



A report for Virgin Media O2

# Creating the Conditions for Scaled Connectivity Challenges

May 2023

# 1. Introduction

## 2. Summary

## 3. Policy Background

## 4. Market Deep Dives

Denmark

France

Germany

Portugal

Spain

## 5. References

## 6. Important Notice

# About

**Founded in 2017, Assembly is an independent, London-based analyst firm providing custom and subscription-based research on regulatory, policy and legislative developments that affect communications markets and the wider digital economy.**

Virgin Media O2 commissioned Assembly to produce an independent report that looks at the economic, societal and competition benefits gained from having more than one scaled gigabit-capable fixed network (based on any technology), and the environment and conditions needed for scaled network competition to occur.

In producing this analysis, we have chosen four markets in Europe (Denmark, France, Portugal, Spain) that have scaled fixed network competition and one that currently does not (Germany).

Research correct as of Q1 2023.



# Foreword

**Policymakers provide the incentives and confidence that unlocks gigabit-capable fixed investment, resulting in a competitive landscape from which benefits to consumers and businesses flow.**

The UK Government recognised early on that competition between rival networks is best placed to deliver its objective of extending availability of full fibre. It pointed to Spain, Portugal and France as examples of countries where infrastructure competition had led to higher levels of fibre coverage.

Across Europe our research finds that investments in fibre are being made by a range of operators, with former incumbents not always having spearheaded this shift. Where it was incumbent-led, the presence of scaled connectivity challengers has required it to maintain a consistent pace of rollout and/or to ramp up investment.

In some countries, it is the largest challengers that have brought some of the fastest download speeds to the market.

We have seen that the deployment of more than one scaled fibre network can also stimulate competition at the wholesale level, which can enable others to expand their retail offerings from both a geographic and product perspective.

In the UK, the broadband market is set to enter an era of scaled challengers, after first a period of dominance from the incumbent followed by a proliferation of altnets.

In short, our analysis confirms the UK Government's belief that it is competition that drives better broadband, with scaled challengers helping drive the transformation of digital infrastructure.

“

**The UK broadband market is set to enter an era of scaled challengers, after first a period of dominance from the incumbent followed by a proliferation of altnets.**

”

*Matthew Howett, Founder & CEO*



1. Introduction

**2. Summary**

3. Policy Background

4. Market Deep Dives

Denmark

France

Germany

Portugal

Spain

5. References

6. Important Notice

# Key conditions



## Policy environment

### Policymakers can provide the incentives and confidence to invest

Policymakers have a critical role to play in creating the conditions necessary to enable a competitive fibre build and the widespread availability of high-speed broadband. Studying five European markets uncovers a number of policy considerations:

- A clearly defined and targeted national broadband plan focuses the industry (Denmark is aiming for 98% gigabit coverage by 2025);
- A pro-investment approach encourages operators to share the investment burden;
- A well-functioning physical infrastructure access regime can kick-start fibre rollouts (as was the case in Portugal and Spain);
- Co-investment agreements can lower cost barriers to deployments; and
- Targeted financial support facilitates the deployment of high-speed broadband in less densely populated areas.



## Investment & build

### Altnets have been catalysts to fibre deployments

Investments in fibre have been made by a multitude of operators. In those countries we've studied, annual fixed network capex has surged in recent years, driven by network-based competition. As a result, FTTH is accessible to a strong majority of households (even surpassing the 90% mark in Portugal).

This achievement has been possible due to the emergence of a diverse fibre landscape, in which the former incumbent telco has not always spearheaded the shift to fibre. In Denmark, for instance, the rollouts of utilities firms, which have begun to provide access to their networks that stimulates competition downstream.

Where a country's fibre build has been incumbent-led (e.g. France), the presence and ambitions of altnets have required it to maintain a consistent pace of rollout and to ramp up investment. In others (e.g. Germany) the incumbent's rollout was sparked by ambition and action of competitors.



## Product portfolio

### Competition among, and demand for, gigabit networks is rising

Amid continued infrastructure investment, many operators offer customers 1Gbps+ services, with this speed tier becoming a focal point of competition in certain countries. In France, Free and SFR have now brought up to 8Gbps services to the market. The development of a rich fibre scene with multiple networks can also stimulate competition at the wholesale level, which some operators are looking to become active in and can enable others to expand their offerings (from a geographic and product perspective) in the retail market.

Demand for premium speeds is rising, with fibre becoming the leading fixed broadband technology in some markets. Where fibre deployments are more limited (Germany), DSL can still dominate.

The increasing take-up of high-speed broadband services is filtering through to average download speeds. On average, speeds in the study counties have grown more than 450% over the 2017-2021 period.



## Consumer value

### Consumers are enjoying better value for money than ever before

With the expanding coverage of competing fibre networks, an increasing proportion of consumers have upgraded their broadband service – with some countries seeing this migration take place at an increasingly faster rate. Fibre is the main driver of new connections in Spain, while the Danish Energy Agency saw greater demand for 500Mbps+.

Rising adoption of fibre is being met by an increase in monthly fixed data traffic. At the same time, average broadband prices have fallen, which when considered relative to broadband consumption, demonstrates that consumers are paying less per GB of traffic.

When prices are considered in the context of download speeds, consumers are getting a better deal now than ever before.



## Societal benefits

### Competitive fibre rollouts are supporting efforts to close the digital divide

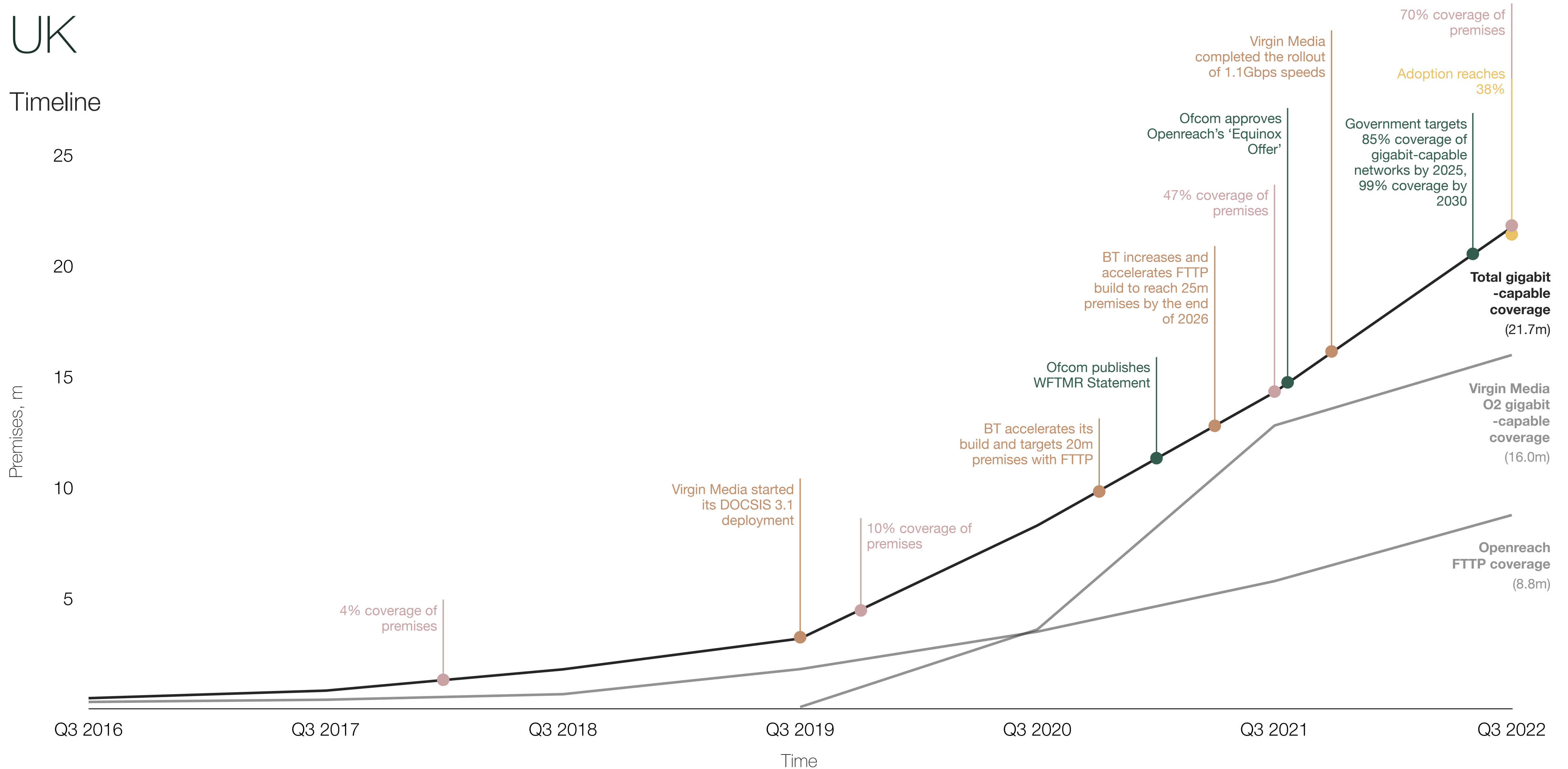
Fibre penetration into rural areas has increased significantly. On average, the digital divide has reduced 40% since 2019. Operators' commercial builds have been responsible for much of this, although partnerships between operators or joint ventures between operators and investors have become more common.

In Denmark, the presence of multiple network builders means that rural fibre coverage is now slightly above that in urban areas. More broadly, operators are increasingly focusing their rollouts in less densely populated communities, with government support where market economics do not work.

Beyond the deployment of infrastructure, altnets are having positive socioeconomic impacts, for example by promoting digital inclusion and skills, and by taking steps to reduce carbon emissions within their businesses and across their supply chains.

# UK

## Timeline



1. Introduction

2. Summary

**3. Policy Background**

4. Market Deep Dives

Denmark

France

Germany

Portugal

Spain

5. References

6. Important Notice



# Government support for gigabit connectivity

23 July 2018

## Future Telecoms Infrastructure Review published

The Government's Industrial Strategy set out the opportunity for the UK to become a world leader in digital connectivity – increasing its competitiveness, boosting productivity and meeting future demands of consumers and businesses.

The FTIR considered the changes that need to be made to the UK telecoms market and policy framework to give the best chance of meeting these goals.

29 October 2019

## Government sets strategic priorities for Ofcom

A direction to the regulator to set out a framework of “stable and long-term regulation that encourages network investment.”

24 November 2019

## Pledge to bring “full-fibre and gigabit-capable broadband to every home and business across the UK by 2025”

The prominent reference to gigabit broadband suggested that the Government was open to considering a more technology-neutral approach to meeting the target, rather than fulfilling it only through full-fibre deployment across the whole country.

25 November 2020

## A further revised broadband target

The National Infrastructure Strategy revised the target to deliver nationwide gigabit-broadband by 2025 to a minimum of 85% of premises by 2025.

24 July 2019

## Pledge to bring full-fibre connectivity to the whole of the UK

When Boris Johnson took over the leadership of the Conservative party and became Prime Minister he gave his first speech in Downing Street and referenced broadband.

This represented a renewed and strengthened ambition compared to the objectives set out by the previous Government through the FTIR.

19 December 2019

## A revision of the broadband target

In detail laid out in the Queen's Speech, the Government only refers to a target for “gigabit-capable broadband”. All reference to the 2025 deadline was also removed.

2 February 2022

## Government unveils levelling up plan to transform the UK

The Levelling Up White Paper set a new target for gigabit-broadband to be available nationwide by 2030, where nationwide coverage means at least 99% of premises.



# DCMS: Future Telecoms Infrastructure Review (FTIR)

## The need for change

The 2018 FTIR<sup>1</sup> recognised there has been some progress on gigabit-capable network roll out, but that more needed to be done. Under existing market and policy conditions it was expected that only 3/4 of the country would be covered with FTTP and that it would take 20 years to do so. This drove the desire to accelerate fibre rollout, by aiming for 15m premises by 2025 and full coverage by 2033. However strategic uncertainties and a high degree of risk were seen as barriers to deployment.

## Policy objectives

The strategy relied on getting five things right:

1. **Making the cost of deploying fibre networks as low as possible;**
2. **Supporting market entry and expansion by alternative network operators;**
3. **Stable and long-term regulation that incentivises competitive network investment;**
4. **An ‘outside in’ approach to deployment; and**
5. **A switchover process to increase demand for full fibre services.**

## Giving Ofcom more power

The conclusions of the Review formed the basis of the Government’s Statement of Strategic Priorities to Ofcom, setting out the strategic objectives and outcomes that the regulator should have regard to in the exercise of its regulatory functions.

The review was intended to incentivise established players to invest more in fibre networks and also make it more attractive for competing providers to build their own networks rather than buying wholesale services from the incumbent.

## Stable and long-term regulation to encourage competitive network investment

### Learning from European neighbours

The FTIR recognised that competition between rival networks is best placed to deliver the Government’s objectives of extending full fibre. It pointed to Spain, Portugal and France as examples of countries where infrastructure competition had led to higher levels of fibre coverage. The government estimate at least a third (with the potential to be substantially higher) of UK premises are likely to be able to support three or more competing gigabit-capable networks; and up to half (or lower if there are more three-network areas) of premises are likely to be in areas that can support competition between two gigabit-capable networks.

## A model that relied on promoting competition

### A change in approach

The FTIR envisaged the need to change the existing regulatory and policy environment, which had worked well to date in stimulating retail competition based on existing networks. The objective was to now incentivise large-scale deployment of new networks in rural and urban areas across the UK.

### Competition for the market

The Review’s conclusion was that the most effective way to deliver the full fibre was to promote competition where possible, but to intervene where necessary. This approach combined the benefits of network competition where the market can sustain it with ‘competition for the market’ mechanisms and/or additional funding where necessary in other areas.

### Stimulating a race to deploy

It relied on creating the right conditions to enable competition between providers and a race to roll out fibre services, as the key driver of investment

It highlighted the significant benefits to consumers from network competition, versus competition based on regulated access to BT’s network. As a result, the incumbent is forced to invest rapidly in order to avoid losing market share.

## Evidence that competition drives investment

### The review recognised that network competition has driven investment in network quality and speeds in the UK:

- BT accelerated the launch of its initial DSL broadband service after cable broadband got to market first, and quicker than BT anticipated
- BT announced its roll out of superfast broadband shortly after Virgin Media’s upgrade to DOCSIS 3.0
- BT’s G.Fast investment plans was made in the context of Virgin Media offering a maximum service speed of 200 Mbps compared to a maximum of 80 Mbps available from Openreach using its FTTC network
- The announcement of significant investment by alternative network operators coincided with BT’s investment plans for full fibre

“

**We want to ensure that the UK has the strongest conditions in place to secure the investment we need. To do this [...] we will make sure that competition and innovation can thrive. This means regulation that is limited to where it is necessary, and provides the longer-term stability and predictability that investors need.**

”

*Jeremy Wright – Secretary of State for Digital, Culture, Media and Sport – July 2018*





# Ofcom: Wholesale Fixed Telecoms Market Review (WFTMR)

## Ofcom's strategic priorities

### Ofcom must give regard to the Government's strategic priorities i.e. a competitive deployment of new networks

The Government showed awareness of needing the right regulatory environment for gigabit broadband in setting out Ofcom's strategic priorities in 2019, through which it directed the regulator to set out a framework of "stable and long-term regulation that encourages network investment". The framework should ensure that investment comes from a range of providers, and that network competition is promoted as a key driver for network roll-out.

### The need for predictable and stable regulatory environment

Regulatory stability and clarity was to be provided through five-year market review periods; by regulating only where necessary; and ensure there is clarity regarding the application of the 'fair bet' principle over an extended time scale, to give firms confidence that any regulation will reflect a fair return on investment. Ofcom reiterated this at the FTTH Council Europe in December 2020 – "If companies play by the rules, competition is healthy and prices remain affordable, Ofcom would not expect to intervene during the investment cycle in a way that hampers investment... We don't expect to introduce cost-based prices for fibre services until at least 2031."

“

**We see this present period as a window of opportunity for competing network build, as Openreach has not yet upgraded the majority of its network to full fibre.**

”

*Melanie Dawes, Chief Executive,  
Ofcom – March 2021*

## Promoting competition and investment in fibre networks: 2021-2026

### An overall aim to promote competition and investment in the fixed telecoms market

Ofcom's Wholesale Fixed Telecoms Market Review<sup>2</sup> was designed to promote competition and investment in the fixed telecoms market in the UK with a particular focus on improving quality of service and lowering prices for consumers. It covered a range of areas including new rules for pricing of access to BT's network, new measures to encourage investment in new broadband infrastructure (such as duct and pole access), and the promotion of competition in the provision of leased lines.

## Encouraging competition between different networks

### “Competition is the most effective driver for innovation and investment”

Ofcom's approach to supporting investment in gigabit-capable networks is focused on encouraging competition between different networks. In addition to existing competition, predominantly from Virgin Media's network, the UK is now seeing significant additional competition emerging from a number of network operators. Ofcom's market analysis suggests that with enabling remedies, competitive network investment in 70% of the UK (so-called Area 2), could be material.

The Virgin Media network already provides a valuable source of competition in Area 2 and Ofcom expects over the next few years to see Virgin Media to invest further in its network, both to increase its coverage and to upgrade it to be gigabit-capable. Pricing remedies therefore not only need to support investment by new competing networks, they also need to recognise existing sources of competition.

## Recognising the business case for competitive network investment is challenging

### The opportunity for material competitive network investment across 70% of the UK

Ofcom recognised that the move to gigabit-capable networks offers a window of opportunity for other network operators to invest, as large volumes of customers will need to be migrated from Openreach's legacy network to a new full-fibre network, which Openreach has not yet deployed at scale. This provides an opportunity for rivals to deploy gigabit-capable networks in competition with Openreach and compete for ISPs and their end customers. Together with the right price regulation, Ofcom saw the opportunity for material competitive network investment in Area 2.

### A pricing regime that allows a fair return

Ofcom set flat, inflation-adjusted, regulated prices for Openreach's entry-level superfast broadband service (the so-called 40/10 anchor product). It decided not to regulate the prices of Openreach's higher-speed services, so as to provide an incentive for investment by Openreach and competing networks.

The aim of this approach was to provide stability and regulatory certainty to investors and allows all companies the potential to earn a fair return, while also helping make sure consumers still have access to affordable broadband.

### The importance of price regulation

Ofcom recognised that price regulation, while one factor among others, is an important consideration in the investment decisions by new and existing competitors to BT, and their investors. This is because price regulation will be the dominant influence on prices in these markets in this review period and will also signal the path of pricing beyond the review period.

Higher wholesale prices make investment more attractive for new competitors by increasing their expected returns. Conversely, price cuts damage new entrants, reduce their ability to compete profitably and give ISPs less reason to move away from Openreach.

1. Introduction

2. Summary

3. Policy Background

**4. Market Deep Dives**

Denmark

France

Germany

Portugal

Spain

5. References

6. Important Notice



# Denmark

## Overview

Denmark compares favourably with its peers on various connectivity metrics. Much of the country's fibre build-out has been led by regional energy firms, establishing technological leadership over the incumbent TDC. Nowadays, fibre-owning utilities tend to have relationships with most major fixed broadband operators, thereby delivering competition upstream and the retail level. Fixed network investment has witnessed an acceleration since 2018 as operators scale up their fibre ambitions and push further into hard-to-reach areas.

**820,000**

Households passed with fibre by **Norlys**, Denmark's largest altnet by network coverage

**40%**

Adoption of fibre services, with the take-up rate doubling over the past six years

**78%**

Premises in rural areas with fibre coverage, more than twice the EU average



### Policy environment

- Denmark's national broadband plan aims to reach 98% of households and businesses with gigabit connectivity by 2025, while tackling challenges such as climate change and digital exclusion.
- While determining to remain technologically neutral, the focus of policymakers has long been on enabling commercial deployments of high-speed broadband networks.
- The DBA's latest market review defined 21 geographic markets for wholesale broadband access based on utilities' energy (and fibre) networks – and therefore may not be a replicable approach for regulators elsewhere.



### Investment & build

- Availability of fibre networks now extends to almost three in four homes in Denmark and has been underpinned by the rollouts of altnets/energy firms, which has so far managed to minimise overbuild.
- Fibre is driving a surge in investment by operators, with fixed network capex growing by close to 75% between 2015 and 2021 (from €529m to €918m).
- Following its acquisition by investors, TDC has ramped up fibre investment to modernise its network and is targeting coverage of 1m households by 2025.



### Product portfolio

- The largest operators in the retail market often also have a wholesale access proposition, typically via their parent company's upstream network business (e.g. Waoow and its owner Fibia).
- Given a consistent pace of growth in adoption, fibre became the dominant broadband access technology in the country as of H1 2021, overtaking cable, which had superseded DSL.
- With the increasing take-up of high-speed broadband services, median download speeds have grown 370% over the 2017-2021 period (from 53Mbps to 250Mbps).



### Consumer value

- Amid rising demand for very high-capacity broadband, fibre subscriptions have reached 1.1m (an increase of almost 0.6m since 2016), with over 500,000 of connections offering gigabit speeds.
- Fixed data traffic spiked in H1 2020 (growing 47GB per connection per month), with broadband networks now in use more so than ever as more people work and stream entertainment content from home.
- When prices are considered relative to broadband consumption, consumers have paid less per GB of traffic over time, with this downwards trend accelerating due to COVID-19 restrictions.



### Societal benefits

- Though DSL remains the most widespread fixed broadband technology in rural areas, fibre coverage has seen some acceleration and now extends to 79% of households.
- The bulk of deployments has been led by altnets such as Norlys (which has a considerably more rural fibre footprint than the incumbent TDC), supported by limited public funding programmes.
- Altnets in Denmark are making positive contributions beyond infrastructure deployments, for example supporting the country's green transition and the ambitions of the UN's Sustainable Development Goals.

**91%**

Premises covered with gigabit-capable broadband

**€389m**

Increase in annual fixed network capex since 2017

**370%**

Rise in download speeds over the 2017-2021 period

**63%**

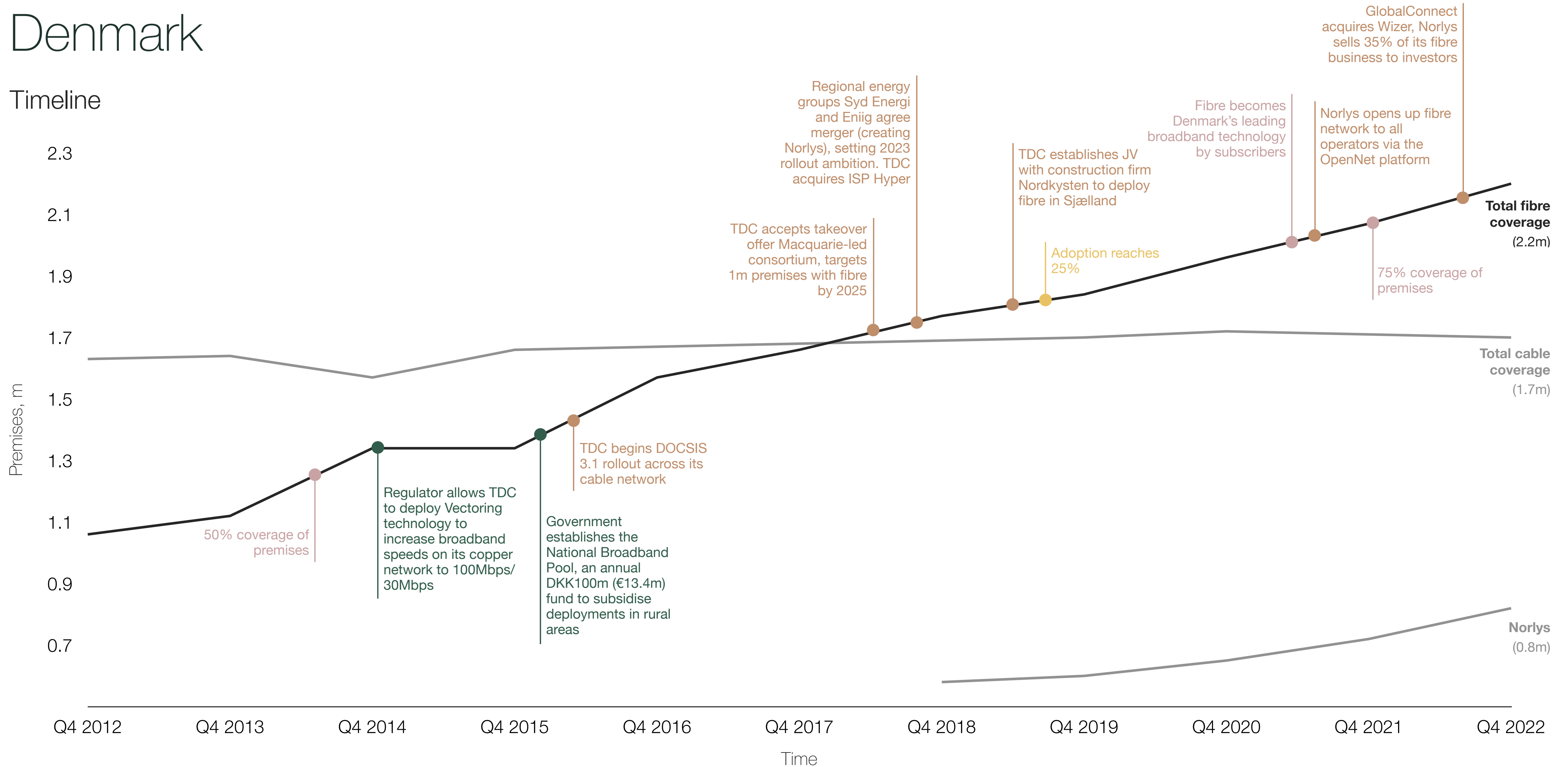
Improvement in fixed broadband value since 2017

**32%**

Reduction in the size of the digital divide since 2019

# Denmark

## Timeline



# Denmark



## Policy environment

### Government broadband strategy

#### The Government aims to make Denmark a digital frontrunner

Denmark’s national broadband plan, the Digital Strategy 2022-2025, was agreed in 2021, and will account for a quarter of the country’s Recovery and Resilience Plan’s €1.6bn budget. It features initiatives to address worker shortages, support climate change mitigation and promote digital inclusion. According to the plan, a digital society must be inclusive for all, and the public sector has an obligation to ensure that the greatest number of people possible have the opportunity and the skills to participate.

The Digital Strategy also includes ambitious coverage goals, namely to: cover all households and businesses with 100/30Mbps broadband by 2025; cover 98% of households and businesses with 1Gbps download speeds by 2025; and identify the needs and demand for gigabit speeds by 2030.

#### Fibre is doing much of the heavy lifting

Denmark’s primary focus is on the rollout of high-speed network infrastructure based on private investments mainly through market-based deployments. The country has decided to remain technology neutral in delivering its broadband targets, although, in practice, the majority of fixed broadband development revolves around fibre.

A key role is reserved for municipalities in coordinating and promoting the process in cooperation with telecoms operators, with some support from public grants in rural, non-commercially viable areas.

### Government broadband targets

#### (2025 coverage, % of premises)

100Mbps	1Gbps
<b>100%</b>	<b>98%</b>

### Approach to wholesale pricing

#### Commercial broadband investment remains the priority

The Danish Energy Agency (DEA, Energistyrelsen) is part of the Ministry of Climate, Energy and Utilities and acts as the principal regulator for telecoms in Denmark. The agency is tasked with the implementation of broadband policy, as well as matters related to physical infrastructure, rights-of-way, radio equipment, net neutrality and spectrum management. The DEA is supported by the Danish Business Authority (DBA), the independent authority in charge of market analysis and decisions.

The focus of regulators in Denmark has long been on enabling commercial deployments of high-speed broadband networks – and has been a strong ground-up movement driven by the fibre deployments of several utility providers. Given its technology neutral approach, in 2014, the DBA made a decision to permit TDC to upgrade its copper network through Vectoring. From 1 January 2015, the decision amended TDC’s obligations, requiring it to offer virtual unbundled local access (VULA) to operators downstream. While once seen as having great potential, Vectoring has not been significantly utilised by TDC, which appears to have pivoted to fibre – albeit several years later than many of its competitors.

The DEA monitors broadband development via the mapping tool ‘Tjekditnet’, an interactive platform of offered and technically possible speeds, and available technologies and providers of subscriptions at an address level for all Danish addresses, including households, businesses, public buildings and holiday homes.

#### Price-related obligations vary by type of operator

The DBA has developed a generic LRAIC model for wholesale pricing, which can be adapted and applied to specific operators.<sup>3</sup> Following the 2021 wholesale broadband access review, the DBA secured price commitments from four operators deemed to have significant market power (SMP) in high capacity infrastructure, imposing maximum average price requirements on a further three vertically integrated operators. On wholesale-only providers, the DBA imposed obligations of fair and reasonable prices (as well as access and non-discrimination).

### Latest wholesale broadband market review

#### The DBA’s market definition may not be widely copied

Wholesale access to TDC’s fibre network has been regulated since 2010, while there has been an increasing availability of commercial access to utility firms’ fibre infrastructure in recent years.

The DBA’s latest market review of 2021 separated high-capacity services (FTTH and cable) from low-capacity services (copper, including DSL). The regulator defined 21 sub-national markets for wholesale high-speed services, based on the footprints of the regional utilities. The DBA found that an operator had significant market power (SMP) in 17 of the 21 sub-national markets, with four instances being TDC. After the EC issued a ‘serious doubts’ letter, the DBA was forced to withdraw its decisions in four geographic markets.

“

**This approach to ex-ante regulation is specific to Denmark and will likely not be adopted in other countries (particularly if market conditions differ)**

”

#### Dedicated public funding supports national broadband goals

To further stimulate the expansion of 100Mbps broadband (where there may be a lack of sufficient market incentives), the Ministry of Energy, Climate and Utilities established the National Broadband Pool in 2016. This public fund is mainly aimed at providing grants for the delivery of 100Mbps broadband to underserved areas with low population density. In each year since it was established, the Government has set aside DKK100m (€13.4m) for the National Broadband Pool. In 2022, eligibility criteria was broadened to homes that could not receive more than 10Mbps download speeds and 2Mbps upload speeds.



# Denmark



## Investment & build

### Operator rollouts and capex

#### Fibre coverage surpasses many European countries

Fixed broadband access is almost ubiquitous across Denmark, with coverage of very high capacity networks (VHCNs), i.e. fibre and DOCSIS 3.1, reaching the vast majority of premises. As the availability of VDSL services retreats, cable infrastructure (which is prevalent in the country's urban areas) has all but been upgraded to the DOCSIS 3.1 standard. That said, fibre is the most widespread next-generation broadband technology available to households in Denmark, with almost three-quarter of homes passed.

#### Altnets have driven the bulk of fibre deployments

Unlike some other European countries, much of the relatively fast and extensive rollout of fibre in Denmark can be attributed to a host of altnets, rather than the incumbent (TDC). These altnets are usually local (consumer-owned) energy utilities, which have been deploying fibre in specific regions, including in many rural areas and with relatively little overlap to date. They may be wholesale-only or may also operate at the retail level. Norlys, the product of the Syd Energi/Eniig merger, has the largest fibre network in Denmark, of which 35% was sold to a consortium in March 2022. Fibia is another larger altnet, whose fibre network reached more than 600,000 homes and businesses at the end of 2021 – and had over 250,000 customers.

Around a decade ago, TDC was seemingly unconvinced by the fibre business case, arguing the market required no more than VDSL could offer.<sup>4</sup> However, it has since changed tack, ramping up fibre investments via new infrastructure arm TDC Net while foregoing the use of G.fast as part of its network strategy.

#### Fixed network investment

(€m)



Source: SDFI

### Summary of build progress and sources of investment

Operator	Start of fibre investment	Build plans	Investment commitments	Source of funding	Progress to date	Geographic focus	Pace of rollout
Fibia	2005	Coverage of Andel and NRGi footprint with gigabit services by the end of 2023	DKK1.4bn (€188m) invested in 2021	Internal	>600,000 premises passed with fibre (year-end 2021)	Sjælland and east Jutland	100,000 new households passed with fibre in 2021
Onefiber (GlobalConnect)	2017 (as Wizer)	100,000 households “over the coming years”	Triple-digit million DKK acquisition of Wizer in 2022	Internal	20,000 households passed with fibre	Sjælland and Greater Copenhagen	Unknown
Norlys	2005	1m households passed with fibre by year-end 2023, targeting nationwide coverage	Invested DKK3bn (€403m) in 2022 into its power grid, fibre network and renewable energy sources	Internal, sale of 35% stake in Norlys Tele to EDF Invest and PGGM for DKK8bn (€1.1bn)	820,000 households passed with fibre (year-end 2022)	Primarily Jutland	>100,000 new households passed with fibre in 2022
TDC Net	2009 (via the acquisition of DONG Energy)	1m households passed with fibre by 2025	DKK2.2bn in the first nine months of 2022	Internal, debt	565,000 homes passed with fibre (Q3 2022)	National, mainly overbuilding its own network with fibre	68,000 new homes passed with fibre in the first nine months of 2022

Source: Assembly



# Denmark



## Product portfolio

### Propositions in the market

#### Denmark's largest operators all offer fibre services

Through their own FTTH networks or via mandated or commercial wholesale access, Denmark's largest telcos (by subscribers) all offer fibre services to consumers at the retail level, as well as to enterprise customers – e.g. Fibia's 'Business Light' and 'Business Pro'. Stofa, Hiper and YouSee (the second two being Nuuday brands) also offer broadband via cable networks, which have all but been upgraded to DOCSIS 3.1 technology.

