (Curram et al., 2019, p. 65; cf. also Gerli & Whalley, 2021, p. 2). These reflections illustrate very well that for telecommunications operators, deploying networks is a decision taken in the context of competition with other telecommunications operators and their networks for the demand of users and subscribers. Depending on the constellation of potential subscribers, other telecommunications providers and other types of networks, it may or may not be worthwhile to invest in deploying a network.

Following the breadcrumbs we have been given regarding demand in the context of deployment, it becomes clear that demand is, in some way, important to network deployment. But how exactly? From what Curram et al. (2019) describe, we see that demand may be enacted by operators in the process of deploying telecommunications networks in a variety of ways, and any of these practices may be interwoven with others at the same time. First, demand may be enacted as *an object which can be observed and monitored* by operators in order to determine whether investment into a new network is worthwhile. We have seen this mostly relates to the number of subscribers (e.g. the subscriber base of a telecommunications provider), but we can also see that this same object functions differently in different contexts (e.g. presenting a track record of securing subscribers vs. monitoring the level of demand experienced by other operators in a region).

Secondly, demand is enacted through the *types of revenues* a telecommunications operator aims at generating: a wholesale operator experiences demand from other telecommunications operators, which implies that demand is measured and even stimulated in different ways than in the case of retail operators, who will measure demand in terms of subscriptions and devise marketing campaigns aiming to increase the number of subscriptions. Demand here can also be understood as a guarantee that someone else, neither state nor telecommunications provider, will shoulder the cost of network deployment (cf. also Gerli & Whalley, 2021, p. 7).

Thirdly, operators enact demand as *pertaining to different types of networks and network technologies*, and therefore deploy certain types of networks and network technologies to satisfy the demand identified.[49] We caught a glimpse of this when demand was positioned as a function of differences in performance, but this practice is also a core part of the discussion of competition we encountered earlier – in fact, the entire framing of the issue of competition is grounded in a discussion of types of networks and technologies.

Finally, demand is enacted by operators as the *intensity of potential usage* of different types of networks – as a strain put on the capacity of a network, as a force that the network should withstand

[49] Whereas for end-users, the type of network or network technology may be unclear and the price or service parameters are more important (cf. RTR, 2020, pp. 43 and 56).

until a certain threshold specified for each technology, but importantly, also as the threat of splitting a subscriber base through overbuilding. Here, a time component also enters the mix: on the one hand, today's demand for fibre optics networks is understood to be lower than the demand experienced by FTTP in the next ten, twenty or fifty years, while demand experienced by copper networks may have reached a peak. On the other hand, the entire discussion of investments and future revenue streams shows how network deployment is a practice which is enmeshed in temporalities future and otherwise.

The exploration of how demand is enacted by telecommunications operators which I have advanced here does not seek to be conclusive. My aim is rather to pick apart a few of the considerations revolving around the concept of demand and to show how these considerations can be understood as practices. In other literature, the outcomes of what I describe here as practices has been discussed as potential market failures (e.g. Gerli & Whalley, 2021) within the perspectives and tools offered by economics. Similarly, these practices could be conceptualised as deployment practices, or even as competition practices, and they are certainly interlinked; but the trail I would like to follow here is how demand is enacted concretely in the context of deployment through particular practices. If we trust the account offered by Curram et al. (2019), deployment starts with recognising the circumstances under which demand is sufficient for deploying a network – and hence, my case study is interested in identifying exactly these moments.

9. Annex II: Interview guidelines

This annex contains the interview guidelines I initially developed and discussed with interview participants, excluding any follow-up questions. It has been anonymised to remove hints as to the identity of the interview participants.

9.1. Interview I

Q1: Questions on the broadband strategy

- What is the role of Burgenland Energie and BE Technology in connection with the development of the broadband strategy of Burgenland?
- How do you see the role of BE Technology in the context of implementing the broadband strategy?
- Which other actors are or were involved in the implementation of the strategy?
- How would you describe the overarching aims and the strategic framework in which the broadband strategy is embedded?