The largest operators in the retail market often also have a wholesale proposition, typically via their parent company's upstream network business. For example, TDC Net is TDC's infrastructure arm and sister company to Nuuday (a 'family' of eight different brands). Telia offers wholesale mobile and fixed voice services, while its agreement with Fibia enables its to offer retail fibre services to around 600,000 households.

### Market overview

Operator	Technologies	Speeds	Wholesale offering
Wao	FTTH	1Gbps	Yes (via Fibia)
Hiper	DSL, Cable, FTTH	1Gbps	Yes (via TDC Net)
Stofa	Cable, FTTH	1Gbps	Yes (via Norlys)
YouSee (Nuuday)	DSL, Cable, FTTH	1Gbps	Yes (via TDC Net)

Source: Assembly

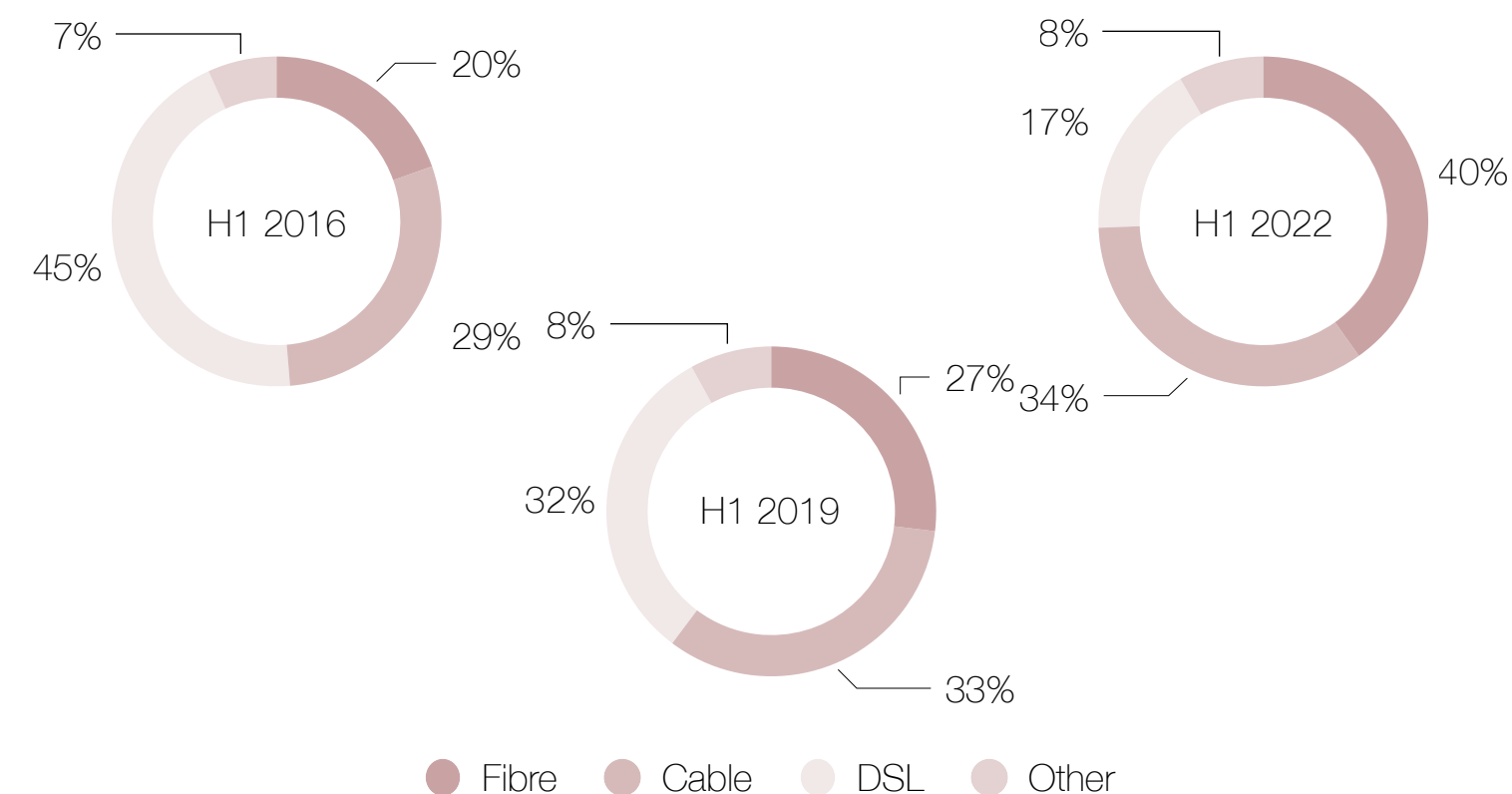
### Technologies

#### Fibre has become the leading form of broadband access

Operators continue to offer broadband via legacy DSL infrastructure, although it has accounted for a falling share of total connections over the past decade (falling from 55% to 17%). DSL was replaced by cable as Denmark's leading fixed network technology in H1 2019, although its market share appears to have reached its peak.

Given a consistent pace of growth in adoption, fibre became the dominant form of broadband access in the country as of H1 2021. In the latest reported period (H1 2022), fibre take-up was nearing the 1.1m mark, representing a 40% adoption rate.

#### Technology mix (% of subscriptions)



Source: SDFI

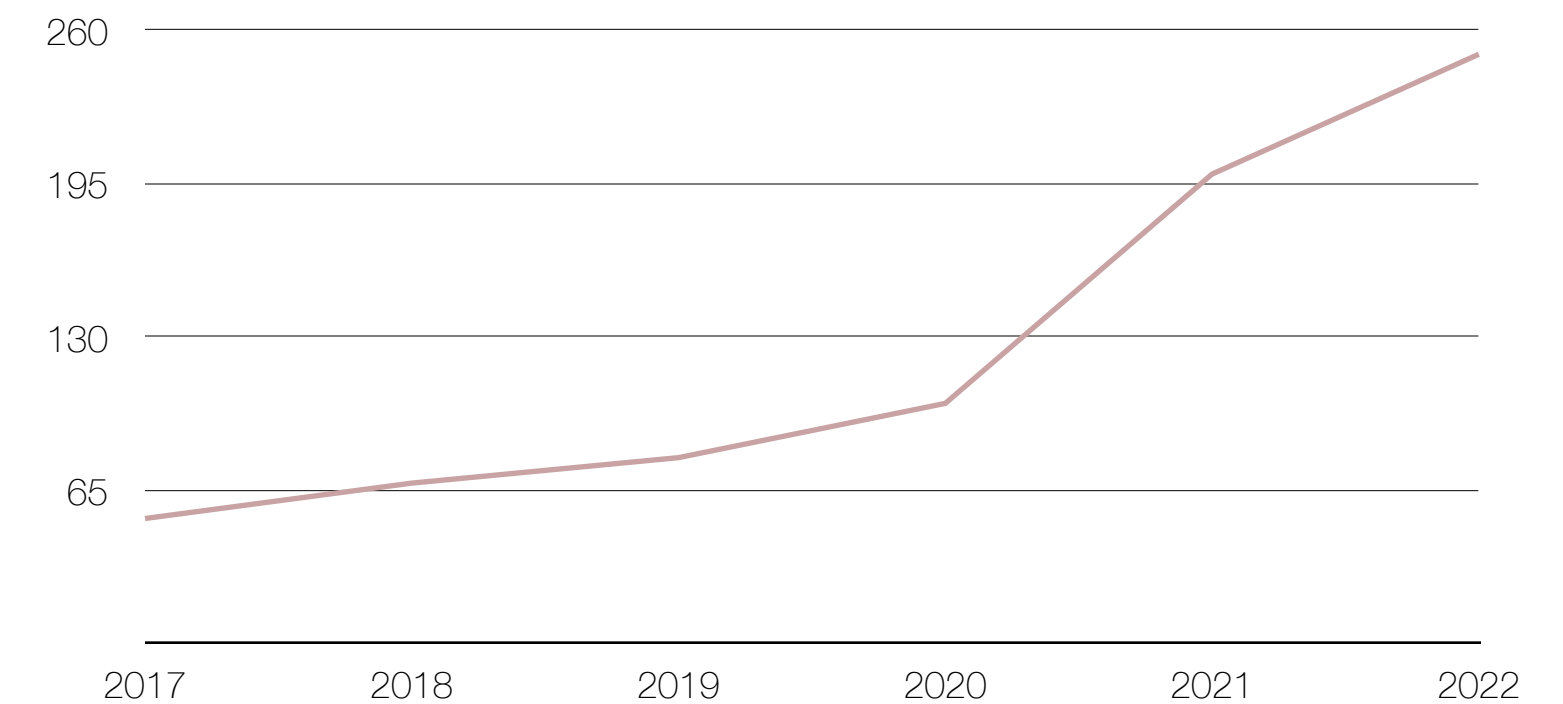
### Speeds

#### Download speeds have grown strongly since 2017

Amid increasing take-up of high-speed broadband subscriptions (with a particularly rapid growth in adoption of 500Mbps+ services), download speeds are rising across Denmark. The country's largest four operators now offer gigabit-capable services at the retail level, either via fibre or cable infrastructure, or both.

As a result, median download speeds have grown 370% over the 2017-2021 period (from 53Mbps to 250Mbps). The biggest single rise in broadband speeds occurred in 2021 – the same year that fibre saw a notable increase in adoption and rural coverage.

#### Median download speeds (Mbps)



Source: SDFI

# Denmark



## Consumer value

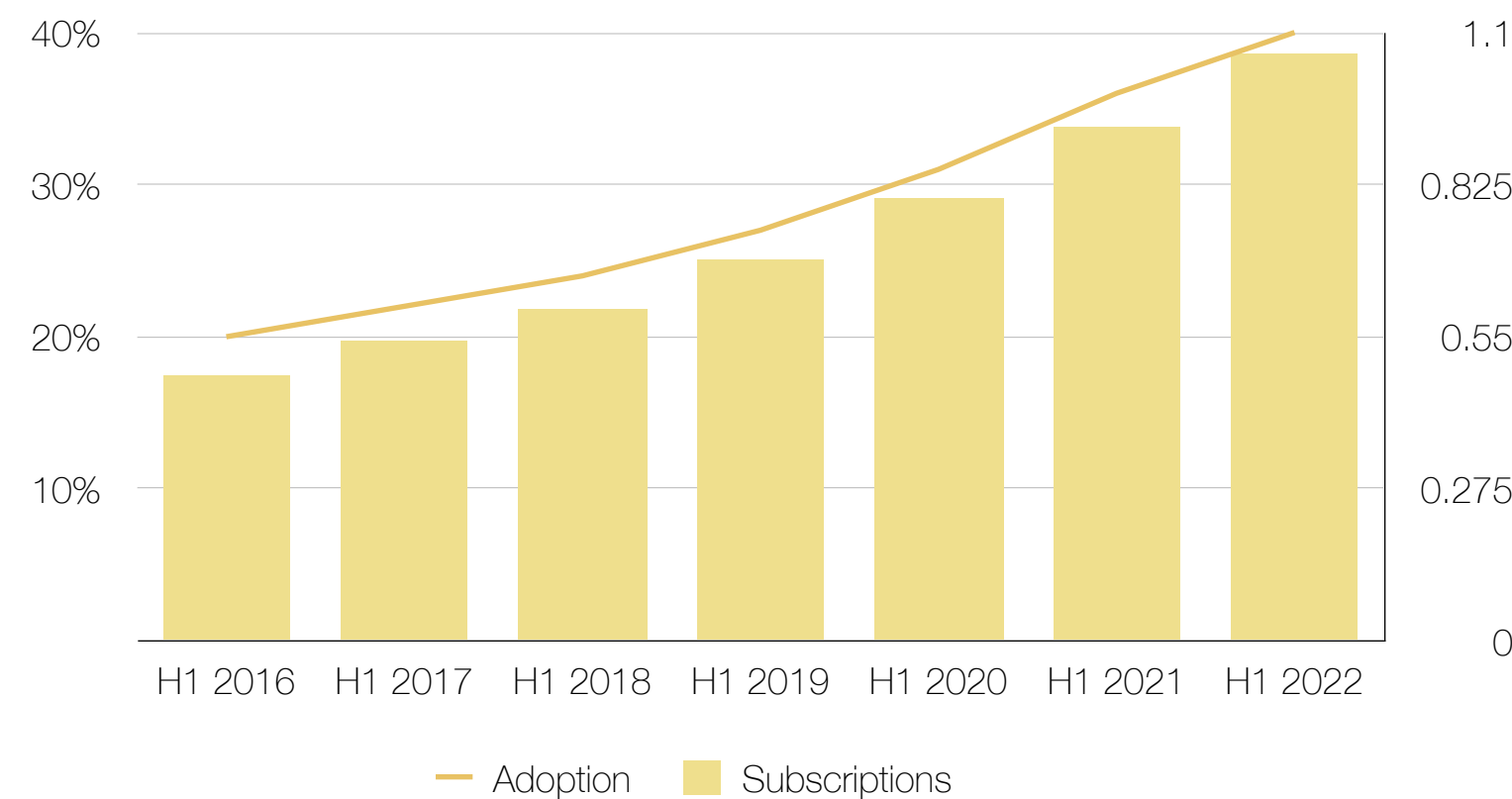
### Adoption

#### Accelerating growth in fibre adoption

In 2022, Denmark ranked first among the 27 EU Member States on the connectivity pillar of the bloc's Digital Economy and Society Index (DESI). The country reports adoption of 100Mbps+ services that is comfortably above the regional average. During the COVID-19 pandemic, the DEA observed increased demand for very high-capacity broadband due to lockdowns. As of H1 2022, gigabit connections had surpassed 500,000.

By the same point in time, total fibre subscriptions in Denmark was approaching 1.1m, equivalent to 40% adoption (i.e. share of total subscriptions). A decade earlier, fibre connections stood at just 245,000 – an adoption rate of 11%.

**FTTH adoption**  
(Subscriptions (m), % of subscriptions)



Source: SDFI

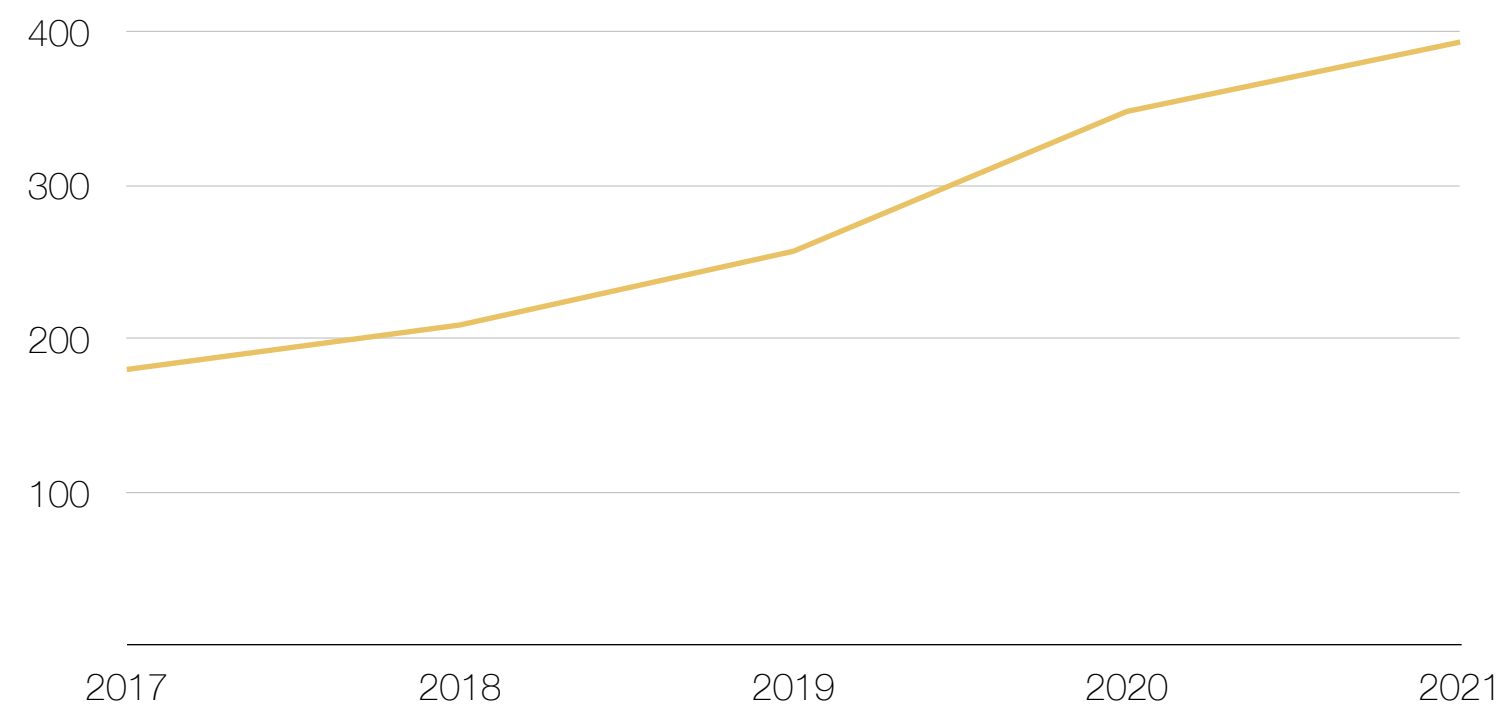
### Usage

#### COVID-19 triggered higher data consumption

With extensive fibre coverage and take-up of high-speed broadband, Denmark reports significant fixed data usage. Monthly data consumption per connection had been growing prior to the COVID-19 pandemic but, like many markets, saw an surge in traffic when the first round of lockdowns were implemented in 2020. During this period, outgoing landline voice minutes also increased after years of decline.<sup>5</sup>

The increase in fixed data consumption was most notable in H1 2020 when monthly usage per connection jumped 47GB, growing almost as strongly in the second half of the year. With more people working and streaming entertainment content from home, broadband networks are now in use more so than ever.

**Fixed data usage**  
(GB/connection/month)



Source: DEA

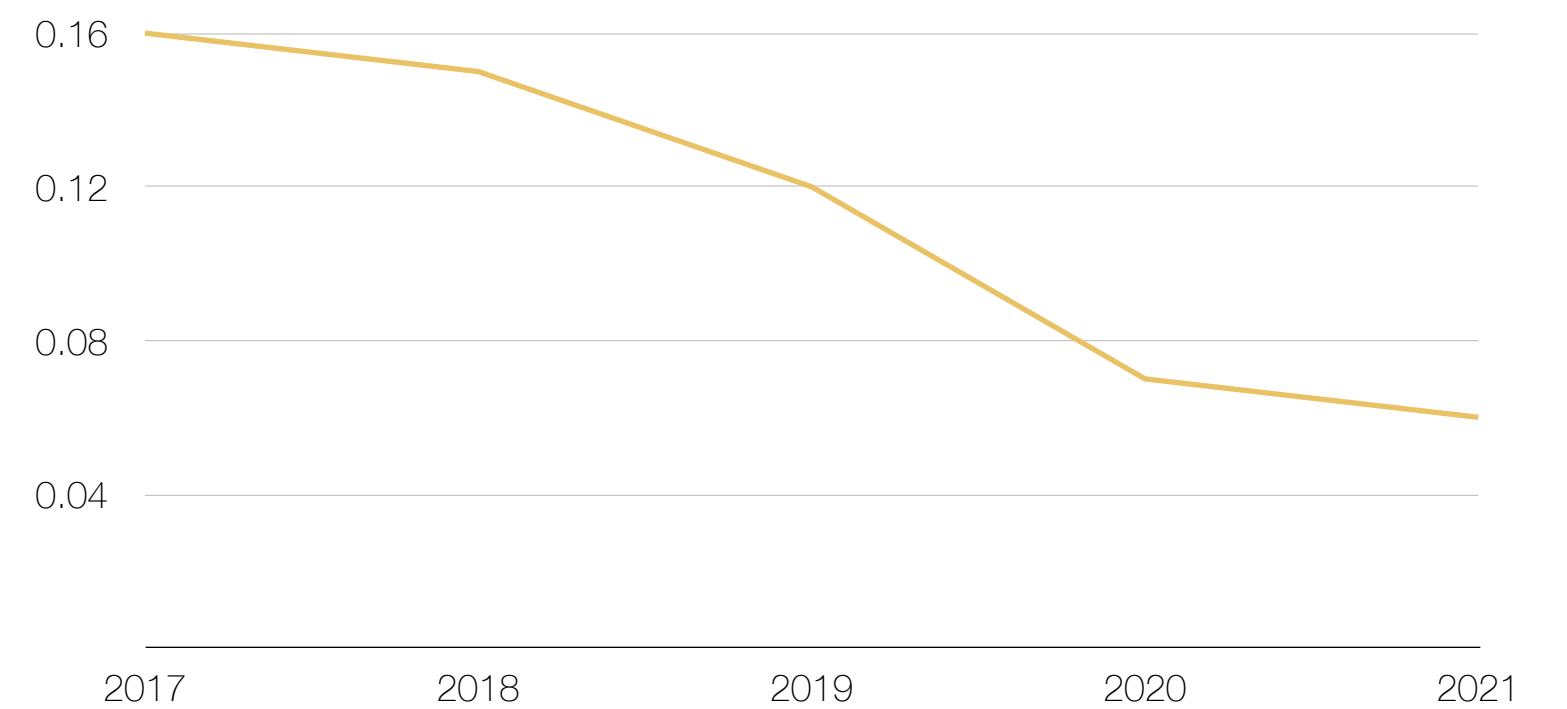
### Overall value

#### Prices have fallen as data consumption has risen

In Denmark, the average price of standalone fixed broadband (above 30Mbps) declined between 2017-2021, with a notable reduction in the price of 100Mbps+ services in 2020 (which is now below the EU average). Though there has since been a small uplift in prices across speed tiers, prices fell more than 10% overall during the relevant period.

When prices are considered relative to broadband consumption, consumers have paid less per GB of traffic over time, with this downwards trend accelerating due to COVID-19 restrictions. A similar trend is visible when prices are also considered in the context of median download speeds, with the price-Mbps ratio falling consistently over recent years.

**Fixed broadband value**  
(€/connection/month)



Source: Assembly, DEA, EC

# Denmark



## Societal benefits

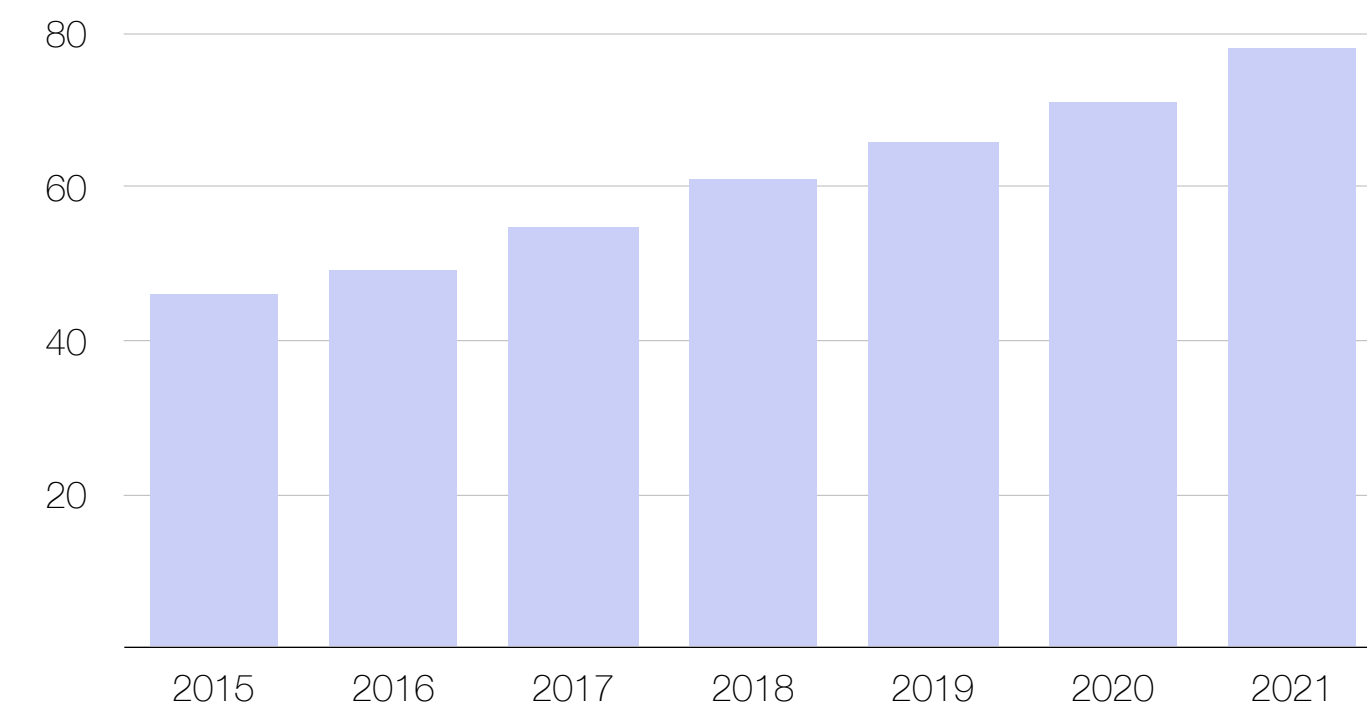
### Rural coverage

#### Fibre availability is higher in rural areas than urban centres

Fibre coverage has increased significantly in rural parts of Denmark, with some acceleration in the annual growth rate over 2015-2021 period. For instance, availability of full fibre services rose three percentage points in 2016, five percentage points in 2019 and then almost seven percentage points in 2021. As a result, nearly 78% of households in rural areas could access fibre broadband. This level of coverage positions Denmark considerably above the EU average and as one of the leading markets in the bloc.

There is a degree of variation between regions, with next-generation access (NGA) coverage lowest in the southeastern region of Sjælland. Nevertheless, full fibre services are currently available to a greater proportion of rural households than urban ones.

**Fibre coverage in rural areas**  
(Households passed, %)



Source: EC

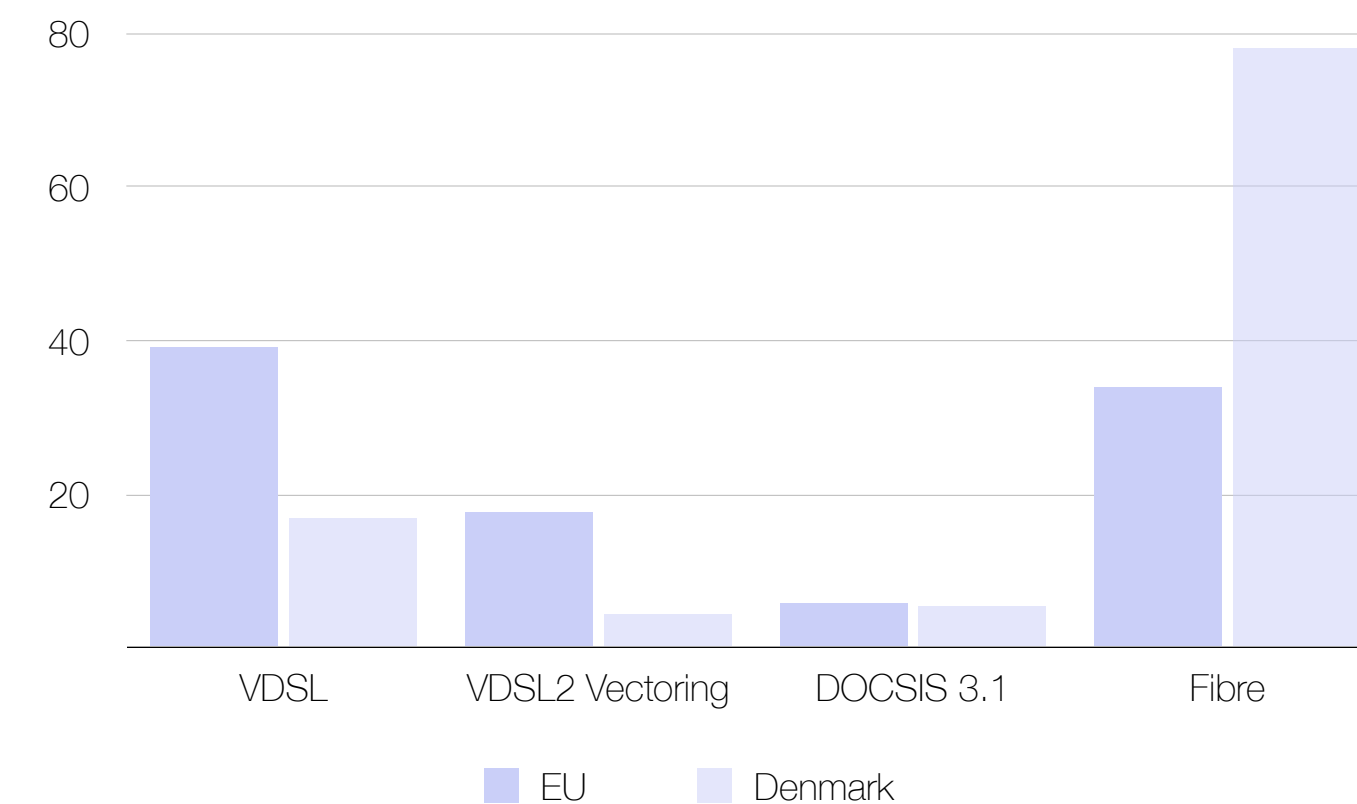
### Operators' rural rollouts

#### Altnets have relatively high rural network footprints

In rural areas of Denmark, DSL remains the most widespread fixed broadband technology reaching nine in 10 households. However, as is the case at the national level, DSL and VDSL network coverage is now in decline. In order to deliver an upgrade in speeds, telcos have tended to deploy new fibre infrastructure, with Vectoring used to a less extent than in Germany, for example, where it has been extensively employed by Deutsche Telekom.

Whereas the number of cable deployments is gradually falling, rollouts of FTTH networks continue across less densely populated areas. Much of this has been led by altnets such as Norlys (which has a considerably more rural fibre footprint than the incumbent TDC), supported by the National Broadband Pool. This government initiative reserves public funding for areas with poor coverage, allocating €13.4m in 2022.

**Coverage by technology, rural areas**  
(Households, %)



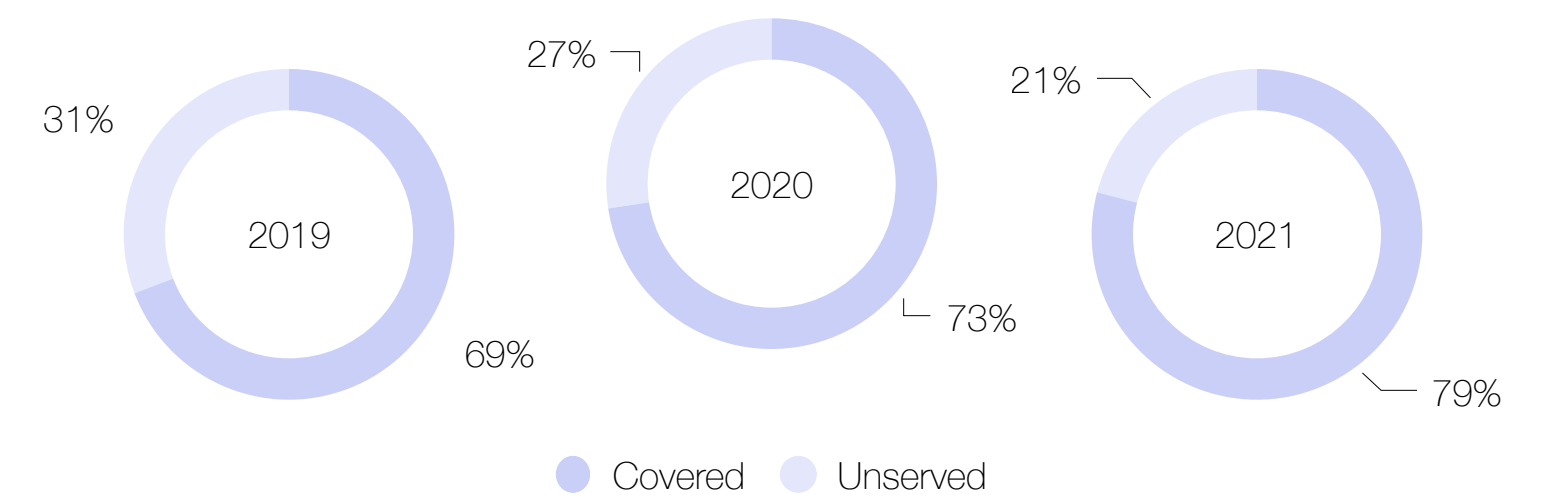
Source: EC

### Digital inclusion

#### Denmark has achieved almost 80% VHCN coverage in rural areas

With a low (and slowly declining) coverage of DOCSIS 3.1 standard cable networks, fibre has been largely responsible for increasing the availability of gigabit-capable networks in rural areas, which now reach 79% of homes.

**Fibre and cable broadband coverage in rural areas**  
(% of premises)



Source: EC

#### Altnets deliver wider socioeconomic benefits

Altnets in Denmark are making positive contributions beyond the deployment of telecoms networks:

- Social responsibility is a stated priority for Stofa-owner Norlys, with its work based on the UN's Sustainable Development Goals (SDGs), particularly SDG7 (Affordable and clean energy) and SDG9 (Industry, Innovation and Infrastructure).
- The SDGs also guide Andel (co-owner of Fibia), which aims to play a significant role in the green transition of energy production in Denmark.
- Telenor Denmark is committed to achieving the group-level goal of carbon neutrality by 2030, investing in AI solutions to help reduce power consumption in its network, and signing an agreement with Better Energy for the construction of a new solar park.



# France

## Overview

A decade ago, France's telecoms networks were largely copper-based, with the rollout of fibre happening at a slow pace and trailing neighbouring countries. With the announcement of a new national broadband plan – later refreshed to emphasise the importance of FTTH – and the implementation of the regulator's pro-investment framework, fibre deployments have accelerated across the country. As adoption of fibre has also increased significantly, there have been knock-on effects for average download speeds and fixed data consumption.

**€11.3bn**

Fixed network investment in 2021, of which most has been employed in fibre network rollouts

**77%**

Premises covered by FTTH, with even greater access rates in urban and rural areas targeted by operators' commercial builds

**14.9m**

Premises in rural areas with access to FTTH services, a direct result of operators' commercial rollouts



### Policy environment

- Arcep has sought to maintain a pro-investment regime as it seeks to support the migration from copper and businesses' digital transformation.
- The latest market analysis decisions (cycle 6, December 2020) imposed maximum copper local loop prices and asymmetric regulation on Orange, as well as symmetric regulation on all FTTH network operators.
- The French Government refreshed the national broadband plan in February 2020, defining a new objective for the availability of fibre to 100% of households by the end of 2025.



### Investment & build

- At Q3 2022, FTTH coverage had been extended to 33.1m premises, equivalent to 77% of the total and an increase of 28m premises since Q3 2015.
- Fibre is driving a rise in investment by operators, with fixed network capex more than doubling between 2015 and 2021 (from €5.5bn to €11.3bn).
- Orange accounts for the majority of FTTH deployments in France; however, the presence of competing fibre builders has required the incumbent to maintain the pace of its rollout.



### Product portfolio

- All four major telcos offer fibre services to consumers at the retail level, although only Orange and SFR currently also operate at the wholesale level (with Bouygues looking to move into this market).
- The number of fibre subscribers surpassed that of copper (or any other type of broadband) by the end of 2021, with the FTTH take-up rate reaching 50% in early 2022.
- At 120Mbps, France is now in the top 10 countries globally for mean broadband download speeds, while two altnets (Free and SFR) offer the fastest connectivity currently available in the market of up to 8Gbps.



### Consumer value

- Total FTTH subscriptions in France increased from 2.9m to 17.1m over the past five years, with the largest rise in adoption occurring during 2020/21.
- In 2021, fixed data consumption per capita exceeded 136GB per month, equivalent to a 445% increase since 2017 (when usage was 25GB).
- Considering the price of broadband services relative to fixed data consumption indicates a clear downward trend over time as consumers have got more for their money, particularly so before 2020.



### Societal benefits

- Commercial fibre deployment has improved access to 100Mbps+ broadband services in rural areas, with availability doubling to 92% over the past six years.
- SFR had deployed over 2.9m FTTH lines in 'less dense' areas as of Q3 2022, representing 20% of the total (up from just 6% in 2016).
- Altnets in France are making positive contributions beyond infrastructure deployments, for instance supporting efforts to drive digital inclusion and reducing the environmental impact of broadband routers.

**562%**

Increase in fibre coverage since 2015

**105%**

Growth in annual fixed network capex since 2015

**794%**

Rise in download speeds over the 2017-2021 period

**82%**

Improvement in fixed broadband value since 2017

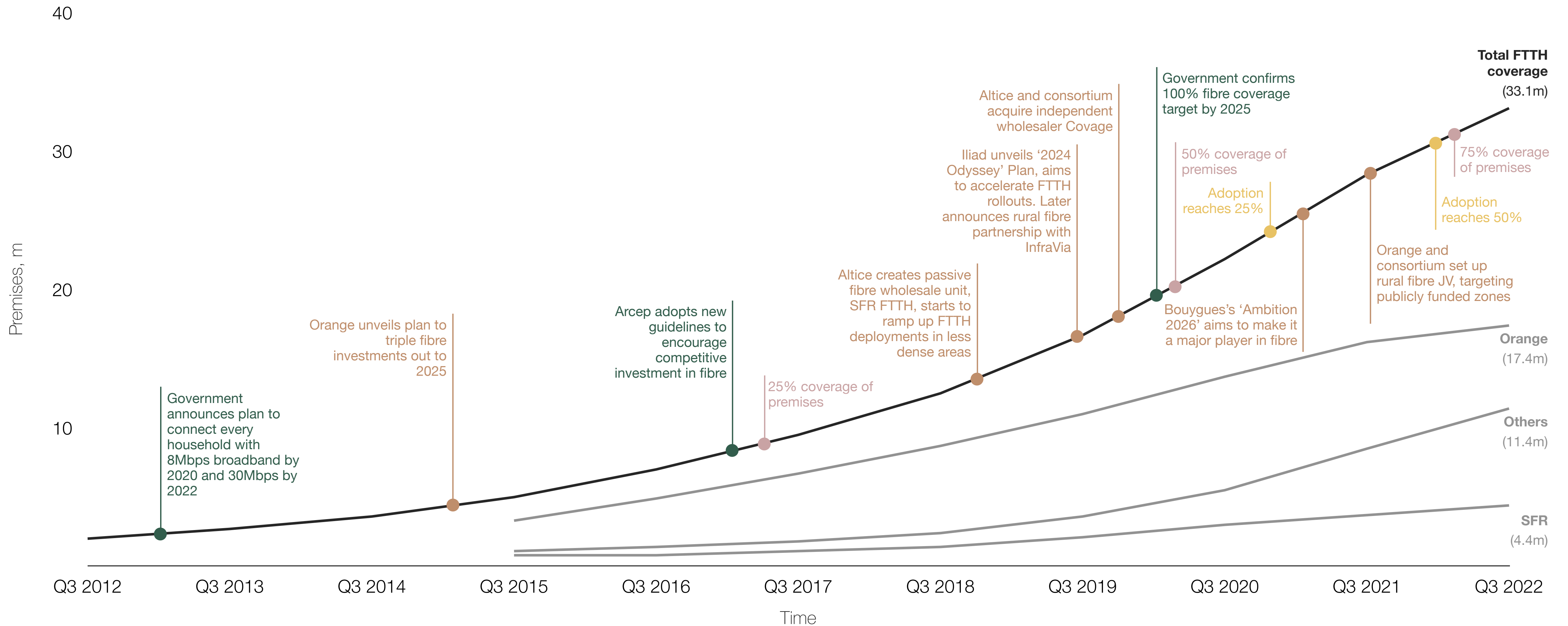
**85%**

Reduction in the size of the digital divide since 2016



# France

## Timeline



# France



## Policy environment

### Government broadband strategy

#### The national broadband places an emphasis on FTTH

In February 2013, the French government launched the Plan Très Haut Débit, a €20bn national strategy that aimed to deliver to every household 8Mbps broadband access by 2020 and 30Mbps services by 2022. In the years since, several public-private partnership (PPP) projects under concession contracts were signed to enable network rollout and operation rural parts of France between local authorities (regions and departments) and private partners (e.g. construction companies, network operators and infrastructure investment funds). Given high investment costs in low density rural areas, PPP contracts have complemented operator’s commercial builds.

In February 2020, the Government refreshed the national broadband plan, defining a new objective for the availability of fibre to all by the end of 2025. Through this target, France has demonstrated a preference for FTTH technology, with operators, local authorities and the state sharing the required investments. In more isolated areas, satellite and mobile networks are seen as a viable solution to expand broadband coverage.

#### Public funding has targeted boosting digital skills

In 2021, France allocated €250m to help people better understand how to use the internet. Part of this budget went to “Aidants Connect”, a scheme in which social workers and other government employees provide tutorials to help people struggling with various online tasks.

### Government broadband targets

(100% of households)



### Approach to wholesale pricing

“

#### Maintain pro-investment regulation to make fibre the fixed infrastructure of reference

”

#### The regulator has sought to implement a pro-investment regime

Arcep sets the regulatory framework governing fixed networks in France and has made fibre a central focus of its market reviews as it seeks to support the migration from copper and businesses’ digital transformation.

The purpose of the regulation established for the 2017-2020 period (i.e. market review cycle 5) was to encourage all operators to participate in the “investment effort”, particularly in areas where only Orange was present.<sup>4</sup> Arcep considers that this goal has been achieved, with competition upstream and healthy momentum in the retail FTTH market.

#### Wholesale prices aim to encourage copper migration

In December 2020, Arcep adopted a decision setting the maximum tariffs that Orange can charge for accessing its copper local loop, from 2021 to 2023. To incentivise the market’s transition from the legacy copper network to fibre, Arcep has introduced a review clause in the pricing framework governing unbundling, which would make it possible to increase prices if Orange is ambitious in its switch-off plan and timetable.

To determine these maximum prices, Arcep relied for the first time on a new cost assessment method based on modelling of a shared optical local loop, to take the technological transition to ultrafast access into account. Because the transition away from the copper network is occurring at an increasingly accelerated pace, the method based on regulatory cost accounting no longer makes it possible to deliver a stable and predictable price signal.

For this next round of price caps, Arcep therefore made the choice of relying on the model it developed, which creates the ability to introduce a long-term signal into the tariffs, to keep pace with this transition.

### Latest wholesale broadband market review

#### Fibre is the focus of recent regulation

Arcep views FTTH as the infrastructure that will “outfit the entire country for several decades to come”; however, network rollouts represent an unprecedented undertaking, in terms of both scale and form.

For the current market review period (2021-2023),<sup>5</sup> Arcep identified three main objectives: facilitating the transition from the legacy copper network to fibre; maintaining pro-investment regulation to make fibre the fixed infrastructure of reference; and energising the business market. In addition to setting maximum tariffs for accessing Orange’s copper local loop, the latest market analysis decisions (cycle 6) imposed “asymmetric” regulation on Orange as well as “symmetric” regulation that applies to all FTTH network operators.

In addition, Arcep has required operators to provide access to dark fibre on a non-discriminatory basis at ‘mutualisation points’, which can host in around 1,000 lines in less dense areas. In low population, publicly-funded areas, Arcep has also required Orange to provide access to its civic infrastructure and to give operators the possibility of autonomously carrying out renovation works where needed, while retaining ownership of the infrastructure.

#### Arcep is currently developing regulation for the next five years

In July 2022, Arcep took the first step in the process of reviewing wholesale fixed broadband and superfast broadband market regulation for the 2023-2028 period.<sup>6</sup> Core issues identified include: fibre coverage and capacity; copper QoS until network switch-off; competition in the B2B market; and effective access physical civil engineering infrastructure.

“

#### Regulation has a vital role to play in creating the right incentives and enabling the market to harness its full investment power

”

# France



## Investment & build

### Operator rollouts and capex

#### FTTH coverage and investment have increased significantly

At Q3 2022, coverage had been extended to 33.1m premises (77% of the total), an increase of 28m since Q3 2015. In absolute terms, the growth in new fibre lines peaked in 2020 as operators connected close to 5.8m premises. This has been achieved by increased investment by operators, with fixed network capex doubling between 2015-2021 (from €5.5bn to €11.3bn).

#### Rivals keep up the pressure on Orange

Orange accounts for the majority of FTTH deployments, but the presence of competing fibre builders required Orange to begin its network rollout in earnest and to maintain the pace since. In early 2006, Orange (then France Télécom) announced a pilot fibre rollout, but this was soon followed by a major announcement by Free that it would invest €1bn in its FTTH network out to 2021. Free then announced the acquisition of Paris-based altnet Citéfibre. Orange, which had not yet presented any big investment plans, quickly committed to connecting up to 200,000 premises by year-end 2008. With Numericable also making fibre a priority from 2009, Orange later announced that it would investment €2bn over the period 2010-2015 to extend FTTH coverage to 10m homes.

In recent years, Free has focused much of its FTTH rollout on ‘very dense’ areas, accounting for around 5% of total annual deployments. However, SFR is the largest altnet investor in France, accounting for 13% of all premises connected to fibre in Q3 2022. Under its Ambition 2026 plan, Bouygues is aiming double its FTTH coverage by 2026 and to develop its fixed wholesale offering by leveraging its experience and expertise in the mobile market.

#### Fixed network investment (€bn)



Source: Arcep

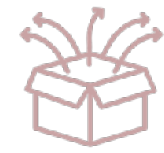
### Summary of build progress and sources of investment

Operator	Start of fibre investment	Build plans	Investment commitments	Source of funding	Progress to date	Geographic focus	Pace of rollout
Bouygues	2010 (in high density areas)	35m connectable sockets (i.e. premises marketed to) by 2026	€1.3bn annually, including for co-financing of FTTH and mobile (excluding spectrum)	Internal, partnerships (e.g. with Vauban Infra Fibre)	28.3m connectable sockets (Q3 2022)	Urban areas (and rural AMEL zones via Axione)	Unknown
Free	2007 (in Paris)	30m connectable sockets by 2024	€1bn announced in 2006, 8bn invested since 2010	Internal, €600m from InfraVia for 51% stake in Investissements dans la Fibre des Territoires	29.8m connectable sockets, 0.3m lines deployed in very dense areas (Q3 2022)	Urban areas	4,000 new homes connected (very dense areas only, Q3 2021-Q3 2022)
Orange	Pilots in 2006, deployments stepped up from 2007	36m households connectable by 2023	€2bn announced in 2010, €4.1bn invested annually (France overall)	Internal, sale of 50% equity stake in Orange concessions in €1.3bn deal	32.3 households connectable, 17.4m lines deployed (Q3 2022)	National	1.2m new homes connected (Q3 2021-Q3 2022)
SFR	Pre-2010 (accelerated rollouts in less dense areas during 2019)	Nationwide fibre by 2025	€465m equity contribution to acquisition of Covage, €1.7bn in annual capex in telecoms business	Internal, sale of 49.99% stake in SFR FTTH for €1.7bn, debt	29.9m fibre homes passed, 4.4m lines deployed (Q3 2022)	National	717,000 new homes connected (Q3 2021-Q3 2022)

Source: Assembly, Arcep



# France



## Product portfolio

### Propositions in the market

#### All operators are offering fibre services

Whether as a consequence of their own FTTH deployments or by accessing a rival's network, all four major telcos offer fibre services to consumers at the retail level, as well as to business customers (e.g. 'Free Pro'). SFR is the only one of the four operators to also run a cable network after its acquisition by Altice subsidiary Numericable in 2014.

Orange and SFR currently wholesale access, while Bouygues is looking to become a significant player in this market. SFR established a standalone wholesale fibre unit in November 2018, at which point it already counted Free, Orange and some regional providers as customers. SFR FTTH would sell wholesale services to all operators at the same terms and conditions. In November 2019, SFR acquired Covage, subsequently rebranding its wholesale business Xp Fibre.

### Market overview

Operator	Technologies	Speeds	Wholesale offering
Bouygues	DSL, FTTH	Up to 2Gbps	Under development
Free	DSL, FTTH	Up to 8Gbps	No
Orange	DSL, FTTH	Up to 2Gbps	Yes
SFR	Cable, DSL, FTTH	Up to 8Gbps	Yes

Source: Assembly

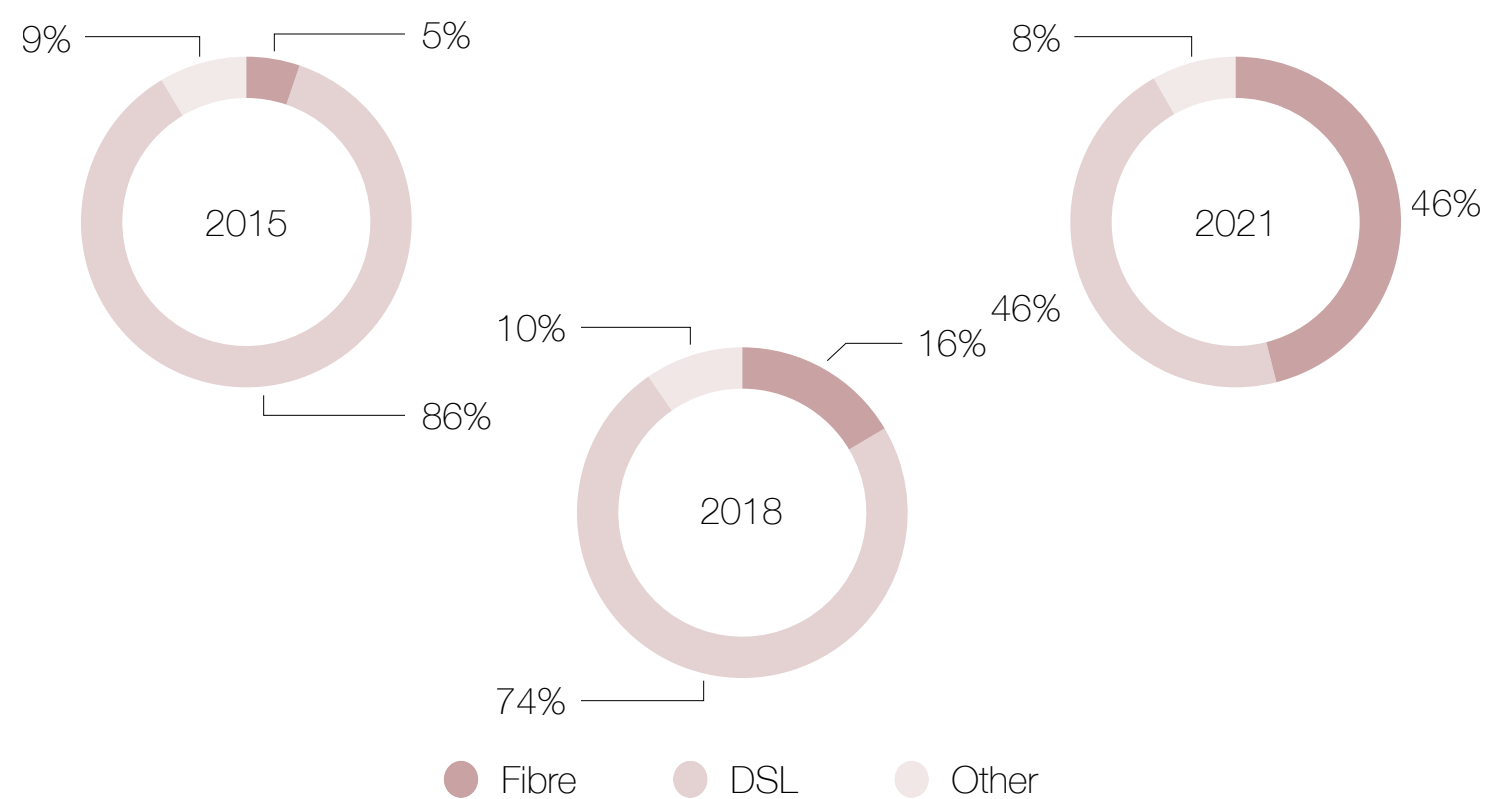
### Technologies

#### Fibre is now France's leading broadband technology

Operators continue to offer DSL-based broadband, typically alongside other communications services such as pay TV or mobile. However, the number of fibre subscribers had surpassed that of copper (or any other type of broadband) by the end of 2021. The take-up rate reached 50% in early 2022, a rapid increase from just 5% at year-end 2015.

FTTH accounts for the vast majority of connections above 100Mbps, with cable services capable of delivering this level of speed witnessing a fall in overall connections over the past five years.

### Technology mix (% of subscriptions)



Source: Arcep

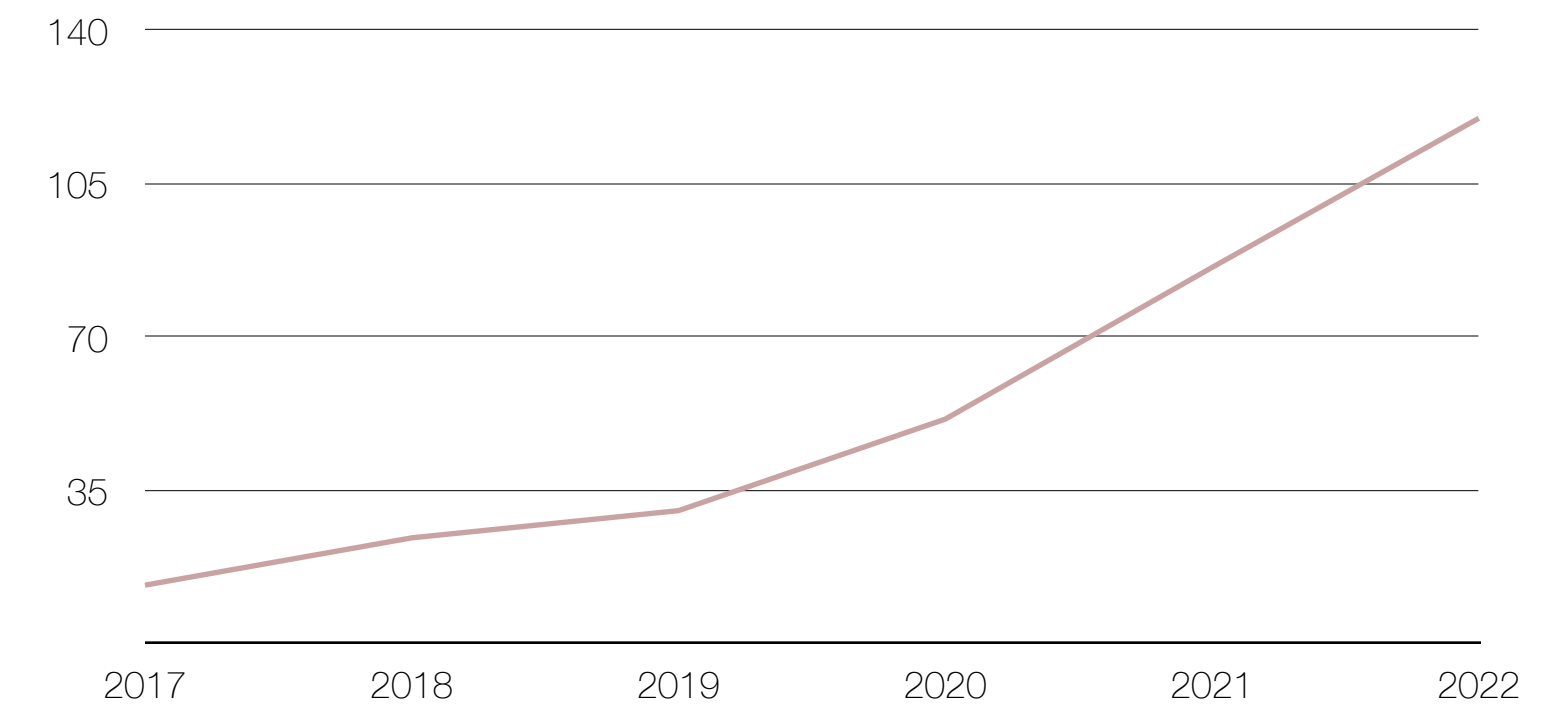
### Speeds

#### Speeds have increased four-fold in three years

Growth rates in fibre coverage and take-up have been responsible for driving up broadband speeds. All four operators now offer gigabit services at the retail level, with altnets Free and SFR marketing the fastest propositions of up to 8Gbps download speeds. SFR launched its 8Gbps-capable router in February 2022 to challenge Free's 'Freebox Delta' offering.

France is now in the top 10 countries globally for mean download speeds, rising 27 places since 2017. It is also in the top seven countries in Europe based on this metric. Broadband speeds have increased from 13Mbps on average in 2017 to 120Mbps in 2022, and four-fold since 2019 when they were 30Mbps.

### Mean download speeds (Mbps)



Source: Cable/M-Lab



# France



## Adoption

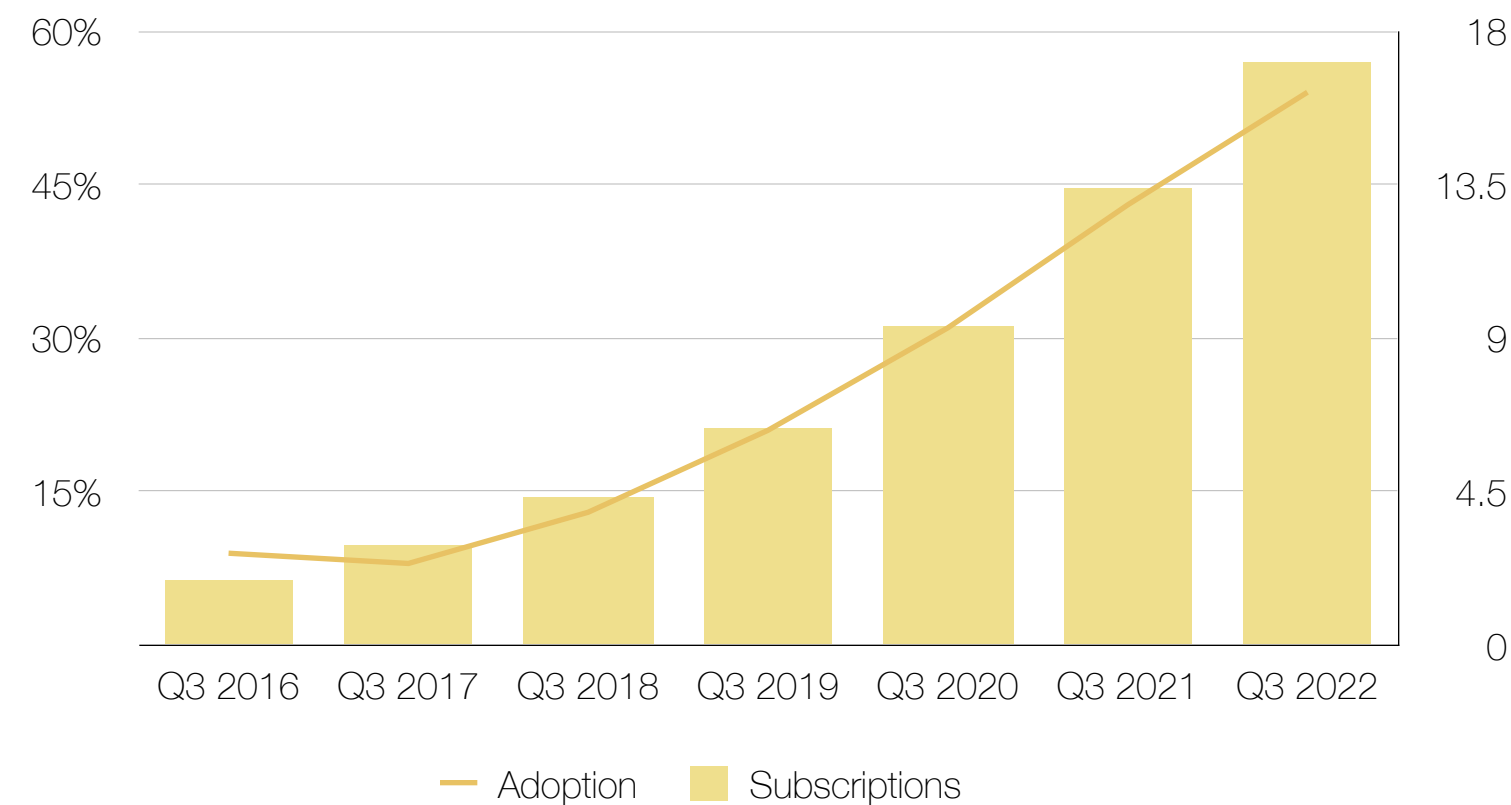
### Rising demand is translating into conversions

With the expanding coverage of fibre networks, an increasing proportion of consumers have upgraded their broadband service. As of Q3 2022, total FTTH subscriptions in France reached 17.1m, equivalent to a 54% adoption rate (i.e. share of total broadband subscriptions).

Five years previous, fibre connections stood at just 2.9m – an adoption rate of less than 10%. Take-up expanded especially quickly between Q3 2020 and Q3 2021, with FTTH's share of total broadband connections in France doubling from 23%.

DSL-based services for some operators, including Orange and SFR, are priced the same as fibre, which may have helped support the country's transition to higher speed broadband.

**FTTH adoption**  
(Subscriptions (m), % of subscriptions)



Source: Arcep

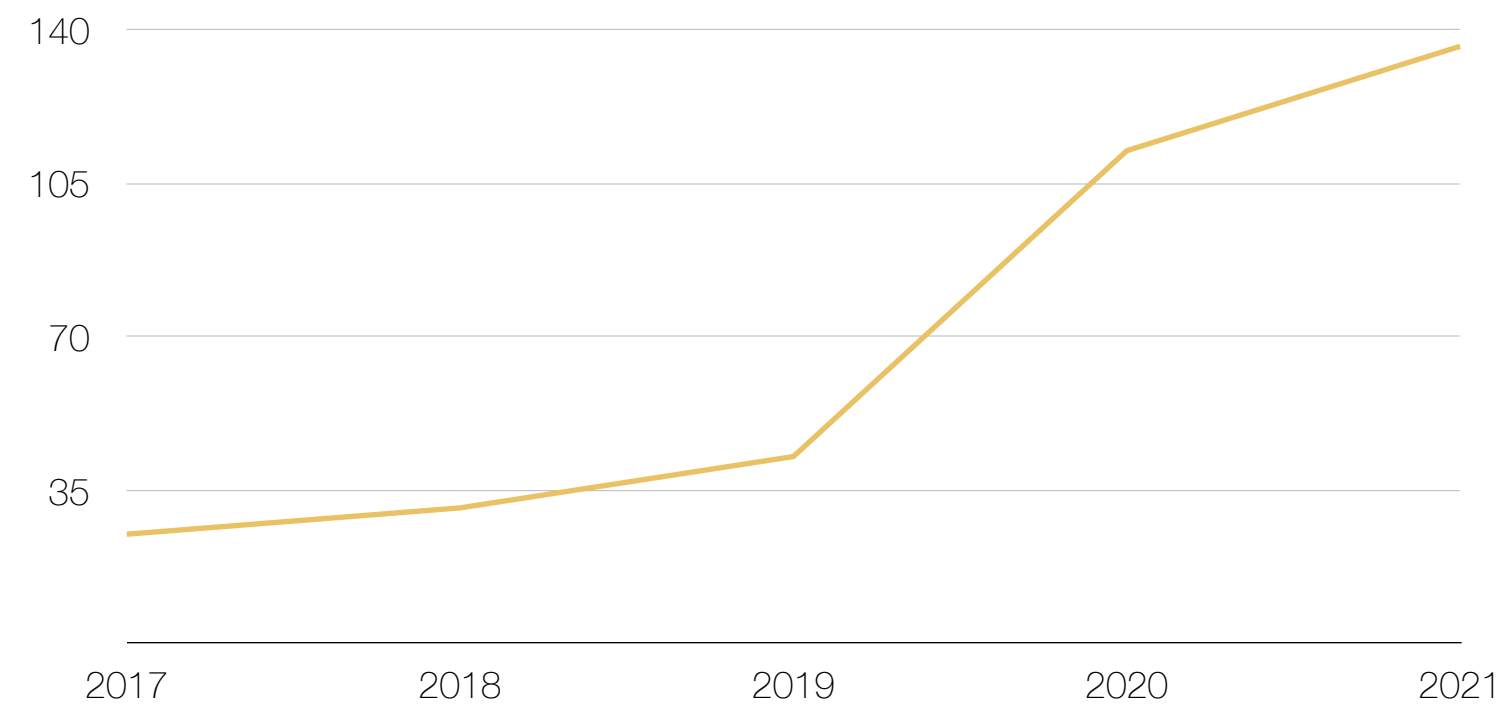
## Usage

### Consumers are reaping the benefits of quality connectivity

As fibre take-up and average end user speeds have both increased, so too has fixed data consumption as consumers spend more of their lives online and businesses engage more actively in the digital economy. This is particularly the case since the outbreak of COVID-19.

In 2021, fixed data usage per capita exceeded 136GB per month – a 445% increase since 2017 (when usage was 25GB). The greatest year-on-year increase in monthly data consumption was seen in 2020 when restrictions on movement and trading were often in place.