Q2: Questions on the relation between energy and fibre networks

- How is the deployment of fibre optics networks connected to energy infrastructure?
- Why does BE Technology deploy fibre optics networks (and not e.g. DSL?)
- How does the deployment of fibre optics networks work for BE Technology in practice – what happens when they deploy fibre optics networks?
- How does BE Technology decide on which areas to connect first?

Q3: Questions on demand

- How does BE Technology estimate or measure demand?
- How does BE Technology establish whether demand for fibre optics networks exists in a certain place?
- Do you see any differences between demand for fibre optics networks and demand for other types of broadband technology?

- Do you see any differences between demand for broadband in comparison to demand for energy connections?

9.2. Interview II

- From the perspective of the municipality, could you tell me more about the development of the topic of broadband and particularly the topic of fibre optics networks in the past years?
- Do all households and businesses have a broadband connection? If not, why?
- Which possibilities do you have to draw attention to the need for broadband in your community?
- How does fibre optics roll-out work in practice for your municipality? What exactly happens when fibre optics networks are rolled out?
- As a municipality, what has been your experience with the providers which have deployed broadband networks?
- As a municipality, have you also had experiences who wanted to initiate a fibre optics network project?
- Are there any differences between the situation in different cadastral municipalities when it comes to broadband expansion?

10. Abstract in German

Telekommunikationsnetze sind eine der vielen Infrastrukturen, die einen wichtigen Teil des täglichen Lebens ausmachen. Sie sind jedoch nicht flächendeckend vorhanden. Aus diesem Grund werden manchmal politische Maßnahmen gesetzt, un die digitale Kluft zwischen Gebieten mit guter und schlechter Breitbandversorgung zu verringern. Im Allgemeinen betrifft diese digitale Kluft ländliche Gebiete, da deren Anbindung *aufgrund der geringeren Nachfrage* als kostspieliger gilt.

Diese Masterarbeit beleuchtet als Fallstudie den Ausbau von Glasfasernetzen in Burgenland (Österreich), welcher sich an der für diese Region entwickelten Breitbandstrategie orientiert. Glasfasernetze sind noch nicht sehr weit verbreitet, weshalb ich in diesem Kontext Praktiken beobachten kann, die mit dem Ausbau neuer Infrastruktur verbunden sind. Eine weitere Besonderheit dieser Fallstudie liegt darin, dass im Rahmen der Breitbandstrategie eine Tochtergesellschaft eines Energieversorgers gegründet wurde, um die Umsetzung voranzutreiben. Daher beleuchtet diese Fallstudie unter anderem auch, wie Energieversorger den Ausbau von Glasfasernetzen praktizieren.

Um das Thema des Ausbaus von Telekommunikationsnetzen aus einer STS-Perspektive zu beleuchten, habe ich mich auf die Rolle der Nachfrage in diesem Prozess konzentriert. Unter Verwendung des Konzeptes der ontologischen Vielfalt (Mol, 2002) betrachte ich den Aufbau dieser Infrastrukturen als ein ontologisches Experiment (C. B. Jensen & Morita, 2015), bei dem 'Nachfrage' performativ (Callon, 2007) im Zusammenhang mit unterschiedlichen Praktiken entsteht. Auf der Grundlage einer Analyse der burgenländischen Breitbandstrategie, zweier Interviews und dreier ethnografischer Feldforschungen gehe ich in dieser Fallstudie der Frage nach, wie 'Nachfrage' im Kontext der Infrastrukturentwicklung umgesetzt wird.

Die empirischen Ergebnisse zeigen, wie 'Nachfrage' unter den Bedingungen der Breitbandstrategie in heterogener Weise ausgeübt wird. Das bedeutet, Nachfrage kann mit verschiedenen Instrumenten an unterschiedlichen Orten beobachtet werden. Die Ausübung der Nachfrage umfasst darüber hinaus Praktiken, die mit der Erstellung eines Business Case oder der Auswahl bestimmter Formen der Nachfrageaggregation zu verschiedenen Zeitpunkten des Ausbauprozesses verbunden sind. Da die Breitbandstrategie durch die dadurch involvierten Akteure eine Verbindung zwischen dem Energienetz und dem Glasfaserausbau herstellt, wird 'Nachfrage' unter anderem zu einem Konzept, das sich auch auf Windkraftanlagen bezieht.