**Fixed data usage**  
(GB/capita/month)



Source: Ofcom

## Overall value

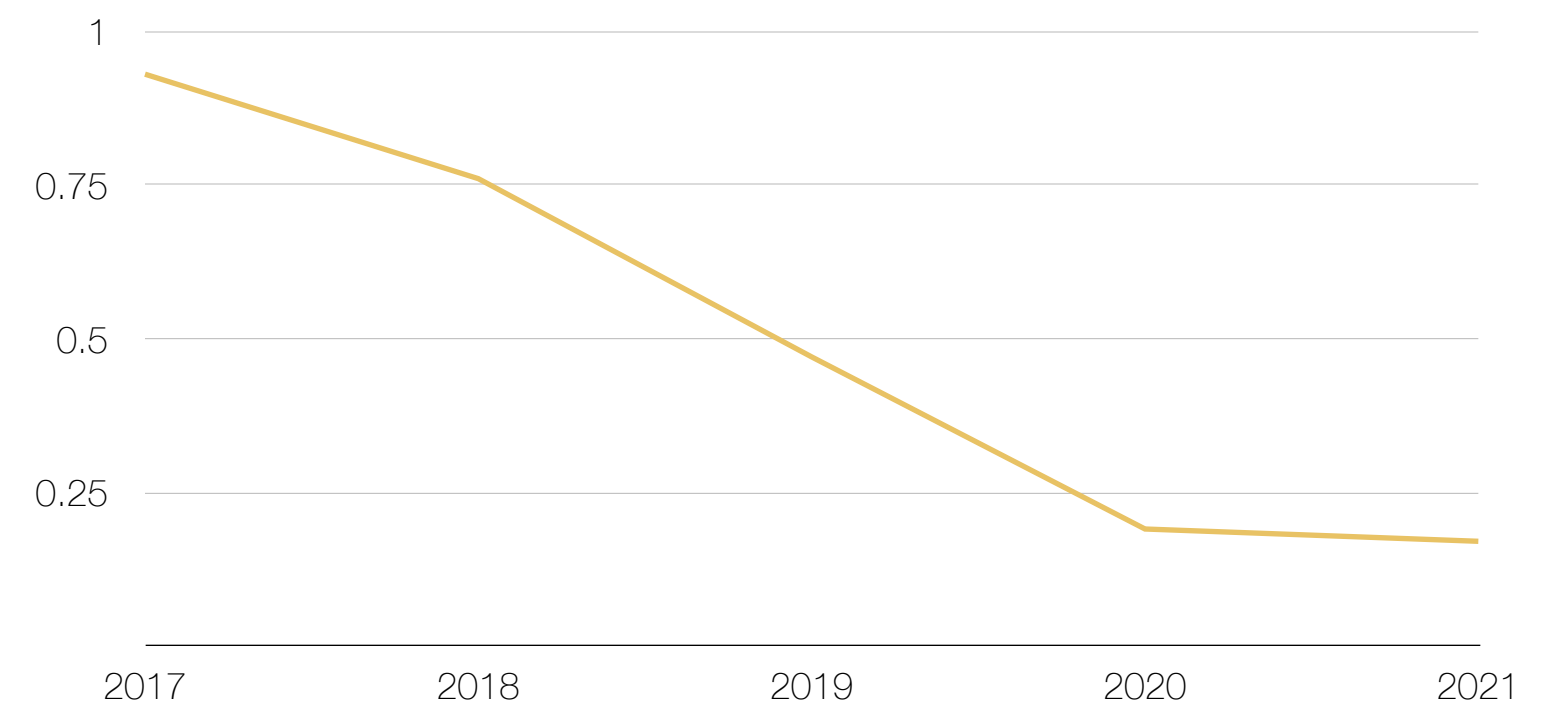
### Value for money has risen over time

On average, the price of standalone fixed broadband services above 30Mbps fluctuated slightly between 2017-2021, although they have declined overall during the period.

When prices are considered relative to data consumption there is a downward trend over time as consumers have got more for their money, particularly so before 2020.

A similar downward trend is visible when the same prices are considered relative to download speeds. As such, consumers have seen a relative drop in prices at the same time as benefiting from higher quality and faster services.

**Fixed broadband value**  
(€/capita/month)



Source: Assembly, EC, Ofcom

# France



## Societal benefits

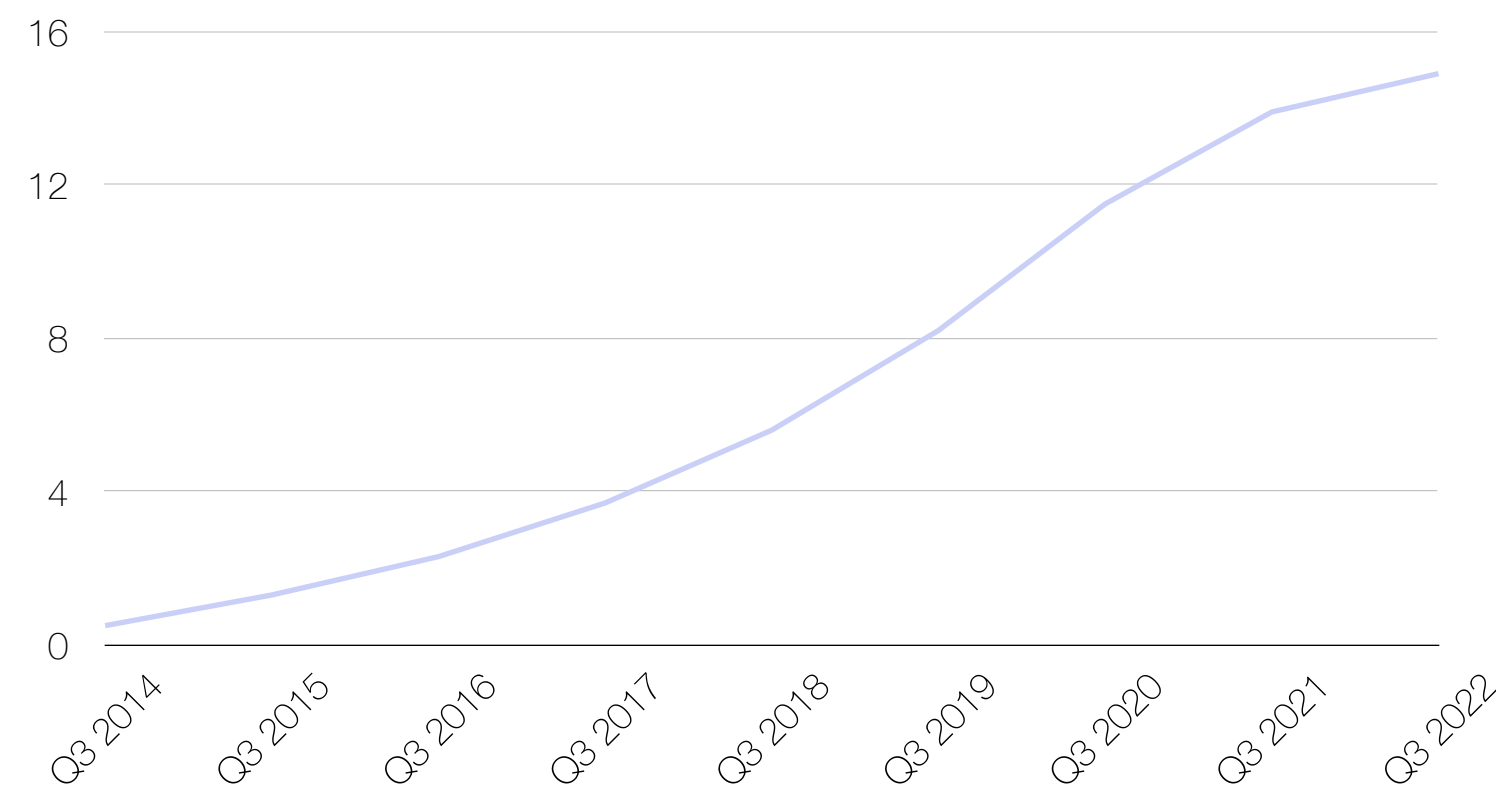
### Rural coverage

#### Rural FTTH rollouts have sought to keep pace with urban ones

Fibre coverage in 'zones moins denses d'initiative privée' (i.e. less dense areas where there is private network investment, also known as AMII zones) has increased from 0.5m to 14.9m premises over the past eight years. As a result, 88% of premises in France now able to access FTTH services.

In absolute terms, the scale of commercial rollouts in less dense areas peaked in Q4 2020 when telcos connected over 1.1m new premises. While the pace of commercial rural deployments has slowed (for example, the annual growth rate was 61% in Q3 2017 compared to 21% in Q3 2021), operators still connected around 1m new premises over the past year alone – compared to 345,000 in very dense areas.

**Total commercial fibre deployments in rural areas**  
(Premises, m)



Source: Arcep

### Operators' rural rollouts

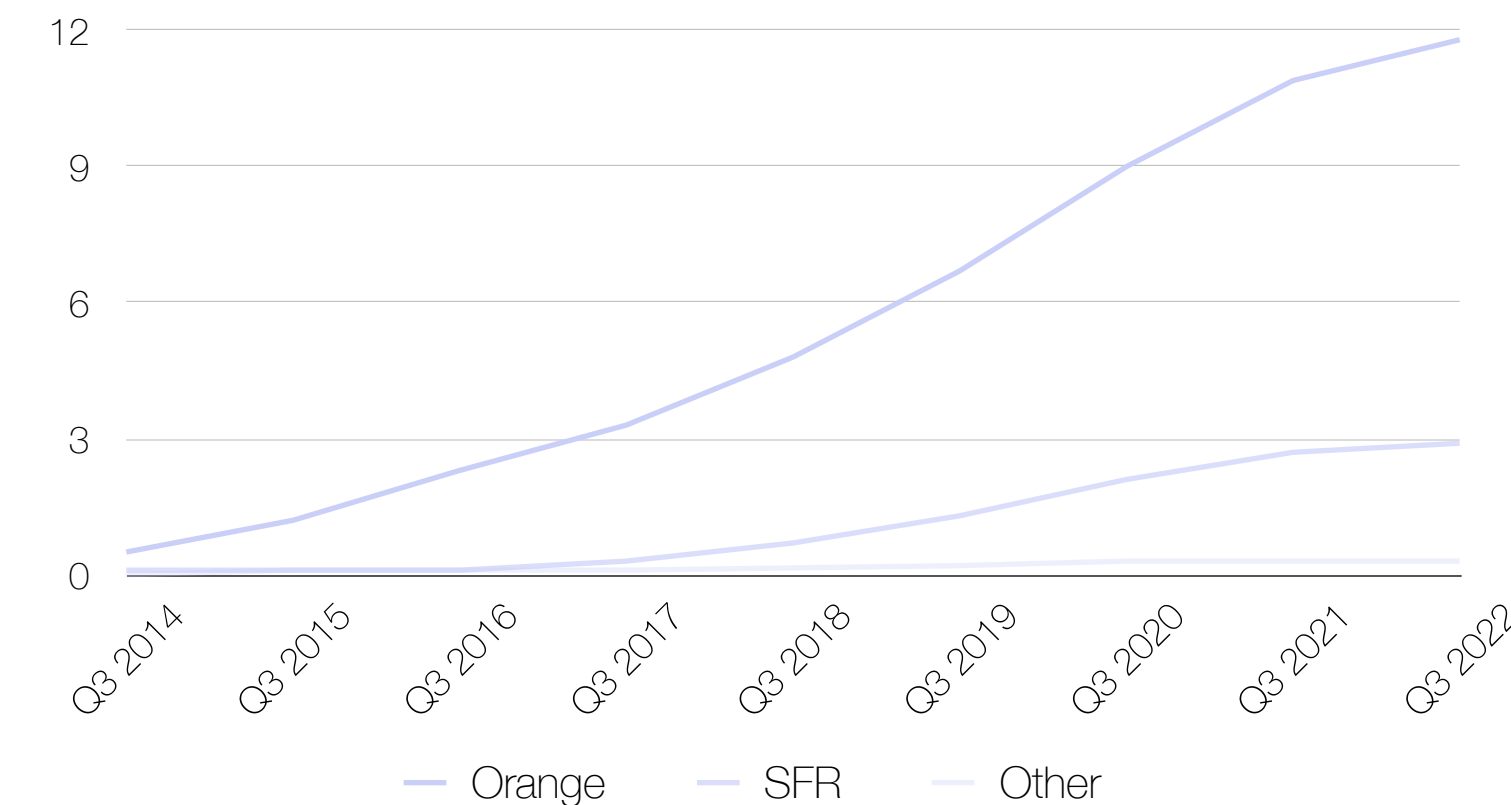
#### SFR accounts for a rising share of rural fibre deployments

As well as targeting urban centres, operators' commercial fibre builds have also focused on rural areas, helping to ensure that a new digital divide does not emerge.

SFR had deployed over 2.9m FTTH lines in less dense areas by Q3 2022, increasing from 0.3m five years ago. It now has a 20% share of deployments in these areas, up from just 6% in 2016. In addition to deploying in urban areas, Iliad's partnership with InfraVia aims to accelerate the rollout of fibre in remote parts of France (in line with its Odyssey 2024 plan).

Government-backed rollouts are complementing commercial ones: Altnets, including Altitude Infrastructure, Bouygues-subsiary Axione, Free and SFR, are using state funds to connect 'lower density public-initiative areas' (AMEL zones) to fibre – and account for over 75% of this type of deployment.

**Commercial fibre deployments in rural areas**  
(Premises (m) by operator)



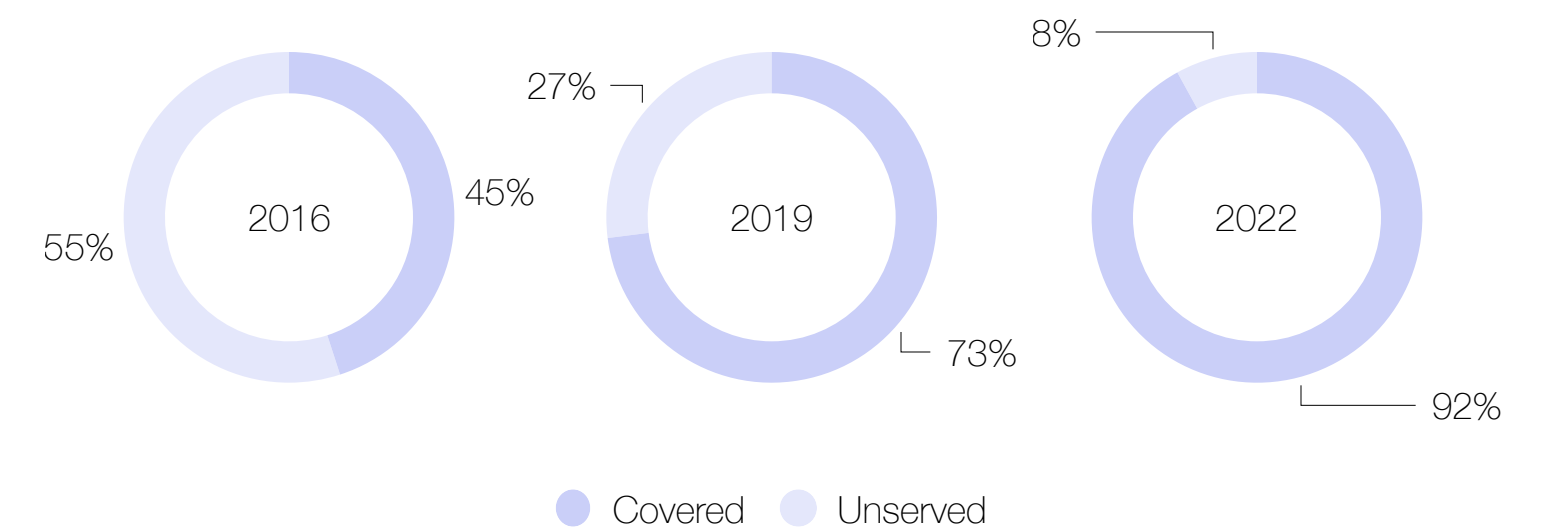
Source: Arcep

### Digital inclusion

#### FTTH drives coverage of 'très haut débit' broadband

In the past six years, access to 100Mbps+ broadband services in rural areas has more than doubled (with fibre underpinning this growth). FTTH is also representing a greater proportion of very high speed broadband subscriptions, taking market share from cable and VDSL2.

**Very high speed broadband coverage**  
(% of premises)



Source: Arcep

#### Altnets deliver wider socioeconomic benefits

Altnets in France are making positive contributions beyond the deployment of telecoms networks:

- Bouygues is committed to reducing its carbon footprint and has developed with suppliers an action plan to lower the environmental impact of routers.
- Free Mobile has launched a free monthly plan for Ukrainian refugees, which includes unlimited calls to Ukraine, 4h of calls to mainland France and Poland, and 10GB of data.
- SFR has made digital inclusion a priority, focusing on three issues: access to equipment; access to online resources; and digital skills. It has supported Emmaüs Connect, a NGO dedicated to helping people use internet-based services, distributing equipment and tackling exclusion.

# Germany

## Overview

Germany reports high-speed broadband coverage above the EU average, greater fixed data consumption per head than some European peers and a recent growth in average download speeds. However, the country is a clear laggard in terms of fibre. FTTH coverage is relatively poor, while there is a persistent urban-rural digital divide in gigabit connectivity (which is being driven by cable upgrades rather than new fibre deployments). Triggered by altnets' actions, the incumbent's FTTH rollout is only just kicking into gear, leaving the country in catch-up mode.

7%

Adoption of full fibre broadband, compared with 69% for DSL-based services

2.6m

Fibre connections in Germany, representing a 600,000 uplift year-on-year

11%

Premises in rural areas covered by fibre, while 59% have access to VDSL2 Vectoring networks



### Policy environment

- With digital infrastructure now a national priority, Germany's Gigabit Strategy (adopted in July 2022) targets availability of FTTH to all places where people live, work and travel by 2030.
- While the regulator has often highlighted the significant potential of fibre, its approval of Deutsche Telekom's use of Vectoring means altnets have represented major drivers of FTTH network build-out.
- BNetzA's latest fixed access market review imposes new obligations on Deutsche Telekom, including access to its unused duct capacity for rival operators at reasonable rates.



### Investment & build

- Operators in Germany have historically focused on upgrading copper and cable infrastructure, leaving fibre coverage (8.9m premises passed) among the lowest in the EU – putting the achievement of key digital targets at risk.
- Recent growth in fibre deployments (and investment) has driven largely by altnets such as Deutsche Glasfaser, while Telefónica and Allianz have also established a joint venture targeting rural and underserved areas with FTTH services.
- Having long favoured copper, Deutsche Telekom is now accelerating its FTTH build, partnering with utility company EWE and Australia-based IMF Investors to jointly deploy fibre networks.



### Product portfolio

- Germany's four largest operators all offer fibre services at the retail level, while O2 and Vodafone also offer broadband via cable networks, which are in the process of being upgraded to the DOCSIS 3.1 standard.
- DSL remains the country's dominant broadband technology, with 25.4m connections at the end of 2021 – almost 10 times the number of active fibre subscriptions.
- Average broadband speeds have grown almost three-fold since 2019 to reach 73Mbps, although the country is ranked only 21/47 in Europe based on this metric.



### Consumer value

- Fibre as a share of total broadband connections is expected to grow sharply in the coming years; however, relatively high prices for FTTH services and price sensitivity among consumers could hinder adoption.
- Germany saw an uptick in data consumption as a result of COVID-19; however, unlike some peers, the pace of growth did not tail off, largely continuing through 2021.
- Price as a function of data consumption yields a downward trend, with Germany offering good overall fixed broadband value for money compared to some other European countries studied.



### Societal benefits

- Operators have continued to upgrade copper networks to VDSL2 using Vectoring technology, which is available to close to 60% of rural households (nearly 3.5x the EU average).
- With some operators preferring to upgrade legacy infrastructure rather than replace it, fibre and DOCSIS 3.1 coverage is currently limited to just 23% of rural households.
- Altnets in Germany are making positive contributions beyond infrastructure deployments, for instance promoting online skills and safety, reducing carbon emissions and helping those affected by natural disasters.

15%

Premises that can access full fibre broadband

38%

Increase in annual fixed network capex since 2015

288%

Rise in download speeds over the 2017-2021 period

76%

Improvement in fixed broadband value since 2017

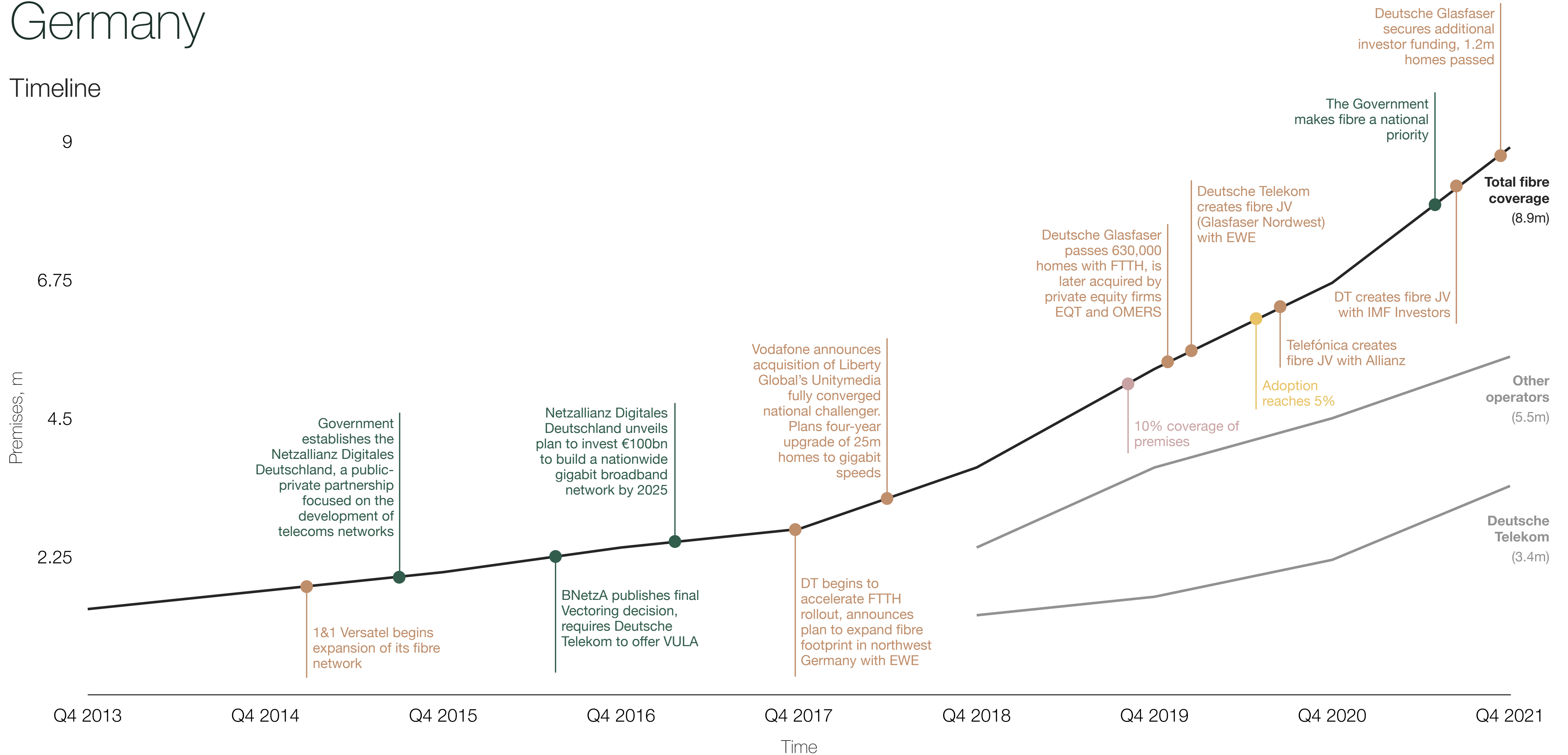
13%

Reduction in the size of the digital divide since 2019



# Germany

## Timeline



# Germany



## Policy environment

### Government broadband strategy

#### Nationwide fibre is now a national priority

In the coalition agreement of the German Federal Government 2021, digital infrastructure was made a national priority. The agreement sees commercial investment as the appropriate vehicle for connecting unserved (or ‘white’) areas, with voucher funding available where necessary.

The Gigabit Strategy (adopted in July 2022) aims to implement the objectives of the coalition agreement and targets availability of FTTH to all places where people live, work and travel – including in rural areas – by 2030. The plan sets an interim target of 50% coverage by 2025.

The Digital Strategy for Germany, launched in August 2022, aligns with these fibre goals, while also seeking to promote innovation, R&D and the creation of a digitally sovereign society.

#### The Government has mobilised public and private sector funding

In 2014, the Federal Ministry of Transport and Digital Infrastructure (BMVI) established the ‘Netzallianz Digitales Deutschland’, a consortium of public and private sector organisations from across the telecoms industry. In 2017, the Netzallianz announced the ‘Zukunftsoffensive Gigabit-Deutschland’, a plan to invest €100bn in order to build a nationwide gigabit-capable broadband network by 2025.

In addition, there is a range of regional broadband strategies, which differ in their broadband targets, sources of funding and preferred technologies.

### Government broadband targets

#### (Fibre coverage, % of households)



### Approach to wholesale pricing

#### The regulator claims to appreciate the value of fibre

In BNetzA’s view, well-developed, comprehensive telecoms infrastructure is a basic requirement for the process of digital transformation and ‘interconnectivity’.<sup>9</sup> However, while highlighting the significant potential of fibre, the regulator has often noted the low rates of adoption and coverage witnessed in Germany.<sup>10</sup>

Despite this, in September 2016, BNetzA made the decision to grant Deutsche Telekom permission to introduce Vectoring technology into its network. Though this can enable bandwidth improvements by reducing interference between lines, Deutsche Telekom’s initial plan had to be modified following concerns from the EC on the potential impact on the development of competition and on longer term incentives for investment in next-generation networks. Its subsequent use of Vectoring means that competing (often regional) operators currently represent important drivers of FTTH rollout.

In December 2022, BNetzA launched a nationwide infrastructure atlas to facilitate the efficient digital infrastructure deployment. The ‘gigabit register’ contains spatial data about the infrastructure of companies and institutions, including fibre lines and empty ducts.

#### Access pricing looks to facilitate the transition from copper

In June 2022, approved new long-term local loop prices. For the first time, rates have been set for a period of 10 years (instead of the usual three) in order to provide operators and investors with certainty and stability to encourage investments in fibre and further upgrades to cable networks.

**The telecommunications sector remains the main enabler for achieving a smart interconnectivity of our economy [and] society**

### Latest wholesale broadband market review

#### Duct access obligations aim to encourage new fibre deployments

In July 2022, BNetzA finalised the regulatory framework for access to Deutsche Telekom’s last mile network, following the completion of a coordination procedure with the EC. The framework – which will apply for at least the next three years – outlines new conditions for access to the incumbent’s copper and fibre infrastructure at the wholesale level.

Notably, Deutsche Telekom is required to make available and accessible any unused capacity in its ducts to other (non-dominant) network operators. Access must be provided and at reasonable rates in order to accelerate the deployment of new infrastructure.

**We are creating framework conditions for fair competition and further fibre-optic expansion**

#### The Government has sought to boost fibre rollouts

The DigiNetz Act has introduced the Cost Reduction Directive 2014/61/EU of the European Parliament and of the Council of 15 May 2014 on measures to reduce the cost of upgrading high-speed telecoms networks.

In total, the German Government has provided €12bn to subsidise fibre connections. In April 2021, funding was expanded to cover also the grey NGA areas. Apart from fibre access for households, the programme aims at the expansion of gigabit connectivity for socioeconomic drivers such as businesses, hospitals, administrative services, transport hubs and schools.<sup>11</sup>

The 2022 Gigabit Strategy foresees measures that will simplify, speed up and digitise permit granting, strengthen the use of alternative deployment methods and provide more transparency and improved legal frameworks.

# Germany



## Investment & build

### Operator rollouts and capex

#### FTTH coverage is trailing many European peers

Operators in Germany have historically focused on upgrading copper and cable infrastructure, with VDSL and VDSL2 Vectoring network coverage rates some of the highest in the EU. However, fibre availability is currently far below the average for the bloc, potentially putting key digital targets at risk. While fibre deployments have started to progress (premises passed reached 8.9m in 2021, up from 3.7m in 2018), Germany's recent growth in gigabit access has been driven primarily by operators upgrading cable networks to DOCSIS 3.1.

#### Altnets trigger a response from the incumbent

With Deutsche Telekom preferring the use of copper in the last mile, most fibre deployments (and investments) have been undertaken by altnets such as Deutsche Glasfaser. In December 2021, the firm secured a further €5.75bn from investors to roll out fibre to four million households. In October 2020, O2-owned Telefónica and Allianz created the joint venture 'Unsere Grüne Glasfaser' to connect about 2.2m households with fibre, mainly in rural and semi-rural areas.

Such initiatives have required commensurate actions from the incumbent, which in February 2020 established a fibre JV with utility company EWE, targeting 1.5m premises. Then, in November 2021, Deutsche Telekom partnered with IFM Investors (as GlasfaserPlus GmbH) to roll out FTTH to four million households by 2028, predominantly targeting rural and subsidised areas. Deutsche Telekom claims that its "fibre optic engine is running" and that it is aiming to reach two-thirds of households in Germany by 2030.

#### Fixed network investment (€bn)



Source: BNetzA

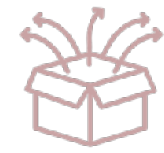
### Summary of build progress and sources of investment

Operator	Start of fibre investment	Build plans	Investment commitments	Source of funding	Progress to date	Geographic focus	Pace of rollout
1&1 Versatel	A focus of expanding the fibre network since 2015	Unknown. Will be supporting cities like Berlin in implementing its gigabit strategy	Acquired BT's fibre assets in four cities (part of an ongoing "fibre-optic offensive")	Internal	Coverage in around 300 cities	Urban areas, business parks	Rolled out in around 50 new cities over the past year
DT	Acceleration from 2017 (2022 with respect to GlasfaserPlus)	10m homes by 2024, 2.5m new homes every year after (not including JV footprints)	€30bn on fibre by 2030 (including GlasfaserPlus investments)	Internal, EIB loan, €900m from IMF Investors into GlasfaserPlus, other partnerships (e.g. Glasfaser Nordwest)	5.4m homes passed with FTTH (year-end 2022)	National	Over 2m new home passed with FTTH in 2022
O2	2021	2.2m homes	€5bn over six years (with Allianz)	Internal, debt, €1bn from Allianz	Unknown. Rollout focused on smaller communities with up to 10,000 households	Rural areas	Unknown
Vodafone	2023	7m homes with Altice, 150,000 homes with ruhrfibre	€7bn over six years (with Altice)	Internal, debt, €1.2bn from Altice	Fibre JV will be 80% focused around large housing associations and will support ongoing cable network upgrades	Existing Vodafone footprint	JV with Altice will connect over 1m homes with FTTH each year

Source: Assembly



# Germany



## Product portfolio

### Propositions in the market

#### Germany's four largest operators all offer fibre services

Through individual or joint FTTH deployments, or wholesale agreements, Germany's four largest telcos all offer fibre services to consumers at the retail level, as well as to business customers (e.g. 1&1's 'Glasfaser Connect' and 'Glasfaser Premium'). O2 and Vodafone also offer broadband via cable networks, which are being upgraded to DOCSIS 3.1 technology.

Deutsche Telekom and Vodafone (plus others such as Deutsche Glasfaser) wholesale access to their networks, which has enabled O2's entry into the fixed broadband market. Since the end of 2020, O2 has been offering retail broadband services via a wholesale agreement with Vodafone. This cooperation was extended in April 2022 to allow O2 to market 1Gbps services. O2 has also signed agreements to access Deutsche Telekom's FTTH network for 10 years and Tele Columbus's cable and fibre networks.

### Market overview

Operator	Technologies	Speeds	Wholesale offering
1&1	DSL, FTTH	Up to 1Gbps	No
DT	DSL, FTTH	Up to 1Gbps	Yes
O2	Cable, DSL, FTTH	Up to 1Gbps	No
Vodafone	Cable, DSL, FTTH	Up to 1Gbps	Yes

Source: Assembly

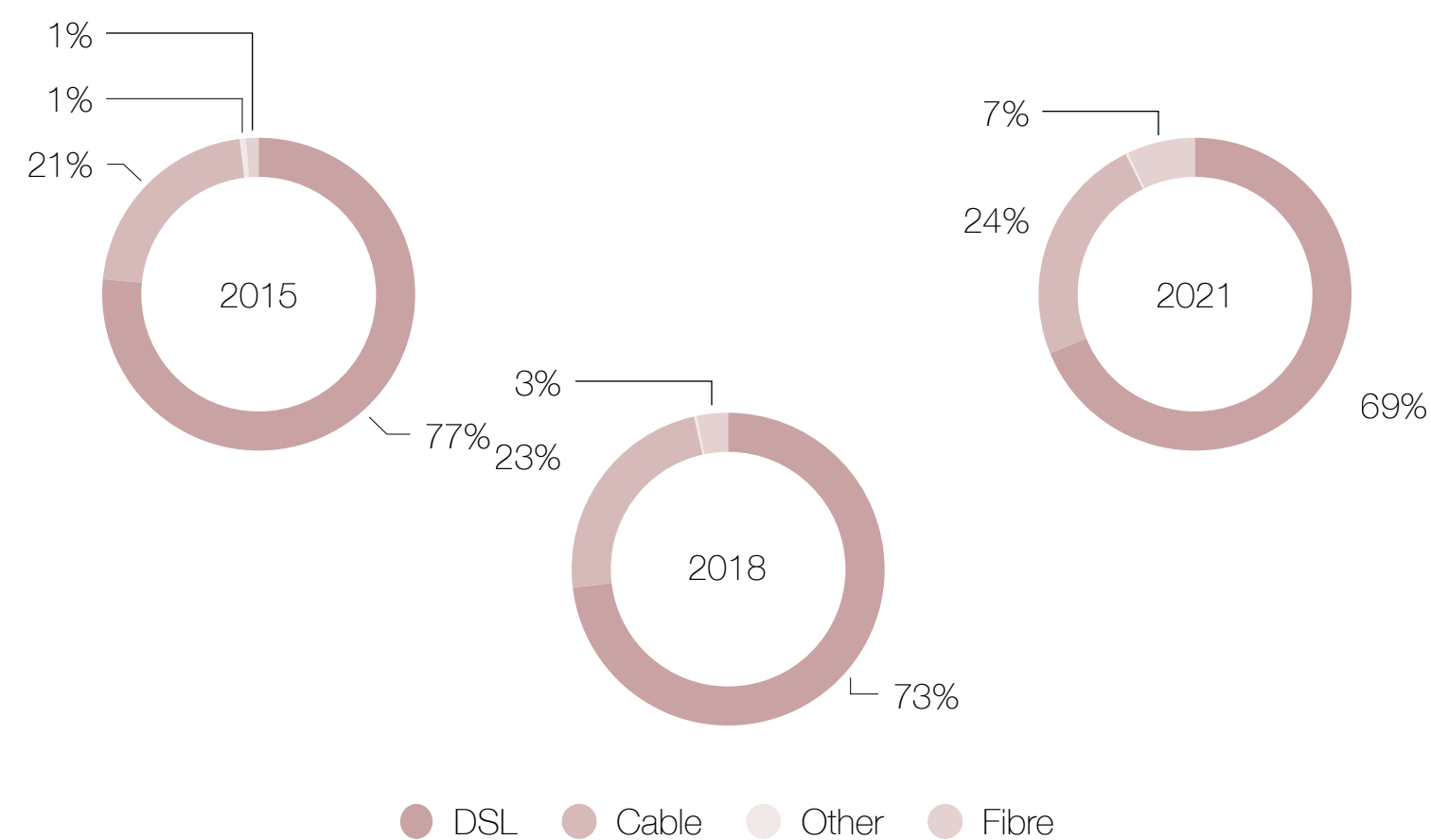
### Technologies

#### DSL remains Germany's dominant broadband technology

Operators continue to offer broadband via DSL, which is marketed prominently on their websites (alongside fibre and/or cable). DSL-based services tend to offer speeds of up to 250Mbps, which is considerably higher than can be found in some other countries, e.g. Spain, given the use of Vectoring technology by telcos in Germany.

As a result, DSL is still the country's leading broadband technology. Although DSL's share of total connections has declined over the past decade, adoption has only recently dropped below 70%. Cable has steadily grown its share of fixed broadband subscribers, while fibre adoption languishes in third place (with growth potentially affected by its low availability).

#### Technology mix (% of subscriptions)



Source: BNetzA

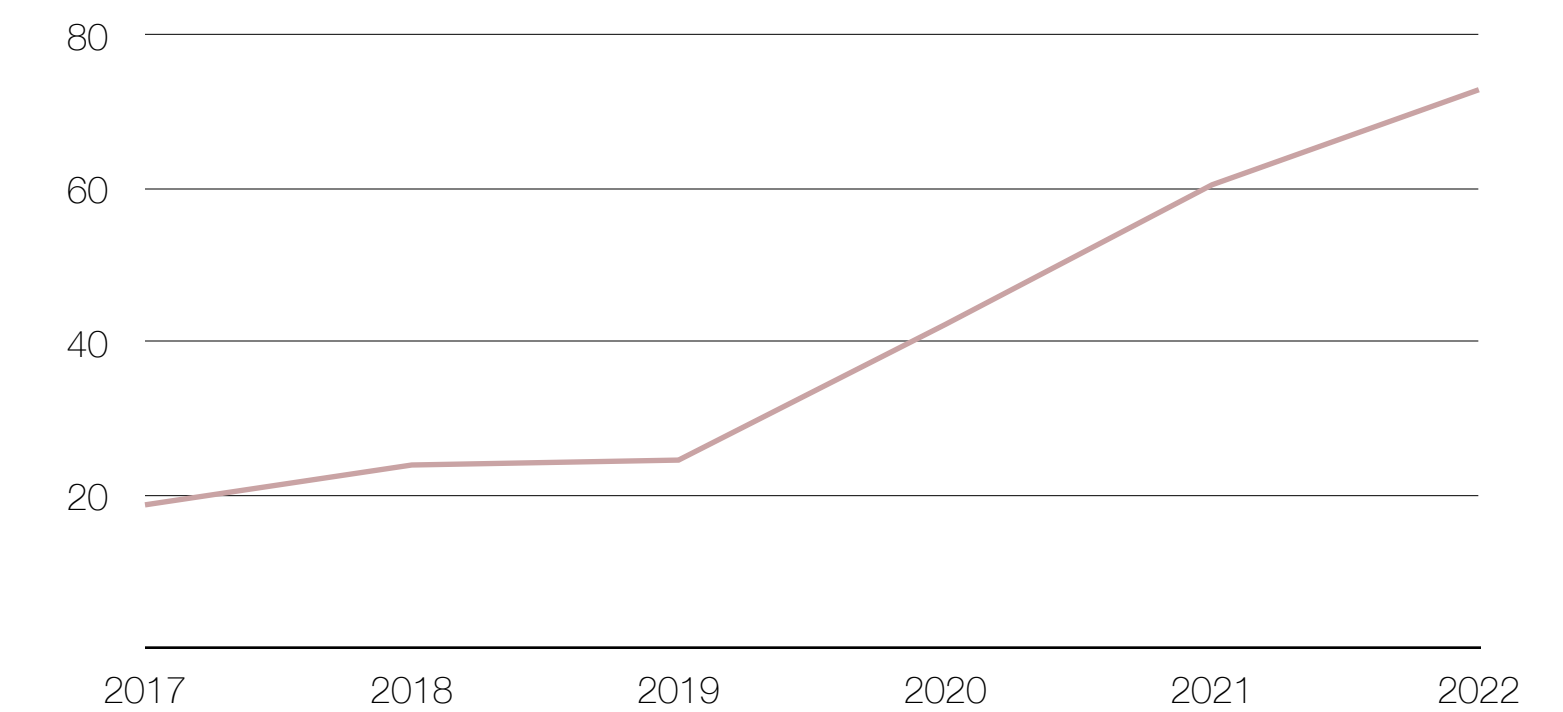
### Speeds

#### Download speeds have trebled since 2019

Despite DSL's continued presence in the market, the availability and adoption of faster and more reliable services via cable or fibre are gradually increasing. All four operators now offer gigabit-capable broadband at the retail level, with Deutsche Telekom the first to do so in 2018.

Nevertheless, Germany is ranked 33rd for mean download speeds globally, and 21st in Europe. Broadband speeds remained largely flat between 2017-2019, allowing several other countries to overtake in the rankings. However, speeds have grown almost three-fold since, increasing from 25Mbps on average in 2019 to 73Mbps in 2022.

#### Mean download speeds (Mbps)



Source: Cable/M-Lab

# Germany



## Consumer value

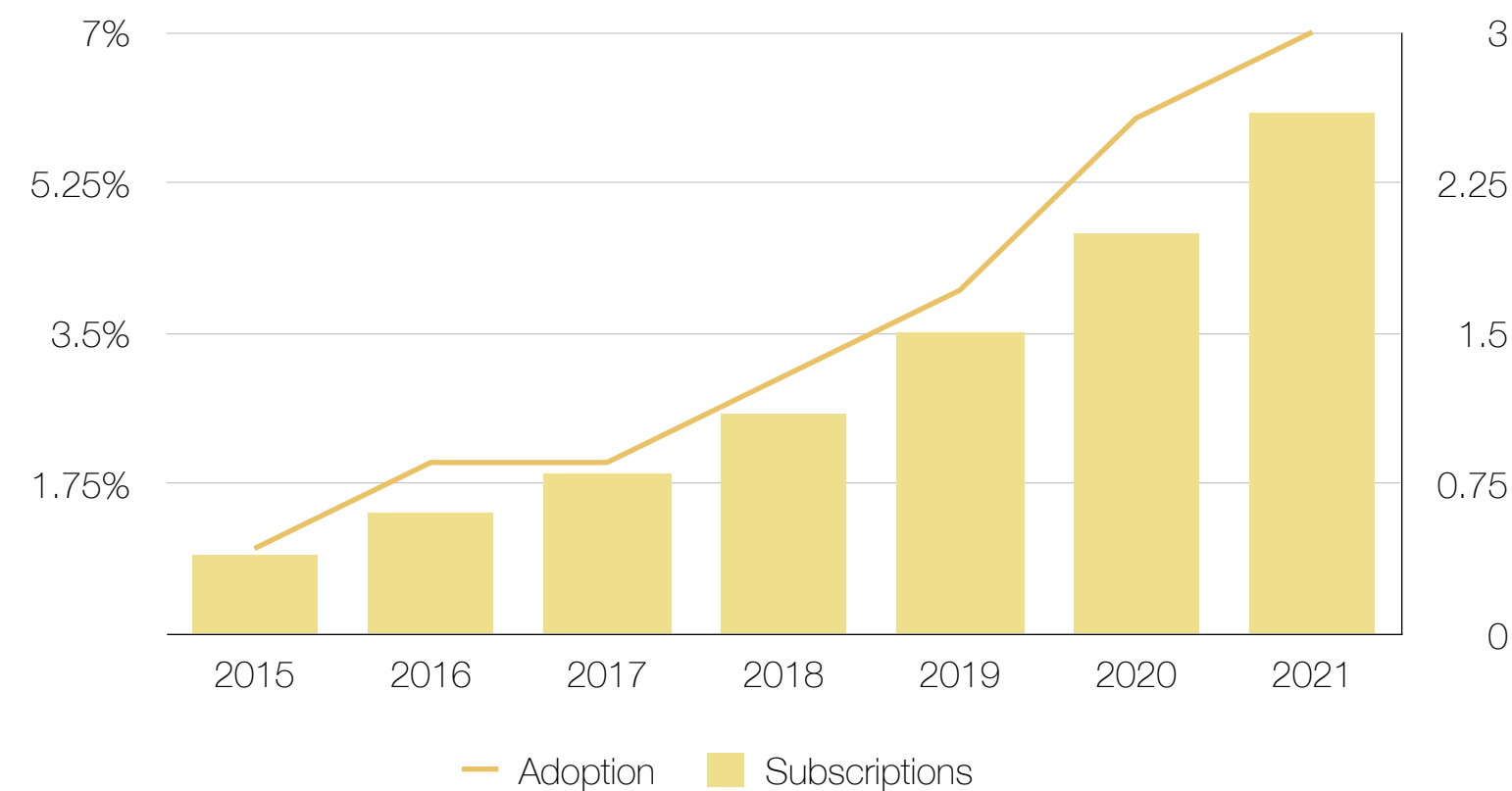
### Adoption

#### Fibre adoption has yet to hit the 10% mark

The number of active fibre connections in Germany reached 2.6m at the end of 2021, 600,000 more than the previous year. This was equivalent to a 7% adoption rate (i.e. share of total broadband subscriptions). With the number of premises passed by fibre networks rising 8.9m (an increase of 2.2m on 2020), BNetzA estimates a penetration rate of almost 30%.

According to the regulator, demand for fibre is building and is driving the growth in overall broadband connections. BNetzA expects fibre's share of total broadband connections to grow sharply in the coming years; however, with Germany already exhibiting a wide gap between NGA coverage and take-up, relatively high prices for fibre services and price sensitivity among consumers could present challenges to a rapid growth in adoption.

**Fibre adoption**  
(Subscriptions (m), % of subscriptions)



Source: BNetzA

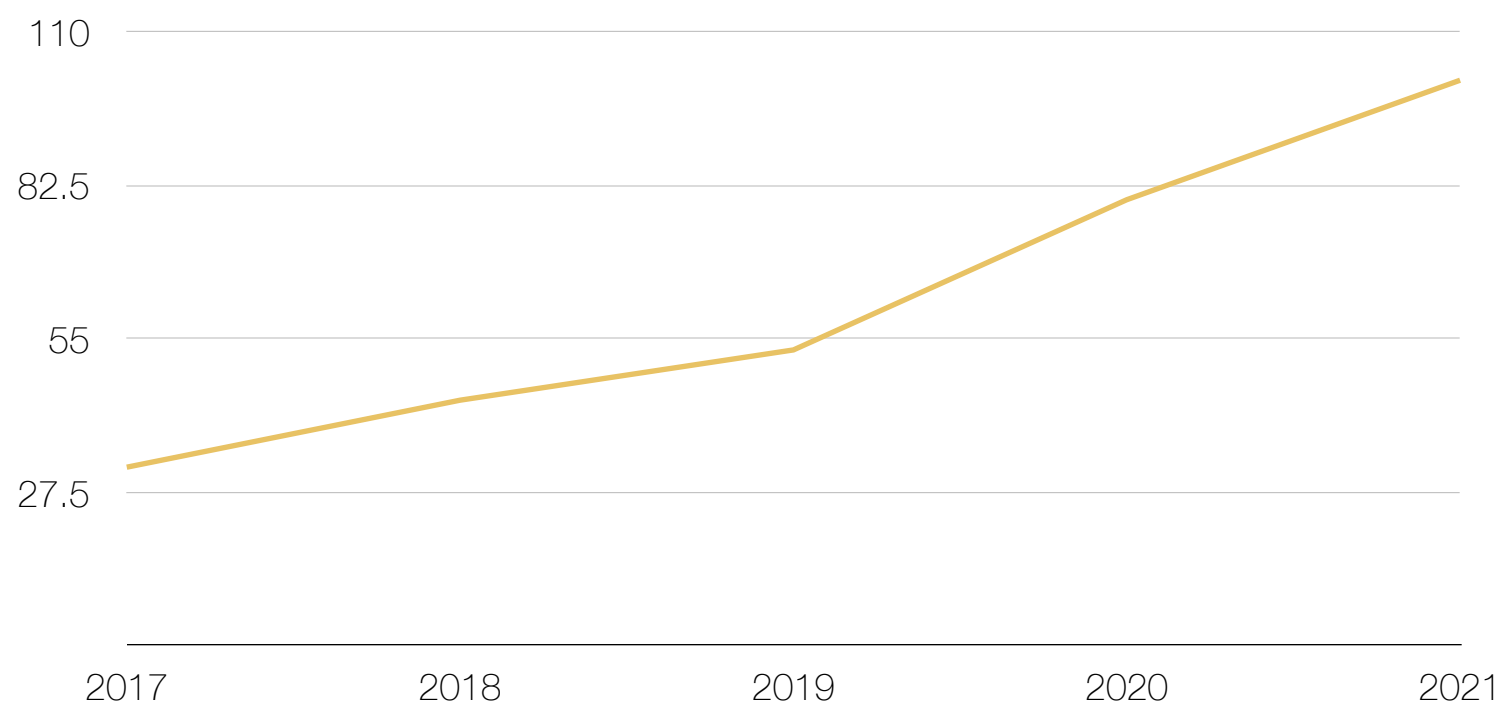
### Usage

#### COVID-19 accelerated data consumption and digitisation

While fibre coverage and adoption rates are not as high as many other European countries, Germany does still report greater fixed data usage than the likes of Portugal and Spain. Monthly data consumption per capita had been growing consistently before the pandemic but, like most markets, saw an uptick once mobility restrictions were implemented in early 2020. Network performance saw a slight degradation as a result of these measures.<sup>12</sup>

Unlike peers such as France, the pace of growth in data consumption did not seem to tail off, largely continuing through 2021. Fixed data usage per capita has now reached 101GB per month – a 217% increase since 2017 (when usage was 32GB).

**Fixed data usage**  
(GB/capita/month)



Source: Ofcom

### Overall value

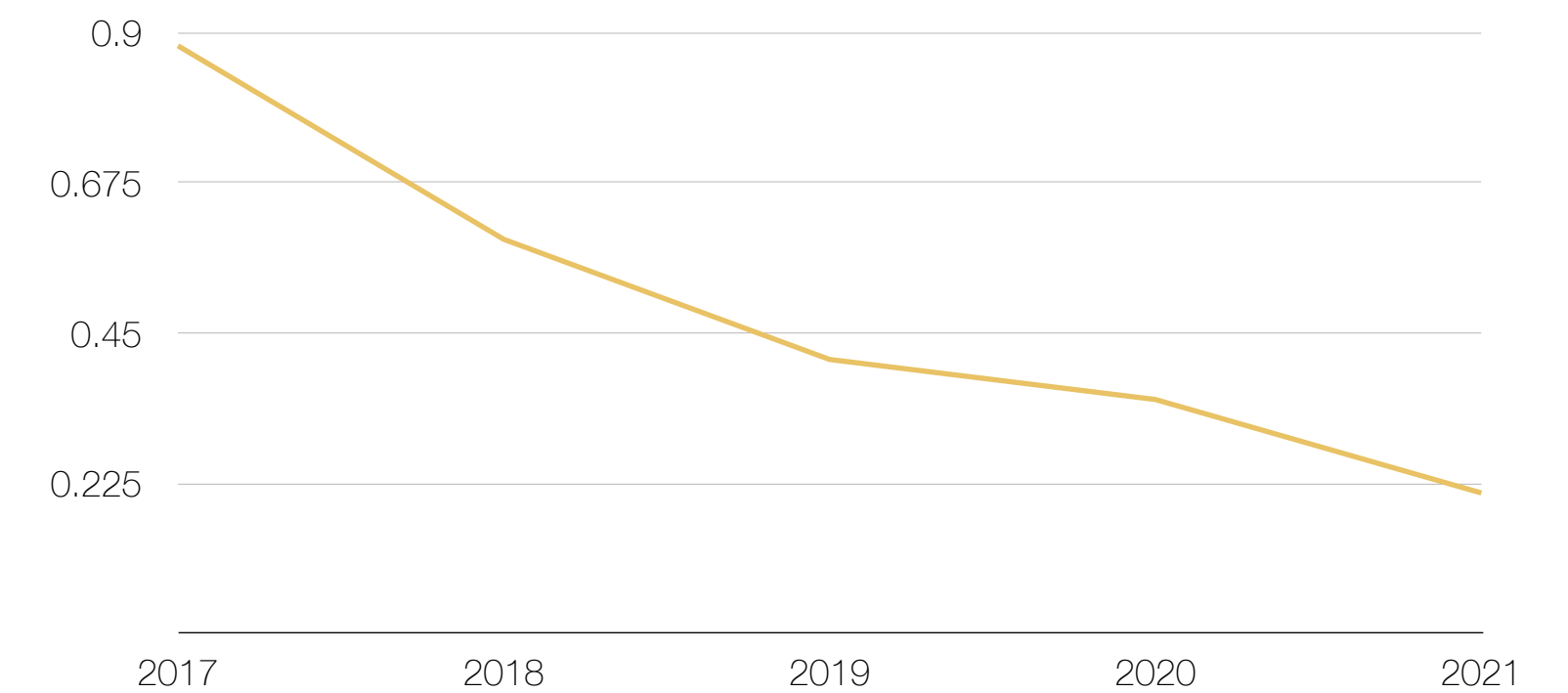
#### Good value for money despite speeds not being the fastest

The average price of standalone fixed broadband services above 30Mbps has declined by nearly 25% between 2017-2021. Though there was a degree of fluctuation during that time, broadband prices in Germany have tended to be relatively competitive compared to those in other European markets.

When prices are considered relative to data consumption there is a fairly consistent downward trend, with Germany offering some of the best fixed broadband value for money in the European countries studied, after France.

A similar downward trend is visible when prices are considered relative to download speeds. While Germany is not a leading market in terms of speed, consumers have seen a steady drop in price per Mbps, currently paying less than their counterparts in Portugal.

**Fixed broadband value**  
(€/capita/month)



Source: Assembly, EC, Ofcom

# Germany



## Societal benefits

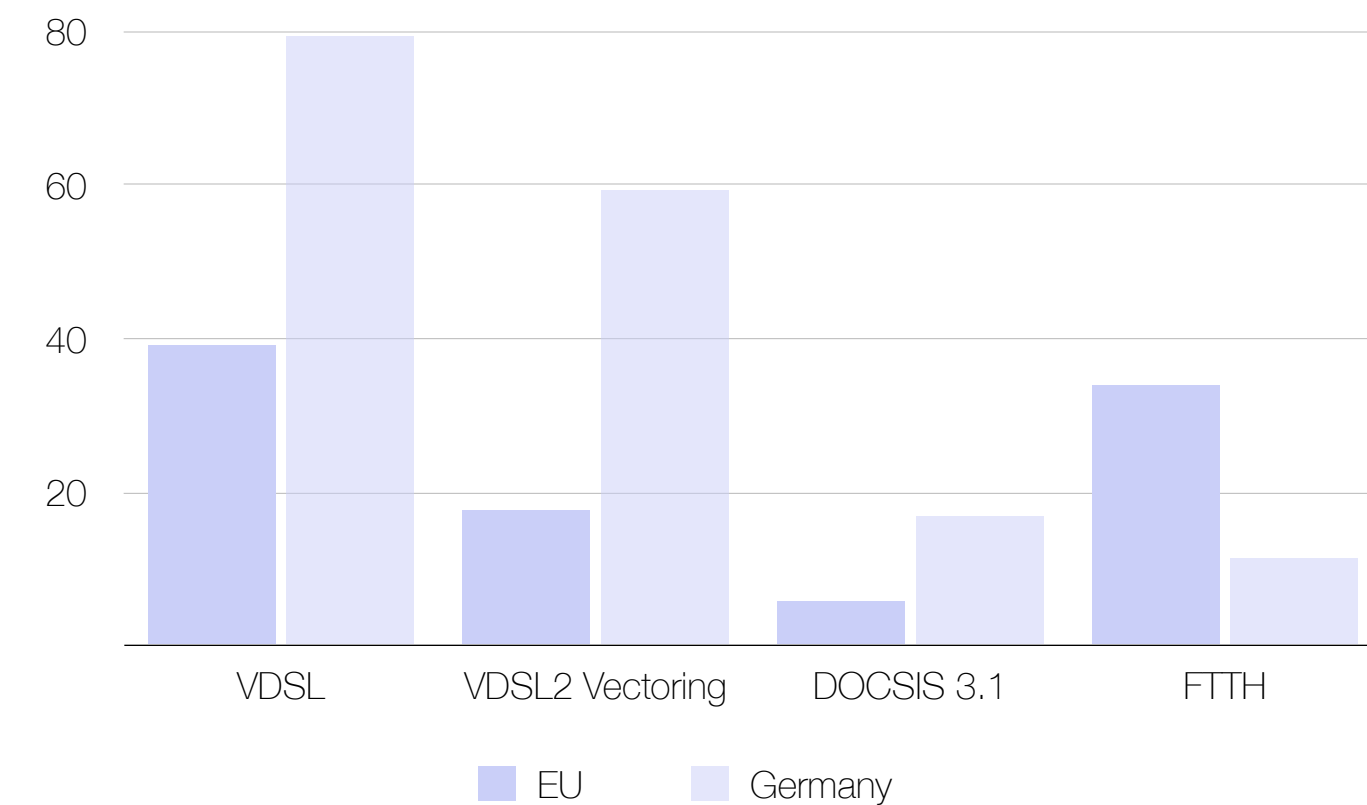
### Rural coverage

#### A preference for sweating copper assets

In Germany's rural areas, DSL remains the most prevalent fixed broadband technology, with almost four in five households having access to VDSL networks (more than double the EU average). Operators have also continued to upgrade to VDSL2 using Vectoring technology, which is available to close to 60% of rural households (nearly 3.5x the EU average).

While operators have begun to upgrade large parts of their cable networks in rural regions to DOCSIS 3.1, only recently have they started diverting investments towards more advanced technologies (i.e. fibre) in order to meet national and EU connectivity targets. As a result, fibre access for rural households is low and significantly below the EU average (33.8%), with more densely populated parts not faring much better.

Coverage by technology, rural areas (Households, %)



Source: EC

### Operators' rural rollouts

#### Fibre networks are yet to reach more rural areas

The decision to upgrade legacy copper networks using Vectoring has enabled telcos in Germany to provide higher-capacity bandwidth services with download speeds in excess of 100Mbps. Rural next-generation access (NGA) coverage – i.e. broadband networks supporting speeds of 30Mbps+ – therefore sits comfortably above the EU average.

However, and despite ongoing cable upgrades, fibre deployments are at a nascent stage, meaning that very high capacity networks (VHCNs) are yet to reach a quarter of rural premises in Germany. FTTH will be vital to meeting the EU's 'gigabit for everyone' by 2030 goal, but operators have only recently stepped up their efforts to connect rural areas, with dense urban centres the initial rollout priority.

“

Telefónica and Allianz will create an independent open-access wholesale operator focused on deploying fibre in rural and semi-rural areas all over Germany to tap the potential of Europe's largest broadband market

”

Telefónica, September 2022

“

By 2030, we want to build 8m fibre-optic connections in communities with fewer than 20,000 inhabitants

”

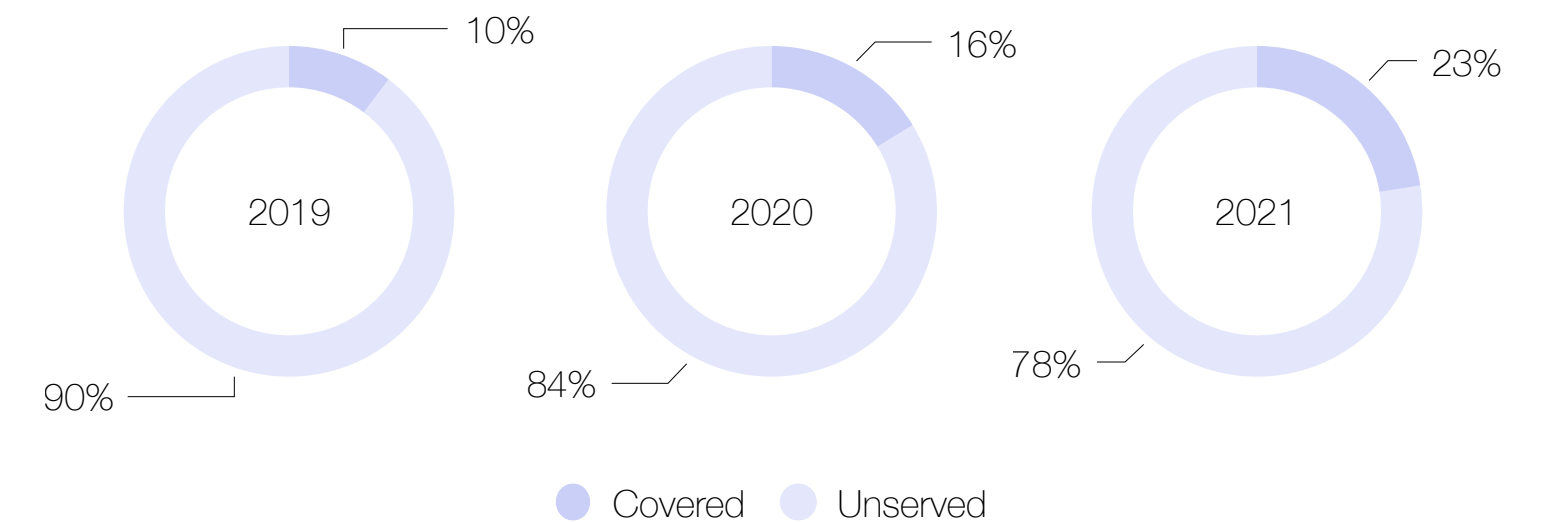
Deutsche Telekom, December 2021

### Digital inclusion

#### Less than 25% VHCN coverage in rural areas

With the majority of operators' DOCSIS 3.1 upgrades focused on urban areas, fibre coverage also remains limited to only 11.3% of rural households in Germany. Consequently, coverage of VHCNs in less dense areas is still well below the EU average.

Fibre and cable broadband coverage in rural areas (% of premises)



Source: EC

#### Altnets deliver wider socioeconomic benefits

Altnets in Germany are making positive contributions beyond the deployment of telecoms networks:

- As part of its corporate responsibility efforts, O2 cut CO2 emissions 77% year-on-year, raised its energy efficiency target and sought to promote internet safety for young people through the WAKE UP Now! programme.
- Following the damage and displacement caused by floods in Germany in 2021, Vodafone contributed €500,000 (matched by the Vodafone Group Foundation) in financial and humanitarian aid for victims.
- United Internet's 'Digital Guide – Ihr Ratgeber rund um Erfolg im Internet' was published in 2016 to provide freely accessible, internally-developed content on websites, hosting, online marketing and IT.



# Portugal

## Overview

Portugal is often considered a broadband leader within the EU, with infrastructure-based competition resulting in the rollout of 9.6m fibre lines across the country. With cable networks upgraded to the DOCSIS 3.x standard and concurrent deployments of FTTH, it has one of the highest rates of adoption of 100Mbps+ broadband services in the bloc. While fibre coverage is greatest in densely populated cities, a key priority now is driving continued investment in rural areas (typically away from the coast), where fibre access and demand are growing but have not been quite as strong.

**5.9m**

Households now able to access FTTH services, equal to over 91% of total households

**63%**

The FTTH adoption rate (as a share of total broadband connections), an increase from 15% in Q3 2012

**76%**

Premises in rural areas that have access to next-generation access broadband via fibre or cable, or both



### Policy environment

- Portugal's national broadband plan, last updated in 2021, has three key pillars and focuses on the development of digital infrastructure to help citizens to take advantage of the opportunities offered by technology.
- Key features of the regulatory framework have been duct access obligations, the creation of a central online database of ducts and other infrastructure, and mandatory fibre access in new buildings.
- ANACOM has approved a reduction in the monthly fees applied in MEO's Reference Duct Access Offer (RDAO) by 35% and in the Reference Poles Access Offer (RPAO) by 20% to ensure cost orientation.



### Investment & build

- 9.6m FTTH lines have now been deployed in Portugal (up from 2.2m a decade ago), while over 91% of households are connected to fibre by at least one operator.
- The growth in fibre deployments has been underpinned by significant telecoms industry capex, which reached €874m in 2021 (up from €648m in 2017).
- Vodafone has invested heavily in deploying its own fibre network, accelerating plans from 2013 to compete with MEO (formerly PT), and signed a network sharing agreement with NOS.



### Product portfolio

- Portugal's four largest telcos all offer fibre services at the retail level, while both NOS and NOWO also offer broadband via their cable networks, which use DOCSIS 3.x technology.
- Fibre became Portugal's leading broadband technology as early as Q1 2017 and currently accounts for 68% of connections above 100Mbps, with cable accounting for a further 30%.
- Average broadband speeds remained largely flat between 2017-2019, but have since surged, increasing from 23Mbps in 2019 to 92Mbps in 2022 – equivalent to a 303% rise.



### Consumer value

- Total FTTH subscriptions in Portugal have reached 2.8m, equivalent to a 63% adoption rate (which has increased by close to 50 percentage points since 2012).
- Fixed data consumption in Portugal was already growing before the start of the pandemic, driven by the launch and rising popularity of new digital services, but it has hit historic highs (rising by almost 75% in 2020).
- Considering the price of broadband services relative to fixed data consumption shows a downward trend as consumers have got more for their money, particularly so in 2018 and then in 2020 due to the impacts of COVID-19.



### Societal benefits

- High-speed broadband coverage continues to increase across Portugal, with over 6m households connected to a fibre and/or a cable network as of Q3 2022 – a 2.6% increase year-on-year.
- Fibre is driving the availability of high-speed connectivity in less dense regions, with 76% of rural premises now able to access FTTH or cable services (up from 64% in 2015).
- Altnets are making positive contributions beyond infrastructure deployments, for instance supporting sustainability initiatives and helping to boost digital skills among young people.

**142%**

Increase in fibre coverage since 2015

**35%**

Growth in annual telecoms sector investment since 2017

**322%**

Rise in download speeds over the 2017-2021 period

**78%**

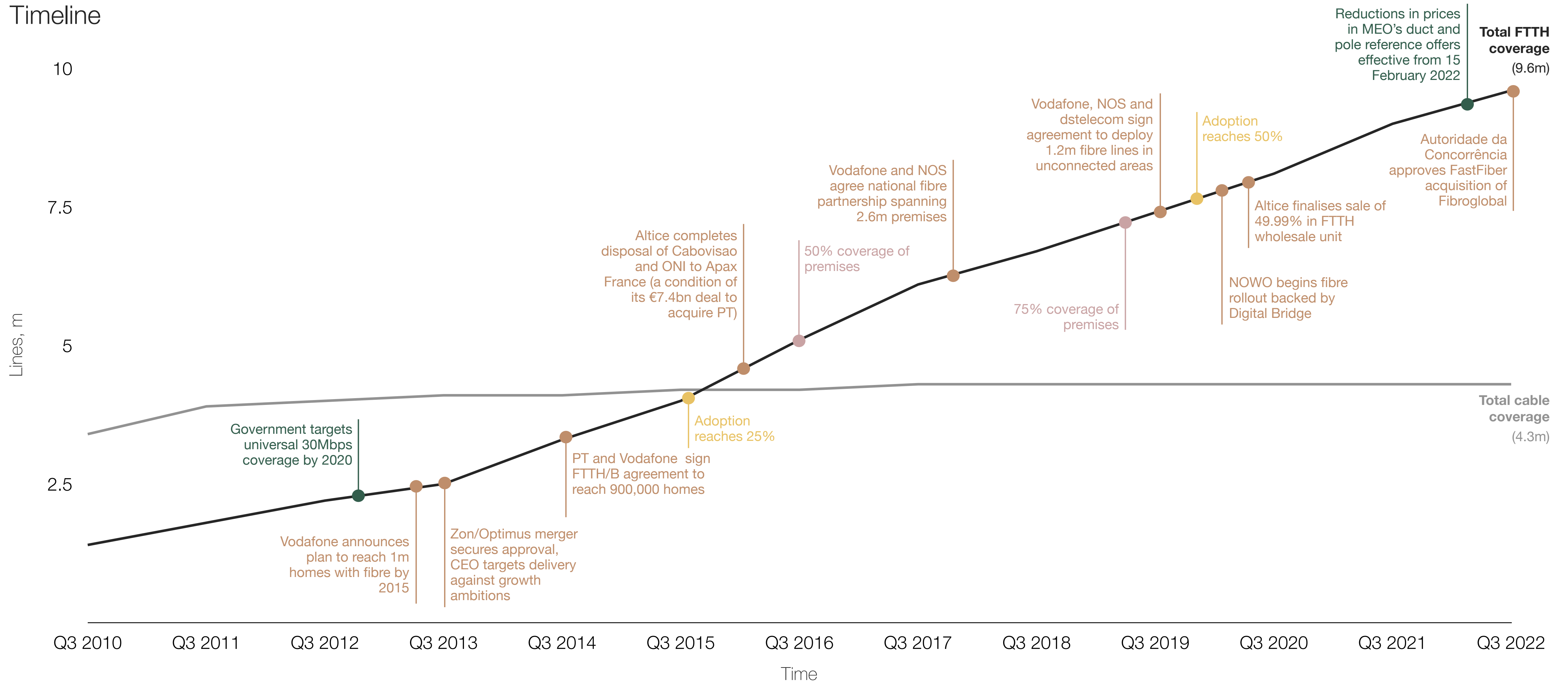
Improvement in fixed broadband value since 2017

**27%**

Reduction in the size of the digital divide since 2018

# Portugal

## Timeline



# Portugal



## Policy environment

### Government broadband strategy

#### The national broadband plan has not defined coverage targets

The Agenda Portugal Digital was approved in December 2012, aligning with the priorities of the Digital Agenda for Europe and the Europe 2020 strategy, including access to broadband and the digital market, and improving digital literacy, skills and inclusion. It targeted 30Mbps broadband for all and 50% 100Mbps coverage by 2020.

The plan was updated in April 2015 to reinforce alignment with EU initiatives and most recently in 2021. The Agenda Portugal Digital – Portugal’s Action Plan for Digital Transition currently aims to support the development of digital infrastructure that allows citizens to take advantage of the new opportunities offered by technologies. The Secretary of State for digitalisation and administrative modernisation is responsible for digitalisation issues, while the Ministry of Infrastructure and Housing defines broadband policy and the political framework of the national broadband strategy.

Portugal’s broadband plan comprises three main pillars of action:

1. Capacity building and digital inclusion;
2. Businesses’ digital transformation; and
3. Public services’ digitalisation.

The plan also features a ‘catalyst dimension’, with connectivity and infrastructure mentioned as one of the catalysts. However, it does not set any more concrete aims related to broadband infrastructure and therefore does not align with the EC’s 2016 Connectivity for a European Gigabit Society strategy.

#### Fibre rollouts have benefited from government funds

In 2009, Portugal ran public competitions to award subsidies intended to spur investment in open access networks in rural areas. Though the contests were technologically neutral, only FTT-based proposals were presented. The government also created a €800m credit line to support telcos’ fibre rollouts in the wake of the global financial crisis. Large-scale public funding for broadband deployment ended several years ago, with the country since relying on a market-driven approach.

### Approach to wholesale pricing

#### Regulation has championed market-driven deployments

ANACOM has several responsibilities relating to broadband, including the promotion of competition, transparency and further development of telecoms networks and markets.

A key tenet of the regulatory framework has been the facilitation of market-based solutions through duct access obligations. In 2009, legislation required: public entities provide to operators access to ducts (and other infrastructure apt to carry fibre); the creation of a central online database of ducts and other infrastructure; a framework of rules for the construction of ducts and other infrastructure; and fibre access in new (mandatory) and old buildings. These measures have helped kickstart operators’ fibre deployments, particularly in cities where there is a high volume of multi-dwelling units.

In 2016, ANACOM established the ‘Sistema de Informação Centralizado’ (CIS), a central information system for broadband infrastructure mapping. The CIS aims to avoid inefficient duplication and inconvenience caused to citizens and businesses by frequent and extensive underground work. ANACOM has also permitted operators to jointly build out networks and determine agreements to reciprocally use their respective fibre infrastructure – NOS and Vodafone’s agreements represent a case in point.

#### Wholesale prices are subject to cost orientation

The market has continued the deployment despite concerns about the lack of updated prices on regulated access to civil infrastructures, particularly to MEO’s ducts and poles. Regulated prices on access to ducts and poles date back to 2006 and 2010 respectively, to copper local loop to 2010, and to leased lines to 2012.<sup>13</sup>

In August 2022, ANACOM approved a decision to implement a reduction in the monthly fees applied in the Reference Duct Access Offer (RDAO) by 35% and in the Reference Poles Access Offer (RPAO) by 20%. The revisions were considered necessary to ensure cost orientation and justified given the margins reported over recent years.

### Latest wholesale broadband market review

#### Ducts and poles have been key to altnets’ fibre rollouts

On 8 November 2022, ANACOM approved the final decision on amendments to the RDAO and RPAO provided by MEO. These measures aim to encourage a faster and less burdensome installation of very high-capacity networks (VHCNs) by operators, facilitating the provision of broadband to end users.

According to ANACOM, the measures will improve competition in the market, namely by allowing greater speed and flexibility in network installation supported on MEO’s wholesale RDAO and RPAO offers, which have been fundamental means of promoting sustained competition in the Portuguese telecoms market. In adopting the final decision, ANACOM ordered MEO to amend the wholesale offers within 30 working days following notification.

“

**The RDAO and RPAO have been key instruments in... promoting investment in high-capacity networks by alternative operators to MEO**

”

#### Underserved areas are in line for public funding

In 2022, ANACOM launched public consultations on the deployment of VHCNs in ‘white areas’. With these identified, public funding (largely from the EU) will become available for network deployments.

Portugal’s roadmap to implement the EU’s Connectivity Toolbox foresees revising legislation to provide model regulations on electronic communications network deployment, launching a digital guide and new cooperation between the government, ANACOM and municipalities to harmonise permit-granting procedures. Portugal also plans to set up a permanent group for improving transparency through the single information point and the right of access to existing physical infrastructures.



# Portugal



## Investment & build

### Operator rollouts and capex

#### Telcos have continued to invest in fibre

At Q3 2022, 9.6m FTTH lines had been deployed in Portugal, up from 2.2m a decade ago. In absolute terms, the growth in new fibre lines was strongest during the 2015-2017 period. As more than one operator may roll out fibre to any given premises, ANACOM estimates that 5.9m individual households (or 91.1% of the total) are now able to access FTTH services.

Operators' investments have enabled more people to connect to high-speed networks, known as 'redes de alta velocidade' or 'RAV'. NOS increased its infrastructure capex for three consecutive years after its creation through the Optimus/Zon merger. On average, between 2016 and 2019, NOS's capex has been 38.8% higher than in 2015.<sup>14</sup> Together, telcos in Portugal invested €874m in their businesses in 2021, compared with €648m in 2017.

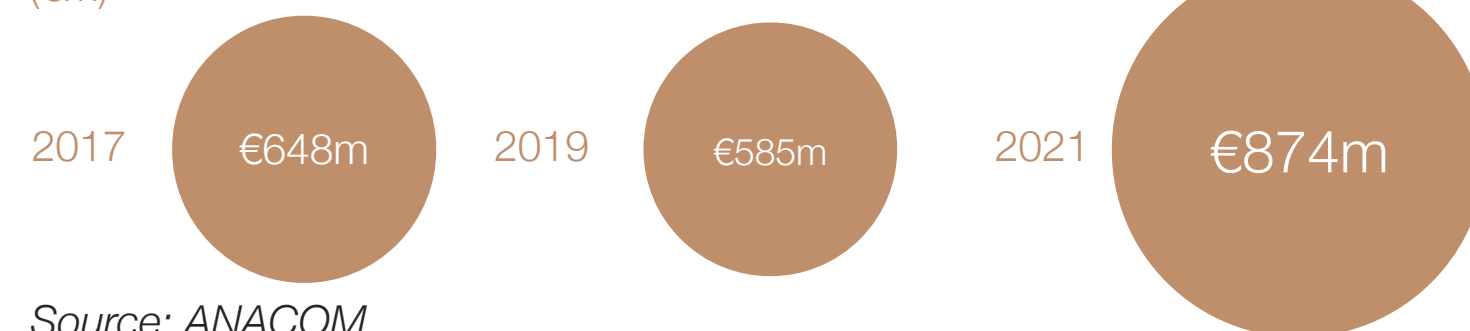
#### Portugal is home to multiple fibre builders

Since 2011, operators in Portugal have all but ceased new cable deployments. While network upgrades have taken place, attention (and investment) has pivoted to FTTH. Altice-owned MEO (formerly PT) operates the largest fibre network in the country, which was boosted in 2022 by the acquisition of Fibroglobal via its FastFiber subsidiary.

Vodafone has also invested heavily in deploying its own fibre network, accelerating plans from 2013 to compete with PT. It later acquired assets from NOS and struck a network sharing agreement with NOS in 2017. NOWO's fibre rollout is at a less advanced stage, although its network still passes around 1m homes.

#### Telecoms industry investment

(€m)



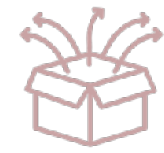
Source: ANACOM

### Summary of build progress and sources of investment

Operator	Start of fibre investment	Build plans	Investment commitments	Source of funding	Progress to date	Geographic focus	Pace of rollout
MEO	2008 (as PT)	Nationwide coverage	€150m for initial fibre build, Fibroglobal acquisition, €3bn invested since 2015	Internal, sale of 49.99% stake in wholesale business for €1.57bn	6.1m premises passed with FTTH (Q1 2022)	National	400,000 new homes connected (Q1 2021-Q1 2022)
NOS	2009 (as Optimus, via JV with Vodafone)	Individual rollout, plus around 3.8m premises through partnerships	€406m in 'telco' investment in 2021	Internal, partnerships (e.g. with dstelecom and Vodafone)	5.2m premises passed (Q3 2022). 2.1m with cable, 3.1m with FTTH	National	600,000 new homes connected (Q3 2021-Q3 2022)
NOWO	Unknown	3.5m homes (with Digital Bridge), eventually becoming nationwide	€30m for network upgrades announced in 2016 following rebrand from Cabovisão	Internal, supported by €500m from Digital Bridge	Around 1m homes covered	National	Unknown
Vodafone	2009 (via JV with Optimus)	Individual rollout, plus around 4.7m premises through partnerships	€125m announced in 2015, acquisition of Optimus assets, €232m invested in Portugal in 2021	Internal, partnerships (e.g. with PT, dstelecom and NOS)	4.2m premises passed with FTTH (Q2 2022)	National	200,000 new homes connected (Q2 2021-Q2 2022)

Source: Assembly

# Portugal



## Product portfolio

### Propositions in the market

#### Portugal's four largest operators all offer fibre services

Whether through individual or joint FTTH deployments, reciprocal access arrangements or wholesale agreements, Portugal's four largest telcos all offer fibre services to consumers at the retail level, as well as to business customers (e.g. Vodafone's 'Pro' and 'Pro +'). Both NOS and NOWO also offer broadband via their cable networks, which use DOCSIS 3.x technology.

MEO, NOS and Vodafone all currently offer broadband access at the wholesale level. MEO has had a commercial wholesale fibre product in place since March 2016. Its owner Altice created a separate wholesale unit comprising all of MEO's fibre assets (including FTTH and dark fibre), of which it sold 49.99% to Morgan Stanley Infrastructure Partners for over €1.57bn. Once the transaction closed in April 2020, Altice Portugal FTTH was renamed Fastfiber. Altice stated that Fastfiber would sell wholesale services to all operators on the same financial terms.

### Market overview

Operator	Technologies	Speeds	Wholesale offering
MEO	DSL, FTTH	Up to 1Gbps	Yes (via Fastfiber)
NOS	Cable, FTTH	Up to 1Gbps	Yes
NOWO	Cable, FTTH	Up to 1Gbps	No
Vodafone	FTTH	Up to 1Gbps	Yes

Source: Assembly

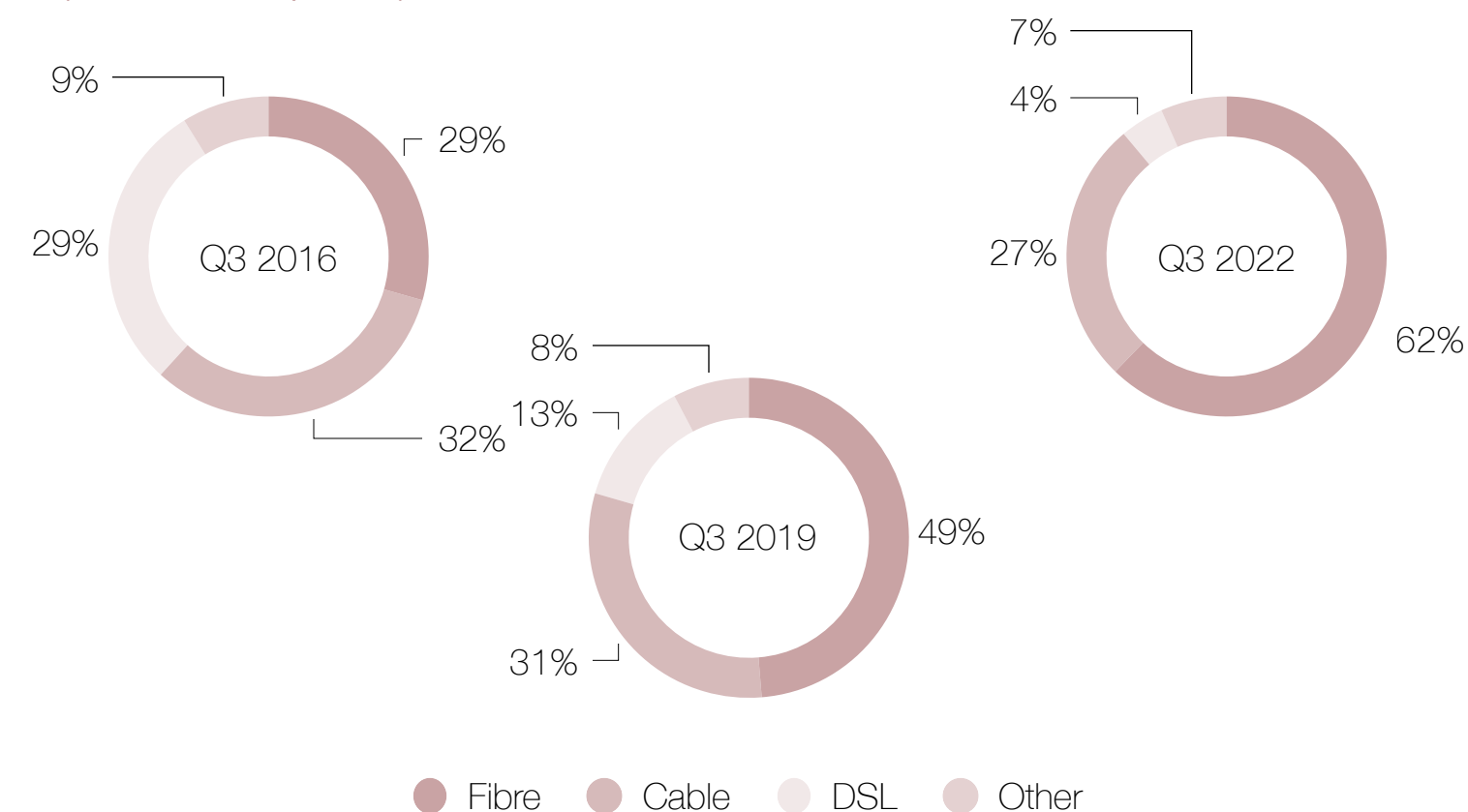
### Technologies

#### FTTH is the main form of broadband access

Operators continue to offer broadband via DSL, although it was replaced by cable as Portugal's leading fixed technology by the end of 2015. However, this reign was short-lived, with the number of fibre connections overtaking that of cable in early 2017. Since then, the broadband market shares of cable and DSL have continued to wane, falling to 27% and 4%, respectively.

Meanwhile, the FTTH take-up rate reached 50% by the end of 2019 and is now approaching the two-thirds mark. Fibre accounts for an even greater share of broadband connections above 100Mbps (68%), with cable accounting for a further 30%.

#### Technology mix (% of subscriptions)



Source: ANACOM

### Speeds

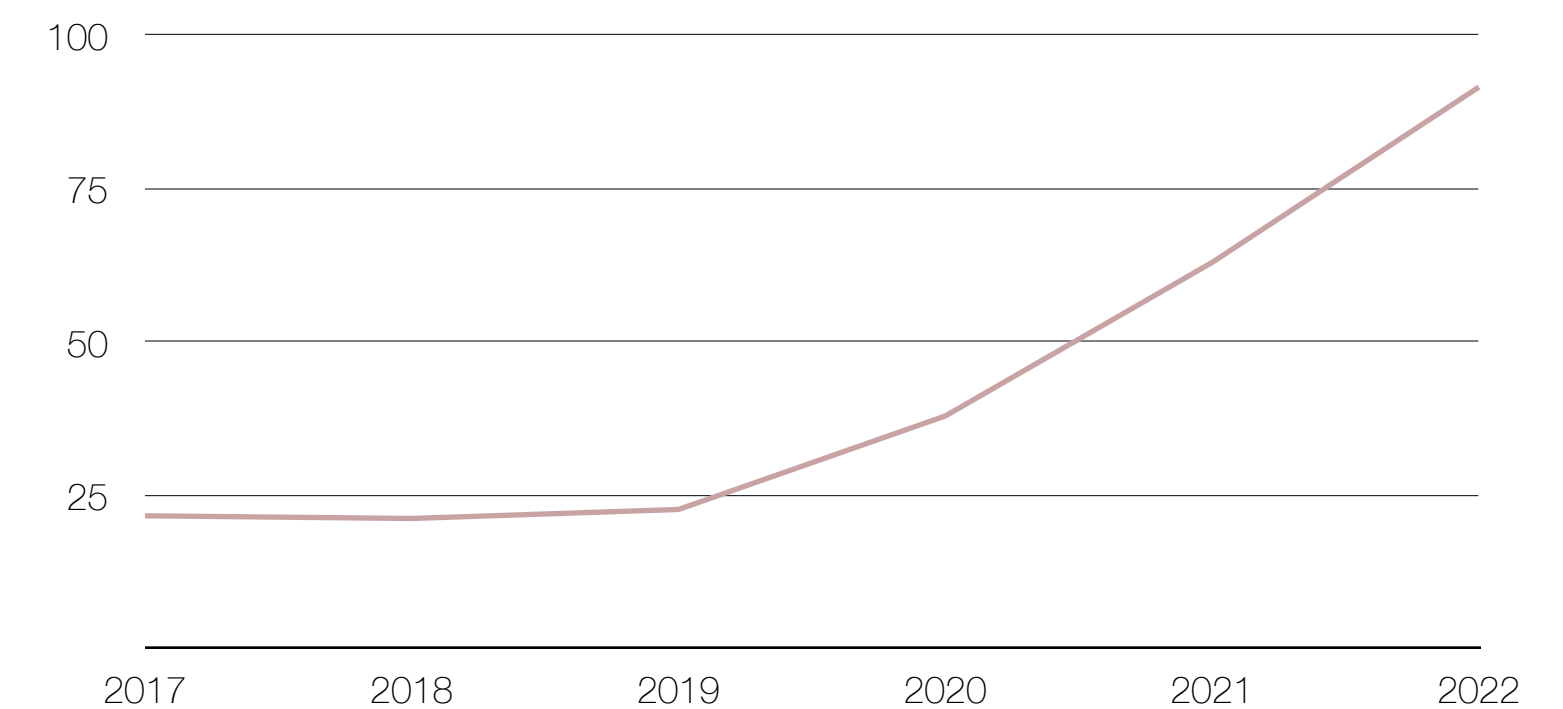
#### Speeds have taken off since 2020

The increase in the proportion of ultrafast broadband connections has occurred simultaneously with the development of FTTH and the introduction of DOCSIS 3.x into cable TV networks. As a result, all four operators now offer gigabit services at the retail level. Vodafone launched a triple-play offer featuring FTTH in 2013, while MEO introduced its 1Gbps plan in September 2016, superseding its 400Mbps proposition.

Portugal is now in the top 25 countries globally for mean download speeds, and top 15 in Europe. Broadband speeds remained largely flat between 2017-2019, allowing a host of other countries to overtake in the rankings.

However, speeds have since surged, increasing from 23Mbps on average in 2019 to 92Mbps in 2022 – equivalent to a 303% rise.

#### Mean download speeds (Mbps)



Source: Cable/M-Lab

# Portugal



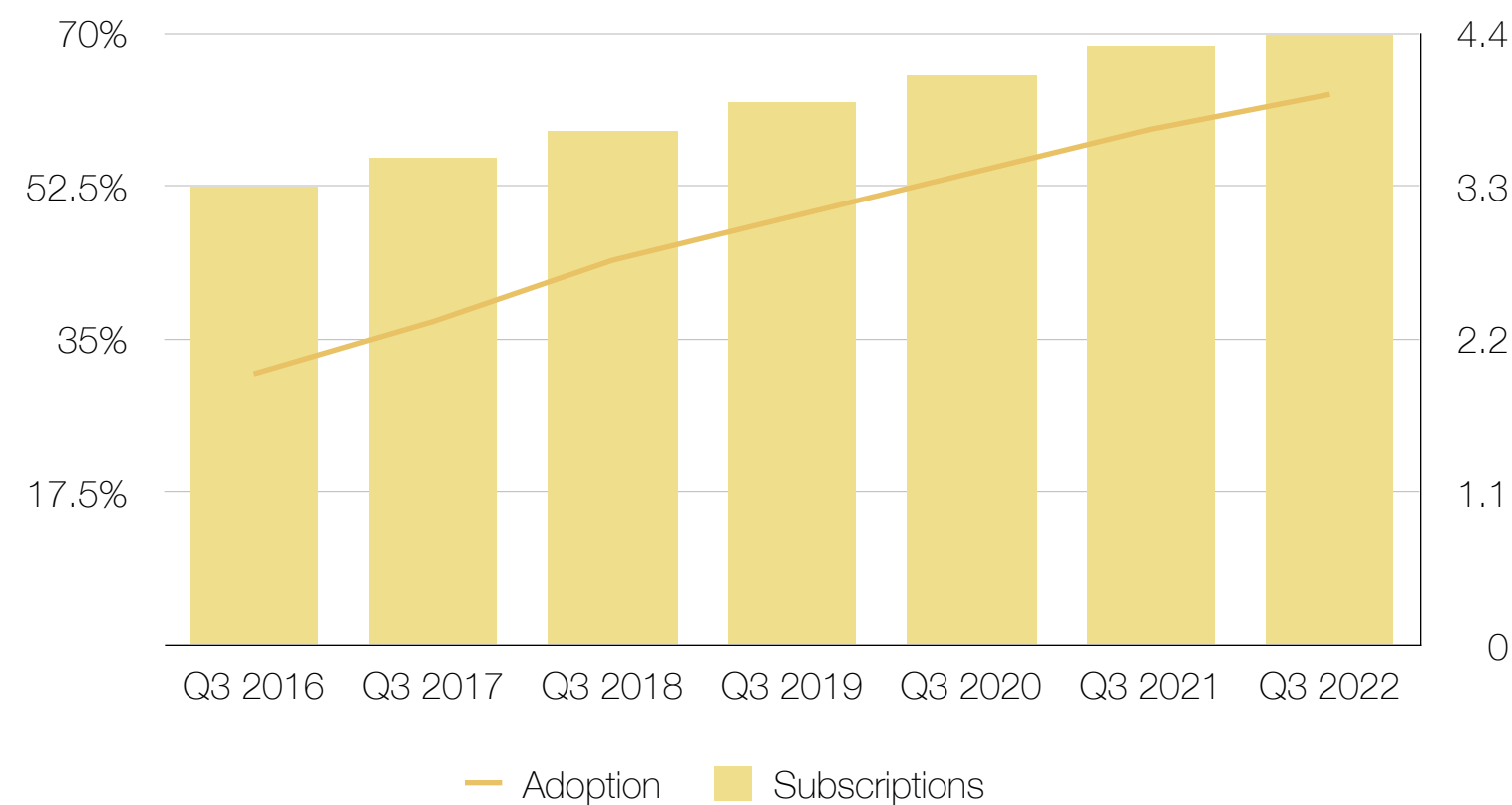
## Adoption

### Consistent growth in fibre adoption

By Q3 2022, total FTTH subscriptions in Portugal reached 2.8m, equivalent to 63% of total subscriptions (i.e. 63% adoption). A decade earlier, fibre connections stood at just 337,000 – an adoption rate of less than 15%. Take-up has therefore increased by close to 50 percentage points since 2012, on average growing at almost 5% year-on-year during that period.

As a result, Portugal has the fourth highest proportion of connections with download speeds equal to or greater than 100Mbps in the EU. FTTH is also the main growth driver of new fixed broadband connections (as other technologies lose subscribers), and underpins 60% of residential pay TV subscriptions.<sup>15</sup>

**FTTH adoption**  
(Subscriptions (m), % of subscriptions)



Source: ANACOM

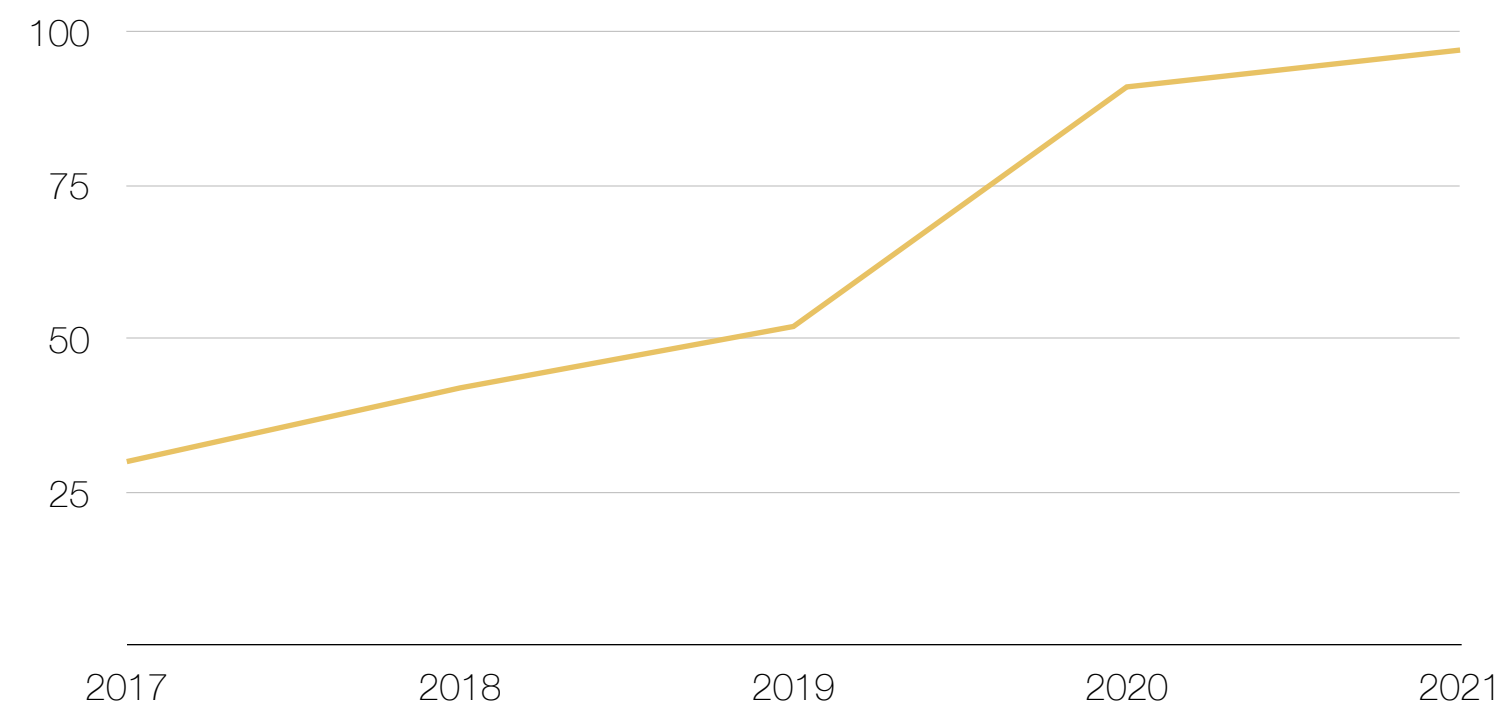
## Usage

### The pandemic saw fixed data traffic surge

Data consumption in Portugal was already growing before the start of the pandemic, driven by the launch and rising popularity of new digital services, such as video streaming applications, and greater intensity of internet use across the subscriber base.

However, the emergence of COVID-19 saw fixed data consumption hit historic highs (rising by almost 75% in 2020) as many people took to working or learning from home. Overall, fixed broadband usage per capita has more than trebled over the 2017-2021 period to reach 97GB per month.

**Fixed data usage**  
(GB/capita/month)



Source: Assembly, ANACOM, World Bank

## Overall value

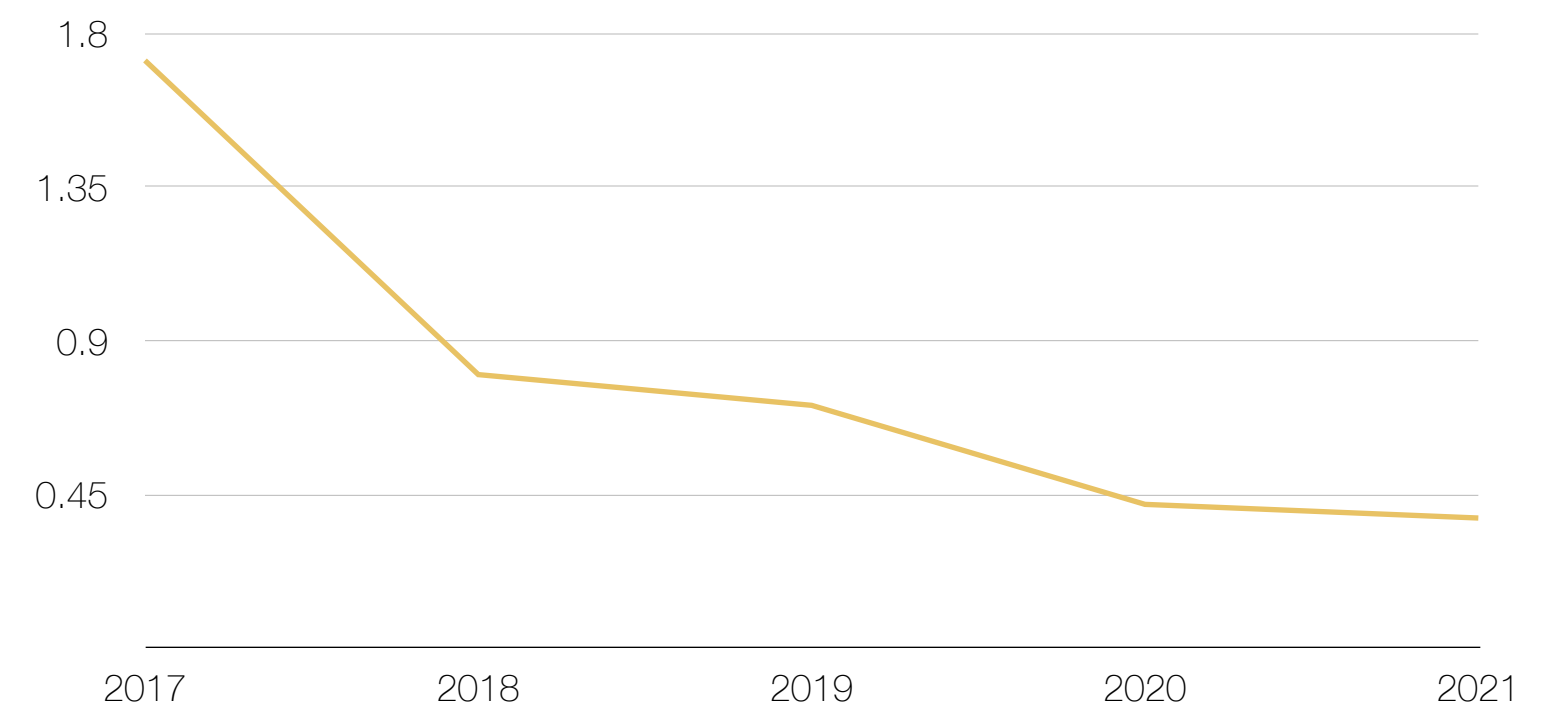
### Consumers are getting better value for money

In Portugal, the average price of standalone fixed broadband services above 30Mbps fell sharply in 2018, before stabilising in subsequent years. While prices tend to be higher than in some other southern European markets such as Italy, Malta and Spain (particularly at premium speed tiers), they declined overall during the 2017-2021 period.

When prices are considered relative to fixed data usage there is a downward trend over time as consumers have got more for their money, particularly so in 2018 and then in 2020 due to the impacts of COVID-19.

A downward trend is also visible when prices are considered relative to download speeds. In 2020 and 2021, consumers experienced a sharp fall in price per Mbps as average broadband speeds surged.

**Fixed broadband value**  
(€/capita/month)



Source: Assembly, ANACOM, EC, World Bank



# Portugal



## Societal benefits

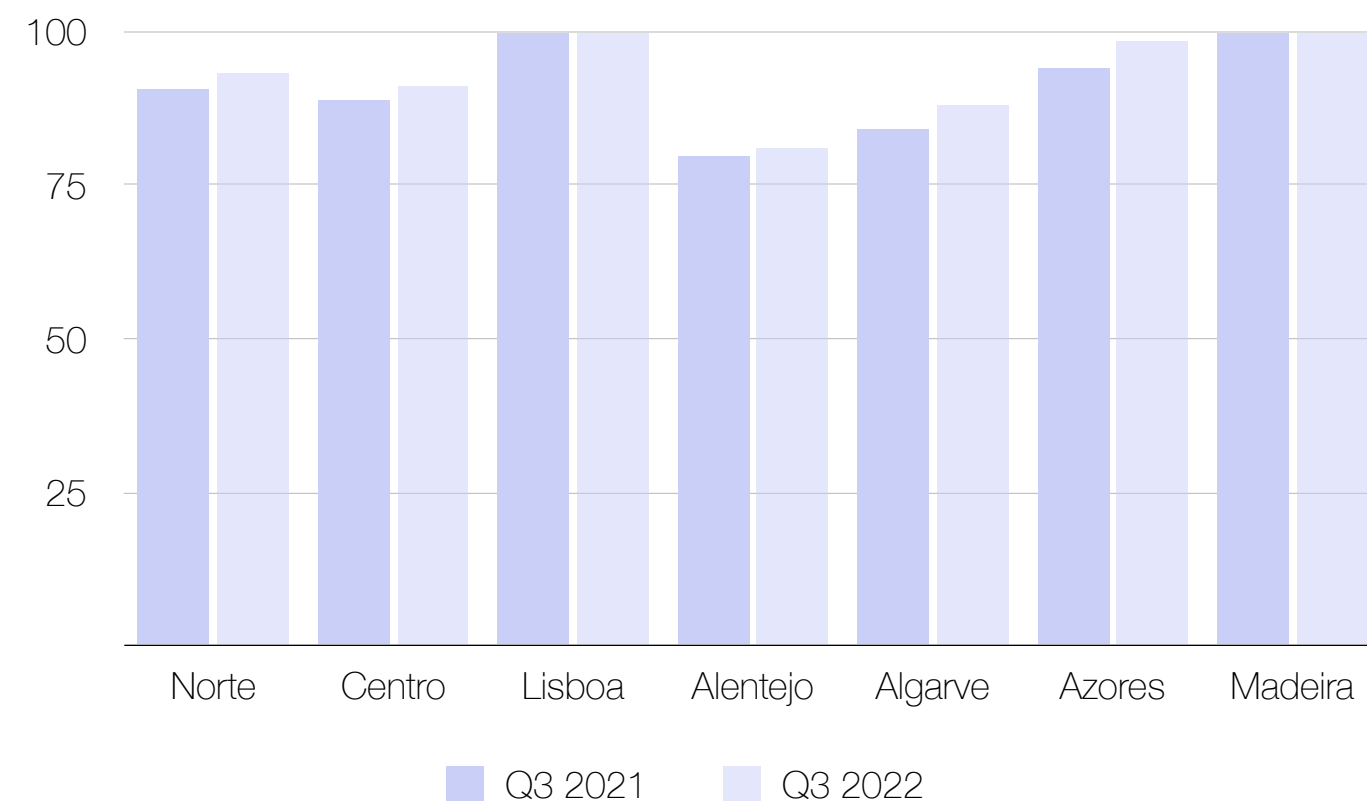
### Rural coverage

#### Availability of FTTH in rural areas is rising

RAV coverage continues to increase across Portugal, with over 6m households connected to a fibre and/or a cable network as of Q3 2022 – a 2.6% increase year-on-year. Overall, 93.2% of premises now have access to high-speed broadband services via one of these technologies, or both.

Operators' fibre rollouts are the principal reason for the growth in coverage, which is highest in the more densely populated parts of the country such as Lisbon, where 96.8% of premises can connect to a FTTH network. Coverage is below the national average in lower density regions, including Alentejo, although the growth rate has accelerated since 2019.

**RAV coverage by region**  
(Premises, %)



Source: ANACOM

### Operators' rural rollouts

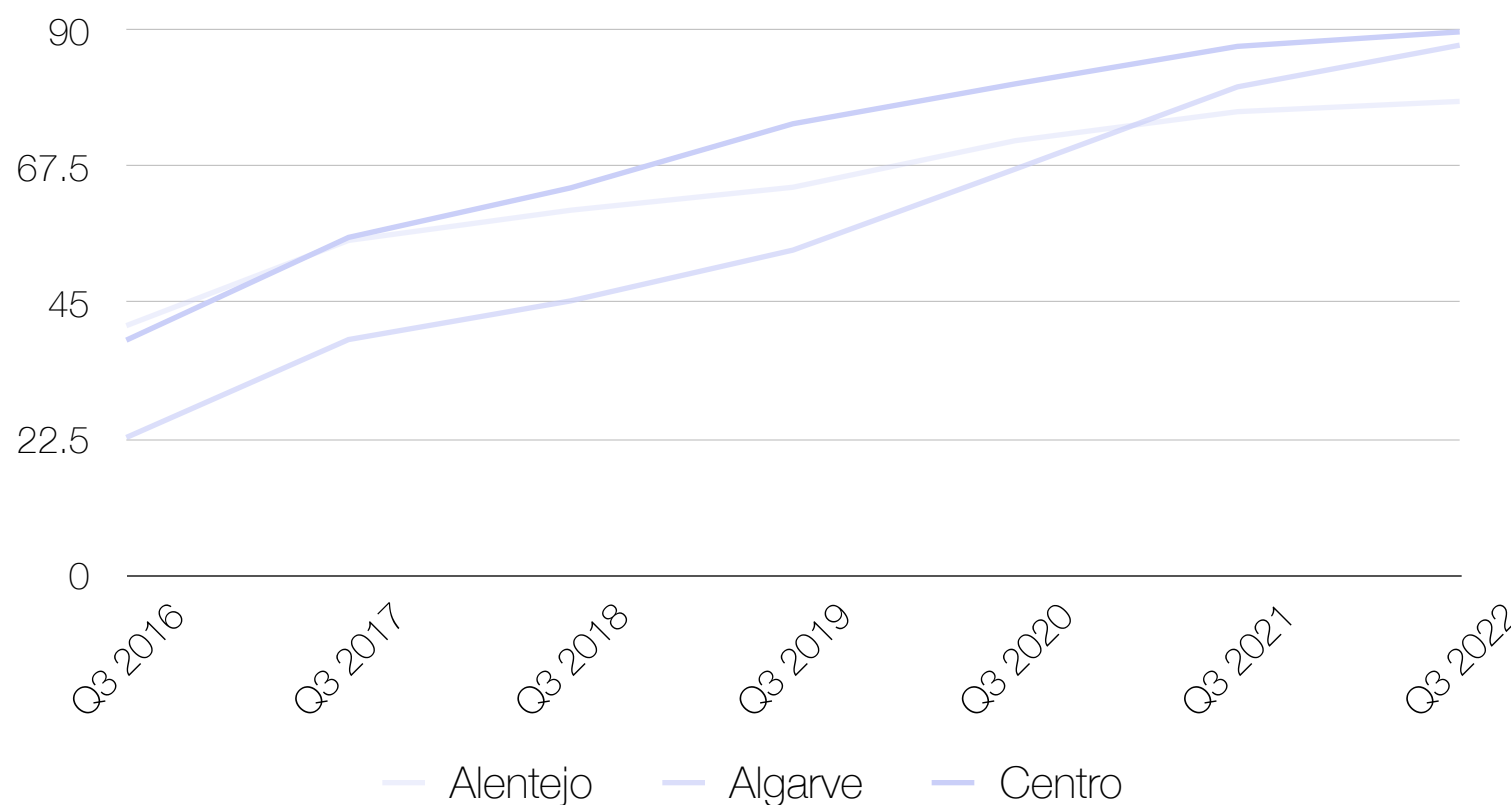
#### Fibre is key to levelling up less dense areas

In some regions, for example Alentejo and Centro, cable network coverage has remained significantly lower than other areas, reaching less than a third of premises in the latest reported quarter.

Fibre has been the driving force behind the increasing availability of high-speed connectivity in these regions, helping to tackle the digital divide and reduce regional asymmetries. In the Algarve, FTTH coverage has increased from just 22.7% in Q3 2016 to 87.6% in Q3 2022.

Telcos' commercial rollout programmes have been complemented by the open access FTTH networks of Fibroglobal and dstelecom, which received subsidies in 2010 to deploy infrastructure in rural municipalities.

**Fibre deployments in less dense areas**  
(Premises covered, %)



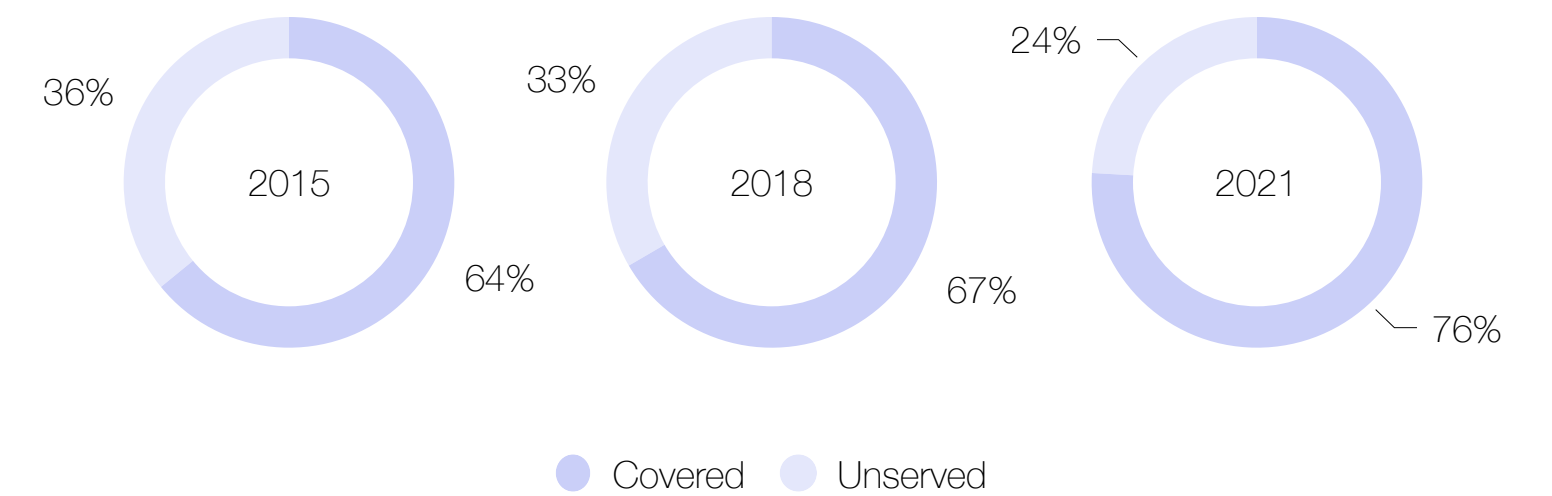
Source: ANACOM

### Digital inclusion

#### FTTH driving NGA coverage

In the past six years, availability of next-generation access (NGA) broadband services in rural areas has increased 12 percentage points, reaching over three-quarters of premises. Fibre has driven this growth, with cable network coverage remaining largely flat.

**Fibre and cable broadband coverage in rural areas**  
(% of premises)



Source: EC

#### Altnets deliver wider socioeconomic benefits

Altnets in Portugal are making positive contributions beyond the deployment of telecoms networks:

- Since 2001, the Vodafone Portugal Foundation has been responsible for implementing the group's social responsibility strategy. It has pursued a number of initiatives, including creating a digital platform to help young people with making their academic choices.
- In March 2022, Nowo invested in two sustainability projects that aim to use technology to support the decarbonisation of cities.
- NOS and ENSICO have created the Projeto ZER01, an initiative focused on providing computing lessons to over 400 school students.

# Spain

## Overview

Prior to 2010, Spain was considered a laggard in fibre; however, with the right regulatory and competitive conditions, the country has seen a rapid deployment of FTTH networks in the past decade. Alternative operators have been major contributors to this achievement, providing strong competition to the incumbent both at the infrastructure and retail levels. While a digital divide still exists between rural and urban areas, this has narrowed significantly and its closure is a key target for the Government's broadband strategy out to 2026.

**66m**

Total FTTH lines deployed at the end of 2021, a 16% rise year-on-year

**13.5m**

The number of fibre connections in Spain, compared with 4.4m in 2016

**82%**

FTTH adoption (as a proportion of total broadband connections), one of the highest rates in the EU



### Policy environment

- Key features of the regulatory framework have been access to civii infrastructure (such as ducts and poles) and obligations on landlords to provide access to in-building fibre.
- The CNMC has increased the number of municipalities it considered to be “competitive zones” for wholesale broadband, lifting fibre access obligations from Telefónica in these areas.
- The Digital Spain Agenda is targeting 100Mbps broadband for all by 2026, with the aim of eliminating the digital divide and reinforcing territorial cohesion.



### Investment & build

- Spain is one of the most competitive retail markets in Europe, while there is also strong fibre network competition as a host of altnets challenge the incumbent Telefónica.
- Total fibre lines deployed in Spain reached 65.9m at the end of 2021, increasing by more than 8.8m year-on-year – equivalent to a 16% uplift.
- Operators' fibre rollouts have required an increase in investment, with telecoms industry capex (excluding spectrum) rising from €4.5bn in 2017 to €6.5bn in 2021.



### Product portfolio

- Spain's four largest operators all offer fibre services at the retail level, while both MasMovil and Vodafone also operate cable networks following their respective acquisitions of Euskaltel and Ono.
- Some operators continue to offer broadband via DSL, although these services are often not to be advertised as prominently as FTTH, or are marketed as ‘second home’ tariffs.
- Average broadband speeds have grown rapidly, jumping 25Mbps in the past year alone to reach 115Mbps, while Orange, Telefónica and Vodafone all now offer gigabit-capable services.



### Consumer value

- With just under 13.5m connections, Spain boasts a FTTH adoption rate of 82%, as well as the highest proportion of subscribers with 100Mbps+ broadband anywhere in the EU.
- Fixed broadband usage has more than trebled over the 2017-2021 period, accelerating after the start of the coronavirus pandemic and continuing to increase since to reach 95GB per capita per month.
- When prices are considered relative to data consumption, there is a downward trend over time as consumers have got greater value for money, especially given the spike in internet usage caused by COVID-19 lockdowns.



### Societal benefits

- While availability of fibre services is highest in Madrid and Barcelona, 80% of FTTH lines rolled out in 2021 were deployed in municipalities with less than half a million inhabitants.
- Operators' investments are pushing fibre connectivity to all corners of the country, helping to reduce the digital divide from 71% in 2017 to 21% at the end of 2021.
- Altnets are making positive contributions beyond infrastructure deployments, for example supporting digital skills initiatives, reducing carbon emissions and promoting entrepreneurship.

**197%**

Increase in fibre coverage since 2015

**44%**

Growth in annual telecoms sector investment since 2017

**490%**

Rise in download speeds over the 2017-2021 period

**79%**

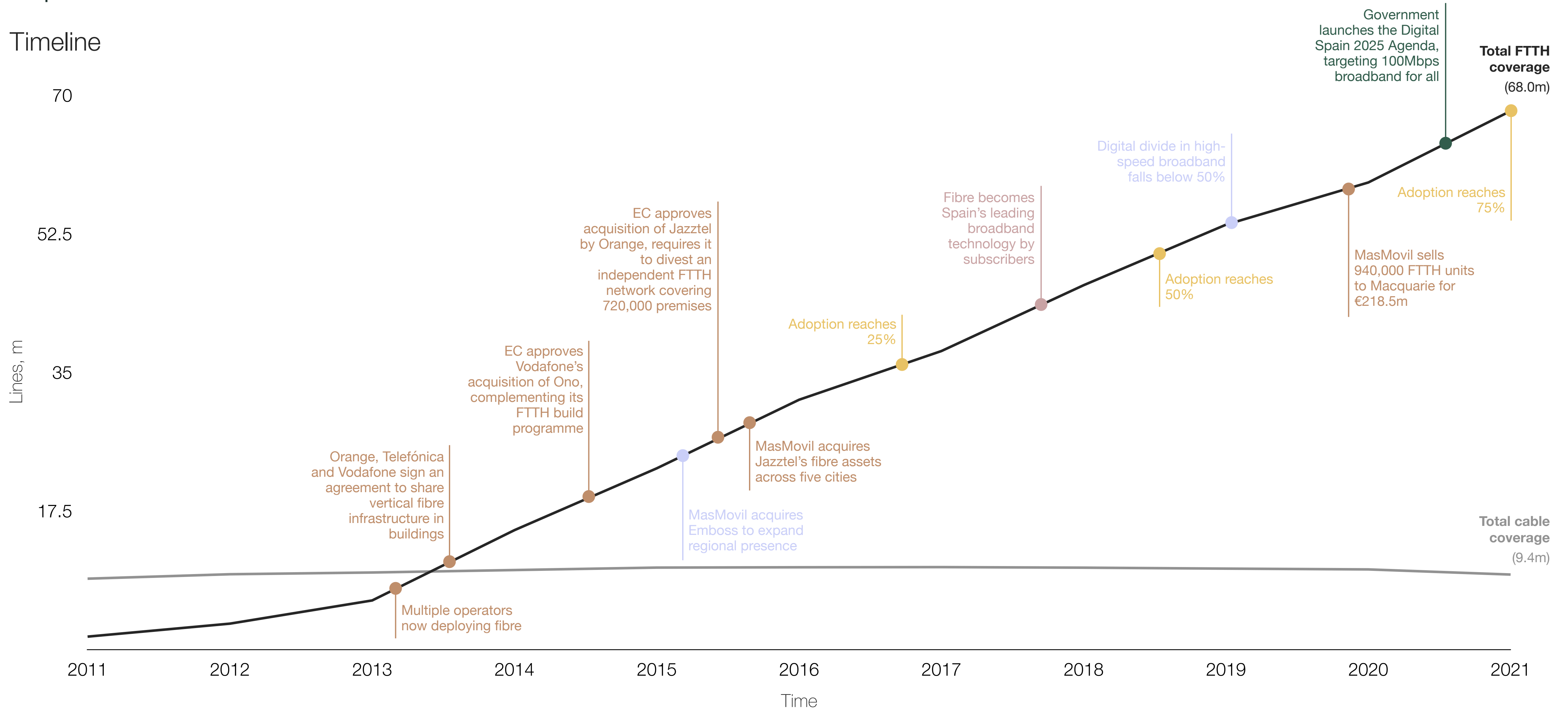
Improvement in fixed broadband value since 2017

**70%**

Reduction in the size of the digital divide since 2017

# Spain

## Timeline





# Spain



## Policy environment

### Government broadband strategy

#### The Government wants to close the digital divide by 2026

In July 2020, the Government launched the Digital Spain 2025 Agenda. Mobilising €70bn in public and private investment, the strategy would focus on promoting digital transformation as an essential lever to spur economic growth, reducing inequality, increasing productivity and harnessing opportunities offered by new technologies.

Two years after the launch of Digital Spain, in which time the country's COVID-19 recovery plan has been approved, the Government took stock of progress and updated the strategy with a 2026 horizon. The Agenda is now structured according to three pillars (Infrastructure and technology; Economy; and People).

Connectivity-related goals sit under the first pillar, with the strategy targeting 100Mbps broadband for all by 2026, thereby eliminating the digital divide and reinforcing territorial cohesion. Spain is also seeking to extend gigabit services to public entities and to strengthen R&D spend.

#### Some regions have their own digital policies

Various regions ('Comunidades Autónomas') have developed their own broadband strategies and goals, which typically utilise internal financial resources, private sector investments and EU funds. Regional strategies are often similar and grounded in the Spanish or European agenda, but they also exhibit some differences in their scope and emphasis.

### Government broadband targets

**(100% of the population)**

2026

100Mbps

### Approach to wholesale pricing

#### Civil infrastructure has been central to the rollout of fibre

The National Commission of Markets and Competition (Comisión Nacional de los Mercados y la Competencia, CNMC) is responsible for regulating all markets and productive sectors of the Spanish economy to ensure free competition and consumer protection.

The regulator has taken a number of actions to stimulate investment and competition in fibre, including permitting operators to jointly build out networks (which enabled Jazztel and Vodafone to enter the fibre market) and to determine agreements in non-regulated areas based upon commercial terms and conditions.

Operators were also granted access to the civil infrastructure needed to connect FTTH networks, including manholes, ducts and poles, as well as an obligation for landlords were obliged to provide access to in-building fibre infrastructure. In addition, Telefónica was not obliged to allow other telcos access to its network at speeds above 30Mbps, creating further incentives for alternative operators to roll out fibre networks. The fallout has been a flurry of investment, which was followed by a period of consolidation.

In clearing the acquisition of Jazztel by Orange in 2015, the EC required Orange to divest an independent FTTH network covering 700,000-800,000 building units. The EC considered this commitment would ensure that a fourth nationwide operator can enter the Spanish market and be able to compete effectively in the fixed broadband markets.

#### Wholesale prices have been reviewed regularly

In October 2021, the CNMC reviewed the prices of Telefónica's reference offer for wholesale access to physical infrastructure, which resulted in a 20% reduction in monthly fees and a 13.7% increase in non-recurring fees due to increased labour costs.

### Latest wholesale broadband market review

#### Wholesale broadband access is seeing deregulation

In October 2021, the CNMC approved a resolution regarding the wholesale broadband markets, which, among other things, increased from 66 to 696 the number of municipalities it considered to be "competitive zones" (now covering over two-thirds of the Spanish population), and lifted Telefónica's access obligations (as the operator with significant market power) in those areas.

However, there are geographical areas where wholesale broadband is not yet considered competitive by the CNMC and in which it has imposed obligations on Telefónica (for example, providing separate accounts, non-discrimination and transparency measures).

“

**The CNMC has increased from 66 to 696 the number of municipalities it considered to be “competitive zones” (now covering over two-thirds of the Spanish population)**

”

#### The CNMC is enabling Telefónica's copper switch-off

The copper switch-off process is still ongoing and experienced a stuttering start. The regulator had mandated an exchange closure notice period of five years in order to reduce the risk that some customers could be left without service. In its latest wholesale broadband access market review, the CNMC cut this to two years, which should provide a (much-needed) boost to Telefónica's switch-off plan.

Between 2013-2020, €344m in public aid facilitated the deployment of broadband in more than 40% of Spanish municipalities. This incentive to invest in 'unprofitable areas' – usually those with less than 5,000 inhabitants – helped subsidise 40-60% of a the typical build cost.<sup>16</sup>

# Spain



## Investment & build

### Operator rollouts and capex

#### Spain has long been a frontrunner in fibre deployment

Total fibre lines deployed in Spain reached 65.9m at the end of 2021, increasing by more than 8.8m (or 16%) year-on-year. Fibre is the only technology being deployed, with operators sustaining their investments despite falling revenues and low returns on capital.

#### The incumbent has faced network-based competition

Spain is one of the most competitive telecoms markets in Europe, with price competition (even for 1Gbps broadband) intensifying. There is also strong competition in infrastructure, where altnets are challenging Telefónica – and account for the majority of recent fibre deployments. Telefónica is targeting 100% fibre coverage by 2025 and is stepping up its copper switch-off plan to meet the deadline. By the end of 2022, it has closed 2,181 copper exchanges (up from 1,010) at the end of 2021.<sup>17</sup>

Orange is the second larger fibre builder in Spain, while Vodafone has pivoted investments to FTTH and lately FWA having upgraded its cable network to DOCSIS 3.1 in Q4 2018. Orange and Vodafone both increased capex compared to the year in which they merged with Jazztel and OnO, respectively, and have co-invested in fibre infrastructure.

Masmovil has deployed 9.3m FTTH lines, and is also co-investing with Orange to deploy up to 2.75m lines by 2023. Masmovil increased its overall capex significantly since it acquired Jazztel's FTTH network, going on to purchase Basque-based Euskaltel in 2021.

#### Telecoms sector investment (excluding spectrum)

(€bn)



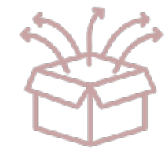
Source: CNMC

### Summary of build progress and sources of investment

Operator	Start of fibre investment	Build plans	Investment commitments	Source of funding	Progress to date	Geographic focus	Pace of rollout
MasMovil	2012 (Jazztel co-investment with Telefónica)	3m with Telefónica, 2.75m by 2023 with Orange, 1.2 with Euskaltel investors	€863m invested in 2021 (excluding spectrum)	Takeover by private investors, asset sales (e.g. 51% stake in the Euskaltel network for €580m)	9.3m FTTH lines, 2.3m cable lines (2021)	Regional	307,000 FTTH lines deployed in 2021
Orange	Trials and commercial launch in 2010	18m homes, plus 2.75m by 2023 with MasMovil	€1bn shared rollout with Vodafone announced in 2013, €1.2bn invested in 2021 (excluding spectrum)	Internal, partnerships	16m FTTH lines (2021)	National	739,000 FTTH lines deployed in 2021
Telefónica	Pilots in Madrid and Barcelona in 2008, commercial launch in 2019	Nationwide fibre coverage by 2025	€1.6bn invested in 2021 (excluding spectrum)	Internal, sale of 45% stake in Bluevia Fibra for €1bn	26.9m FTTH lines (2021)	National	1.7m FTTH lines deployed in 2021
Vodafone	2013 (via co-investment partnership with Orange)	Individual rollout target unknown	€1bn shared rollout with Vodafone announced in 2013, €1.1bn invested in 2021 (excluding spectrum)	Internal, partnerships	3.8m FTTH lines, 7.6m cable lines (2021)	Urban and rural areas	66,000 FTTH lines deployed in 2021

Source: Assembly

# Spain



## Product portfolio

### Propositions in the market

#### Four national operators are competing in fibre

The four major telcos in Spain all offer fibre services to consumers at the retail level, as well as to business customers (e.g. MasMovil's 'FIBRA + MÓVIL PRO'). As a result of acquisitions in recent years, both MasMovil and Vodafone also operate cable networks.

Orange, Telefónica and Vodafone currently offer wholesale access to their networks. As the incumbent, Telefónica has been required to do so, but has agreed deals with competitors on commercial terms outside of regulated areas. Orange – the largest alternative wholesale player – also has a 20-year reciprocal access agreement in place with MasMovil, the scope of which was expanded in 2020. Following the Ono acquisition, Vodafone agreed provide Orange with access to 1m homes on the Ono network as part of an updated fibre co-investment plan. In 2021, MasMovil sold a second tranche of fibre infrastructure to Onivia, doubling the size of Onivia's wholesale-only network.

### Market overview

Operator	Technologies	Speeds	Wholesale offering
MasMovil	Cable, DSL, FTTH	600Mbps	No
Orange	DSL, FTTH	1Gbps	Yes
Telefónica	DSL, FTTH	1Gbps	Yes
Vodafone	Cable, DSL, FTTH	1Gbps	Yes

Source: Assembly

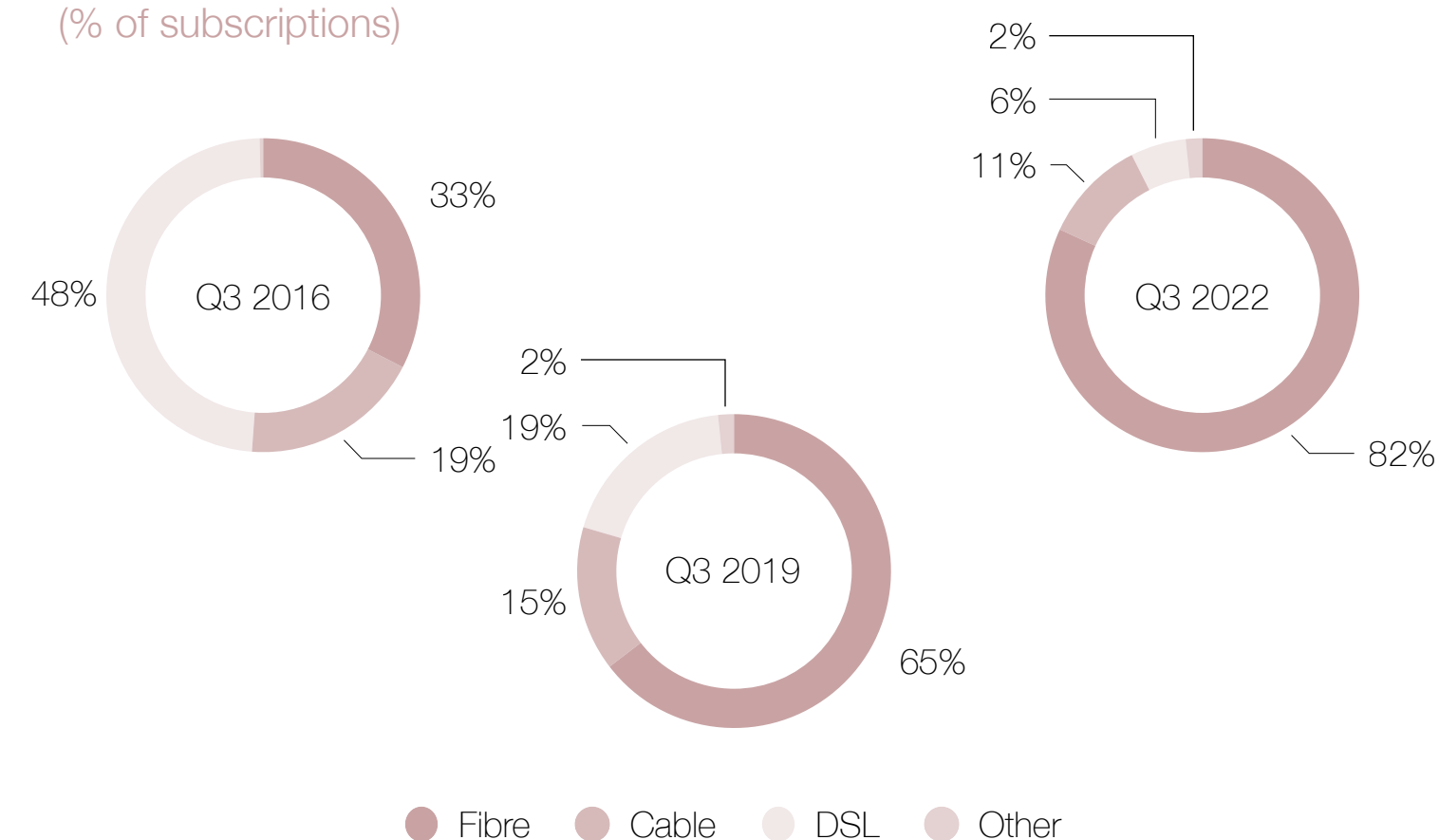
### Technologies

#### FTTH is the main form of broadband access

Some operators continue to offer broadband via DSL, although these services – like MasMovil's 20Mbps proposition – tend not to be advertised as prominently as their fibre counterparts, or are marketed as 'segunda residencia' (second home) tariffs. Others, for example Vodafone at the end of 2018, have discontinued their legacy broadband product.

The number of FTTH connections surpassed that of cable in 2015, with fibre becoming the dominant broadband technology (overtaking copper) by Q3 2017. The country is now home to almost 13.5m fibre connections, compared to 4.4m in 2016.

#### Technology mix (% of subscriptions)



Source: CNMC

### Speeds

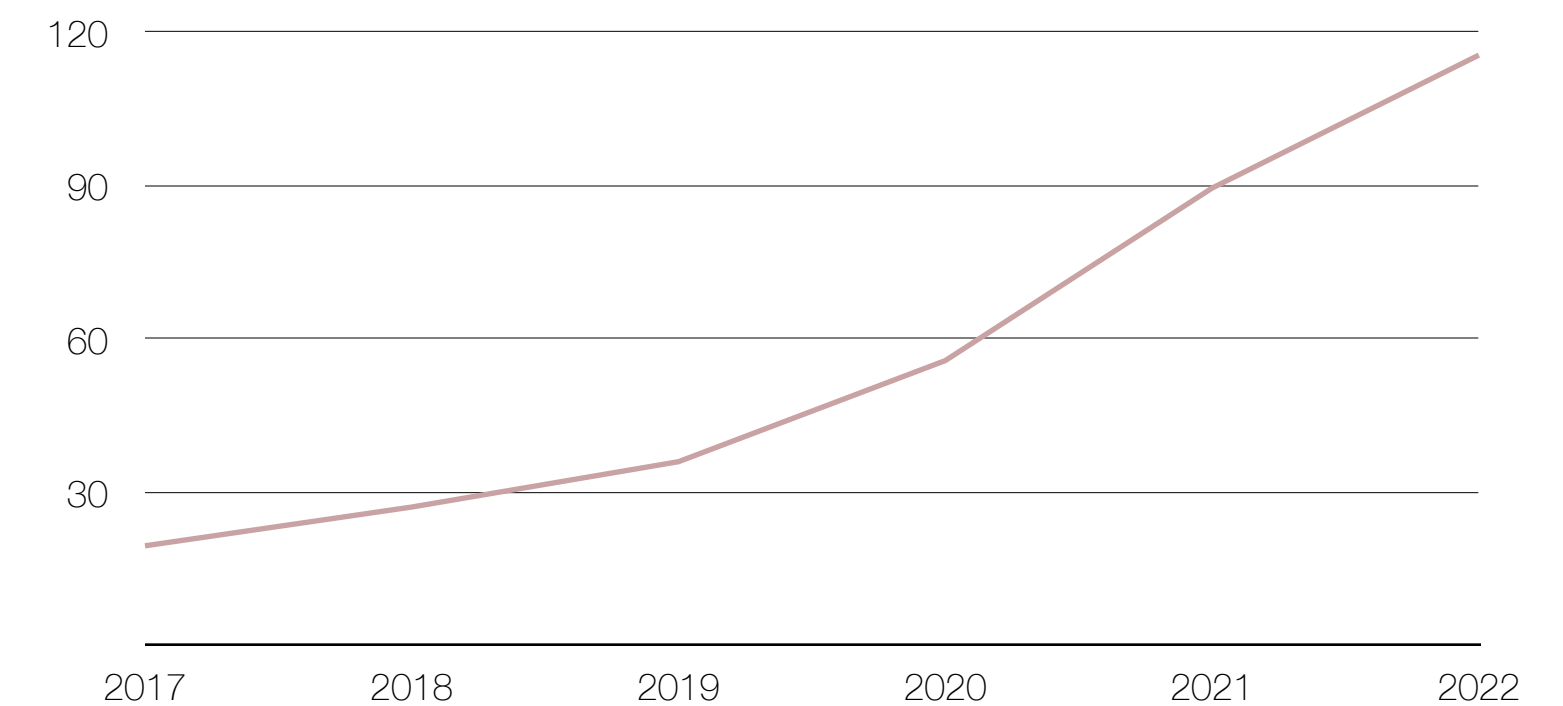
#### Annual speed increases have ratcheted up

While increasing fibre coverage and adoption have been responsible for raising broadband speeds, operators have also had an impact by adopting a 'more for more' approach. Since 2015, telcos have generally offered faster speeds and more data at slightly higher prices. Spain's largest three operators now offer up to 1Gbps services, which has become a locus of competition and witnessed significant price discounting.

Spain is now in the top 13 countries globally for mean download speeds, narrowly behind Singapore and the US. It is also eighth highest in Europe based on this metric, after France.

Broadband speeds have reached 115Mbps on average in 2022, up from 20Mbps in 2017. The pace of growth accelerated in 2020 and 2021, with speeds again rising strongly (by 25Mbps) in the latest full year.

#### Mean download speeds (Mbps)



Source: Cable/M-Lab



# Spain



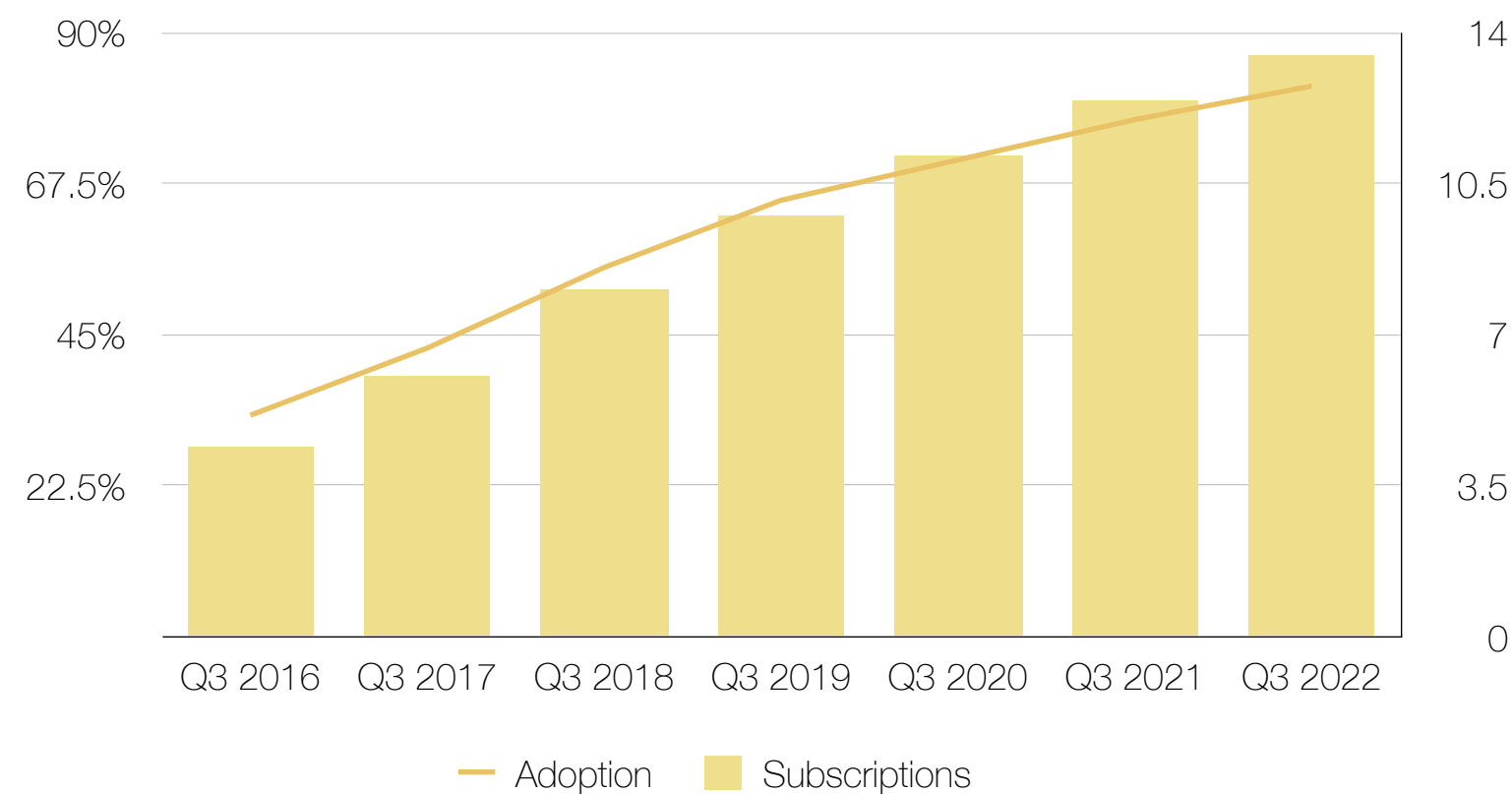
## Adoption

### One of the highest fibre adoption rates in the EU

Over the course of the past decade, fibre take-up in Spain has grown considerably. The rise in adoption was the most pronounced until 2018/19, during which time FTTH cemented its position as the country's leading fixed broadband technology.

As of Q3 2022, FTTH adoption (as a share of total broadband subscriptions) had reached 82%, increasing 80 percentage points since 2012. Fibre is the main growth driver of new broadband connections (as other technologies lose subscribers), adding over 1m subscribers in the past year alone. As a result, Spain has the highest proportion of connections with download speeds equal to or greater than 100Mbps in the EU.<sup>18</sup>

**FTTH adoption**  
(Subscriptions (m), % of subscriptions)



Source: CNMC

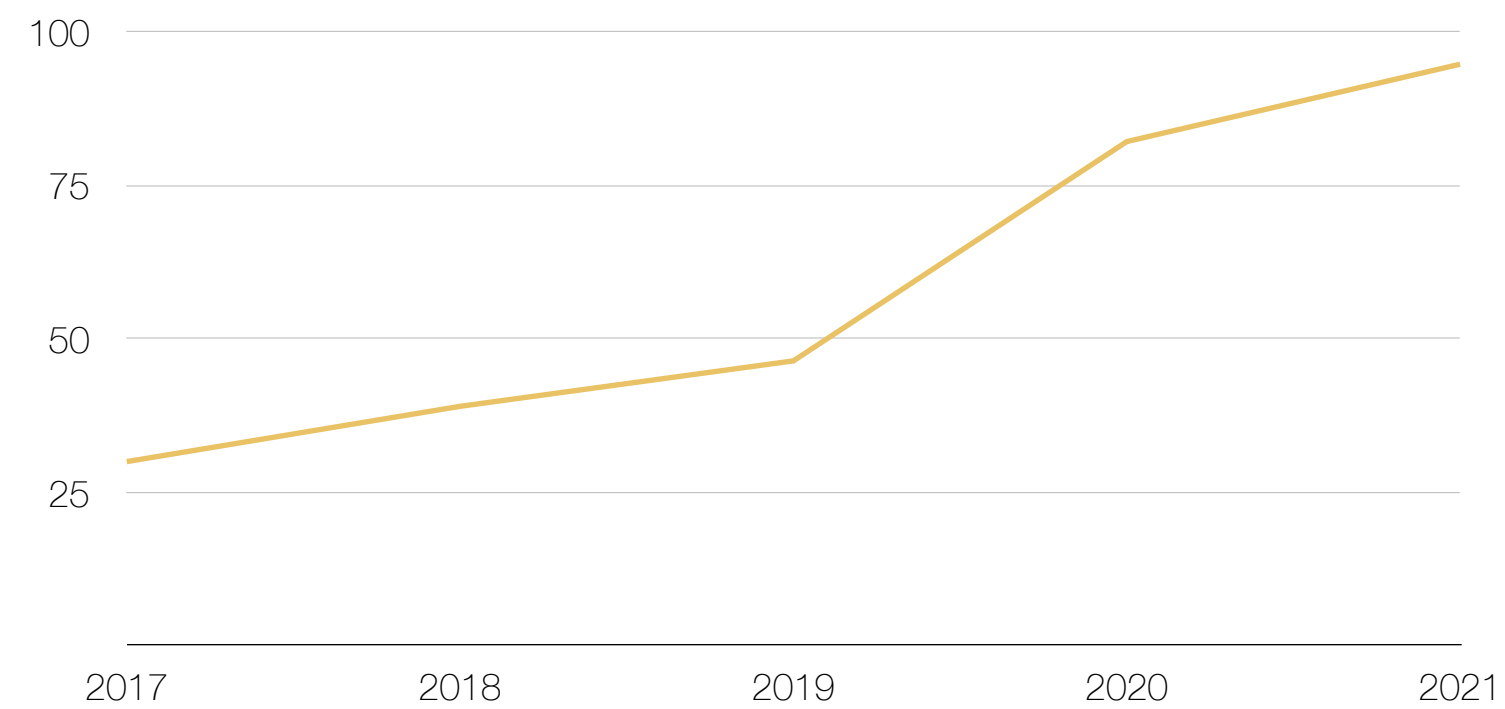
## Usage

### COVID-19 accelerated data consumption and digitisation

With the increases in fibre take-up and average download speeds, Spain has also seen a rise fixed data consumption. This trend was apparent before the outbreak of COVID-19 as more people have come online and innovative digital services have grown in popularity.

However, since the beginning of the pandemic, data consumption accelerated – as did digital transformation across the economy. Usage has continued to grow (though at a slower rate), reaching 95GB per capita per month in 2021. Overall, fixed broadband consumption in Spain has more than trebled in the 2017-2021 period, with the country exhibiting a comparable growth pattern to that of neighbouring Portugal.

**Fixed data usage**  
(GB/capita/month)



Source: Ofcom

## Overall value

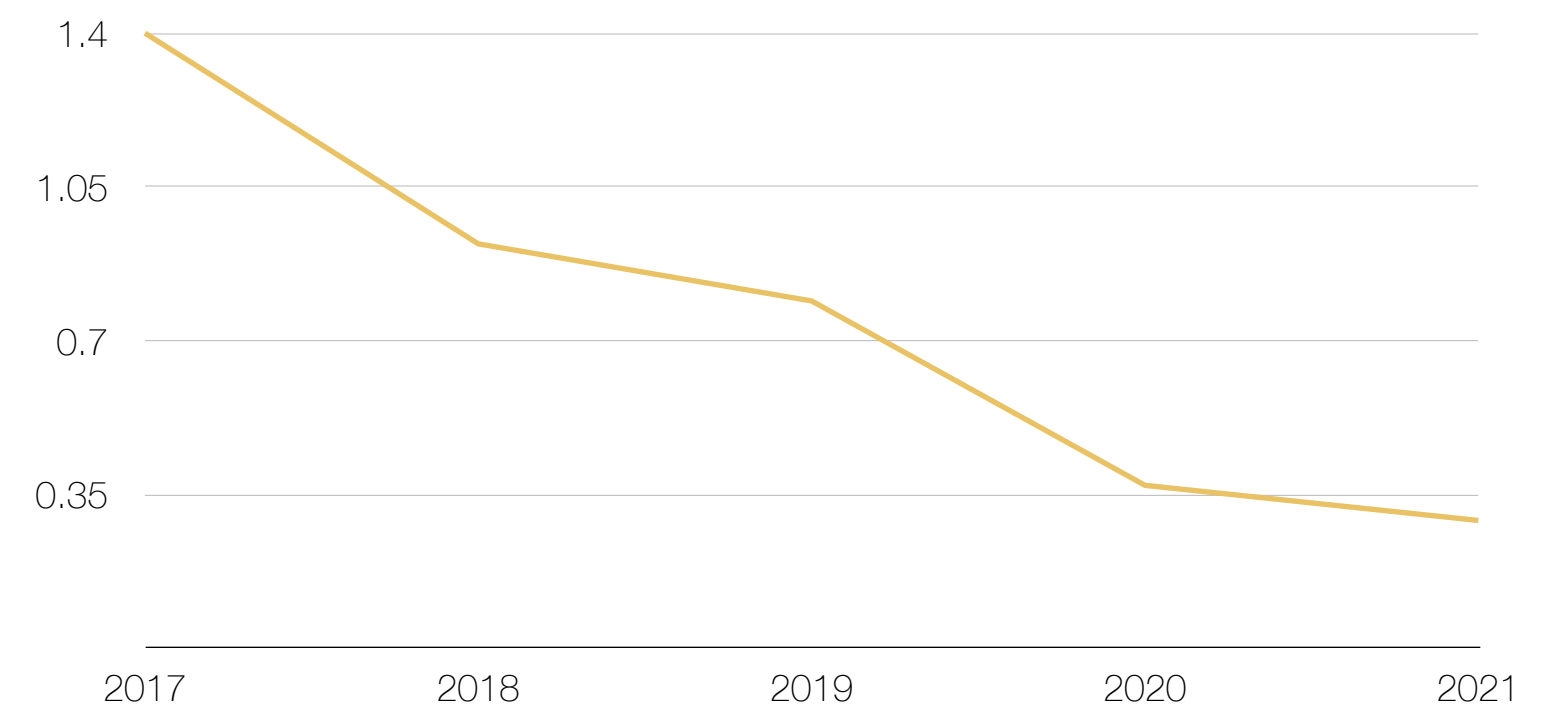
### Prices have fallen as usage has surged

In Spain, the average price of standalone fixed broadband declined considerably over the 2017-2021 period, driven by falls in very high speed services (particularly in 2018 and 2020).

When prices are considered relative to broadband usage, there is a downward trend over time as consumers have got more for their money, especially given the spike in data consumption caused by COVID-19 lockdowns.

A downward trend is also visible when prices are considered relative to download speeds. The price per Mbps paid by consumers has dropped due to rising broadband speeds and a general fall in prices overall.

**Fixed broadband value**  
(€/capita/month)



Source: Assembly, EC, Ofcom

# Spain



## Societal benefits

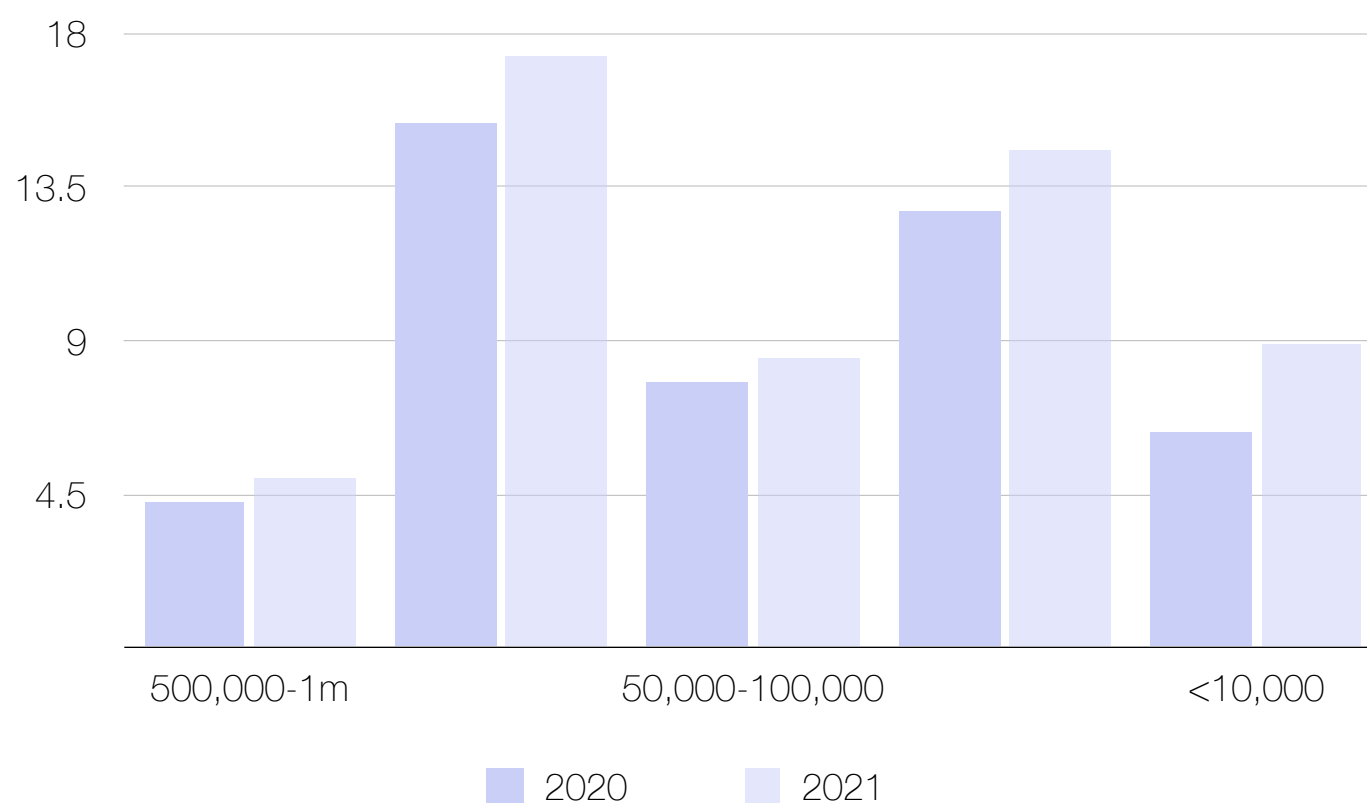
### Rural coverage

#### Growth in FTTH coverage strongest in less dense areas

While availability of fibre services is highest in Spain's largest metropolitan areas, i.e. Madrid and Barcelona, it is also growing across less densely populated regions. In 2021, a total of 8.7m new FTTH lines were installed nationwide, 80% of which were deployed in municipalities with less than half a million inhabitants.<sup>19</sup> Meanwhile, municipalities with less than 10,000 inhabitants witnessed the greatest relative increase in lines deployed.

Madrid and Barcelona again lead in terms of fibre penetration (connections per 100 people); however, there has been a notable increase in the penetration rate in smaller municipalities. In areas with a population of 50,000 to 1m, FTTH penetration is above the national average. Take-up has also grown strongly in towns with less than 10,000 inhabitants – and where the market share of alternative operators has increased the most.

**Fibre coverage by population**  
(Lines deployed, m)



Source: CNMC

### Operators' rural rollouts

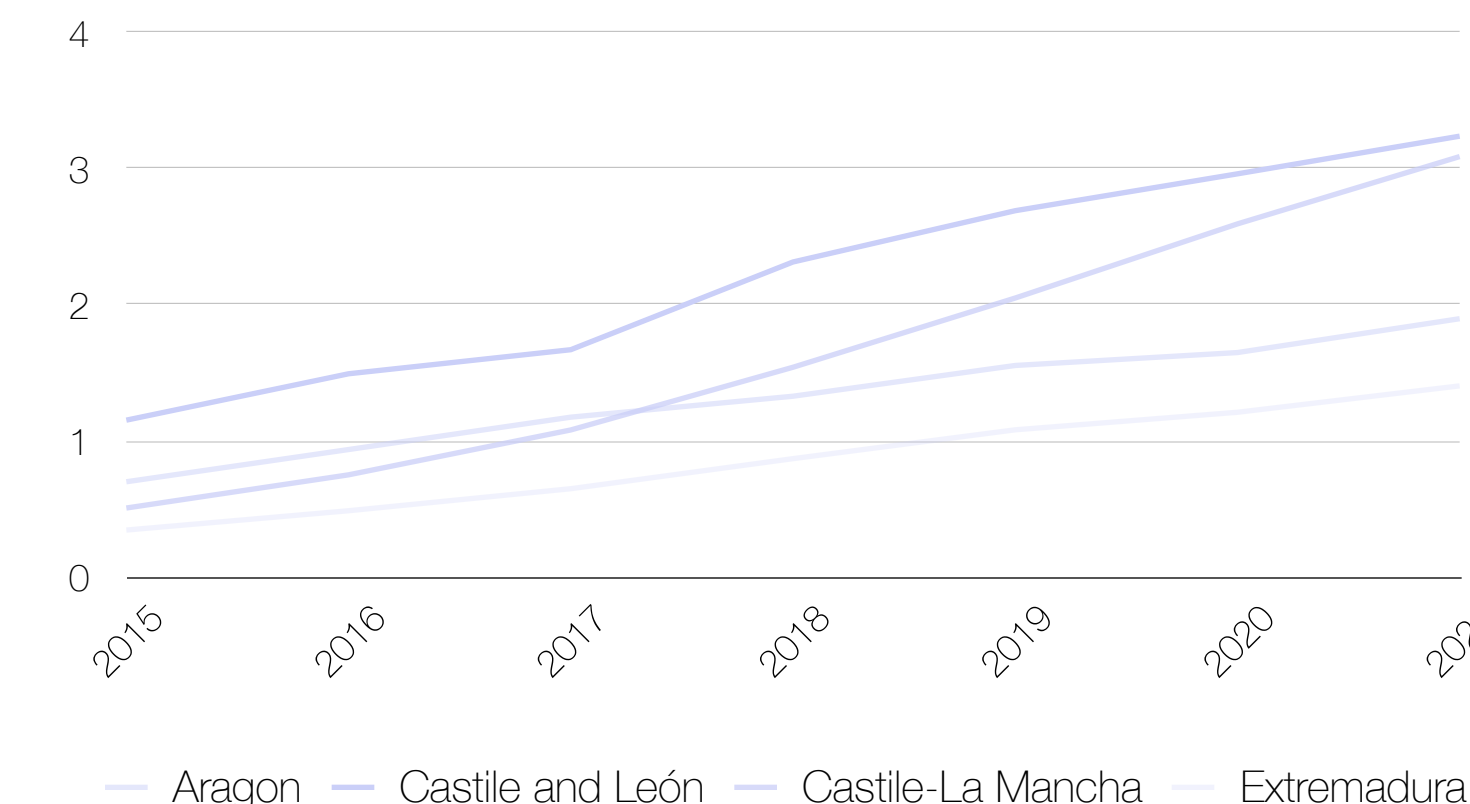
#### Fibre networks permeate across the country

Whereas the number of cable deployments is declining, rollouts of FTTH networks continue across Spain. They have been the driving force behind the increasing presence of high-speed connectivity in smaller municipalities, helping to tackle the digital divide.

As telcos' rollouts have progressed, some have made acquisitions or adopted strategies to help establish (or expand) their footprint in specific regions or rural areas. MasMovil, for example, acquired Aragonese operator Embou in 2015 and began targeting the Basque region with the Guuk brand in 2020.

Commercial rollouts have also been complemented by a number of smaller – often regionally-focused – operators, including Adamo, Avatar and Onivia, as well as neutral wholesale operator Lyntia.

**Fibre deployments in the least dense regions**  
(Lines deployed, m)



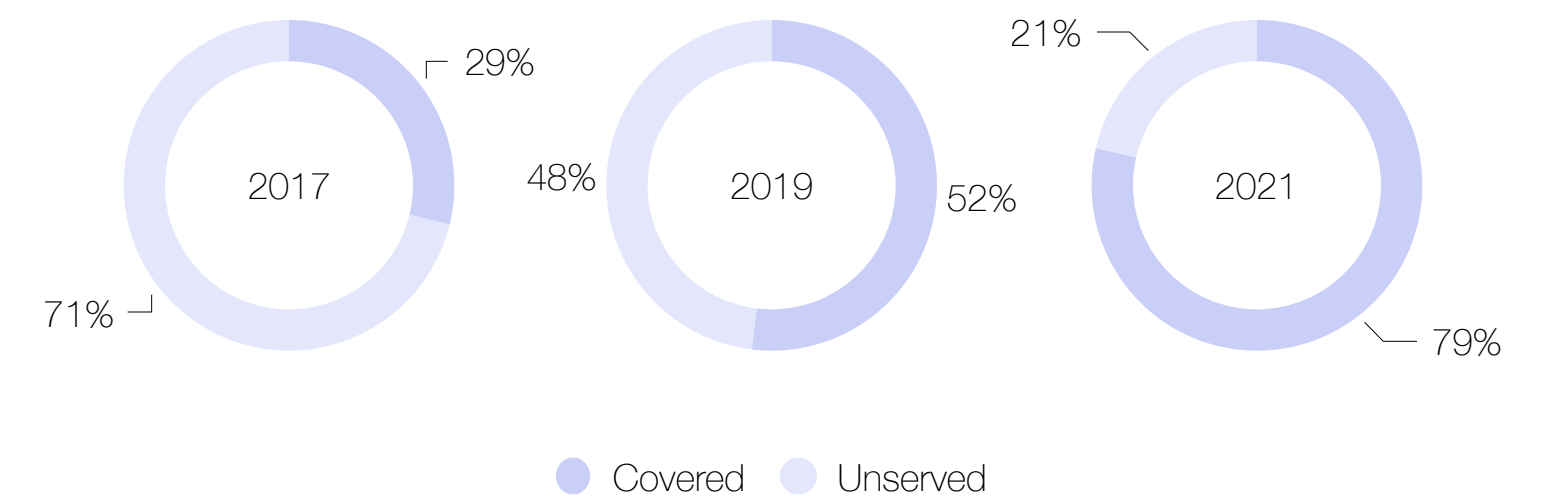
Source: CNMC

### Digital inclusion

#### Persistent urban-rural gaps are closing

Over the 2017-2021 period, availability of high-speed broadband services (via fibre or cable) in rural areas has increased 50 percentage points, reaching almost four in five premises. Fibre has driven this rapid growth, replacing cable infrastructure in some cases.

**Fibre and cable broadband coverage in rural areas**  
(% of premises)



Source: EC

#### Altnets deliver wider socioeconomic benefits

Altnets in Spain are making positive contributions beyond the deployment of telecoms networks:

- The Vodafone Foundation has joined the Pact for the Digital Generation, an initiative from the Ministry of Economic Affairs and Digital Transformation to help people acquire digital skills.
- MasMovil was the first European telco to become a B Corp-certified company, achieving net zero Scope 1 and 2 emissions in 2020.
- Orange has launched the Digital Center, an online education platform that aims to improve digital inclusion and promoting innovation and entrepreneurship.

1. Introduction

2. Summary

3. Policy Background

4. Market Deep Dives

Denmark

France

Germany

Portugal

Spain

**5. References**

6. Important Notice



# References

1. [Future Telecoms Infrastructure Review](#)
2. [Wholesale Fixed Telecoms Market Review 2021-26](#)
3. [WBA market review, 2021](#)
4. [The Danes don't care about fibre](#)
5. [SDFI COVID-19 impact](#)
6. [Fixed Market Regulation, 2021-2023](#)
7. [Market review cycle 6](#)
8. [Fixed Market Regulation, 2023-2028](#)
9. [BNetzA Digital transformation report, 2017](#)
10. [BnetzA Annual Reports](#)
11. [DESI 2022 Germany](#)
12. [MedUX Germany network performance](#)
13. [DESI 2022 Portugal](#)
14. [NOS capex, 2015-2019](#)
15. [Pay TV connections, Q3 2022](#)
16. [CNMC Public Funding blog](#)
17. [CNMC Copper Exchanges blog](#)
18. [CNMC DESI blog](#)
19. [CNMC Broadband Access 2022](#)

1. Introduction

2. Summary

3. Policy Background

4. Market Deep Dives

France

Germany

Norway

Portugal

Spain

5. References

**6. Important Notice**

# Important Notice

By accepting this research, the recipient agrees to be bound by the following terms of use. This research has been prepared by Assembly Research Limited and published solely for guidance and general informational purposes. It may contain the personal opinions of analysts based on research undertaken. Assembly Research Limited gives no undertaking to provide the recipient with access to any additional information or to update or keep current any information or opinions contained herein. The information and any opinions contained herein are based on sources believed to be reliable but the information relied on has not been independently verified. Assembly Research Limited, its officers, employees and agents make no warranties or representations, express or implied, as to the accuracy or completeness of information and opinions contained herein and exclude all liability to the fullest extent permitted by law for any direct or indirect loss or damage or any other costs or expenses of any kind which may arise directly or indirectly out of the use of this research, including but not limited to anything caused by any viruses or any failures in computer transmission. The recipient hereby indemnifies Assembly Research Limited, its officers, employees and agents and any entity which directly or indirectly controls, is controlled by, or is under direct or indirect common control with Assembly Research Limited from time to time, against any direct or indirect loss or damage or any other costs or expenses of any kind which they may incur directly or indirectly as a result of the recipient's use of this research.

"Assembly" and "Assembly Research" are trading names of Assembly Research Limited. Assembly Research Limited is a company registered in England and Wales with company number 11022819, whose registered office is 36 Spital Square, London, E1 6DY, United Kingdom.

© 2023 Assembly Research Limited. All rights reserved.



**London**

36 Spital Square  
London  
E1 6DY  
United Kingdom

+44 20 3026 2700

[info@assemblyresearch.co.uk](mailto:info@assemblyresearch.co.uk)